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Cloud Computing Knowledge-Based Framework for Information Access and Use in an Open University Library

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Abstract

The A cloud computing technology-based framework for information access and use in an open university library was investigated in this study. Issues concerning the information services provided by the National Open University of Nigeria library, such as building a digital library, searching library data, building community power, and the implications of cloud computing in terms of cost, staff, and maintenance, were investigated. The study's objectives include, among other things, determining how the National Open University of Nigeria library provides information services and access to its students spread across the country. Two research objectives were proposed: the information services provided by cloud computing in the National Open University of Nigeria library and the cost implications of cloud computing.

Introduction

Cloud computing gets its name from the fact that the information being accessed is located remotely in the cloud or a virtual space. Cloud service providers allow users to store files and applications on remote servers and then access the data via the Internet. To deal with the current information deluge, a medium and educational institution such as a library must be established for the proper acquisition, processing, documentation, retrieval, and dissemination of information. From print materials to non-print sources such as Compact Discs (CD), Diskettes, Magnetic Tapes, CD ROMS, Hard Disks, Punched Paper Tapes, Internet Publications, Zip Disks, Educational Video and Transparencies, Books on Cassettes, Micro Form Publications, Electric Publications, Machine Readable Tape, and Cloud Computing, the mode of information storage and transmission has undergone many radical changes in format.

Some cloud computing services have been used by libraries, such as online databases and union catalogs. Cloud applications are used to access online databases. Cloud applications can also be defined as large union catalogs. The use of any of these information resources is a continuous process influenced by changing curriculum and the availability of new materials for Library Services. According to Abdallah (2020), these media are useful for securely storing data, information, and applications.

According to Al-Issa, Ottom, and Tamrawi (2019), cloud computing becomes important when a computer requires more capacity or capabilities without the need to invest in new infrastructure, hire new staff, or license new software. Users don't have to worry about maintaining or managing information technology infrastructure because they can access database resources whenever and from wherever they need to via the internet.

The definition of cloud computing is hotly debated; Armbrust et al (2020) defined it as a type of computing that allows users to share highly scalable virtualized resources. Users are not required to be aware of the services before using them. Furthermore, a person on the internet can communicate with multiple servers at the same time, and these servers can exchange data with one another. Because of the internet, data and adoption in the cloud can essentially be accessed from anywhere and from any device with internet connectivity.

Stroh et al. (2019) define "cloud computing" as computer programs and services that can be accessed online rather than being stored locally on a computer or internal server. Using internet technologies, a massively scalable and elastic IT-enabled capability is provided as a service to external consumers. Klynveld Peat Marwick Goerdeler (KPMG) classified cloud computing into four distinct categories: infrastructure, platform, applications, and services. The practice of renting time and space on external servers is known as infrastructure.

A platform, on the other hand, is a pre-existing software platform where one can create their own program, such as Facebook. A service is a ready-to-use product, whereas an application is a software program that is accessed via a web browser, such as Google Docs and Salesforce.com. Bansode and Pujar (2017) described the three service models as follows: In contrast to Software as a Service (SaaS), which allows users to consume the provider's cloud applications through a

web browser, Platform as a Service (PaaS) allows customers to deploy their own applications on the provider's cloud infrastructure within the provider's environment.

Infrastructure as a service provides users with control and management of computer resources (IaaS). Cloud computing has the potential to transform both the development of information systems and the delivery of services. This allows the library to reach out to its users at any time and from any location. Everyone with internet access is likely to use cloud computing on a regular basis in some capacity. They are interacting with the cloud whether they are using Gmail from Google, organizing images on Flickr, or searching the web with Bing. As Geoffrey (2019) pointed out, the interesting thing about cloud computing is that it was first developed by the public with services like Facebook and Flickr rather than as a technology for business enterprises. Communication is important in terms of material distribution.

Servers, storage, and software are in high demand at universities. The National Open University of Nigeria, for example, uses an e-learning management system called ILEARN for its lectures and course materials. It also hosts the Information Gateway, a digital library with multimedia tutorials. According to Okwoli (2019), the primary function of university libraries is to support teaching, learning, research, and community services in a manner consistent with and supportive of the institution's vision and goals. According to Niu (2020), libraries can use cloud computing technology to improve computing performance, storage capacity, accessibility for all, and cost savings. Libraries can benefit from this by reducing the fixed and ongoing costs of their information technology investments in hardware, software, and computer services.

With cloud computing, libraries can avoid financial waste, better monitor staff activity, and technological annoyances like computer viruses, system failures, and data loss. The use of cloud computing in libraries will almost certainly have a significant impact on library services. According to Nurnberg (2022), cloud computing makes it easier to retrieve data from a variety of devices. This is especially useful for mobile devices because all that is required is an internet connection. Libraries are shifting their services to cloud computing technology in order to provide services anywhere and at any time.

According to Ahmat, the following areas of application for cloud computing in libraries have been identified: Building Digital Library/Repositories, Searching Library Data, Web Site Hosting,

Searching Scholarly Content, File Storage, Building Community Power, and Library Automation (2019). Nonetheless, the most significant advantage of adopting cloud computing technology is that one does not "buy" the cloud in the same way that software and hardware purchases are made for library automation. Much like a common utility, one simply pays for what is consumed and then turns it off when finished.

Many people are drawn to cloud deployment because it allows them to have a server somewhere, not have to worry about it, scale it up as needed, and pay only for what is used. The library community can use cloud infrastructure to improve collaboration and create a significant, unified presence on the Web. This method of computing can help libraries save time and money by streamlining processes. Until recently, the primary motivation for libraries to exist was the need to share their vast collection of materials (Okwoli,2019).

Objectives

The broad objective of the study is to examine the cloud computing technology-based framework for information access and use in an open university library. The specific objectives are:

(1) To determine the information services provided using cloud computing in National Open University of Nigeria Library.

(2) To proffer solutions to the implications in terms cost, staff, and maintenance of cloud computing in National Open University of Nigeria Library.

Cloud Computing Offers Library Information Services

The libraries now have access to a more affordable infrastructure or setting thanks to cloud computing. Solving the storage and computerization problems has drawn considerable interest from the fields of academia, business, government, the military, and libraries. Yang (2019) asserted that starting in 2011, an increasing number of library providers started offering cloud solutions for their Integrated Library System (ILS) and discovery tools. While many companies provide choices to host the traditional ILS as a cloud solution, some are also creating a new breed of ILS specifically for the cloud, she emphasized.

According to a review of the literature on libraries and cloud computing, libraries can utilize this technology to create digital collections and repositories, search library data, host websites, look up academic articles, store files, strengthen community connections, and automate library operations.

Cloud Computing Offers Library Information Services

Cloud computing is only useful in a digital library; it is not a branch of cloud computing, but it does give libraries the chance to use a cost-effective platform to create an effective and functional digital library. It has been noted that cloud computing isn't entirely a new technology but rather an adaptation of earlier ones. The following was listed by Dhanevandin & Tamizhcheven (2014) as a characteristic of a digital library: I A digital item with audio, video, and multimedia components Tools for automated knowledge discovery contain a variety of components. Users can access rare and expensive material remotely (iii) from their desks (iv). Virtual library is just one step removed from digital library for these authors. It has flaws, what cloud computing can help to address. Accordingly, Al-Issa, Ottom & Tamrawi (2019) emphasized the issues with local library-maintained digital libraries that are stored on servers: (1) Because different libraries' data resources are largely independent, this causes redundant projects to be created. (2) Due to uneven economic growth in several regions, DL has very few resources.

To address this issue, they recommended an upgrade to the user services model in libraries, which involves the adoption of cloud technology in digital libraries. The cost of purchasing, maintaining, installing, and other costs are significant. The ability to create a digital library on the cloud-thanks to-cloud computing enables libraries to make resources, information, and services efficiently accessible through a network. OPAC (Online Public Access Catalog) and ILL (Inter-library Loan) services already exist, however according to Al-Issa, Ottom, & Tamrawi (2019), platform is still inaccessible to library customers. However, a distributed uniform access interface-supporting integrated library resource is offered by cloud computing. A consistent access platform may simultaneously promote library materials, assist users, and provide information by employing high-quality navigation.

Additionally, they emphasized that as libraries naturally store, organize, and disseminate knowledge, the knowledge service model may offer consumers effective information and knowledge services. In relation to cloud-based digital library software, Niu (2020) claimed that

Duraspace has two programs, Dspace and Fedora Commons, although Duraspace is frequently used for creating digital libraries and repositories with standardized interfaces and open-source codes for the two programs.

A unified search service is offered by a digital library built on cloud infrastructure, allowing users to conduct searches on a collection of library data using any internet-connected device. According to some, cloud computing offers integrated library resources. In the findings of Pornel & Saidana (2018) who asserted that OCLC is one of the best instances of a company that has been using cloud computing to share library data for many years. They emphasized further that OCLC provides a variety of services connected to circulation, cataloguing, acquisition, and other library-related services via a cloud platform via an online share management system.

A research platform based in the cloud makes it easier to find and share academic content. According to Pornel & Saidana (2018) Knimbus is a knowledge cloud committed to fostering scholarly collaboration and knowledge discovery. Since its founding in 2010 by businessmen Rahul Agarwalla and Tarun Arora, Knimbus has grown to include more than 600 academic institutions, 50,000 researchers, and R & D labs. It was created to help researchers overcome the difficulties associated with searching through and accessing a variety of information sources. Yang (2019) asserts that the cloud-based new generation of ILS enables data sharing among numerous libraries. As an illustration, full-text journal titles from electronic databases can be shared when numerous libraries use the same databases. All the databases are provided in a pulldown menu under the acquisitions section. By clicking on the button, a library can select a database for purchase and turn on the journal list.

Due to the inherent fragility of all physical storage devices, cloud data storage is necessary. It's possible to lose a USB flash drive, have a laptop or desktop crash, or even become the victim of hacking. There are also instances of hardware malfunctions, software errors, virus attacks, and other issues. According to Pornel & Saidana (2018), file storage capacity offered on the cloud is practically endless and offers a much higher level of reliability than most libraries can achieve within their own data center. Okwoli (2019) also pointed out that cloud computing reduces the risk associated with hardware failure and makes it much simpler to create backups. By utilizing social networking capabilities, cloud computing technology provides libraries with a wonderful potential to create networks among library users, information science experts, and other

interested parties, such as information searchers. Twitter and Facebook are the two most well-known social networking sites. They are crucial in developing communal power. This kind of library collaboration will encourage time savings, efficiency, more visibility, and shared intelligence for improved decision-making. Additionally, it offers a forum for creativity and the exchange of ideas, knowledge, and discussions among intellectuals.

The term "library automation" refers to the shift away from traditional libraries that collect, arrange, and offer library services and resources in hard copies to libraries that computerize their library resources. According to Pornel & Saidana (2018), an automated library completely automates all the library's operations, including cataloguing, circulation, and acquisition. According to Parker & Castleman (2019) research, Polaris offers a variety of cloud-based services for library automation, including acquisition, cataloguing, process systems, digital contents, and the integration of cutting-edge library technologies. Additionally, it supports several standards, including XML, Unicode, MARCZI, and 239.50. They added that these ones have a direct connection to information science and libraries.

The following four areas of implementing cloud computing in libraries were system libraries (Examples includes catalogue, discovery systems, request man-system) Initiatives in Education (such as outreach to students, instructional support) Scientific communication such as digital repositories) Public services like enhancing online conversations with patrons). Additionally, cloud computing enables shared resources that users can access, typically from distant data centers. Services can be scaled up or down, and usage is tracked and billed appropriately for each customer. A cloud computing company may offer a variety of services over the Internet. Han (2019) identifies three primary service models for cloud computing, including:

Software-As-A-Service

A pre-made application, as well as any necessary software, operating system, hardware, and network, are delivered in the software as a service paradigm. SaaS uses a multitenant architecture to offer a single application via the browser to thousands of users. It eliminates the need for customers to make an upfront investment in servers or software license, while on the provider's end, the cost is lower than with traditional hosting because there is just one app to maintain.

According to Breeding (2017), most Software-as-a-Service offerings feature numerous libraries or users sharing a single instance of the software, allowing all updates and improvements to be made at once. The various users of the service may adjust their software as necessary, personalize the branding, color schemes, and navigation controls, and set functional preferences and policies in accordance with regional requirements. Users are relieved of the taxing responsibility associated with maintaining enhancements, upgrades, and fixes because the service provider handles these tasks when it comes to local software. Users can access and use any software offered by cloud vendors under this service model.

Users do not need to purchase the software, install, run, or maintain the apps on a machine or a server when using SaaS. SaaS offers online email programs, free services, infinite storage, and remote access from any computer or device with an Internet connection, according to Kumar *et al* (2019). They also emphasized that although the idea of accessing software applications online is not particularly new, many software companies have been hosting their products since the 1990s under a system known as an application service provider, or ASP.

On the other side, Han (2017) believed that the public are the main SaaS users. Popular SaaS Services include Gmail, Google Drive, Google Calendars, Windows Sky Drive, and Dropbox. The idea of accessing software applications online is not particularly new, many software companies have been hosting their products since the 1990s under a system known as an application service provider, or ASP. On the other side, Han (2017) believed that the public are the main SaaS users. Popular SaaS Services include Gmail, Google Drive, Google Calendars, Windows Sky Drive, and Dropbox.

Platform-As-A-Service

In PaaS, the customer installs or creates their own software and applications while using the provided hardware, operating system, and network. The consumer has control over the deployed apps and maybe the configuration options for the application but does not manage or control the underlying cloud infrastructure, including the network, servers, operating systems, or storage. By using the platform as a service paradigm, computing platforms can be created to execute software and other tools over the Internet without the need for end-user management of software and hardware.

PaaS provides a full development and production environment, free from worries about underlying infrastructure specifics. Examples of PaaS models that give users platforms for supporting and maintaining their IT infrastructure without investing a lot of money on hardware, software, and related/technology include Amazon Elastic Cloud (AEC), EMC Atmos, and Aptana.

While cloud computing technology have arrived in the mainstream, libraries have been reluctant to apply and adopt a cloud-based system to enterprises users (Okwoli, 2019) Cost, staff, and maintenance implication in the adoption of cloud computing.

The Financial Impact of Cloud Computing in Libraries

Increased flexibility and agility are the primary real benefits that cloud computing is beginning to offer as it moves past the hype stage. But as Breeding points out, switching to the cloud may also result in increased costs. Moving huge amounts of data to public cloud services and storing that data there for a long time might cost tens of thousands of dollars a year. Although data and systems are being hosted off-site, Ambrust et al. (2020) argued that there are internal labor costs with cloud computing. "People think there are no labor costs with cloud, but as you scale up to meet workload, there is a cost associated with internal labor," they wrote.

According to Ahmat (2019) he explained that leveraging the cloud can drastically lower the total cost of ownership of infrastructure. Some customers claim to have saved between fifty and seventy-five percent. The potential savings realized by utilizing cloud technology or services will differ for each client because they are all unique. The following variables influence the total cost of ownership of running infrastructure: Lower Upfront Cost: Companies can depreciate the cost of equipment over a period of three to five years by investing in it. However, this means that a library will incur the same CapEx (Capital Expense) each month of the project, regardless of the actual utilization. Usage-based Pricing: Temporary workloads such as software testing and development, load testing, quality assurance, troubleshooting, big data analytics, and seasonal websites require IT to invest time in purchasing equipment, deploying equipment in data centers, and then configuring the environment so that end users of cloud computing pay only for the resources they use. (ii) Automation: Cloud computing makes it easier to provision, de-provision, and re-resource resources through automation and user-friendly online consoles and APIs.

The effectiveness of cloud computing decreases the amount of time needed for infrastructure management and support on the part of an IT systems administrator. (iii) Operational Services and Support: the advantages of self-provisioning and automation in infrastructure management. Utilizing the management infrastructure is another method. In addition, libraries can cut costs by utilizing managed services from a cloud provider and systems integrator for their web server, database, and middleware software and systems, as well as their collaboration, mobility, storage, backup, and enterprise application. (iv)Reduced Downtime: By having the ability to quickly spin up a temporary environment of servers, storage, and networking, it is possible to troubleshoot problems that cause system downtime more quickly modifying a server's processor, memory, and storage performance when troubleshooting problems that make system utilization a problem. (v) Virtualization: By leveraging technology to construct several virtual machines on a single physical machine, hardware and power expenses can be greatly decreased. Virtualization is already widely used in large businesses. (vi) Resource scalability: multi-tenant architecture in a private or public cloud enables customers to benefit from enhanced scalability and resource leverage. With increasingly huge data sets, the economic advantages of local storage and cloud storage drastically shift. This is important to keep in mind for libraries that work with multiple terabyte-sized data sets, such as enormous image and video collections (Gbaje & Aliyu 2014).

The Workforce Influence of Cloud Computing in Libraries

The personnel implications for information technology departments are becoming increasingly apparent as more mid-sized libraries migrate to the cloud. Current personnel and staffing movements will determine whether a giving library's IT staff size needs to alter as it moves into the cloud. Individuals working in IT now will need new skills, and some roles will move from the enterprise to the cloud service provider suggested by Parker & Castleman (2019).

The idea that cloud-based systems will govern themselves is wishful thinking, according to experts. The library will still want people who are familiar with its software applications and how those programs connect to the business even if the information technology department of the library is operating in a cloud computing environment.

Due to the interdisciplinary nature of cloud computing difficulties, they cannot be fully resolved from a merely technical standpoint (Ahmat, 2019). Collaboration between library administrators,

practitioners, other library staff, cloud users (lecturers and students), and cloud service providers is required for the successful adoption of cloud computing in library services. It is crucial to remember that moving IT applications and systems to the cloud requires time. The adoption of cloud computing can take several months to several years, depending on the situation (Parker & Castleman, 2019).

It is crucial that competent and sufficient employees are involved in the administration and adoption of cloud computing. They also noted the importance of ongoing training and retraining to maintain a positive view on the delivery of pertinent library services. Although there are concerns about security, the resolutions passed on all these subjects are generally positive. In the study of Wang (2012), found that the level of comfort with utilizing cloud-based solutions varied depending on the nature of the information and activity involved.

Libraries that handle highly sensitive information may therefore prefer private cloud options over public ones. They also argued that while the issues were still present, there is no denying that libraries are embracing cloud computing technology and utilizing cloud-based services, particularly for the creation of digital libraries, social networking, and communication with patrons. Confidentiality, theft, and file loss were added to the list by Romero (2017). Therefore, it makes sense that IT departments would want personnel with in-depth knowledge of security issues.

The Impact of Cloud Computing on Library Preservation

According to Romero (2017), the ability to access virtually limitless amounts of documents, images, and movies from any phone, tablet, or computer is driving the popularity of cloud computing. Despite its brilliance, cloud computing creates a slew of maintenance issues. Few people appear to be comfortable with their private and sensitive information being stored in an unidentified "cloud" location. Parker and Castleman (2019) stated that just because cloud computing is intangible and invisible does not make it a risky way to store data. The most significant advantage of cloud computing is the management of data by the cloud provider.

NIST recommends the following approach to cloud computing maintenance (2018). There are nine issues: There are nine options. (1) Organizational governance: Establish policies, procedures, and usage guidelines. (2) Compliance: Confirm that the cloud provider's services meet all criteria for

records management and data security controls. (3) Trust: Make service agreements with cloud providers who are transparent about their security and upkeep practices. (4) Architectural: Learn about the technology used by the cloud provider. It is critical that the proper restrictions are communicated to the service provider in order for them to secure authentication and other identity and access management functions.NIST recommends the following approach to cloud computing maintenance (2018). There are nine issues: There are nine options. (1) Organizational governance: Establish policies, procedures, and usage guidelines. (2) Compliance: Confirm that the cloud provider's services meet all criteria for records management and data security controls. (3) Trust: Make service agreements with cloud providers who are transparent about their security and upkeep practices. (4) Architectural: Learn about the technology used by the cloud provider. It is critical that the proper restrictions are communicated to the service provider for them to secure authentication and other identity and access management functions. (5) Software Isolation: Be familiar with the virtualization and additional isolation strategies that the cloud provider will use. (6) Data Protection: Examine the data management tools and upkeep provided by the cloud service provider. (7) Availability: Ascertain that the contract's availability, data backup and recovery, and disaster recovery policies and processes satisfy the library's continuity and contingency planning needs. (8) Incident Response: Ensure that the contract provisions and procedures for incident response meet the requirements of your library.

Nin (2020) explained that once the relationship is established the library can rest that the information is safe and well maintained in capable hands. Much of the work on cloud computing attempts to allay the concerns and fears of potential users of the service. Although, as Olivia (2014) noted, the primary benefit of any new technology is that it increases human potential, this can obviously be resolved by maintenance, as the adoption of cloud computing technology, libraries can get out of the business of technology and concentrate on collection development, patron services, and innovation. Decommissioned servers don't need to be replaced every five years (or less). Employees won't have to worry about upgrading the intricate software stack that is required to run local systems anymore.

Conclusion

The National Open University of Nigeria Library, according to the study's findings, should use cloud computing to provide library and information services to its dispersed students across the country, where access to information must be unrestricted and not location-specific. Furthermore, to help National Open University of Nigeria librarians avoid technical issues like computer infections, system failures, and data loss while saving time, money, and streamlining workflow.

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