CLOUD COMPUTING PARADIGM AND LIBRARIES AND INFORMATION ESTABLISHMENTS IN KENYA: ANY OPPORTUNITIES FOR OPERATIONAL RESILIENCE?

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Abstract

Modern technological solutions are rapidly changing the information landscape in organizations including libraries and information establishments. One such innovative solution that is gaining momentum in information centers is cloud computing. The purpose of this paper is to explore and compare opportunities and challenges of this emerging trend of “cloud computing paradigm” in libraries and information establishments in the face of the present hard economic situation and limited financial budgets. Cloud computing is proving as the best management practice for handling and supporting quality delivery of services in information centers due to numerous competing challenges and issues in organizations. Libraries in developing countries face many challenges of inadequate information infrastructure, limited financial budgets, manpower issues and rapid changes in technological systems. In the context of hard economic times, cloud computing is critical in adding value as well as advancing the goals and objectives of modern libraries and information establishments. Cloud computing is the “best technology practice” that is poised to play crucial roles in enhancing quality provision and delivery of information services in libraries. There are many competing challenges and claims but potential benefits for operational resilience count more. Additionally, cloud computing is the “must have technology” for modern libraries and information centers already burdened with the demand to develop effective and efficient technological solutions due to subsequent changing needs of the digital environment. Cloud computing paradigm provides libraries and information establishments with the business opportunity to use comprehensive technological solutions with reduced capital expenditure and safe methods of data storage. This eases the inconveniences normally caused by the need to develop and own such comprehensive technological solutions. Cloud computing has been gaining momentum in Kenya, especially in business organizations as compared to libraries and information establishments.
Introduction

Across the world, the information landscape is rapidly changing due to modern technological solutions or innovations. Technological solutions play crucial roles in provision and delivery of services in library and information establishments. The emerging trend of cloud computing is a blessing dramatically reshaping the information environment in the same way other technological developments have done in the past. In modern information centers, cloud computing provides effective and efficient utilization and sharing of information services. This model of computing is increasingly becoming attractive in libraries and information centers. Cloud computing has brought new innovative ways of empowering the creation, diffusion, utilization and sharing of information, knowledge and intellectual records in organizational libraries, while reducing management related issues.

Historically, information centers are powerhouses that provide unlimited and unrestricted access to knowledge and intellectual records to clients. The information center therefore includes libraries, documentation centers, information analysis centers, bibliographic centers, information referral centers, archives, and record centers, mass media or communication centers, publishing houses, bookshops and cyber cafes. Libraries are powerhouses of information, knowledge and communication (Makori, 2015). Parliament libraries provide information and research services to Members of Parliament and staff in relation to parliamentary duties. In institutions of higher education and learning, academic libraries are fountains of knowledge that manage, preserve, organize, distribute and utilize information to support research, teaching, learning, scholarly communication and community services. Libraries exist for the sake of clients whose major interests are that desired information materials should be readily made available when needed, and in the appropriate format (Khan & Rubina, 2009). Modern library is service industry or institution that acquires, processes, preserves, markets and provides information services to the clients. In addition, the library extends beyond the physical walls of the building through technological and digital applications such as social computing, cloud computing, mobile phones and internet solutions.

In the 21st century, cloud computing model is displacing the client server architecture and reshaping delivery of information services to the customers. Of critical importance is the need for information professionals to play a leadership role in implementation of cloud computing solutions. In Kenya, cloud computing is gaining momentum in business organizations. In library and information centers, cloud service cannot be ignored because of its crucial role in management of information services due to hard economic situation and limited financial budgets facing organizations including parliament and institutions of higher education and learning. Cloud computing has brought new business ways to handle, support and manage information services.
Libraries are “agents of change” that proactively should be involved in implementation of new and smart technological solutions so as to enhance and support delivery of services to the clients. The purpose of this paper is to provide up-to-date account of the potential of cloud computing in management, utilization and sharing of information, knowledge and intellectual records in libraries, in addition to, creation of online communities for scholarly communication, collaboration and participation.

Cloud Computing Paradigm

Based on Forrester Research, Nuance Communications (2009) reports, that, ... cloud computing is one of the top 15 technology trends and that it warrants investment now so you can gain the experience necessary to take advantage of it in its many forms to transform your organization into a more efficient and responsive service provider to the business. Cloud Computing is the recent trend of innovative technological solutions in the modern information and digital environment. Historically, cloud computing is the emerging revolution after the development of personal computing and internet based solutions. Cloud computing is the provision and enhancement of services through distributed systems having large data centers and powerful servers that host web applications. This involves creation, integration, diffusion and distribution of resources and services using distributed computers on the internet. Provisioning and sharing of resources, software, applications and information on public cloud services are made available to the clients.

Cloud computing is internet based computing, involving sharing of resources, software and information provided to computers and other devices on-demand through the internet (Wikipedia, 2012). Basically, the name implies the image or shape of the cloud symbol used to represent the concept. Nimis (2010) notes, that building on compute and storage virtualization, cloud computing provides scalable, network-centric, abstracted information technology infrastructure, platforms and applications as on-demand services that are billed by consumption. In view of the above, cloud computing is internet computing that involves provisioning, utilization and sharing of resources, software, applications and services on the internet with minimum management and maintenance efforts.
Cloud computing is emerging as the new information communication technology paradigm with the biggest impact since the invention of the web. Cloud computing architecture is the systems architecture of the software systems involved in provision and delivery of cloud computing. Typically, this involves multiple cloud components communicating with each other over application programming interfaces of web based services. Cloud is the collection of networked features with on-demand services used to share computing resources such as networks, servers, storage, applications and services.

Cloud computing architecture consists of two main components namely the front end and the back end. The front end is the part seen by the client, the computer user. This includes the client’s network, computer and applications used to access the cloud via user interface like the web browser. The back end is the ‘cloud’ itself consisting of computers, networks, servers and data storage devices.
Cloud computing incorporates four types of “clouds” namely public cloud, private cloud, community cloud and hybrid cloud. Public cloud computing environment is normally available and open to the general public. This is managed and supported by organizations selling cloud services such as Amazon Web Services and Google AppEngine. Private cloud computing environment is purely managed and operated within the organization or through the third party that exists on the premise (internal) or off premise (external) for the purpose of controlling own resources. Community cloud computing environment is made up of several organizations supporting particular community having shared values such as vision, mission and security issues. In addition, community cloud is managed and supported by the respective organizations or through the third party that exists on the premise or off premise. Hybrid cloud computing incorporates both public and private clouds based on standardized or proprietary technology.

**Cloud Computing Services**

Cloud computing allows users to choose from a pool of hardware, software and networking infrastructure managed independently within an organization or externally by a vendor (Armbrust et al., 2010 & Joint et al., 2009). This involves provision and delivery of services through the internet. The main purpose is to effectively and efficiently improve utilization and sharing of resources. These include service orientation, infrastructure virtualization and cloud computing. Generally, cloud services are broadly divided into the following three categories:

1. Software-as-a-Service (SaaS)
2. Platform-as-a-Service (PaaS)
3. Infrastructure-as-a-Service (IaaS)

Software-as-a-Service provides software or applications and related services involving deployment and hosting of the application by the service provider to the serving clients or customers through the internet. SaaS is the business purchase software based on the needs and demands of the clients or users. This helps organizations and firms to save on initial and upfront costs since the software is paid based on the number of clients. The concept provides the platform for small and medium enterprises to enjoy the benefits of commercial software with minimum costs since the applications are installed, handled and managed by the service provider. In addition, minimum management issues are involved since the user does not need to worry about the maintenance and support of the software and the actual resources. Web based applications (Hotmail, Google Apps and Skype) and web 2.0 solutions (Facebook, Twitter and Flickr) are examples of SaaS useful in libraries and information centers.
Platform-as-a-Service model offers services dealing with the development, creation, testing environment, deployment, hosting services and maintenance of software and web based applications. The end users write own code and the PaaS provider uploads the code and presents the same to the web (Kayeyia, 2010). The author adds, that PaaS provider offers faster service, cost effective, manages and supports upgrades including routine maintenance. The PaaS platform is based on subscription or metering model where clients pay for what is used or consumed. Basically, payment is only made on what is consumed, and the more the client consumes the more the pay and vice versa.

PaaS services provide the necessary business tools that support the needs and interests of the clients. The service provides four types of solutions namely social application, raw compute application, web application and business application. The use of social networking tools like Facebook provides the opportunity for third parties to develop, create and write new applications for the clients or end users. The best example of commercial cloud computing is Amazon’s elastic compute cloud (EC2) that allows clients to rent compute cycles on Amazon’s infrastructure. This service is used in conjunction with the simple storage service (S3) that provides data storage services (Thomas, 2011). In libraries and information centers, cloud computing applications offer free solutions such as Google Apps for information, a free online suite of tools that include Gmail for electronic mail (email) and Google Docs for documents, spreadsheets and presentations, and Microsoft’s cloud service like SkyDrive. Google also provides the platform to develop and create web applications. This provides instant and real time access, retrieval, dissemination, publication and sharing of information, knowledge and intellectual records for scholarly communication, online collaboration and participation.

Infrastructure-as-a-Service is the best alternative for outsourcing that provides storage and computing power on scalable, flexible or elastic basis. IaaS is also known as Hardware-as-a-Service (HaaS) or utility computing. In Kenya, companies offering cloud solutions include Safaricom, MTN Business, Biashara Cloud, Flexus Technologies, Connections and InfoConnect, in addition to, international firms such as Google, IBM and Amazo.com. HaaS is a costly business venture for organizations and firms. The best option is for organizations to purchase only the required infrastructure based on the requirement, need and demand or outsource all the resources instead of acquiring the entire infrastructure including servers, networking facilities and software that might be unused or unutilized. Like PaaS, IaaS is based on requirement and need model where the client “pays as you go”. The client pays only for what is consumed or used. IaaS provides better numerous advantages such as unlimited access to superior technological resources, reduced costs, cost-effectiveness services and dynamic scaling.
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Figure 2: Top Cloud Enterprise or Organization (Researcher, 2015)

**Application of Cloud Computing**

In cloud computing, the clients normally pay for the physical infrastructure instead of owning the entire system. The client outsources cloud services by renting from the service provider or third party. Many internet based companies and firms have huge storage database capacities that are normally unutilized. This has led to the need to rent out the extra space and storage of resources on remote servers or clouds. The organizations and companies must be in a position to provide the necessary infrastructure, software and platform applications. In cloud computing practice, the client avoids use of direct capital expenditure (CapEx) on infrastructure or hardware, software and service, instead preferring to deal with the service provider. Cloud computing implies that the client uses or utilizes resources as a service and only pays on the resources consumed based on the individual need and requirement. Additionally, payment is based on what the client consumes as exemplified in other utilities such as electricity and water. This helps the client to enjoy business opportunities at relatively minimum cost instead of purchasing all services.
Potential Opportunities for Embracing Cloud Computing in Libraries and Information Establishments

Globally, the information landscape is in a constant state of change and revolution. At the center of the debate is the development of the knowledge society, leading to the commoditization of information and knowledge in the marketplace of ideas. Additionally, the information environment is characterized by the information explosion or glut on the web that has forced information centers to look at effective methods of providing quality services to the clients. Modern technological trends brought by personal computing and networking revolutions are making information centers to create online communities. Other factors include globalization of information services, unlimited access to information and communication services, mass provision of information services, economics of information and open source systems. Cloud computing is the “emerging new guru” of handling and supporting information services that takes advantage of numerous open source applications, modules and components.

In the 21st century, university libraries must change the traditional practices of handling and managing information services. Traditional management practices are proving hard to address all the informational and technological needs of the clients where emphasis is on quality delivery of services. There is need to embrace modern management and technological practices in information work and activities. Many internet based organizations, vendors and institutions are involved in various activities or initiatives meant to promote cloud computing model in libraries and information centers. Yahoo, Google and IBM are engaged in funding universities whose purpose is to promote research in cloud computing projects. These companies provide hardware, software and services to augment university curricula and expand research horizons for the academic community using cloud computing model (Erenben, 2009 & Thomas, 2011). In addition, the authors agree that, Yahoo’s partnership with several universities, colleges and K-12 schools districts in the United States of America is already reaping the benefits of switching to the
cloud computing model. Cloud computing adoption and usage in the country is increasingly gaining popularity.

Research on information technology executives and chief information officers across Asia/Pacific excluding Japan (APEJ) in relation to utilization of cloud computing found out numerous reasons for adoption of this technology in organizations (APE, 2009).

Figure 5: What Drove Your Organization Towards Using or Considering Cloud Services (APEJ, 2009)

In the Kenyan context, this new technology is gaining popularity in business establishments especially with the small and medium enterprises (SMEs) and corporate world (Awale, 2012). The author adds that from the start of 2012, more companies are warming up to the idea of cloud computing because of the immense benefits associated with this technology. Business organizations are increasingly conducting and delivering services using this model of computing. The same applies for library and information centers although there is minimum development in the sector. Cloud computing cannot be ignored particularly in libraries and information establishments, where information services keep on changing with many competing needs and demands. In Kenya, libraries and information centers face numerous operating environment and competing needs due to hard economic situations. Cloud computing is increasingly gaining attractiveness as the best means to handle and support delivery of services in libraries and information centers.
In the recent years, rapid advances in knowledge and communication based society have had significant impact on how information professionals should handle and support delivery of services in library and information establishments. In particular, the development of cloud computing in libraries in developing countries is slow and slim. Cloud computing has the potential paradigm to enhance and improve utilization and sharing of information resources in libraries. This business approach is beneficial to libraries and information centers since payment is based on the resources and services utilized or consumed. Through consortium practices, libraries and information centers can develop and manage datacenters, acquire superior technological solutions, share professional expertise and other crucial services.

In the digital or electronic information environment, the cloud concept has positive implications of creating online community, virtual communication and collaboration medium with the clients. Information professionals are most interested in creating strong potential for social interaction and online communication with the clients. The cloud concept has the potential for scholarly communication, storage and sharing of information, knowledge and intellectual records. In the library, the ultimate goal of cloud computing is to create virtual communities of information professionals and clients. This creates a strong social interaction, collaboration and friendly environment in the information center. Web 2.0 applications can be utilized effectively to provide and deliver information services to clients through online scholarly communication, discussion, collaboration and presentation.

The core value and driving force of cloud computing in any library is to provide information services to support research, teaching and community services of respective academic institutions. Since time memorial, technology has been instrumental in handling and supporting information services in libraries and information centers. Information professionals should play the leadership role in the development and use of cloud computing applications. Information services are driven by the needs, demands and interests of clients in relation to technological tools. The vast majority of the clients are young and youthful adults who are technology compliant. Application of web 2.0 tools (Facebook) makes online scholarly communication, collaboration and participation faster and possible. The kinds of technological solutions needed in libraries and information establishments of the 21st century are by far different from the requirements of the predecessors of the last century. Information professionals have no choice in adopting and embracing cloud computing approaches so as to effectively handle and support information services to the satisfaction of the clients.
Figure 6: Application of Cloud Computing Paradigm in University Library (Sanchati & Kulkarni, 2011)

Top Seven Benefits of Cloud Computing

Provisioning, Consuming and Enhancing of Services

Cloud computing paradigm offers the opportunity for provisioning, consuming and enhancing of services based on need and pay by use basis. This helps in shifting the cost structure from capital expenditure to operating expenditure and also helps the information technology systems more agile (Dhar, 2012). The client needs not to worry about purchase, configuration and administration of computing infrastructure. The cloud service provider handles and supports all the services including technological related issues of installation, licensing, upgrading and maintenance of the systems. Cloud computing organizations provide infrastructure, networks, servers, numerous applications, platforms and related services. In a nutshell, all the services are provided by the cloud service providers. This new business paradigm is beneficial to libraries and information establishments that face numerous financial challenges. Information professionals are freed from technological and computing issues to concentrate on quality delivery of services. Fundamentally, this complements information professionals to handle and support services and capabilities with minimum costs.

Superior Information Infrastructure and Platform

Developments in technological innovation have led to shifts in ways libraries and information centers should handle and provide information services. Information communication technology (ICT) is the catalyst used to provide services to the clients. In cloud computing, information professionals create virtual communities through social software systems such as blogs, RSS feeds, instant messaging (IM), wikis, podcasts, vodcasts, Facebook, Twitter, skype
and web conferencing in order to provide services on 24/7 hour basis. The virtual information environment creates scholarly communication, collaboration, discussion and participation based on web applications. Additionally, the cloud service provider, offer the ICT infrastructure used to handle, manage and support cloud integrated library system (Cloud ILS) and cloud online public access catalogue (Cloud OPAC), which clients use to interact with over the internet to search for information resources and services. For information professionals, cloud computing model provides a convergence of information services, client needs and technological solutions.

**Best Management Strategy**

Transition from web to application based systems has brought new ways of handling and supporting delivery of services in organizations. This has seen the emergence of cloud computing where organizations outsource services without owning the complex and expensive information infrastructure. In organizations, cloud services involves outsourcing of solutions and services from service providers or third parties, the same way electricity, water or phone services are provided. This arrangement creates partnership business opportunities involving organizations and cloud service providers. In organizations, outsourcing of cloud services is gaining momentum because minimum management issues are involved as well as being cost-effective. Outsourcing is the best management and technology strategies for organizations to deliver quality services to the clients.

**Business Information Opportunities**

Once the contractual agreement between the client and the service provider is signed, then cloud computing services are immediately deployed to the client. This business paradigm of utility computing is based on subscription or metered model, where clients pay only for what is consumed, the same way clients pay for electricity or water. Cloud computing represents a paradigm shift in how organizations conduct and pay for resources and services. The cloud computing paradigm has created new business opportunities where organizations pay only for what is used or utilized. Cloud computing is the latest trend to outsource some or complete information technology operations to handle and support business services in organizations (Armbrust et al., 2010, Badger et al., 2011, Catteddu & Hogben, 2009 & Dhar, 2012). Cloud computing is build on scalable, flexible and elastic principles, and this helps organizations with the option to seamlessly increase the services based on the needs and requirements. In this respect, libraries and information centers have the business opportunity to pay the cloud service provider only usage fee based on consumption or metering rate, without owning and investing in new and expensive infrastructure and computing, training of new information professionals or licensing of additional software.
Sharing of Resources

Cloud computing model involves the centralization of technological infrastructure and resources on the internet. The computing resources are then shared and made available to the organizations based on individual need and requirement. The concept of sharing involves many organizations leading to increased utilization of the resources. In economies of scale, this is beneficial to libraries and information centers that face competing demands due to limited financial budgets. Modern developments in cloud computing and infrastructure virtualization make the sharing of the resources and services among multiple clients simultaneously possible. Library consortium may also develop and provide cloud services.

Facilitate Innovative Services

In addition to the above, cloud computing is useful in facilitating innovative services. Information professionals are freed from technological related issues such as purchase, installation and maintenance of computing infrastructure to concentrate in core information services. This creates the need for information professionals to regularly monitor and evaluate the available services so as develop new and innovative ones that satisfy the needs of the clients. In libraries and information centers, software development is not the core information operations and services. Libraries and information professionals should better focus on providing core information and competitive services, instead of wasting valuable resources and services on software development issues. Outsourcing allows information professionals to focus on core information services as well as developing new and innovative ones. Cloud model increases the pace of innovation in libraries as outsourcing of the services provides information professionals with the opportunity to concentrate on core information and competitive services. As a result, it is quite cheaper to outsource than to acquire and own the technological resources especially in libraries and information centers already overburden by limited financial allocations. The extended application of cloud computing enables information professionals to create innovative online communities based on the informational and technological needs of the clients. The ever-changing information environment, increases the pace of competition leading to innovation of systems like open source software that are increasingly being utilized in libraries, as promoted through cloud computing.
Adequate Security

Cloud services provide adequate security as opposed to the situation where organizations develop and own the technological systems. Economically, organizations or institutions may lack the resources necessary to put in place the effective ICT security system. Based on traditional business practices, cloud service providers are better placed to mount adequate security services, than internal or on-campus solutions at the institutional level.

In 2014 state of the cloud computing trends identified similar benefits of this innovative practice (RightScale, 2014).

![Figure 7: Cloud Benefits 2014 Vs. 2013 (RightScale 2014 State of the Cloud)](image)

Top Six Challenges or Risks Associated With Cloud

Security Lapses

There are several reasons or factors negatively affecting adoption and implementation of cloud computing in organizations. Equally, cloud service providers and organizational users are affected. One of the single biggest concern and uncertainty compromising cloud services in organizations rotates around security issues. Cloud computing model is prone to security lapses that end up compromising delivery of services in organizations. Once organisations adopt and embrace cloud computing, traditional information boundaries become small and “global village”, facing numerous security risks. In cloud computing, once the system breaks down, the damages caused due to security risks or breaches are potentially harmful to the organizations. In addition, from professional experience outsourced data and resources are never safe. Based on a Deloitte East Africa study, Awale (2012, p. 34) reports, “that nearly 40
percent of organizations in East Africa are reluctant to adopt the cloud technology due to data privacy, legislation and security concerns. In addition, Thomas (2011) argues that, institutions with serious concerns about data security should build own private cloud services to keep costs down. In particular, security concerns should not overshadow the benefits. The author adds that, cloud is no less secure than more traditional information technology delivery models.

**System Failure**

Concept of “centralizing” cloud computing and infrastructure services might affect or compromise the operations and services of the organizations, if the machines break down. With cloud computing, once the system fails, then the whole resources and services are affected. In cloud services, the failure of the system becomes ‘catastrophic or tsunami” issue greatly affecting organizational operations and services.

**Transparent and Ownership Issues**

Transparent and honest business dealings and activities are useful in directing the success and continuity of cloud services in organizations. Numerous uncontrolled factors might affect organizations since issues of honest or trust and ownership are beyond the county’s political boundaries, especially if cloud services are provided by external companies. The stakeholders should be informed of the plans and issues underpinning cloud services model. In order to share and exchange professional and personal experiences, there is need for accountability and transparency in cloud computing approach.

**Business Monopoly**

Provision of cloud computing services is by far and large within the reach of the bigger internet based business organizations such as Google, IBM, Amazo.com, Safaricom, MTN Business and Biashara Cloud. This makes organizations to entirely depend upon these organizations reminiscent of the old approach of doing business in a monopoly environment. Equally, the use of cloud services is a return of the modern colonization by bigger internet organizations and companies to monopolise the market. In addition, dependence on the internet based organizations affects flexibility and innovation.

**Policy and Regulation Issues**

There are a number of important issues including policies, appropriate rules and regulations that guide use and access of cloud services. The policy should guide organizations in protection and storage of data resources locally and across the borders. Appropriate guidelines should be put in place to ensure continuity of services if the system fails. This will avoid situations of losing
access to data resources and accounts by clients. In order to sustain the growth of cloud computing as the emerging business paradigm, there is need to develop appropriate policies, rules and regulations, and guidelines to handle and manage risk concerns responsibly.

**Connectivity and Bandwidth Issues**

In cloud computing, internet connectivity services are important and lack of the same is disastrous. In traditional applications, lack of connectivity allows for some local function to continue until the services are restored (Kayeyia, 2010). In addition, bandwidth issues play crucial roles in delivery of cloud services. Cloud computing organizations may capitalize on the use of bandwidth and end up over-charging the clients. In the business monopoly market, the organizations sell bandwidth services based on “average” or “peak” usage instead of “maximum” usage.

**Conclusion**

In the face of the present hard economic situation and limited financial budget, cloud computing is the best management and technological practice to help libraries and information establishments. Large organizations such as Safaricom, MTN Business and Biashara offer cloud services. Libraries and information centers as well as related agencies must adopt and embrace cloud services in delivery of services to the clients. The paper provides insights into the possibility of using cloud computing to handle and support provision of information services in the digital or electronic economy. Across the world, cloud computing has brought new business paradigm in the virtual information environment leading to improvement, maximum utilization and sharing of resources and services. Cloud services offer attractive business opportunities involving organizations and service providers leading to the satisfaction of the clients. Modern and smart technological solutions will always be invented. Cloud computing is here, although the beautiful one is yet to be borne!
REFERENCES


APEJ (2009). IDC survey conducted with 696 IT executives and CIOs across Asia/Pacific excluding Japan.


