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Adoption of cloud technology services at the National University of Lesotho Library

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Abstract

The information landscape across the globe is swiftly changing owing to the latest developments in technology and innovation. One aspect of such technological developments is cloud computing, which over the few years become the buzzword in the information environment. Libraries are no exception, as they are the powerhouses of information and knowledge. Library and information professionals therefore need to have an understanding of what constitutes cloud computing, and in particular, the issues of data storage, security and retrieval. The purpose of this study is to examine the adoption of cloud technology services at the National University of Lesotho library. This is a qualitative case study which made use of interviews as instruments for data collection. Data was analysed manually by content analysis using the notes taken by the researcher during the interview sessions. The study provides valuable first-hand insight into the adoption and implementation of cloud computing in the context of libraries in Lesotho.

Key words: Cloud computing, academic Libraries, Adoption, implementation

1. INTRODUCTION

Cloud computing has been defined differently by various authors. For instance, Wang, von Laszewski, Younge, Kunze, Tao and Fu (2010:139) defined it as "a set of network enabled services, providing scalable, QoS guaranteed, normally personalised, inexpensive computing platforms on demand, which could be accessed in a simple and pervasive way," while Yuvaraj (2015:570) defined it as "an integrated package of computing services and applications on the web offered as a utility", where the word "cloud" can be seen as the summation of Internet-based data access and exchange along with low-cost computing and applications. However, in the context of this study the adopted definition is that of Quddusi (2014) because it briefly captures all cloud computing features. Cloud computing is defined as a technology that utilises the Internet and central remote servers in order to maintain both data and applications. The

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"cloud" element of Cloud computing according to Yuvaraj (2015) is an acronym, where the C stands for computing services, L-: that are Location independent, O-; accessed through online means, U–: used as a Utility and D-: on Demand availability.

Cloud computing as we know it today was invented by Amazon in 2002. However, other authors trace the existence of cloud computing to as far back as 1960s (Quddusi, 2014; Pal, 2016; Alzahrani, 2016). The adoption of cloud computing services means that instead of owning the entire system, the clients only need to pay for the physical infrastructure. In other words, the client outsources the services by renting from the providers or the third party (Makori, 2016). Das (2014) identified the following five cloud computing principles:

1. Shared resources (including applications, processors, storage and databases);
2. On-demand (users retrieve and use cloud information resources from the cloud);
3. Elasticity, flexibility and scalability (clouds are receptive to user needs);
4. Networked access (wide accessibility); and
5. Metering use (involve payments and storage efficiency

The information landscape across the globe is swiftly changing following the latest developments in technology and innovation. One aspect of such technological developments is cloud computing. Cloud computing has over the few years become the buzzword in the information environment and libraries are no exceptions because they are the powerhouses to information and knowledge. Library and information professionals therefore, need to have an understanding of what constitute cloud computing and in particular, the issues of data storage, security and retrieval.

Cloud computing as conceived by information technologists, appears to be the most important model to transform how the World Wide Web (WWW) and the information systems of the latest generation function (Sharif, 2010; Min, 2012). On the other hand, the librarianship profession is faced by challenges emanating from the latest developments in technology. The emergence of cloud computing and its adoption in libraries according to Liu and Cai (2013) has made librarianship roles more practical and pragmatic in the services they provide to their clients. Makori (2016) cautions that cloud technology is rapidly dislodging the client server based technology in the twenty-first century and as a result urges librarians to claim their leadership role in the implementation.

The organisation of this paper is as follows. First, the study's context is presented focusing mainly on the technological evolution that the University library has experienced over the years. The second part presents the problem statement with objectives. Thirdly, the literature review is presented followed by the methodology adopted by the study. Next are the study results together with an analysis. Finally, the discussion and recommendations for future research conclude the paper.

2. The National University of Lesotho's Thomas Mofolo Library

The National University of Lesotho's Thomas Mofolo Library (TML) is as old as the University itself established in 1954 as the nucleus collection of the former Pius XII College. NUL is located at Roma, about 34 km south-east of Maseru, the capital of the Kingdom of Lesotho. Since its inception, the library maintained a manual catalogue until the early 1990s when an automation project started using the now defund Stilis library management system that had numerous complications resulting in the acquisition of the Integrated Tertiary Software System (ITS) in 1995. ITS remained in use until it was replaced by INNOPAC Millennium in 2014 "because there was a concern from both the students and staff that it was no longer serving the interest of the modern academic demands while also blaming it for their lack of research" (Motsoeli, 2014:5). All these library management systems were client/server based systems, hosted locally. The decision to migrate to the latest innovative Sierra library management system allowed the library an opportunity to also decide to migrate it to the cloud.

3. Problem and purpose of the study

The concept of cloud computing has recently been attractive to different types of organisations including academic libraries (Wale, 2011). However, there is no literature dealing specifically with the adoption and implementation of cloud computing services in academic libraries in Lesotho. Nonetheless, Liu and Cai (2013:27) argued that, "in order to keep pace with progress, libraries need to switch over to cloud and deliver content, tools and services accessible to mobile users via mobile devices. Migrating core library application to the cloud reduces most or all the local technical issues in managing the infrastructure and Operation systems (Liu and Cai, 2013). This investigation is guided by the following research questions:

1. What is the understanding of cloud computing in the context of NUL Library?
2. To what extent do libraries benefit from migrating some of its systems to the cloud?

3. What are the possible challenges and risks that libraries may face libraries in the adoption and implementation of cloud computing?

4. Theory and Literature Review

The following section highlights the theoretical framework guiding this study. The rest of the section briefly reviews the literature on the concept of cloud computing in the context of libraries.

This study is anchored on Rogers's (1962) diffusion of innovation theory. This theory is relevant to the current study because cloud computing is a new technology being adopted for the first time at the National University of Lesotho Library. Kenton (2018:5) defined the diffusion of innovation theory as a "supposition providing a definition on how new technologies and other advancement permeates societies and cultures from inception to wider adoption". This innovation theory is mostly appropriately applied in investigating the adoption of a new technology in higher education and other educational milieus (Medlin, 2001; Parisot, 1995). This theory is one of the oldest social sciences, originally from the communication sciences with the specific purpose of outlining how, over time, an idea or product gains momentum and diffuses through a specific population or social system. According to this theory, "the acceptance of any technology/information system by users is influenced by such characteristics as compatibility, complexity, trialability, observability and relative advantage of the technology as well as to the intensity of promotion by individuals, known as change agents"(Adegbilero-Iwari and Hamzat, 2017:12).

Vaquero, Rodero-Merino, Caceres and Linder (2009) argue that cloud computing and collaboration via the web are the two important concepts characterising the new innovative library automation. A number of benefits have been identified resulting from the adoption of cloud computing services by the libraries. For instance, Yuvaraj (2015:570) remarked that cloud technology enables "optimal resource utilisation, easier access and more effective cost reduction". Furthermore, Yang (2012) opined that the new cloud-based generation of integrated library systems (ILS) enables the sharing of library resources by multiple libraries such as full text articles from electronic databases. Makori (2016) noted that the cloud service providers handle and support all cloud services.

Moreover, the adoption and use of cloud services appears to be cost effective. It is very expensive to install and maintain IT infrastructure. For instance, Wasike and Njoroge (2015)

hold the view that clouds permit libraries to save more money for normally expensive software overhead costs and accordingly focus on other tasks. Bezos (2014) further remarked that when the library migrates some of its major services to the cloud, they save more than 70% of their time and money to improve and grow other library services. According to Makori (2016) in the cloud-based services, the cloud service provider is responsible for issues of support like installation, licensing, upgrading as well as system maintenance. Essentially, "this allows librarians to handle service needs with minimum costs," (Makori, 2016:20).

Enefu (2015) argues that unlike the old systems, the latest technologies offer the possibility of open-oriented architecture. By moving to the cloud, libraries are in a position to make use of this possibility. Several cloud solutions also offer this type of openness with the published applications program interfaces (API's). Mandas and Kumar Das (2013:75) defined API's as "a specification intended to be used as an interface by software components to communicate with each other". In other words, API's enable integration with other systems and libraries will no longer depend on a vendor to take advantage of this technology.

There are many factors affecting the adoption and implementation of cloud computing services in library environments, and one of the single biggest threats concerns security issues (Kajiyama, Jennex and Addo, 2017; Makori, 2016). Cloud computing is susceptible to security lapses which may compromise library services. According to the Deloitte East Africa 2012 study report, "nearly 40% of African organisations in East Africa are hesitant to adopt and implement cloud technology as a result of data privacy, legislation and security concerns,"(Awale, 2012:37). One of the risks associated with cloud computing, according to Kajiyama *et al.* (2017) is that the cloud environment is not wholly impervious to outages and other problems. In fact, Tsidulko (2016) identified and listed the top ten outages of 2016. Furthermore, the fact that the cloud computing facility is entirely under the control of the vendor means the client cannot do anything if at any time the server becomes unresponsive for some reason (Widyastuti and Irwansyah, 2017).

Another challenge or risk of moving services to the cloud relates to Lock-in. Lock-in according to Dhaka (2017) refers to the case where once the client is using a particular cloud service provider, it becomes difficult to switch to another service provider and that results in dependency. This dependency also applies to the availability of the Internet, where the continued availability of internet services means the continued availability of cloud services. This

also means that any problem with Internet services leads to the problem of accessing the cloud services (Kumar, 2017).

5. Methodology

Taking into account the objectives, the current study followed the qualitative approach with a case study design. A qualitative approach was considered appropriate for this study because it focuses on observing events from the perspectives of those who are involved and is aimed at understanding the attitudes, behaviour and opinions of those individuals (Powell & Connaway 2004). In investigating the adoption of cloud computing by Small and Medium Enterprises (SMEs) in the North-East of England, Alshamaila, Papagiannidis and Li, (2013) also made use of a qualitative approach. Structured interviews were used for data collection. According to Leedy and Omrod (2005), the use of structured interviews in a qualitative study approach may facilitate exploring all the factors and the communication with all stakeholders within an Information and Communication Technology (ICT) innovation adoption process. The interview process was conducted with five staff categories, mainly the library staff as the users of the system, some ICT staff who were directly involved in the migration process and the library management who had made the decision to migrate from the physical servers to the cloud; therefore, a purposive sampling technique was used to select the study population. The table below represents the characteristics of the study's interviewees.

Table 1: Characteristics of respondents

Sampling		
Gender	Designation	Respondent classification
Female	University Librarian	Respondent A
Male	Systems Librarian	Respondent B
Female	Librarian Cataloguing	Respondent C
Male	Assistant librarian	Respondent D
Male	Network Admin	Respondent E

The interviews were recorded with the permission of the participants and were immediately transcribed on completion. Data were analysed manually by content analysis using the notes taken by interviewers. The researcher did not discuss issues related to the response rate of the

study because this is qualitative research and therefore results will not be generalised (Neuman, 2006).

6. Findings and discussion

The following section presents the findings of the investigation based on the interviews held by the researcher. The interviews were conducted with all the respondents as presented in Table: 1 above.

6.1 Understanding of cloud computing in the library context

Wada (2018:20) defined cloud computing as different services that are remotely provided over the Internet. This seems to be the general understanding of what constitutes cloud computing among Thomas Mofolo librarians. Below are the responses regarding the understanding of cloud computing in the library context.

Respondent A

Cloud computing refers to services provided by third party over the internet and these services can be accessed anywhere with the help of internet connection.

Respondent B

The way I understand it is that it has to do with outsourcing of internet based services instead of acquiring the expensive IT equipment and connect all system from there.

Respondent C

Cloud computing particularly in the context of libraries may mean that libraries may no longer have to buy their own IT equipment to host whatever systems they have but rather have them hosted somewhere at the vendor's fees.

Respondent D

Cloud computing is like Google where a lot of services are rented without necessarily acquiring own IT equipment

Respondent E

It refers to all services provided by the vendor through data centres and can be accessed over the internet.

On the question of security of data that is not hosted on local servers, the general observation and understanding was that there is a binding contract between the Library and the cloud service provider and so there was also an element of trust that data was as safe in the hands of the service provider as it was hosted on local servers. Respondents provided the following responses.

Respondent A

I think the issue of trust is very important in any business. This is actually the same as e-mails because we do not know where and who manages them but all business correspondence goes through emails including financials.

Respondent B

I don't think there is a problem as long as there is a binding contract between the two parties and they also need to trust each other.

Respondent C

I don't think service providers can ran the risk around security of client's data because their business with then be at stake.

Respondent D

Those are professional business people who would not want to jeopardise their business in any way so yes we are not worried at all about our data.

Respondent E

Cloud computing has always been there and so I think service providers are trusted now.

On the question of motivation of moving to the cloud, the IT staff mentioned the issue of a lack of resources to host the system locally such as servers. The IT staff provided the following responses:

Respondent B

The university is currently facing financial problems and therefore we thought by migrating to the cloud, we will have saved the costs.

Respondent D

IT equipment is very expensive because the new system comes with its new specifications in the form of servers so we did not have the financial muscle to take that option.

This seems to be consistent in the literature. For instance, For example, Makori (2016) argues that the cloud service provider is responsible for all support services including issues of installation, licensing, upgrading and maintenance of all systems, this permits libraries to focus on their service needs with lower costs.

6.2 Benefits of cloud computing in libraries

Wada (2018:25) posited that cloud computing is the cornerstone cooperation for organisations and particularly libraries. He argued, “cloud computing serves as an engine that allows different

institutions and private organisation invest in information resources consortiums, applications and infrastructure that benefit all". By means cooperation, libraries can exploit information resources in the cloud and divert their efforts, time and different resources, avoid duplication thereby improving service delivery. According to the library IT staff members; one of the benefits the library derived from migrating to the cloud is the issue of saving costs because they did not have to purchase any IT infrastructure when the migration decision was made. The following are responses from IT staff:

Respondent B

Adoption of cloud computing services means we are saving costs in terms of buying new servers and other equipment for the new system. We will also save in terms of system maintenance and software updates because the service provider will take care of everything.

Respondent C

The most important benefit according to me is that we can use the money intended for IT equipment for other equally important library activities such as paying for more databases or books.

These responses are in line with what Makori (2016) has alluded to, that cloud computing helps in diverting the cost structure from capital expenditure and also assists in making IT systems more agile. Similarly, Scale (2010) argues that cloud computing allows information professionals to shift from the custodianship and maintenance of resources towards the provision of information controlled and maintained by others.

Furthermore, according to the librarians, the move to the cloud allowed the library to always be functional in terms of minimal downtime, if any at all. In fact, Respondent

A argued that:

Since migration to the cloud which was five months back, the library had not experienced any downtime except the one caused by no internet connection.

6.3 Challenges and risks associate with cloud computing

Despite its ever-growing popularity, several concerns surround cloud computing. One of the obvious challenges of this technology is that it relies on the Internet and therefore, if there is no Internet connection, there is no cloud computing. This is the first concern of both the IT library and the University IT staff. In fact, the university IT staff did not encourage the library at all to undertake this migration process as, in the view of respondent E

"This project is going to fail because of our low bandwidth."

Doherty, Carcary and Conway (2015) also showed the importance of Internet connection for cloud computing. Neethu and Vanaja (2017:3) argue that "with the multiplicity of mobile and personal devices such as smartphones and tablets there has been an increase in the cloud-based storage services like Google Drive, Dropbox or Microsoft Dropbox which has raised the issues of data privacy, and confidentiality, putting the user at a legal risk".

Another challenge raised by the library IT staff is that of cyber attacks targeted specifically at the cloud computing services. According to Turab, Taleb and Masadeh (2013) there several threats and different levels listed below:

1. Guest-hopping attack
   Defined as any separation failure between shared infrastructures. An attacker will try to get access to one virtual machine by penetrating another virtual machine hosted in the same hardware.
2. SQL injection:
   Is often used to attack websites. It is accomplished by injecting SQL commands into a database of an application from the web to dump or crash that database.
3. Side channel attack: when the attacker places a malicious virtual machine on the same physical machine as the victim machine; in that way the attacker can access all the confidential information on the victim machine.

The responses on the challenges of cloud computing from IT staff are listed below:

Respondent B

The data centre can be attacked at anytime and it means our data may be lost as well, but also it is the same as in the case where our local server may catch fire or any disaster.

Respondent D

The challenge we are likely to face is that we are relying on the availability of the internet otherwise if there is no internet; it means we are not going to have access to our data.

On the challenge of security, Thomas (2011) suggests that organisations with serious data security concerns should consider building their own private cloud services to minimise the costs over time. However, it should be noted that cloud computing challenges should not overshadow is benefits. After all, cloud computing is no less secure than our traditional IT delivery models (Thomas, 2011).

7. Discussions and conclusions

Cloud computing has brought change, thus replacing the traditional IT practices for organisations including academic libraries wishing to cut IT costs while also striving for efficiency. Due to its benefits, cloud computing is considered the engine of innovation because of its potential benefits to academic libraries. According to this study, the following key findings deserve a mention:

- There is a strong awareness in as far as cloud computing is concerned although staff members were not particularly aware of its drawbacks.
- The findings also revealed that the library management decided to go ahead with the migration project based on the fact that they could not afford the IT infrastructure that comes with local implementation. This is also despite the fact that the University IT personnel tried to discourage them to and their bases was the low internet bandwidth.
- It has been revealed that cloud computing has benefits mainly pertaining to cost saving as the University is currently in a financial crises.

- On the challenges, the study revealed internet connectivity as the main concern because cloud computing relies on its availability

Overall, the NUL library staff have shown a positive attitude towards the cloud based sierra system and seem to be consistent with the study's theory that the innovation is generally accepted and is now part of their daily routines.

Data collection for this study did not cover all university libraries and different campuses because of resources. This study investigated the adoption of the Sierra library management system on the cloud. It is important to remember that academic libraries are part of the entire university and therefore should not be perceived as if they operate in isolation. It has emerged from the study's findings that the university IT personnel did not encourage the library to undertake the migration project based on their perceived low Internet bandwidth. This may be the result of not having enough knowledge of cloud computing. It therefore becomes important to investigate cloud computing from the perspective of the entire university. Moreover, the study does not cover private academic libraries, but is limited to the National University library.

Arising for the study findings, the following recommendations are made:

- It is recommended that the whole University should adopt cloud computing. This will save them from worrying about system crushes, viruses and loss of data while saving on money and time.
- It is also recommended that in order to connect the entire university to the cloud, the University should increase the internet bandwidth.
- This study was only limited to the national university of Lesotho library and its findings cannot be generalized to other academic libraries in Lesotho. It is therefore recommended that a study be undertaken encompassing all academic libraries.

The study can help libraries transform their current paradigm from their traditional client/server-based technological operations to the modern cloud-based technological operations. The study results may further inform policy in other industries with regard to the adoption and implentation of cloud computing services.

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