International Journal of Science and Research (IJSR)
ISSN: 2319-7064
ResearchGate Impact Factor (2018): 0.28 | SJIF (2018): 7.426

# Cloud Computing in Libraries: Prospects and Challenges from Kenyan Perspective

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**Abstract:** ***Cloud computing has been a maiden name in the Information Communication Technology industry from the better part of the 21st century. A good number of industrial and organizational players have been struggling to have their share in muscling the contribution of the cloud computing in offsite data storage. One of the notable players in cloud computing are the libraries and information centers. This paper, therefore presents the rationale of cloud computing in the management of libraryservices in Kenya. By focusing on the libraries as data centers,cloud computing application can accelerate resource utilization for better information service provision. In order to understand how the cloud computing can be used in the library environment, it is necessary to first become familiar with the cloud's features and its prospects. The likely challenges cloud computing poses to the traditional routines and the users in the libraries and information centers.***

**Keywords:** Cloud computing, Library services, Information centers, Library automation

## 1. Introduction

Cloud computing is the on-demand availability of computer system resources, especially data storage and computing power, without direct active management by the user. The term is generally used to describe data centers available to many users over the Internet.

Romero (2012) observed that in the recent years it has become increasingly more common to hear about the virtues and benefits of the so-called "cloud" for the use of corporate software. Although the use of the cloud in the business environment has already transformed the concept of data storage and resource management, its use in the field of libraries and information centers is somewhat less widespread. Conversely, Kaushik & Kumar (2013) argues that contemporary libraries are using cloud computing technology for enhancing the services by adding more values, attracting the users and cost effectiveness.

Mavodza (2013) suggests that in the current discontinuous IT revolution, libraries have become one of the spaces in which most academic institutions use the cloud to cope with the new information environment in meeting the needs of patrons. Librarians therefore need to widen their skills set and think more openly so as to understand and cope because these kind of developments affect their professional environment in irreversible ways. Dealing with a broader range of information resources and services than by traditionally wellknown means makes it important for them to be well conversant about the choices and options available to them.

### 1.1 What is cloud computing?

According to the National Institute of Standards and Technology (NIST) definition (2009), Cloud computing is 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. Cloud computing is a model for delivery of resources as a service.

The Gartner Group (2009) defines 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 KPMG breaks this into essentially four different types of cloud computing: infrastructure, platform, applications and services.

Romero (2012) describes Cloud Computing, also known as "The Cloud", as a highly scalable platform promising quick access to hardware and software over the Internet, in addition to easymanagement and access by non-expert users.

### 1.2 Types of clouds

Bhattacharjee and Purkayastha (2013) describe cloud computing in two distinct models as follows;

***1) Deployment models***

This refers to the location and management of the cloud's infrastructure. Deployment models are of four type's; public, private, hybrid and community.

*Public cloud:* A public cloud is a shared cloud computing infrastructure that anyone can access. Public clouds services are available to the clients for free of cost or with cost from a third party service provider through Internet. It is also known as provider cloud. In public cloud an organization can rents the cloud system and pay for what they use on-demand. The public cloud infrastructure is available for public use alternatively for an organization or an industry group and it is owned by an organization selling cloud services. Rack space, Amazon, Google, Microsoft Azure, IBM offerings are examples of public clouds.

*Private cloud*: A private cloud is a cloud computing infrastructure owned by a single party. The private cloud technology is functioned for the special use of an organization. Private clouds are available only to the

members of the organization and it is may be managed by that organization or a third party. Private cloud is also known as "internal cloud". In private cloud an organization turns its IT environment into cloud and uses it to deliver services to their users. Private cloud will facilitate user to store and disseminate their data on respective cloud (e.g. institutional cloud, eBay).

*Hybrid cloud*: A hybrid cloud is a combination of public and private cloud. It is also known as combined cloud. In hybrid cloud, private and public clouds retain their unique identities but are bound together as a unit. A hybrid cloud may offer standardize or proprietary access to data and applications, as well as application portability. An example of hybrid clouds is Google Apps.

*Community cloud*: Community clouds are specifically organized clouds, to serve a common function or purpose. It may be for a particular organization or a group of organization, but they share common concerns such as their mission, policies, security, and so on. It can be managed by the organization itself or by the third party (e.g. Institutional Gmail of Google Apps)

***2) Service models***

This is particularly based on type of services that any user can access on a cloud computing platform.

*Software as a service (SaaS)*: In this service model hardware, operating system and other special purpose software are made available by the service provider to the user over the Internet. It is a complete operating environment with applications, management and the user interface. In this model all types of responsibilities are upon the vendors, the client's responsibility begins and ends with entering and managing their data. SaaS eliminates customer worries about application servers, storage, application development and related concerns of Information technology. When a cloud computing vendor offers software running in the cloud with the use of application on a pay-as-you-go-model, it is referred as SaaS. Some examples of SaaS cloud service providers are: Google Apps,Sales Force.com and SQL Azure

*Platform as a Service (PaaS)*: In the PaaS model, cloud providers deliver a computing platform together with hardware, OS, framework, database, and web server and application developer can develop and run their software solutions on that cloud platform. There will be some restrictions on the type of software that developers can run. PaaS saves costs by reducing upfront software licensing and infrastructure costs, and by reducing ongoing operational cost for development, test and hosting environment. An example of PaaS service is that SalesForce.com opened an API called the Force API that allowed developers to create applications based on the SalesForce.com technologies.

*Infrastructure as a Service (IaaS)*: This is the provisioning of virtual computers, virtual storage, virtual infrastructure and other hardware accessories where the organization has control over the operating system, thereby allowing the execution of arbitrary software. In this model the service provider manages the entire infrastructure and the clients are responsible for all other deployment. Examples of IaaS service provider include; Amazon elastic computer cloud (EC2), Eucalyptus, Go-grid, Terre-mark etc.

## 2. Advantages of Cloud Computing

Ramero (2012) summarizes the advantages of cloud computing as follows;

- *Cost reduction*. Ability to increase or decrease the consumption of hardware or software resources immediately and in some cases automatically.
- *Scalability*. "Pay as you go" allowing a more efficient control of expenditures.
- *Lower investment, reduced risk*. Immediate access to the improvements in the resource proposed (hardware and software) and debugging.
- *Support included*. Enjoyment of the most advanced security procedures, availability and performance of providers with experience and knowledge in this type of service.
- *Greater security and accessibility*. Access to resources from any geographical point and the ability to test and evaluate resources at no cost.

## 3. Challenges in adoption of Cloud Computing

Kimutai and Muli (2015) summarises the challenges of cloud computing as follows:

- *Control*: in a cloud solution, there is less control over software preferences, and businesses can no longer ask their IT staff to install software or make modifications to a software package to meet their needs.
- *Data mining*: some cloud solution providers own the data put into their "cloud" and are free to mine the data (particularly providers that provide the cloud solution for free or for a nominal fee). Institutions should ensure the data put into the cloud is owned by them, and that the service provider cannot mine that data.
- *Data storage location*: depending on where the provider locates their server/s, they may be subject to legislative requirements in that location that can impact access to information.
- *Functionality*: some functionality may not be available, or may be very different in "the cloud". The performance on a cloud-based solution can also be very different to in-house systems. For example, computer functionality may be unavailable in a cloud solution (tasks such as video editing and other bandwidth-intensive tasks are best kept out of the cloud).
- *Knowledge of cloud service providers*: Many businesses lack knowledge about cloud service providers and hence may make mistakes in choosing the best service provider for their business.
- *Reluctance from IT staff*: An organizations" IT staff may not be supportive of a move to cloud solutions as they may not have the required expertise and they may feel threatened by such a move.
- *Inadequate bandwidth*: Cloud solutions require continuous internet access. If internet access is down, intermittent or slow, it affects the availability of the cloud services.
- *Security and privacy*: With a cloud service provider, data

is stored with a third party. It is necessary to signservice level agreements to ensure privacy and confidentiality of the data.

- *Technical issues*: In spite of cloud solutions being generally well maintained, often to a higher standard than in-house systems, there will be times when the system may not work as required for example when the fibre optic cables are damaged under sea.

## 4. Application Cloud Computing in Libraries

Mavodza (2013) submits that when discussing cloud computing in a library context, it is important to define how the models apply it terms of the types of services involved, the infrastructure used, the platform on which applications are built and the associated applications. The use of a Platform (PaaS) refers to a situation where software already exists, such as when the library uses an Integrated Library System whether it is open source such as Koha or Greenstone, library catalogues, subject catalogues, OverDrive, Googledocs, and WorldCat. Software as a Service (SaaS) can be viewed in the use of Lib-Guides, the library catalogue, WorldCat, OverDrive, aggregated subject gateways that support systematic unified web-scale resource discovery such as Ebsco Discovery Service, Primo Central (Ex Libris), Free and Open Source Software (FOSS), Citation Management software. From the examples, it is apparent that, because library systems use both platforms and software, there is sometimes no demarcation between PaaS and SaaS. Services that are referred to as cloud-based also include the provision of actual resources, for example, Over Drive e-books, research guides and online reference services that are ready for use. The function of cloud applications is exemplified by Google Docs or library e-book readers such as for ebrary books or Safari books that are accessed with a web browser. Cloud Infrastructure (IaaS) refers mostly to the space/time that users can buy to use external servers for electronic storage as in institutional digital repositories or institutional archives. It is also the infrastructure that enables open-source software for running repositories, for example, D-Space, E-prints, or hosted software packages such as Digital Commons, and Simple DL.

The semantics, human, legal, and international aspects are involved because of the use of the cloud need to be addressed. The reason is that libraries have stepped and are increasingly stepping into the realm of digital librarianship as well as platforms that extend IT's existing capabilities, and this extensively depends on using the cloud (Mavodza 2013). In terms of the use of semantics, the research of Alemu et al. (2012) suggests that "the proliferation of metadata standards has brought interoperability problems between disparate digital libraries". Adding to this discussion is a point raised by Diekema (2012) that "enabling users to search across languages requires translation resources to cross the language barrier, which can be challenging depending on the language and resource availability".

In using the library website, if tagging is put in place as a function, its use would be based on lessons gained from information literacy exercises (Mavodzo 2013). Macgregor and McCulloch (2006) suggest that tagging can be an effective method of organizing resources that faculty needs to support teaching, and that can in the process replace traditional subject guides. By using a platform such as delicious.com that allows cloud computing, librarians can actually invite each other into a specified closed network, add useful resources to it in a non-formal but constructive way, and in the process be accumulating knowledge for practical use.

Goldner (2011) quips that resilience is important if a library has to maintain its character and yet be adaptive to inevitable and unpredictable changes that happen at an accelerated pace. This calls for librarians being able to provide a wide variety of information from an equally varied selection of sources and formats, particularly with the prevalence of cloud use. The implication is for librarians to work as complementary teams within the library and with other relevant departments/institutions. It is realized that cloud computing enables new streamlined workflows for cooperation and community building among libraries.

Kaushick and Kumar (2013) observed that OCLC is one of the best examples for making use of cloud computing for sharing libraries data for years together. For instance, OCLC World Cat service is one of the popular service for searching library data now is available on the cloud. OCLC is offering 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 to develop an open and collaborative platform in which each library can share their resources, services, ideas and problems with the library community on the clouds. On the other hand, the main aim of web – scale services is to provide cloud based platforms, resources and services with cost benefit and effectiveness to share the data and build in the broaden collaboration in the community.

Kaushick and Kumar (2013) further insist that Cloud plays a cardinal role in library automation , for instance Polaris provides variant cloud based services such as acquisitions, cataloguing, process system, digital contents and provision for inclusion of cutting edge technologies used in libraries and also supports various standards such as MARC21, XML, Z39.50, Unicode and so on which directly related to library and information science area. Apart from this, nowadays many of the software vendors such as Ex-Libris, OSS Labs are also offering this service on the cloud and third party services offering hosting of this service (SaaS approach) on the cloud to save libraries from investing in hardware for this purpose. Besides cost-benefit, the libraries will be free from taking maintenance viz. software updates, backup and so on.

Cloud computing in libraries reduces technological costs, increases capacity reliability and performance, while limiting computer user maintenance. Special, historical and rare documents can be scanned and stored in online database through local area network (LAN) – networks for easy access and use. Backed-up files are maintained and reprographically created for users .However, this may, in the long, run strain data integrity and jam the network (Wasike

& Njoroge, 2015)

**Library and information center clientele issues**

- The right to privacy of libraries and other users is likely to beinfringed as the companies providing the cloud services have control and thus can monitor illegally the communication and data transmission between the user and the service center.
- In order to comply with certain government regulatory agencies libraries and other users may have to adopt community or hybrid models which are far more expensive andhave restricted benefits to the users
- Legal issues are a wash within the cloud computing, including but not limited to; data sharing, data security and infringement of user rights.
- Misuse of the services by users who pay for the cloud computing service for arterial motives including password cracking and unlashing virus attacks from the 'safe heavens'.
- Long term sustainability of cloud computing in terms of environmental and energy saving effects is not well known to a majority of users due to limited published literature on the same.

## 5. Conclusion

Libraries are shifting their services by attachment to cloud with an intention of seizing the facilities to access these services anywhere and anytime. Therefore, for libraries to be continually relevant, they need to embrace cloud technology in this dynamic technological environment. By taking advantage of these technical advancements, libraries will make information more accessible than at any other time in history, thus meeting their obligations as information providers.

Libraries and information centers resource sharing can lower the cost of information resource acquisition through cloud computing without necessary owning the hardware, software and databases all in one which would be very expensive for a single entity.

However, the library fraternity should also be more cautious that clouds like other systems have weaknesses and challenges that have been highlighted above.

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