A SUSTAINABLE INFORMATION ENVIRONMENT IN AFRICA, WITH SPECIFIC REFERENCE TO CLOUD AND MOBILE TECHNOLOGIES

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Abstract

Modern technological solutions have altered the traditional library landscape beyond recognition. Two innovative solutions that are gaining momentum in information centres, are cloud computing and mobile technology. The purpose of this paper is to explore how these technologies can contribute towards a sustainable information environment in Africa in the face of hard financial times and other challenges. Libraries in developing countries face many challenges of inadequate information infrastructure, limited financial budgets, manpower issues and rapid changes in technological systems. Cloud computing is proving to be the best management practice for handling these challenges and for supporting quality delivery of services in information centres. The most literal interpretation of "cloud" refer to it as computing delivered as a utility. Cloud computing is designed to give organizations a powerful, managed environment that has maximized resource utilization. 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 centre. The cloud concept also has the potential for scholarly communication, storage and sharing of information, knowledge and intellectual records. Further, cloud computing offers benefits such as physical and data security, stability and faster software delivery, eliminating the need for libraries to replace end-of-live hardware, predicting and providing for capacity planning and upgrade and troubleshoot applications. Content is becoming increasingly digital, and people are consuming it through various types of devices, including mobile. As a result the library has become a new kind of media center. This paper will further discuss how mobile applications from the cloud can assist end-users to access the library and how it can assist library staff in offering mobile circulation functions in the library. Cloud computing and its possibilities have been gaining momentum worldwide and therefore should be seen as "must have technology" for modern libraries.

Keywords: Cloud computing; Mobile technology; Technological trends; Library technology

1. Introduction

Cloud computing continues to gain the most momentum and stands positioned to most radically transform the shape of library technology. Many new products are based on cloud computing technologies. This has a profound impact on the models of resource sharing available to libraries. We are at one of those major turning points where technology rounds a curve into a new vision of the mainstream.

This paper covers current and future trends in the field of cloud computing and mobile technologies. While this paper offers a detailed overview of cloud computing in libraries, it also focuses on how cloud computing and mobile technologies can contribute towards a sustainable information environment in Africa in the face of hard financial times and other challenges.

2. Gartner Hype Cycle Cloud Computing 2015

Cloud computing usage is growing in every industry and in all geographic locations worldwide.

Organizations cite three key benefits in their use of cloud services:

- Increased operational and organizational agility
- Cost benefits
- Innovation

In this 2015 update of the Hype Cycle for Cloud Computing the term "cloud computing" is positioned on the Hype Cycle at the bottom of the Trough of Disillusionment, which reflects the fact that most organizations have a sense of the technology's benefits and risks (Gartner Identifies the Top 10 Strategic Technology Trends for 2015, 2014).

3. Gartner Top Technology Trends

"We have identified the top ten technology trends that organizations cannot afford to ignore in their strategic planning processes". "This does not necessarily mean adoption and investment in all the trends at the same rate, but companies should look to make deliberate decisions about them during the next two years." (Gartner Identifies the Top 10 Strategic Technology Trends for 2015, 2014).

1. Computing everywhere
   Mobile-device proliferation is an obvious trend

2. Internet of Things
   "This expanded and comprehensive view of the internet is what Gartner calls the Internet of Everything."

3. 3D printing
   Gartner believes that 3D printing will continue to grow at an incredible rate for the foreseeable future. Businesses must be alert and re-evaluate their market position based on what impact 3D printing will have on their products and cost structure.

4. Advanced, pervasive, and invisible analytics
   Gartner said that embedded systems (IoT) will only add to the crush of structured and unstructured data already filling company databases. The amount and variety of data will demand more advanced analytics than are currently available. A Gartner researcher said, "The value is in the answers, not the data."

5. Context-rich systems
   Gartner thinks the next step will be to ingrain intelligence into IoT devices that will interact with the advanced analytics mentioned earlier, resulting in systems that will not only report, but also respond environmental conditions.

6. Smart machines
   The combination of advanced analytics and context-rich embedded systems will evolve into smart machines. Prototypes of autonomous vehicles, advanced robots, and the like will bring in the most disruptive smart-machine era in the history of IT.

7. Cloud/client computing
   "Cloud is the new style of elastically scalable, self-service computing, and both internal applications and external applications will be built on this new style," Cearley said. "While network and bandwidth costs may continue to favour apps that use the intelligence and storage of the client device effectively, coordination and management will be based in the cloud."

8. Software-defined applications and infrastructure
   Expanding the digital environment to include the entire physical world will require flexibility — something existing hardware-controlled networks don't have. Software-defined networks, storage, data centers, and security will be required to make it all work.

9. Web-scale IT
   Gartner believes that organizations will start incorporating global-class computing into the company setting.

10. Risk-based security and self-protection
    Gartner and others suggest security positioning through risk assessments is a more realistic goal — and it won't impede progress.

3. Where it began

3.1 It All Began With Mainframes

Massive mainframes dominated the earliest days of computing. Their processing power, so modest by today's standards, happened within room-sized processors operated by terminals with no computing capabilities of their own with text only screens (A Cloud forecast for libraries, 2011).

3.2 Client/Server Computing

A major shift in technology began in the mid-1990s with the advent of client/server computing and a new wave of library automation systems sporting graphical user interfaces. This new approach to technology aimed to make better use of the personal computers that were then proliferating in workplaces to take up some of the burden of the central server of a major application such as a library automation system. The advent of this model of computing was a mixed blessing: Its graphical interfaces proved easier to understand than the complex text-only interfaces.

3.3 Cloud Computing on the Rise

Service-oriented architectures and browser-based interfaces deployed through cloud-based infrastructure stand as the key technologies preferred for new software development efforts today. Cloud computing delivers applications through web-based interfaces or lightweight apps. These new technology services make use of processing and storage resources provided through highly virtualized components clustered together, usually in large-scale data centers distributed throughout multiple physical locations.

4. All Clouds Are Not Equal

4.1 Models of Cloud Computing

4.1.1 Service Models:

Although there are various service models that originated, three service models are widely used for delivering the different cloud based services described below:

Infrastructure as a Service (IaaS):
This service model comprises a wide range of features, services and resources which support to build a virtual infrastructure for computing. Organizations can develop entire infrastructures on demand, e.g. Amazon Web Services, Rackspace, Savvis, HP, IBM, Sun and Google Base.
Platform as a Service (PaaS):

The Platform as a Service model helps in generating the computing platforms to run the software and other tools over the internet without managing the software and hardware at the end user side. Amazon Elastic Cloud, EMC Atmos, Aptana and GoGrid are examples of the PaaS model, which is providing platforms to users in maintaining and supporting their IT infrastructure without spending huge amounts for buying hardware, software and related technology.

Software as a Service (SaaS):
In this model, users can avail the facilities to access and use any software available with cloud vendors. However, it is not necessary for the users to buy the software, install, run or maintain the applications on their own servers. The cloud users need not to manage the cloud infrastructure and platform on which the application is running. This service model provides online email applications, free services, limitless storage, and remote access from any computer or device with an Internet connection.

4.1.2 Deployment Models

Currently, four types of cloud deployment models have been defined in the cloud community:

Private Cloud:

This kind of deployment model is solely developed and managed by a single organization or a third party regardless whether it is located in premise or off premise.

Community Cloud:

It is a joint venture of several organizations coming together to build a cloud infrastructure as well as policies through which cloud services will be rendered.

Public Cloud:

Public cloud is meant for general public use and open to all.

Hybrid Cloud:

This type of cloud is made from more than one cloud deployment model that may be public, private or community. The Hybrid cloud model is widely used by institutions and organizations because this model provides more facilities and flexibilities in making optimum use of their resources and accomplishing their tasks (International Journal of Library Science, 2013).

5. Benefits

5.1 Building Community Power

Cloud computing technology offers great opportunities for libraries to build networks among the library and information science professionals as well as other interested people including information seekers by using social networking tools. The most famous social networking services viz. Twitter and Facebook play a key role in building community power. This cooperative effort of libraries will create time saving, efficiencies and wider recognition, cooperative intelligence for better decision making and provides the platform for innovation and sharing their intellectual conversations, ideas and knowledge.

5.2 Hardware cost

For many organizations, local computing involves high cost and low efficiency. Even though prices have declined over recent years, still server hardware requires a major expenditure. Because this equipment must last for five or more years, organizations tend to purchase excess capacity beyond immediate needs to accommodate anticipated growth in use. With cloud computing you pay for what you use as you use it instead of paying for excess capacity which is never consumed.

5.3 Personnel cost

The maintenance of local servers involve keeping constant attention on operating systems on the latest versions, applying security patches on a regular schedule, tuning servers for optimum performance, monitoring systems availability as well as implementing customizations and configuration changes. Implementing cloud solutions could greatly reduce personnel cost.

5.4 Increased Storage

With the massive Infrastructure that is offered by Cloud providers today, storage & maintenance of large volumes of data is a reality. Sudden workload spikes are also managed effectively & efficiently, since the cloud can scale dynamically.

5.5 Innovative & mission driven services

Today's libraries face the horrendous task of fulfilling their missions more than ever with few resources. Cloud computing can contribute an important dimension to technology strategies. Libraries need to possess every possible tool available to them. In the absence of diminishing technical personnel and smaller budgets for computing equipment, it may be possible to gain access to equal or even superior automation products through cloud-based services. In broad terms, increased adoption of cloud services will enable the library to focus more on innovative services.

6. Disadvantages of Cloud Computing

Data security and privacy: Data security and privacy are the biggest concern about cloud computing.

Data stored in the cloud is exposed to theft and virus attacks if proper security measures are not taken. Data loss can also occur in the event of system failure, if proper and regular back up is not done periodically.

Network connectivity: Constant connectivity to the Internet at high speed is essential for effective functioning of cloud services. Internet is still an expensive facility in South Africa.

Dependence on outside service providers: As cloud services are offered over the Internet by service providers, there is no local control on the data.

Standardization: If uniform standards are not followed by the service providers, then migration from one service provider to another will be a major hindrance.

7. Why Cloud computing for libraries?

- Because, we were, are and will be facing:
- Changing formats and usage patterns;
- Customized services;
- Incredible demand with resources like staff and budget;
- Challenges in managing hardware and software. And… we expect all these to continue.

7.1 The new generation of products

More appropriately called something like library services platforms rather than integrated library systems – it addresses the fundamental changes that libraries have experienced over the course of the last decade or so toward more engagement with electronic and digital content. In their own distinctive ways, these recently announced or delivered systems aim to break free of the models of automation centered mostly on print materials deeply embodied by the incumbent line of integrated library systems. To make up for functionality absent in their core integrated library systems, many libraries implemented a cluster of ancillary products, such as link resolvers, electronic resource management systems, digital asset management systems, and other repository platforms to manage all their different types of materials. The new products aim to simplify library operations through a more inclusive platform designed to handle all the different forms of content. This improvement can be grouped into three basic areas: technology, data and community. Each offers some general and some unique opportunities for libraries.

7.2 Library Services Platform

Integrated library systems continue to incrementally evolve and remain viable for public libraries and others where the central concern continues to focus on print and electronic books. Integrated library systems, though not as radically reengineered as library services platforms, must still make ambitious improvements in functionality, especially in their patron interfaces, to meet library expectations (Breeding, 2013).

Recent years have seen the emergence of library services platforms, a new genre of automation systems designed to manage electronic and print collections. These platforms which follow the services-oriented architecture, are deployed through multitenant SaaS, and have other distinctive characteristics that set them apart from the integrated library systems.

The term "library services platform" was established to differentiate these products from the model of automation inherent in integrated library systems. These two categories also have significant areas of overlap in functionality, and some products embrace characteristics of both.

Library-specific software:

Designed to help libraries automate their internal operations, manage collections, fulfill requests, and deliver services.

Services:

Service oriented architecture;
Exposes Web services and other API's;
Facilitates the services libraries offer to their users.

Platform:

General infrastructure for library automation;
Consistent with the concept of Platform as a Service;
Library programmers address the APIs of the platform to extend functionality, create connections with other systems, and dynamically interact with data.

LSP Characteristics:

Highly shared data models;
Knowledgebase architecture;
Some may take hybrid approach to accommodate local data stores;
Delivered through software as a service;

Multi-tenant:

Unified workflows across formats and media;
Flexible metadata management;
MARC – Dublin Core – VRA – MODS – ONIX;
Bibframe;
New structures not yet invented;
Open APIs for extensibility and interoperability.

8. Evolving Towards Cloud Computing Libraries

The library community can adopt cloud computing to strengthen the cooperation and to build a significant, unified presence on the Web. This approach of computing can help libraries save time and money and at the same time simplifying workflows.

Even in well-connected areas, there will always be circumstances where Internet access is problematic. Though the trend towards cloud computing is gradually heading upward, traditional local computing still dominates in most of the libraries. Whilst it is not certain that all computing will shift to the cloud, there are many cloud and cloud-like services already available, with more individuals and organizations adopting this approach.

Company	Name of Product	Type of Product
SirsiDynix	BLUEcloud LSP	Library Management System
ExLibris	Alma	Library Management System
ExLibris	Primo	Discovery Layer
OCLC	Worldshare	LMS and other products
ProQuest	Summons	Discovery Layer
ProQuest	Intota 2	Library Management System
III	Sierra	Library Management System
LibLime	Koha	Open Source LMS
EBSCO	EDS	Discovery Layer

Figure 1 Cloud Services Already Available.

9. Cloud and Library Services

9.1 Applications of Cloud Computing in Libraries and their services

The library community can apply the concept of cloud computing to amplify the power of cooperation and to build a significant, unified presence on the Web (Goldner, 2010). This new, unified presence has the potential to give libraries significant scale and impact on the Web. It can help libraries save time and money at the same time simplifying workflows.

Library automation and OPAC:

Web OPAC without the library having invested in servers and employed IT skilled staff.

Creating Library websites:

This was one of the important applications of cloud computing. The services like Google sites, weebly.com etc., enables one to host websites without the need of maintaining servers locally.

Library blogs:

Services like Wordpress and Blogspot are most widely used software to create blogs. Blogs offer an interactive platform for libraries to connect to their users.

Institutional Repositories:

Currently libraries are using open source software like DSpace, Greenstone, E-prints etc. that are locally hosted on library servers for creating institutional repositories. This requires IT skilled staff to maintain servers, to take backups and to update the software regularly. Therefore, it is advisable to use the services of the vendors who maintain such databases in cloud.

Resource sharing and storage:

DropBox, Microsoft's SkyDrive, Google drive, icloud etc. are some examples of those who offer free storage space for storing and sharing documents in the cloud. Libraries can use these services for resource sharing with other libraries. These can also be used for library office work. Web conferencing services like Skype and many others can be used even for offering real time reference services to clients.

Library Service Promotion:

Social media like Facebook, Twitter, etc. can very effectively be used for promotion of libraries and their services to stay connected with the users. They can also be used as an effective medium for addressing reference queries (Kaushik & Kumar, 2013).

10. Case Study

10.1 SirsiDynix BLUEcloud Suite

The company has developed the BLUEcloud Suite, a set of web-based products that operate in conjunction with its Symphony or Horizon ILS through a layer of web services.

Configuration for any library system:

Whether a single site or a multi-type consortium, BLUEcloud adapts to the library's needs. Permissions can be set with ease through institution hierarchies, and editing privileges can be dynamically assigned across the consortium with custom groupings.

Bring the library to the users:

The BLUEcloud Suite helps users to engage with the library, wherever they are. With discovery tools for web, mobile, and social media, the BLUEcloud LSP brings the library directly to the community.

Show the library's value:

Data from the LSP can be combined to create custom reports, make important decisions, and showcase the library in new ways.

Open and extensible:

The BLUEcloud LSP is a truly open system, powered by Web Services that can extend almost anywhere. With this flexible architecture, vendors and customers alike can develop integrations and solutions quickly.

10.2 Product Roadmap: From Earth to Cloud

Build LSP in the Cloud and connect to ILS

- New staff apps built in the cloud
- Web Services used to connect new apps to existing database
- No migration from ILS to LSP
- Parallel usage of ILS and LSP
- No Functionality Gap until all ILS functions rebuilt in LSP
- Electronic resources represented by Knowledgebase
- Physical (local) resources in separate database

10.3 Case Study – Durban University of Technology Automation Path

- DUT (as part of esAL) went live with Sirsi's Unicorn version 2003 in November 2005
- Upgraded to Symphony GL3.1 in August 2006
- Symphony 3.2.1 December 2008
- Symphony 3.3.1 December 2010
- Symphony 3.4.1 January 2012
- DUT migrated from the shared esAL server in December 2012
- Symphony 3.5.1 December 2015
- BLUEcloud March 2016

10.4 Case Study – Mobile and Social Applications

Products delivered through the BLUEcloud architecture include MobileCirc, to allow staff to perform selected circulation functions on tablets or other mobile devices; Analytics; eResource Central, for management and access to ebooks and other electronic resources; the Enterprise discovery interface; Portfolio, which extends Enterprise for access to digital collections; BookMyne, a mobile online catalog app; and Social Library, a native Facebook online catalog. Resources currently available through eResource Central include ebooks from OverDrive, 3M Cloud Library, Baker & Taylor's Axis 360, EBSCO, and Recorded Books.

11. The Future Will Take Shape Gradually

Given this current phase of technology, we find ourselves in a period of transition toward cloud computing. Cloud computing, if implemented successfully can help libraries lowering the thresholds of expenses and expertise. While this model may not be a good fit for all libraries it is an option worth investigating and adopting.

Accompanying the emergence of Web 2.0 was a shift from "high-touch, high-margin, high commitment" provisioning of service to "low-touch, low-margin, low-commitment" self-service (Gupta, 2012). Hence, it is hoped and expected that Cloud computing will emerge as a strong weapon which cuts down the cost of the libraries drastically whilst providing quality services.

This new wave of library tech products will phase in slowly. We're just now at the beginning of a product and technology cycle that will play out through the next decade. The uptake of new kinds of products can be a bit slow.

A move to cloud computing does not mean ceding control of a library's strategic technology. Regardless of whether software applications operate on local servers or through externally provided services, a library needs to retain control of the high-level design of its technical environment to ensure that it supports its operational and strategic activities. This control comes in the form of making good choices in regard to which of the competing products to implement, in organizing the data flow among applications, and especially in designing an excellent user experience for the library's patrons.

As this wave of change eventually nears the conclusion of its course, the result will be seen not just in the form of new products deployed but in the way that libraries consume technology. We can anticipate that software as a service will by then stand as the new norm and that locally installed applications will wane. As libraries reach the point of needing to migrate from aging legacy automation systems and as library-housed servers need to be replaced, many are already choosing to shift to some type of vendor-hosting option rather than commit to managing their next generation of hardware and software in-house. Most libraries have more strategic activities for their technology staff than routine tasks such as the administration of servers and operating systems and the upkeep of automation systems.

References

All About the Cloud (2014, November 3). Retrieved from http://www.techrepublic.com/blog/10-things/gartners-top-10-technology-trends-for-2015. *BlueCloud Overview* (n.d). Retrieved from http:///www.sirsidynix.com/bluecloud.

Breeding, Marshall (2011) *A Cloud Forecast for Libraries* (2011, September). Retrieved from http://www.infotoday.com/cilmag/sep11/breeding.shtml.

Breeding, Marshall (2012) 'Cloud Computing in Libraries' *The Tech Set 11*. Chicago: ALA Tech Source.

Breeding, Marshall (2014) 'Shifting to the Cloud: Reshaping Library Technology Infrastructure'. *Computers in Libraries.*

Emre, Erturk & Robert, Iles. *Case Study on Cloud Based Library Software as a service: Evaluating EZproxy.*

Gartner Identifies the top 10 Strategic Technology Trends for 2015 (2014, October 8). Retrieved from http://www.gartner.com/newsroom/id/2867917.

International Journal of Library Science; Volume 9; Issue No.3; Year 2013; IJLS, Ceser publications.

Kaushik, A & Kumar, A. (2013) Application of Cloud Computing in libraries. *International Journal of Information Dissemination and technology, 3(4) 270-273.*

Predicting the next decade of tech (2014, November 3). Retrieved from http://www.zdnet.com/article/predicting-the-next-decade-of-tech.

SirsiDynix Cloud & Architecture Overview (2015). Retrieved from http:///www.sirsidynix.com.

The Library Cloud Pros & Cons (2012, March 5). Retrieved from http://www.thedigitalshift.com/2012/03/the-library-cloud-pros-and-cons.