Issues in the Application of Cloud Computing in Academic Libraries: Implications for Developing Countries

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Abstract

Purpose- *is to view libraries readiness to adopt new technologies such as cloud computing to services as information mangers. Determine awareness level, concept clarifications, use, and application to library service, cost, staff competence and more. This paper is an analysis of library research literatures issues in the application of cloud computing in academic libraries: implications for developing countries.*

Approach-*Study by the standard apex body International Organization for Standardization (ISO) have developed 19,500 standards on different aspects in the world till date but no standards have been developed yet on cloud computing. Another, survey report claims that India is at higher risk when operating as a cloud computing service provider due to the lack of treaties and undeveloped tax laws on cross border transactions that may cause adverse tax consequences. Similarly, Institute of Electrical and Electronics Engineers (IEEE) worked on two groups P2301 (10) and P2302 (11) to standardize the aspect of cloud computing services.*

Finding- *The study revealed the need for legislations and guidelines for a well-established set of standards that can address the cloud computing phenomena before its implementation in the libraries by cloud service provider to be framed. In another study result showed that cloud service providers need to address the problem of cloud legislations define scope and boundaries of services, also resolve issues of data, loss, privacy, migration and back up.*

Implication- *Academic libraries to understudy cloud computing as concepts, the element of library services to move to cloud, IT infrastructure, cost and staff development in text running the trial version as available with the services provider to avoid a pit fall.*

Originality/Value: *Is geared at raising issues of concern for academic libraries with emphasis on emerging technologies and its application to library services with particular reference to cloud computing in libraries the need for critical evaluation to enable libraries explore and derive maximum benefit from it.*

Keywords- *Cloud; Cloud Computing; Academic Libraries; Application of Cloud; Implication for libraries; Developing Countries; Nigeria;*

Introduction

Today information technology is evolving daily and emerging with new innovation that has left the library with puzzles to solve as information managers. It will be out of place to undermine the vital role of information technology in enhancing library services, promoting library resources sharing, and facilitating other range of services. Libraries are shifting their services and personnel competences in this direction to enable them satisfy patrons' needs in an increasing knowledge society. The most recent is the emergence of cloud computing technology adoptions and application to library activities such as collection, storage, organization, processing, analysis of information dissemination and other housekeeping routines. As this new innovative technology emerges, it leaves the professional with many challenges such as clarifications on new concepts, awareness, cost of its application in libraries, and implications the service concept of libraries.

As Whong, (2014) remarked, the primary purpose of University libraries is to support University functions of teaching, learning, research and community services in ways consistent with and supportive of the institution's mission and goals. It therefore means that for libraries to realize these goal they must update their information resources to meet current demands and needs of patrons, and at the same time empower the librarians recent skills for better performance on the job. Many libraries, especially academic libraries, need sufficient supply of network to withstand the additional demand made by the computers asserted by Kessler (2013).This implies that with dwindling and merges allocation for libraries,

they could rarely pay for robust data subscription due to high cost with cloud technology libraries stand to drive a lot of benefits as their network will boost service as it is based on pay as you use and no more renewing of yearly subscriptions, as high cost subscription and server maintenance is eliminated or cut down drastically, this is a plus to libraries.

Different forms of technologies have evolved over the years in the field of librarianship, from the advent of information technology, library automation, networking, virtual libraries, the emergence of digital library, internet usage, these developments moved progressively to the application of web tools in libraries. Today, in library and information science profession and other related fields, cloud computing technology is the new technology of interest. Cloud is a completely new IT technology viewed as the third revolution after PC and internet in IT. Cloud computing technology is the most recent technology in use in library and information science and is use for various purposes for enhance services, infrastructures, and reduce cost in library functions. It has been conceptualized by various authors regards to the functions and benefits. The term cloud computing could be define as the integration of varying Internet-based computing services.

Most cloud computing services are accessed through a web browser like Microsoft Internet Explorer, Microsoft Edge, Mozilla Firefox, or Google Chrome. Cloud services can be used via certain dedicated mobile app through a browser on a smart phone or tablet. Therefore, cloud services don't require users to have sophisticated computers that can run specialized software. Many organization are employing the new technology for managing their organization service, therefore, it is imperative for libraries irrespective of its type to start strategizing as they will all experience similar issues as cloud computing grows to become the major channel through which new technology services are delivered. Thus, the focus of this study is the implication for application of cloud computing technology to academic libraries in Nigeria.

Conceptual Clarifications

Cloud computing is a kind of computing technology which encourages sharing the resources and services over the internet rather than having these services and resources on local servers/nodes or personal devices. The combination of servers, networks, connection, applications and resources is defined as 'cloud'. Cloud computing is acting as a resources pooling technology for accessing infinite computing services and resources as per demand of users and can be compared with models of pay as you use or utility model. The same model as used by mobile services and electricity companies. According to Wikipedia, the concept of cloud computing emerged as far back as the 1960s, when John McCarthy opined that computation may someday be organized as a public utility. Chellappa gave the first academic definition of the term Cloud Computing in 1997 and later on, in the year 2007 the term cloud computing came into popularity and firstly was used in this context when Kevin Kelly opined that eventually we will have the inter-cloud, the cloud of clouds.

In this regard, “Cloud computing” according to Wikipedia: “Cloud computing is Internet-based computing, whereby shared resources, software, and information are provided to computers and other devices on demand, like the electricity grid.” On the other hand VMware, company provider of software and services, gives a more business-oriented definition: “Cloud computing is a new approach that reduces IT complexity by leveraging the efficient pooling of on-demand, self-managed virtual infrastructure, consumed as a service.”Stroh et al, (2009) defined “cloud computing as “the computing software and services that can be accessed via the internet rather than residing on a desktop or internal server.” This implies that services will be accessible at ones comfort zone anywhere and anytime provided there is internet connectivity.

Cloud computing technology innovation evolves to better services which aimed at covering a wider audience at a lower cost without proximity to any library rather the direct connection to the internet and libraries resources hosted in the cloud as a way of collaborating and sharing resources. Geoffrey, (2013) pointed out that the interesting thing about cloud computing is that it did not start as a technology for the business enterprise, but was driven by the public with services like Facebook and Flickr.

> It is essential for libraries to have a solid understanding, acquire knowledge and skills as pertains to this new technology as well as developing strategies and good policies on the cloud computing technology before considering adoption and applications. This is far beyond just

creating awareness. There must be concrete understanding of such concepts as infrastructure- as-a-service, software-as-a-service, and platform-as-a-service, the relative advantages, Strength, Weakness, Opportunities and Threats (SWOT) on the subject of cloud computing technology.

Application cloud computing technology could help libraries and librarians to overcome constraints like those associated with locally supported infrastructure. Therefore, librarians and other personnel who work directly with new technologies should find out more, and have in-depth information, knowledge, skills and competencies on how to plunge directly into practical aspect by exploring the advantage of free levels of service of trial versions offered by some of the top cloud services providers.

This by implication will empower librarians and libraries to render more effective and efficient and quality services that will help meet the high and unstable demands of societal needs. Like Facebook, and other social media platforms that serve millions of people worldwide simultaneously, with cloud computing deployed in libraries, it is certain that the quality of network will be enhanced and libraries can explore it efficiently and this will make impact on researchers' input and output in developing countries.

According to Krubu and Osawam (2011) the impacts of computer networks are felt by libraries in every aspect. Computing technology, communication technology, and mass storage technology are some of the areas of continuous development that reshape the way libraries access, retrieve, store, manipulate and disseminate information to users. These reasons are why libraries should adopt cloud computing through careful planning and strategic evaluation of the adoption process. It important therefore that in adopting cloud computing in libraries, collaboration with experts is essential to successful implementation of the technology for enhancing service delivery.

Cloud computing will reduce expenditure on infrastructural maintenance and eradicate the problem of compatibility of software with hardware and rather boost their services and personnel development. Libraries can equally get out of the business of technology such as hardware breakdown, software problems and focus on collection building, patron services and innovation as posited by Goldner (2012).

Applying Cloud Computing Technology in Academic Libraries

Academic libraries can apply cloud computing to it services in order to enhance effectiveness and efficiency. Some areas of concern raised by NIST (2012), as solutions to cloud computing maintenance in summary includes: governance, policies development, procedures and standard of use; they equally consider the issues of compliance, security controls, records management requirements and the provision of adequate data; and trust which implies cloud providers ensure to make a service arrangement characterized by high visibility, security and maintenance.

Architectural: Develop an understanding of the technology the cloud provider utilizes; Identity Access Management: Ensure the correct controls are communicated to the service provider so as they can secure authentication, and other identification and access management functions; Software Isolation: Understand virtualization and other isolation techniques of the cloud provider will implement; Data Protection: Evaluate the cloud provider's data management solutions and maintenances; Availability: Ensure that the contract provisions and procedures for availability, data backup and recovery, and disaster recovery meet the library's continuity and contingency planning requirements and lastly, Incident Response; Ensure that the contract provisions and procedures for incident response meet the requirements of your library. These are crucial areas libraries must consider before adopting cloud computing.

Importance of Cloud Computing Technology in Academic Libraries

Gates (2000) observed that the main advantage of any new technology is that it amplifies human potentials. Goldner, (2012) posited that with the adoption of cloud computing technology, libraries can get out of the business of technology and focus on collection building, patron services and innovation. This implies that all parties involved in the use of cloud will benefit in a way, for librarians they will have to be empowered, for the patrons they can access library resources round the clock and, to the institution research, output will increase as researchers are exposed to current literatures and materials are readily made available to via

internet service in a variety of sources that they can access.

This will ease libraries from the stress of software, hardware maintenance and damages; libraries energy will now be concentrated on innovation that can enhance better services to meet patrons and societal knowledge needs. And infrastructure as service model will help solve the problem of space which libraries have faced over time. This will drive the library into complete virtual and paperless library. Tierney Smith of TechSoup Canada sums up the advantages of a move towards cloud computing, thus, Libraries will be able to realize cost saving of maintaining their own servers; to cut down pay of consultant; application of the right cloud tools help eliminates barrier and promote transparency with partner and the organizations; Cloud tools promotes and enables sharing and easier collaboration amongst libraries and equally library work.

It will reduce support and hardware needs, such as constant upgrade of computer systems and the infrastructural cloud computing does not need larger number of IT staff for its operation since it is not the responsibility of libraries to manage the software rather it is the services provider who does the maintenance. Cloud computing reduces IT equipment in the office. Adopting the right cloud tools can enable collaboration as a patron does not need to be present in a physical library to access services provided especially if they are using a private or secure Wi-Fi connection. Similarly, by creating a Basecamp platform where patron can view each other activities it will enable team collaboration tools advantage for colleagues such as video conferencing, file sharing via office365 and instant messaging these are made possible on the Software as a service platform environment.

So many factors have necessitated the rationale for the application and adoption of cloud computing technology in the libraries. Such factors include discovery services embedded in cloud computing, disclosure of library's collection on the web, reduction of cloud foot print and compressing library activities into three major component; technology, data and community (Goldner, 2012). The 21st century library functions under these three major components. No modern library operates without technology; libraries subscribe to data for effective service delivery; and the aim which is to meet the changing needs of their community of users.

One of the rationale for the adoption and application of cloud computing is the opportunity for collaboration and cooperative intelligence it affords (Breeding, 2012).It crucial therefore to equip and empower librarians and other library personnel to gain background knowledge and information needed with the practical guides to evaluate the numerous opportunities available in cloud computing for the benefit of their institutions.

After many years of adopting computing technologies, cloud computing technology has invaded the library environment to provide more effective means for sharing and preserving knowledge. Presenting libraries with windows of opportunities to advance from the need to own and manage their servers to rather to enjoy similar benefit via a web-based or internet based services.

Libraries and their services are associated with Information Technology (IT) on content delivery, communication, collaboration. Libraries require server, storage and software in highly demanding. Today, Libraries are moving their services to cloud computing technology to facilitate and enhance its services to a large audience and coverage anywhere and anytime. The following are possible areas that libraries can apply cloud computing technology: Searching scholarly content, building digital library/repositories, search library database, web site hosting, file storage, building community power amongst others.

Cloud computing technology services are categorized into four different types, namely: Infrastructure, Platform, Applications and Services. Infrastructure is acquisition of Space/ times on external servers, marketed by Amazons, A3, and Bungee. Platform is an existing software platform in which libraries can build its own application on, example are Facebook, and Application is a software accessed with a Web browser, like Google Docs, Salesforce.com, whereas, Service is a ready to use service accessed with a Web browser such as ADP.Mell and Gance (2011) defined each of the 2 three services models thus: Software as a Service (SaaS) which allows users to use the provider's applications on a cloud through a web browser, while Platform as a Service (PaaS) allows users to deploy their own applications on the provider's cloud infrastructure under the

provider's environment. Infrastructure as a Service (IaaS) allows users to control and manage computing resources.

Cloud computing will help solve the problem of space as infrastructure is invisibly hosted on the space managed by software service providers now saddled with the responsibilities to manage and ensure network availability to patrons irrespective of their location and time of service demand.

Standardization issues in the adoption Cloud Computing Technology to Library Services

According to Mazumder, Rakib and Uddin (2012), being able to keep important data secure has always been a priority in IT, but as cloud computing takes information outside of the virtual secure walls most corporations have raised red flags to its adoption. The problem is further aggravated as the standard apex body International Organization for Standardization (ISO) claims to have developed 19,500 standards on different aspects in the world till date but no standards have been developed yet on cloud computing. Giving the concern a prime importance, legislations and guidelines with the cloud service provider should be framed. These issues demands for a well-established set of standards that can address the cloud computing phenomena before its implementation in the libraries. This is a very critical observation which that will make libraries to feel reluctant.

A survey report released by Ernst and Young (2012) claims that India is at higher risk when operating as a cloud computing service provider due to the lack of treaties and undeveloped tax laws on cross border transactions that may cause adverse tax consequences. Commenting on the possibilities of implementation of cloud computing in libraries (Yuvaraj, 2014) asserts that although the future of cloud libraries is very cloudy but seeing the trend denial of cloud computing will strip users from the brick-and-mortar libraries but before its implementation there is a need to frame "*Canon of Cloud Libraries*" that should be the guiding principle for the alliance of libraries with Cloud computing. He further adds that the Canon of cloud libraries should address the problem of cloud library legislations, define the scope and boundaries of the library services in the cloud and resolve the issues of data loss, privacy, migration and backups. To support Yuvaraj opinion cloud for libraries should spelt out clearly which library services cloud computing technology will be apply to; it should have a standard polices.

In the recent years Institute of Electrical and Electronics Engineers (IEEE) are working on two groups P2301 (10) and P2302 (11) in order to standardize the aspect of cloud computing services. P2301provides a roadmap for all cloud providers building services under the standard while P2302 defines topology, protocols, functionalities and governance required for cloud interoperability and cloud federation that will ensure the ability of exchange data between clouds (Nguyen, Tran and Hluchy, 2012).Other projects carried out to standardize cloud computing practices are EU FP7 programme (Contrail project homepage, n.d.), 4CaaSt (Eu fp7 programme, n.d.) project targeted towards the creation of software libraries for PaaS (Platform as a Service) that will ease the development of applications, Contrail (Loutas et al., 2010) project that aims to promote an open source system for Cloud Federations, Vision Cloud that aims to encapsulate storage into objects with metadata, extending the limited data migration capabilities, Cloud4SOA (Menchtas, Gatzioura and Varavarigou, 2011) project that deals with semantic interoperability issues within the cloud on various levels.

However, despite the availability of existing standards like OCCI (Open Cloud Computing Initiative) (22) and DTMF`s OVF (Open Virtualization Format) (1) it is almost impossible to move applications between the different cloud providers (e.g. from Amazon (5) to Force.com (14) as each provider has their own proprietary data structure and all providers especially who already have a substantial market share do not take interest to make their services interoperable (Nguyen, Tran and Hluchy, 2012). (Bradshaw, Millard and Walden, 2011) have enlisted four kinds of documents that should be framed in order to standardize cloud computing practices which include: **Terms of Service** (ToS) – Detailed description of the relationship between the cloud services users and the provider; **Service Level Agreement** (SLA) – Specification of the level of service the provider aims to deliver together with the process for compensating customers if the actual service falls short of that; **Acceptable Use Policy** (AUP) – Detailed description of the permitted (or in practice, forbidden) uses of the service; **Privacy Policy** – Description of the provider's approach to using and protecting the customer's personal information.

Challenges of Cloud Computing Technology in Libraries

Cloud computing technology is still in it infant stage in developing countries in terms of clarity of concept, application and adoption for library services, how it works, and many more issues. These may be pose as challenges to its adoption because without sufficient level of awareness adoption is possible. Other challenges as observed by Khajeh and Sriram (2010): are the interdisciplinary natures which they considered cannot be fully addressed from a purely technical perspective. The issues of security and availability of confidential information of libraries and individual still pose as a major problem thereby making libraries and individuals reluctant about depending on cloud-based services.

Fear of cloud vendors going out of business and change in services that could affect the application of the cloud library. Another major fear exhibited by libraries is the potential drawbacks of cloud computing security and availability as a result of security breaches in cloud based services of some high profile organization. Another challenge is with regards to current technology skills level, that is, the issue of not having IT staff and librarians with the technical skills and knowledge to manage and provide services.

In addition, cloud computing technology security and management is majorly the concern of trained experts. Geoffery, (2013) explained that once the relationship is established the library can rest that the information is safe and well maintained in a capable hands as much of the works on cloud computing attempts to allay the concerns and fears of potential users of the service.

Implication of Cloud Computing Technology to Libraries in Developing Countries

Despite the trendy nature of cloud computing technology in libraries and other organizations' and its brilliance, it still raises many concern regarding IT personnel, cost, staff, maintenance and the security of personal confidential documents. At first glance these serve as deterrent to adoption of cloud technologies however a proper analysis will set everything in perspective for proper decision making with regards to cloud computing in Libraries.

- The first implication of cloud computing for academic libraries has to do with staff capacity and readiness. Plans must be put in place to have library IT staff with sound knowledge on library software applications and how it relates with the management of library services in cloud computing technology domain, as this is a new environment that requires continuous skills and knowledge development.
- The other issue is the cost implication of cloud computing. Whereas the initial cost for adopting cloud services that relate offsite storage may be a bit unsettling in the beginning, the long term cost impact is highly effective for libraries in developing nations. This is worth noting for libraries that deal with very large sets of data, involving many terabytes such is video collections, and large image collection. Network bandwidth accounts for much of the cost of moving data, cloud providers might charge upload and download fees and even though data and systems are being hosted off – site. It must however be noted that using cloud can reduce total cost of ownership of infrastructure significantly over time.
- The other key issue to consider is the implication of time variation for migration of IT applications to cloud system could take long period of time
- Finally, cloud computing has implication for future of vital documents. Granted, that cloud is the safest place to keep things, Nigerian academic libraries should consider the potential of cloud computing in preserving their vital documents that are constantly under threat of extinction due to various environmental and man-made problems

Conclusions

Cloud computing technology is a rapidly changing the IT environment in this era of information explosion. This changing environment will undoubtedly continue to play an increasingly significant major role for libraries as well as the IT systems. The question of course is which elements of your library services, IT infrastructure, and library collection should be migrated into the cloud? How and when with the cost implication could then be issues to critically evaluated. In evaluating cloud providers, libraries should find out what options they have for backing up and extracting data, as

the best services allows download of data in a standard nonproprietary format. With the benefits of cloud computing in libraries, Nigerian libraries should deliberately explore its potentials and adopt it as a safer way for preserving knowledge as well as a cost effective way for delivering quality internet mediated services in the 21st century.

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