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Cloud Computing as a Catalyst for Library Empowerment

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ABSTRACT

Cloud computing represents a rapidly advancing trend that utilises various techniques to deliver innovative applications and services over the internet. In the education sector, cloud computing has proven to be an efficient system for supporting e-learning initiatives. Within libraries, the adoption of cloud computing can lead to significant benefits, including reduced system maintenance costs, energy savings, extended global presence online, access to diverse information resources for users and improved service optimisation. This paper examines cloud computing and identifies key areas in libraries where cloud-based solutions can be effectively implemented. It explores the fundamental characteristics of cloud computing, various models, outlines the associated benefits and challenges and discusses the tools and platforms relevant to its application in library settings. The study highlights how cloud computing presents a transformative opportunity for libraries, fostering enhanced professionalism, efficiency and the overall quality of library services.

Keywords: Cloud computing, service model, deployment model, cloud computing platforms and tools, cloud computing in library services.

1. INTRODUCTION

In the era of information explosion, the volume of data and complexity of user needs are growing rapidly. To effectively address these growing needs in the knowledge society and to significantly enhance service delivery, cloud computing has become increasingly important and prevalent today. Cloud computing provides greater opportunities and is growing rapidly due to savings in cost and time, reduce local maintenance requirements, easy accessibility across devices and locations and flexibility to scale services as per demand changes. It is the most recent model to effectively support library services, applications and software than systems limited to on-premises infrastructure.

Cloud computing unlocks new possibilities for libraries. It empowers to manage vast amount of information and to successfully conduct e-resource initiatives entirely over the internet, helping staff and user access platforms and content without being restricted to specific workstations or buildings. By utilising advanced cloud-based services and applications, library operations can be significantly optimised, leading to more efficient and effective management of all library functions and resources.

2. OBJECTIVES

- To understand the concepts of cloud computing as applied in libraries.
- To explore the various types of cloud computing models in libraries.
- To identify the characteristics, advantages and disadvantages associated with the use of cloud computing in libraries.
- To explore the cloud computing tools and platforms for libraries services.
- To examine the applications of cloud computing in libraries.

3. LITERATURE REVIEW

Shaw & De Sarkar (2019) defines cloud computing encompasses distributed computing, parallel computing, grid computing and distributed databases. Grid computing and utility computing are considered predecessors of

cloud computing. The development of cloud computing is motivated by factors such as high-speed internet, virtualisation technology and more powerful hardware chips.

Kaushik and Kumar (2013) provide an overview of cloud computing and of the possible applications that can be combined with online library services. The characteristics of various technologies, including utility computing, network computing, integrated computing and services not only fast but also in new formats with flexibility, such as pay-as-you-go, access at any time anywhere, etc.

Tyagi, Passi and Baberwal (2015) defines what makes cloud computing so different and how its solution benefits the library system. It also reveals the opportunities brings for the library system by connecting services with cloud and help to re-invent the library services in a more effective, compatible and user-centric way.

Krishnamurthy and Arali (2019) explain that cloud data is stored on networked resources accessible via virtual machines. These machines usually operate in data centres located globally, beyond the control of users which causes numerous security and privacy challenges.

Srivastava and Kumar (2011) introduced to concept of cloud computing using a variety of commercially available cloud service platforms. He discovered that cloud computing is altering the way that hardware and software are developed for on-demand capacity fulfilment and web application development in order to make decisions.

Mahalakshmi and Maidhili (2015) highlighted cloud computing offers libraries an efficient way to save time and reduce costs while restructuring their workflows. Additionally, libraries are evolving their services by integrating cloud technology and networking, enabling users to access these resources from anywhere, at any time.

4. CONCEPT AND DEFINITION OF CLOUD COMPUTING

Cloud computing refers to Internet-based computing that delivers shared processing resources and data to computers and other devices as needed. It enables many institutions to prevent the need for locally hosting several servers and equipment, as well as constantly managing hardware failures, software upgrades, and compatibility challenges. Cloud computing can simplify tasks and reduce expenses and time.

According to the National Institute of Standards and Technology (NIST) "Cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction."

According to IBM, "The concept of cloud computing has developed from earlier ides such as grid and utility computing and aims to provide a completely Internet driven, dynamic and scalable service-oriented IT environment, which can be accessed from anywhere using any Web-capable device"

Buyya defined "Cloud computing is a parallel and distributed computing system consisting of a collection of interconnected and virtualized computers that are dynamically provisioned and presented as one or more unified computing resources based on Service Legal Agreements (SLA) established through negotiation between the service provider and consumers."

Xiao and Xiao, senior member of IEEE, defined cloud computing as, "A large scale distributed computing paradigm that is driven by economics of scale, in which a pool of abstracted, virtualised, dynamically- scalable, managed computing power, storage, platforms, and services are delivered on demand to external customers over the Internet"

5. CHARACTERISTICS OF CLOUD COMPUTING

The NIST (National Institute of Standards and Technology, US) has recognised the following five essential characteristics of cloud computing:

- **On-Demand Self-Service**: End users can independently access computing resources without needing assistance from individuals or the cloud service provider.
- **Broad Network Access**: Cloud resources can be accessed over the internet anytime, anywhere, through standard devices such as desktops, laptops, netbooks, tablets, and mobile phones.

- **Resource Pooling**: Cloud service providers are pooled to support all the users by a multi- tenant model. Based on user demands, diverse requirements for both physical and virtual systems are dynamically allocated and reassigned as needed. This includes aspects such as storage, permissions, memory, connectivity, network bandwidth, and virtual machines.

- **Rapid Elasticity**: Elasticity depends on our requirements. We can add or remove any kind of software at any time. In cloud computing, elasticity is the best option.

- **Measured Service**: Cloud system service provides on a pay-per-use concept. The cloud system service is analysed and designed for managing by users and service providers for the use of services.

6. TYPES OF CLOUD COMPUTING MODEL

Mainly two types of cloud computing models are there. They are:
A. Service models
B. Deployment models

A. Service models

The following three primary service models are predominantly used for delivering the different cloud-based services:

- **Software as a Service (SaaS):** This is the most recognised and widely adopted form of cloud computing. SaaS allows users to access sophisticated application functionalities through a web browser, eliminating the need for locally-installed software. It simplifies IT management by reducing concerns related to application servers, storage, development, and updates.

Example: Salesforce CRM, Microsoft Office 365, Google Apps, Skype, Dropbox, Zoom and Adobe Creative Cloud.

Benefits: No extra cost for hardware, automated updates, accessible from any location, pay only for actual usage.

- **Platform as a Service (PaaS):** In this model, clients use a hosted platform to deploy and manage their own applications. While they have control over the applications running on the platform, they do not manage the underlying operating system, hardware or network infrastructure. PaaS generally provides an application framework.

Example: Google App Engine, AWS Elastic Beanstalk, Microsoft Azure App Service, Heroku and Rad Hat OpenShift.

Benefits: Simplifies application with faster service, reduce capital expenses and eliminates the burden of management.

- **Infrastructure as a service (IaaS):** This model offers an extensive range of features, services, and resources designed to create a virtual computing infrastructure. Organisations can develop a complete infrastructure on-demand as needed.

Example: Amazon Web Services, Microsoft Azure Virtual Machines, Google Compute Engine, Oracle Cloud, Digital Ocean Droplet and IBM Cloud.

Benefits: On demand self-service, exact services and broad network access etc.

B. Deployment Models

The cloud community has identified four main types of cloud deployment models, each designed to cater to distinct organisational needs and operational requirements.

- **Private Cloud:** A private cloud is exclusively owned and managed by a single organisation. This model grants the organisation complete control over how virtualised resources and automated services are customised to meet the needs of various business units and stakeholders. Private clouds are often chosen for combining the efficiencies of cloud computing with enhanced resource control and the avoidance of multi-tenancy risks.

Example: Ubuntu Enterprise Cloud, Amazon Virtual Private Cloud, Microsoft ECI Data Centre, VMware Cloud Infrastructure Suite

- **Public Cloud:** Public clouds are operated by third-party providers who offer affordable and on-demand access to computing resources for individuals and organisations. By using public cloud services, users eliminate the need to invest in hardware, software, or infrastructure, as all of these are maintained by the provider.

Example: Amazon Web Services, Google App Engine, Microsoft Azure App Service, Force.com and IBM Smart Cloud.

- **Community Cloud:** The community cloud model is a collaborative effort where multiple organisations pool resources to build a shared cloud infrastructure and establish the governance policies for service delivery. This model promotes economic scalability and fosters collaborative equilibrium among participants. The infrastructure in a community cloud can be hosted by a third-party provider or within one of the participating organisations, depending on the setup.

Example: ASW GovCloud, Microsoft Azure Government, Salesforce Financial Services Cloud.

- **Hybrid Cloud:** A hybrid cloud integrates a private cloud environment with strategic public cloud usage. Since private clouds cannot function entirely in isolation from other IT assets and external services, many organisations adopt a hybrid model. Under this setup, workloads are distributed across data centres, private clouds and public clouds to optimise performance, cost and scalability.

Example: Amazon Web Services, Azure, Google Cloud and VMware

Each model offers unique advantages, allowing organizations to select one based on their specific needs, priorities, and operational constraints.

7. ADVANTAGES OF CLOUD COMPUTING

Cloud computing transforms libraries by offering various strategic advantages that enhance their operational efficiency and user services. Following are the benefits of cloud computing:

- **Adaptability**: Cloud computing offers significantly more flexibility than traditional local organisational computing systems, making it a time and cost-efficient solution. For instance, libraries can conveniently expand their services by requesting additional storage or resources whenever needed.

- **Cost Efficiency**: Pay-as-you-go payment models reduce the expenses of an organisation. This approach enables cost savings due to economies of scale, ensuring entities like libraries only pay for the resources they actually use.

- **Storage Capacity**: Cloud computing provides extensive storage capacities compared to personal computers or locally available resources in libraries and organisations, with scalability options as needs grow.

- **Recovery & Backup**: The whole method of backup and recovery is much easier in comparison to the conventional approach to data storage. Cloud-based service providers usually handle data recovery & backup.

- **Enhanced Mobility**: Library staff and patrons can interact seamlessly from remote locations rather than being restricted to fixed workstations. All that is required is a computer and internet connectivity, enabling greater flexibility and ease of communication.

- **Highly Automated**: IT teams or library staffs are relieved of the burden of constantly ensuring that systems are up to date. When updates are rolled out, the cloud service provider automatically handles software upgrades. Updated features are instantly accessible to all users without requiring individual manual interventions or system refreshes on their end.

- **Shared Resources**: One of the key strengths of cloud computing lies in resource sharing. It grants access to both internal and external users, promoting better collaboration. For example, multiple libraries can pool their resources together in a centralised platform, thereby significantly enhancing the overall assets available to their patrons.

- **Ease of Implementation and Maintenance**: Organisation can concentrate on innovation rather than spending their time managing staff updates and technical concerns. Staff can prioritise other projects because no physical hardware is required to manage cloud services. This simplicity allows for smoother operations and reduces maintenance responsibilities.

8. DISADVANTAGES OF CLOUD COMPUTING

Cloud computing in libraries improve library services but faces challenges like internet reliance, data security and privacy, vendor lock-in, high subscription costs and data loss risks. These disadvantages are discussed as follows:

- **Security & Privacy**: This is the main drawback of cloud computing. Lack of security and privacy, especially for sensitive data. Cloud-stored data faces risks from viruses, theft and also potential data loss from inadequate backup and system failures.

- **Network Connectivity & Bandwidth**: In cloud computing the major disadvantage is the internet connectivity. Organisations may experience a loss of data connectivity until the internet connection is restored due to network issues or server problems, and cloud computing services might also be suspended. With low-speed internet bandwidth, connectivity will not function correctly.

- **Dependency on Outside Agencies:** A significant disadvantage of the cloud platform is hidden dependency; while another issue associated with cloud computing is vendor lock-in.

- **Restricted Control & Flexibility**: In the cloud computing environment, there is restricted control and flexibility by service provider. This environment creates monopoly of service providers.

- **Segregation**: Segregation is one of the disadvantages of cloud computing. In this framework, the information is not segregated. It is disseminated via the cloud network and creates an issue when particular data requires segregation.

- **Cost**: Initially the cloud computing cost is higher, especially for the small organisations and for short term projects. However, organisations may reduce the charges in the future depending on the usage of services.

9. POPULAR CLOUD COMPUTING PLATFORMS & TOOLS FOR LIBRARIES

Several business companies offer cloud computing service platforms specifically designed for library automation management software, digital libraries, search engines and related applications. These platforms allow libraries to manage resources, access digital content and integrate information systems effectively in a cloud environment. The most common cloud computing library platforms are:

- **OCLC (World Share Management Services)**: World Share Management Services (WMS) is a cloud-based library services platform of Online Computer Library Centre (OCLC). It provides libraries with cost savings, improved workflow efficiencies and the ability to deliver added value to users by facilitating the sharing of data and efforts across numerous member libraries. Traditional integrated library systems (ILS), which often involve expenses for maintaining services and software, WMS subscription includes features such as serials management, course reserves and an Open URL resolver.

- **WorldCat**: WorldCat is the world's most comprehensive database of information about library collections built by OCLC. It serving as an essential tool for cataloguing, discovery and resource sharing. WorldCat Discovery Services provide options such as organisation views, remote database search and custom reporting. It enhances library visibility on the web and offers improved data about library systems.

- **DuraCloud**: DuraCloud is an open-source platform developed by DuraSpace, launched as a service in 2011. It provides on-demand storage and digital content services in the cloud for libraries, research centres, and cultural heritage organisations. DuraCloud supports digital preservation, data access, transformation and sharing. It allows users to transfer copies of any type or size of digital content into the cloud, storing them with various providers while offering computing services. DuraSpace offers two primary tools: DSpace and Fedora Commons. Among these, DSpace has gained wider acceptance for creating digital libraries and repositories.

- **LibLime**: LibLime is a provider of open-source library solutions. It was founded in 2005 and acquired by Progressive Technology Federal Systems, Inc. (PTFS) in 2010, specialises in implementing and developing services around Koha, an open-source Integrated Library System (ILS) considered one of the earliest of its kind. Known for its innovation in open accessibility, interoperability and rapid development, LibLime serves all types of libraries and consortia while providing superior customer support. It eliminates the need for costly technical staffing by hosting its software in a distributed cloud computing data centre.

- **ExLibris:** ExLibris Cloud is an integrated library management platform that integrates resource management, discovery and fulfilment. It supports libraries to manage print, digital and electronic materials. It helps libraries in handling various collections, automates workflows such as acquisitions, cataloguing and

circulation and discovery tool to enhance user access. Key functionalities include inter-library loans, third-party integrations and build-in analytics for data-driven decision-making. As a private cloud solution, it offers scalability, flexibility and robust data security, helping libraries modernise operations and concentrate on teaching, research and user engagement.

- **Polaris Integrated Library System**: The Polaris Integrated Library System (ILS) software is designed for efficient user experience and management of library resources. Built on a Microsoft SQL server database, it supports third-party integrations and provides direct access to e-content and shared collections. New features in Polaris ILS 5.0 include Family Holds Pickup, floating collections, automated item renewals, a Carousel toolkit and enhanced bibliographic display options in the PAC, along with comprehensive search and reporting capabilities.

- **LOCKSS & CLOCKSS**: The LOCKSS (Lots of Copies Keep Stuff Safe) and CLOCKSS (Controlled Lots of Copies Keep Stuff Safe), both projects are under the support of Stanford University Libraries. LOCKSS is an international community initiative that develops and supports an open-source system enabling libraries to collect, preserve and provide their readers access to web published materials. The main focus of the system is digital preservation. CLOCKSS is a collaborative, community initiative to provide a decentralised and secure solution to long-term archiving, based on the LOCKSS technology.

- **Knimbus**: Knimbus is a cloud-based research platform designed to facilitate the discovery and sharing of scholarly content. It acts as a comprehensive hub for creators and users of scientific, technical and medical resources, providing access to cutting-edge academic content. Currently, Information and Library Network (INFLIBNET) Centre has incorporated Knimbus cloud service into its UGC INFONET Digital Library Consortium in order to search and retrieve scholarly contents.

- **Scribd**: Scribd launched its unlimited e-book subscription service in October 2013, providing customers access to its virtual library for a monthly fee. The partnership with Harper Collins allowed subscribers to access the publisher's entire backlist, marking a significant release of its catalogue. In March 2014, Scribd partnered with Lonely Planet to include its complete library for subscribers. As of February 2016, subscribers could read select titles indefinitely while earning credits to read three books and one audiobook per month, with unused credits carrying over to subsequent months.

- **Service Discovery**: Service discovery is an automated detection of devices and services available on a computer network. A service discovery protocol (SDP) is network protocol that facilitate service discovery. The goal of service discovery is to minimise the configuration efforts needed by users and administrators. Service discovery relies on a common language to enable software agents to access each other's services without constant user intervention.

- **OSS Labs**: Open-Source Software Labs provides customised open-source software services for libraries, facilitating the adoption and management of open-source technologies. It offers integrated library systems for collection oversight, digital preservation solutions and consulting services to ensure successful implementation and maintenance. OSS Labs emphasises community collaboration and contributes to open-source projects while helping clients reduce costs associated with proprietary licenses.

10. APPLICATIONS OF CLOUD COMPUTING IN LIBRARIES

In the present situation, cloud computing can significantly impact on libraries. Cloud computing enables libraries to save time and resources, simplify workflows and provide facilities to access their services from anywhere at any time through cloud-based platforms. The following possible areas have been identified where cloud computing services and applications can benefit libraries:

- **Digital Library Repositories**: Currently, every library seeks to establish a digital library repository to effectively handle and access its resources and services over networks. Creating digital library repositories allows individuals to support institutions by submitting scholarly materials to promote research. Numerous cloud-based digital library software solutions can be found in the market. *Example*: DSpace and Fedora Commons by DuraSpace.

- **Searching Library Data**: An essential service of a library is searching library data. The cloud computing platform provides a range of services, including circulation, cataloguing, acquisition and additional library-related services through its web-based management system. This platform fosters collaboration by enabling libraries to share resources, services, ideas and problems with the library community on the cloud. *Example*: OCLC WorldCat Service.

- **Library Automation**: Libraries are using either open-source integrated library management systems or commercial software to automate their operations. The automation procedure for libraries occurs on locally hosted servers. Many vendors now offer this service on the cloud to help libraries avoid significant upfront hardware investments. This approach not only presents a cost-effective solution but also relieves libraries from responsibilities like software updates, data backups and routine maintenance. Most of the software vendors follow standards like MARC21, XML, Z39.50 and Unicode. *Example*: Polaris, Exlibris and OSS Labs.

- **Website Hosting**: Libraries prefer to host their website through a third-party service provider instead of hosting and maintaining their own server. Website hosting enables numerous library users to access the site at the same time from any location on the globe. Hosted cloud solutions are particularly useful for libraries lacking in technical expertise or having less experienced staff. Vendors handle hardware, operating system and software upgradation, making this approach more cost-effective compared to traditional methods. A service example is Google Site Server.

- **Online Storage**: Cloud computing provides a variety of services for online file storage and access, such as Flickr, Dropbox, Jungle Disk, Google Drive and Microsoft OneDrive. These platforms enable users to upload files and access them from anywhere at any time without requiring specialized hardware or software. Libraries can get advantages of such cloud-based services for various purposes. Tools like LOCKSS (Lots of Copies Keeps Stuff Safe), CLOCKSS (Controlled LOCKSS) and Portico are widely used by libraries and other organisations for digital preservation, safety and accessibility of resources.

- **Searching Scholarly Content**: Researchers may be benefited from this service, as it facilitates knowledge sharing and discussions with peers. A wide range of articles, e-books, e-journals, patents and scholarly contents are easily accessible. Knimbus is a cloud-based research platform for accessing scholarly contents. It is presently incorporated to provide access to the scholarly contents of UGC INFONET Digital Library Consortium managed by the INFLIBNET centre.

- **Building Library Networks:** Cloud computing technology facilitates libraries in creating collaborative networks among library and information professionals, interested stakeholders, information seekers and various organisations through social networking tools like Facebook, Twitter, YouTube, Instagram, WhatsApp, Telegram. This cooperative effort provides a platform for exchanging creative ideas, interests, initiatives, intellectual discussions and share knowledge to improve operational efficiency, enhance decision-making

11. CONCLUSION

The primary goal of a library is to satisfy the information need of its patrons. Cloud computing has become a crucial tool for libraries to optimise resource management, enhance service delivery and facilitate professional operations through advanced technologies. The adoption of cloud computing has significantly simplified the management of library applications and services. Despite challenges such as data security, privacy issues, vendor dependency, legal complexities, limited technical expertise and financial constraints, the importance of cloud computing is gradually increasing today. It provides essential solutions that enhance library services and promote wider usage in professional environments.

REFERENCES

[1] Ahmed, I., Bakht, H. and Mohan, U. (2017). Cloud computing: a comprehensive definition. *Journal of Computing and Management Studies*, 1(1).

[2] Buyya, Rajkumar ... [et al.] (2009). Cloud computing and emerging IT platforms: vision, hype and reality for delivering computing as the 5th utility. *Future Generation Computer Systems*, 25(6), 599-616.

[3] Dastagiri, D., & Kumar, S. P. (2017). Impact of Cloud Computing Applications in Academic Library and Library Services. *International Journal of Library and Information Studies*, 7(3), 225–232.

[4] Gosavi, N., & Shinde, S. (2012). Use of cloud computing in library and information science field. *International Journal of Digital Library Services*, 2(3), 51–106.

[5] Jamal, F. (2020). Emerging Technologies and Developments in Cloud Computing: A Systematic Review. *International Journal of Emerging Trends in Engineering Research*, 8(3), 894–905.

[6] Jayakumara (2022). An overview of cloud computing technology and its application on library services. *International Journal of Information Dissemination and Technology*, 12(3), 110-113.

[7] Kaushik, Anna & Kumar Ashok (2013). Application of cloud computing in libraries. *International Journal of Information Dissemination and Technology*, 3(4), 270-273.

[8] Krishnamurthy, C. and Arali, Soubhagya S. (2019). Cloud computing in academic libraries: issues and challenges. *9th KSCLA National Conference on Library in the Life of the User, Tumkur, India*.

[9] Kumar, Rakesh (2017). Applications of cloud computing in academic libraries. *Library Waves*, 3(1), 80-85.

[10] Mahalakshmi, M. & Maidhili, S. (2015). Application of cloud computing in libraries. *International Journal on Applications in Electrical and Electronics Engineering*, 1(6), 17-20.

[11] Makori, E. O. (2015). Cloud Computing Paradigm and Libraries and Information Establishments in Kenya: Any Opportunities for Operational Resilience?

[12] Mate, K. S. (2016). Use of Cloud Computing in Library Services. *International Journal of Engineering Science and Computing*, 6(5), 4693.

[13] Muhammad Akbar Ravai & Wang, Gunaawan (2020). Cloud computing platform services in the university libraries for digital repository. *International Journal of Advanced Trends in Computer Science and Engineering*, 9(1), 285-294.

[14] Nagalakshmi, L. R., Raghavendra, R., Indrani, V., Narayana, P., Mahipal, D., Tritt, D. D., & Kendrick, K. D. (2013). Impact of Cloud Computing Technology for Library Services. *The South-eastern Librarian*, 2(1), 13–15.

[15] National Institute of Standards and Technology, U.S. Department of Commerce. Special Publication 800-145. https://nvlpubs.nist.gov/nistpubs/legacy/sp/nistspecialpublication800-145.pdf.

[16] Neethu, G. S. & Vanaja, M. N. (2017). Concept and applications of cloud computing in libraries [Special issue]. *International Journal of Trend in Research and Development*, 1-4.

[17] Pawar, Shilpa Shantaram (2016). Applications of cloud computing in digital libraries with reference to improve the functionality. *International Journal of Library & Information Science*, 5(2), 1-6.

[18] Shaw, J. N. & De Sarkar, T. (2019). Model architecture for cloud computing-based library management. *New Review of Information Networking*, 24(1), 17-30. https://doi.org/10.1080/13614576.2019.1608581

[19] Shivaleela, S. Kalyani & Bharathi, V. (2022). Cloud computing and its applications and services in the library and information centre. *International Journal of Innovative Science and Research Technology*, 7(4), 27-30.

[20] Srivastav, Kamal & Kumar, Atul (2011). A new approach of cloud: computing infrastructure on demand. *TRIM*, 7(2), 145-153.

[21] Swaminathan, K. (2009). The value of cloud computing to outsources and their clients. *IBM Software Group*.

[22] Tyagi, Neeraj, Passi, Nidi and Baberwal, Sumit Kumar (2015). Cloud computing and its applications in library systems. *International Journal of Research in Engineering and Technology*, 4(7), 45-47.

[23] Xiao, Z. and Xiao, Y. (2013). Security and privacy in cloud computing. *IEEE Communications Surveys Tutorials*, 15(2), 843-859.

[24] www.digitalpreservation.gov/partners/lockss.html

[25] www.wikipedia.com