

The Role of Cloud Computing in Libraries: Intelligent Approaches for storing and Managing Informations

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Abstract:

Cloud computing is the most important technology produced by digital technologies, as it helps to improve operational efficiency and reduce physical maintenance costs because it does not need a complex physical infrastructure. It also offers automatic service updates and allows easy expansion of storage capacities.

We will get to know them in detail through our study of the role of cloud computing in libraries, where we aim to review the transformations they provide in the ways of storing and managing information, making it easier to access them.

Cloud computing enhances the management of digital resources and electronic collections such as e-books and magazines and allows collaboration between libraries and various institutions easily and conveniently.

Despite the many benefits of cloud computing mentioned in our study, it faces a number of challenges related to security and privacy issues, which necessitates taking the necessary measures to protect sensitive data, and training librarians to deal effectively with this technology is essential.

In general, through this article we are trying to highlight the importance of cloud computing in libraries, which offers a promising future for libraries and opens up new opportunities to improve information services and enhance access to knowledge.

Keywords:Cloud computing ; digital environment ; digital resource management ; libraries ; modern infrastructure.

1. Introduction:

Information and Communication Technology (ICT) has undergone remarkable advancements in recent decades, becoming a primary driver of innovation and digital transformation across various sectors. One of the most prominent technologies emerging from this digital revolution is cloud computing.

Cloud computing has significantly altered the way information is stored and managed in numerous sectors, including libraries, which serve as essential knowledge hubs and cultural centers.

Libraries rely on cloud computing, an internet-based computing model that delivers services, storing and accessing information without the need for complex traditional infrastructure. This provides flexible and secure solutions for data storage and management within libraries, reducing technical burdens and enabling a greater focus on improving reader services. Additional benefits include decreased operational costs, enhanced access to digital resources, and improved efficiency of internal processes."

Modern libraries that leverage cloud computing are characterized by their ability to adapt to rapid technological changes. The cloud enhances the user experience for students, faculty, researchers, and readers alike by providing access to digital books, periodicals, and online research resources. Additionally, it offers the capability to securely store vast amounts of data with backup capabilities, ensuring service continuity in the event of emergencies such as natural disasters or cyberattacks.

Despite the numerous advantages offered by cloud computing, libraries that rely on it face multiple challenges. These include privacy and digital security concerns, the long-term cost of certain cloud services, and the need to adapt to continuous technological developments. Addressing these challenges requires well-considered strategies to maximize the benefits of cloud computing without compromising service quality.

Based on the foregoing, the importance of studying cloud computing as a modern approach to improving library performance and enhancing its ability to meet the needs of users in the digital age is highlighted. Consequently, the following question arises: How can cloud computing contribute to improving information management and developing library services? What are the challenges faced in its effective implementation within the library sector?"

2. The Concept of Cloud Computing

Cloud computing is one of the technologies that has emerged from digital advancements. We find that there are various translations of the term, such as computational cloud, digital cloud, electronic cloud, and cloud computing, with the last term being the most commonly used.

1. Definition:

The Online Dictionary for Library and Information Science (ODLIS) defines cloud computing as a commercial term for delivering technology as a service rather than a product. It allows for the conversion of capital expenditures into operational expenses (from products to services). This model enables the storage and accessibility of data and software on computers and other devices connected to the internet, allowing for their sharing to support information technology services. The end user interacts only with the software interfaces without needing to know where the data is stored or how the delivery system operates. Cloud computing, therefore, relies on the capabilities provided by Web 2.0 technologies (ODLIS).

The National Institute of Standards and Technology (NIST) defines cloud computing as a model that provides fast and convenient access to a shared pool of configurable computing resources (such as servers, networks, storage, applications, and services) that can be rapidly provisioned and managed with minimal administrative effort or service provider interaction (NIST research team).

From these definitions, we can conclude that cloud computing is a technology that enables users to access computing resources and services from anywhere, at any time, via the internet.

2. Components of Cloud Computing:

Cloud computing consists of five components (Al-Hamzawi, J, 2013).

- **Applications:** These are programs that users can run in the cloud, which alleviate the maintenance and development burden from the user.
- **User:** This is the beneficiary who uses their device (whether a computer or mobile phone) to benefit from the service. They may have an operating system that supports cloud services or may use a browser only.
- **Infrastructure:** This refers to the cloud's underlying infrastructure.
- **Platform:** This is what the user utilizes in the cloud, such as Java or Google Web Toolkit in the Google search engine.
- **Service:** This represents the transformation of computing products into services available in the cloud.

3. Aims of Cloud Computing:

- Cloud computing aims to achieve the following objectives (Klo, 2015):
- To make the computer a gateway to access the server that contains storage space, enabling the user to manage their data.
- To provide high-quality storage space for information.

- To enable access to information and ease of retrieval at any time and from anywhere that has internet connectivity.
- To back up information stored on personal computers or external storage devices like disks, flash drives, etc.
- To provide access to operational and application software, often for free, which saves users costs, time, and maintenance.
- To facilitate the sharing of information among users and its easy circulation across the internet, regardless of the size of the information and the formats of its files.
- To enable users to process information remotely related to creating, deleting, or modifying files, as well as determining access levels and organizing their storage.

4. Types of Cloud Computing:

There are four main types of cloud computing, which are as follows:

Public Cloud: This is primarily available for public use and can be accessed by anyone. It sells its services to any individual on the internet and is operated by a third party. Amazon Web Services is considered the largest provider of public cloud services. This type is characterized by lower costs because the infrastructure is managed and shared among multiple users and subscribers.

Private Cloud: This is owned by a specific organization and can be managed by that organization for users who wish to share specific information within it. This type provides enhanced security and privacy, along with greater control over data and infrastructure.

Community Cloud: This is used by a community of users with similar interests, either within a single university or across multiple universities that share common activities, policies, online resources, and a unified catalogue, among others.

Hybrid Cloud: This combines the advantages of both public and private clouds, meaning it is composed of two or more types (private, public, community) connected through a specific technology while maintaining their individual characteristics. This type offers flexibility for organizations to determine what they can store in each type of cloud (Al-Kharinj & Al-Muzain, 2020).

5. Cloud Computing Services:

Cloud computing services are categorized into the following three types:

1. Infrastructure as a Service (IaaS):

This refers to the provision of essential computing resources such as storage, servers, and networks. It is sometimes referred to as "Hardware as a Service" because it includes services like storage, backup, disaster recovery, and databases. This service allows organizations to access infrastructure represented by hardware and equipment, such as servers and storage locations, under a "pay-as-you-go" model. This means that cloud computing enables customers to pay only for what they use. Consumers have control over the operating systems, storage, and applications deployed but cannot manage or control the underlying infrastructure of the cloud (Klo, 2015, p. 04)

A prime example of this type of service is Amazon Web Services (AWS) at <http://aws.amazon.com>.

2. Platform as a Service (PaaS):

PaaS is defined as a collection of software and development tools that are hosted on the provider's infrastructure. It represents the next level of cloud computing and is often used by organizations that develop and modify their software applications. Providers of PaaS can utilize Application Programming Interfaces (APIs), web portals, or gateway software installed on the client's computer (Moawad, 2012).

3. Software as a Service (SaaS):

SaaS is the highest level of cloud services, where service providers install and run the software to be made available through the cloud, allowing users to access applications and their updates published online without needing to install them on personal computers or mobile phones, such as email services.

These services enable libraries to access software at a lower cost than paying for licensed applications. This service is also known as hosted applications, such as the MS Office Cloud suite. This category is characterized by the following features:

- Users cannot download, install, or manage the software; the service provider handles the management.
- The software is accessible through various internet-connected devices.
- It is an optimal subscription model (for software and applications).
- Access to software is available through a web browser without installation, upgrading, or backup requirements (Sabour & Bizan, 2021, p. 174).

6. The Role of Cloud Computing in Digital Transformation:

Digital transformation is a vital step to ensure that libraries remain information and knowledge centers in the modern digital world. Libraries can provide more diverse and efficient services to their users by adopting digital technologies and cloud computing, as the latter allows libraries to store vast amounts of data on cloud servers accessible via the internet.

3. Benefits of Cloud Computing in Libraries:

Cloud computing impacts many fields, including libraries. It uses remote servers to provide a variety of services that can be accessed over the internet, without the need for complex local infrastructure.

Cloud computing has contributed to libraries by improving work efficiency, providing resources, and expanding the range of services offered. Below, we outline the main benefits of using cloud computing in libraries:

1. Cost and Resource Savings:

One of the most significant benefits that cloud computing offers libraries is the ability to reduce costs associated with technical infrastructure. According to a study conducted by Marston, Griffith, and Zhang (2020), libraries that adopted cloud computing saved an average of 25% on infrastructure costs, allowing them to redirect these funds towards improving user services and expanding their digital collections. Al-Zahrani (2021) noted a reduction in costs for academic libraries of up to 40%, enabling them to provide additional services such as e-books and user training.

2. Flexibility and Scalability:

Libraries that rely on cloud computing can expand or contract their computing capabilities as needed, without the necessity for costly updates and operational complexities. This indicates that smaller libraries can benefit from larger libraries without the need for significant investments in infrastructure. A study by Armbrust and Griffith (2019) showed that libraries using cloud computing have a greater capacity to handle seasonal increases in resource demand, as they expanded their server capacity seamlessly and without service interruption.

Al-Harbi (2020) highlighted the role of cloud computing in helping libraries respond quickly to changes in user volumes and requirements, noting that automatic scaling has improved the operational efficiency of both public and private libraries.

3. Improving Access to Information:

The ability to enhance access to information is one of the major benefits of using cloud computing in libraries. Through cloud infrastructure, libraries can offer their digital content more extensively online, allowing users to access electronic databases, e-books, and scientific research from anywhere at any time. This broadens the scope of services available to users. Smith (2018) noted in her study that cloud computing has improved the performance of resource searching within libraries, enabling users to access information 30% faster compared to traditional systems. Additionally, users can access a wide range of digital books and articles from any internet-connected device, thanks to enhanced indexing services in academic libraries, as mentioned by Al-Harbi (2019).

4. Data Protection and Security:

Cloud computing offers numerous advantages for libraries, including data backup and protection against disasters. Data can be stored in multiple locations and distributed geographically, which reduces the risk of loss due to hardware failures or natural disasters. Libraries that adopted cloud computing have experienced a 15% reduction in data loss incidents compared to those relying on traditional protection systems (Bandyopadhyay & Zhang, 2020, pp. 123-135). Cloud computing has also provided innovative solutions for data protection in public libraries, helping safeguard information against cyberattacks and breaches (Al-Dasouri, 2020, pp. 12-25).

5. Collaboration and Sharing:

Collaboration between libraries and academic institutions facilitates access to a larger array of digital resources without duplicating efforts. Cloud computing enables libraries to participate in joint research projects with other academic institutions, allowing them to provide access to their digital collections for researchers worldwide. According to Suleiman (2021), university libraries have been able to enhance collaboration opportunities with other academic institutions thanks to cloud computing, contributing to improved research prospects and increasing resources available to students and researchers.

Furthermore, it has improved international collaboration among libraries, making digital resources more readily accessible to researchers around the globe, as evidenced by a study published by Marston, Griffith, and Zhang (2020).

4. Applications of Cloud Computing in Libraries:

Digital technologies have significantly impacted libraries, with cloud computing being one of the most important technologies as it enables libraries to store data on remote cloud servers, allowing for quick and easy access. Below, we will explore the most notable applications of cloud computing in the field of libraries.

1. Cloud-Based Library Management Systems:

Library management systems are one of the most important applications of cloud computing. They provide solutions for managing library collections in terms of indexing, borrowing, and searching through catalogues easily and smoothly via the internet. This improves the efficiency of daily operations and enhances user access to digital databases. According to Al-Halabi (2021), Arab libraries have adopted the Koha system, which is based on cloud computing and is open-source. It facilitates access to digital catalogues and offers more borrowing services to users. The Ex Libris-Alma system has also helped academic libraries improve their management of electronic resources and reduce operational costs by 20% (Armbrust & Griffith, 2019).

2. E-Books and Digital Collections:

Thanks to cloud computing, libraries can store a large number of e-books, academic journals, and scientific articles on cloud servers, which can be accessed via the internet instead of being stored physically or on local servers. This enables libraries to provide digital content that is easily accessible at any time and from anywhere. Al-Khatib (2019) noted the use of cloud computing by university libraries in the Arab world to provide e-book services, which can be accessed through cloud platforms like Overdrive and ProQuest. Additionally, Marston, Griffith, and Zhang (2020) mentioned in their study that there has been a 30% increase in the number of users accessing resources provided by libraries that rely on cloud computing for storing and distributing e-books.

3. Cloud Archiving and Backup Services:

Cloud archiving and backup services are crucial applications provided by cloud computing for libraries, enabling them to store rare documents, manuscripts, and historical materials, ensuring service continuity even in the event of natural or technical disasters. National libraries in the Middle East are using cloud backup services to protect their important data. For instance, the Saudi National Library uses Google Cloud to archive its digital collections and safeguard them from damage (Al-Zahrani, 2021).

4. E-Learning and Academic Collaboration:

Thanks to cloud platforms, university libraries can offer e-learning services and participate in academic collaboration programmes. They provide tools for document sharing, organising workshops and seminars online, and facilitating teamwork, all of which support scientific research and enrich interaction between faculty and students. Libraries in the United States, especially academic libraries, utilise Google Classroom and various cloud tools to enhance collaboration between students and faculty, improving the quality of e-learning (Smith, 2018, pp. 15-28).

5. Data Analysis and Research Management:

With cloud computing technology, libraries can analyse large data sets and manage scientific research. They can track and analyse usage patterns of books and digital articles, helping them make informed decisions regarding the development of their digital collections. Marston, Griffith, and Zhang (2020) and others noted that researchers can share and analyse data via cloud platforms such as Google Cloud Platform (GCP) and Amazon Web Services (AWS). Furthermore, Al-Dasouri (2020) mentioned that university libraries in the Gulf region are analysing user behaviour and electronic reading patterns using cloud computing, which has helped them direct their investments towards the most sought-after materials.

6. Online Reference Services:

Thanks to cloud platforms, libraries can provide direct inquiry services, research guidance, and instant assistance to users in their search for information through live chat, email, and social media platforms. This facilitates more effective communication between libraries and their users. Both Al-Harbi (2020) and Smith (2018) affirmed that both academic and public libraries that adopted cloud platforms like LibAnswers enabled their users to receive prompt responses, thereby improving library engagement with their audience.

5. Challenges of Cloud Computing:

While cloud computing offers numerous benefits to libraries, there are also significant challenges that hinder its full and effective implementation. These challenges include security, administrative, technical issues, and concerns related to privacy and legislation. Below, we outline the main challenges.

1. Security and Data Protection Issues:

Cloud computing relies on external servers to store and process data, which raises concerns regarding security and data protection. Libraries,

containing user information, historical records, valuable assets, and digital collections, hold sensitive data that must be protected from breaches and cyber-attacks. Bandyopadhyay and Zhang (2020) confirmed in their study that academic libraries face challenges in ensuring the security of data stored in the cloud, with 60% of libraries relying on cloud computing expressing concerns about the protection of privacy and confidentiality of information.

2. Reliance on Cloud Service Providers:

Libraries that rely on cloud computing face a challenge in maintaining full control over their data and managing their systems, as they heavily depend on service providers such as Google Cloud and Amazon Web Services. This reliance limits their ability to make independent decisions (Al-Harbi, Applications of cloud computing in public libraries, 2021).

3. Ongoing Financial Costs:

The ongoing costs of subscriptions and the use of cloud services pose a financial burden on libraries, especially those operating with limited budgets. In some Arab countries, public libraries have faced challenges related to these ongoing costs, as monthly subscriptions have become an additional burden on their limited budgets. This situation may affect libraries' ability to invest in improving their digital collections (Al-Zahrani, 2021). Even in Europe, academic libraries have encountered challenges regarding long-term costs, as subscriptions to services like Azure and AWS have exceeded the budgets allocated for information technology in some universities (Marston, Griffith, & Zhang, 2020, pp. 305-312).

4. Compliance with Local Policies and Laws:

There are legal challenges facing libraries that rely on cloud computing concerning the handling of sensitive data, as the laws governing data protection vary from one country to another. This situation presents libraries with complexities in adhering to these policies. For example, libraries in the Gulf countries face challenges in dealing with data protection laws, as some local policies require that data remain stored within the country, creating difficulties when using international cloud (Al-Khatib, 2019). Additionally, libraries in the European Union encounter challenges related to compliance with GDPR (General Data Protection Regulation), necessitating assurance that the data stored in the cloud aligns with legal standards for privacy (Marston, Griffith, & Zhang, 2020).

5. Lack of Expertise and Technical Skills:

The lack of librarians with the necessary technical background to address the challenges associated with managing cloud systems may lead to implementation or performance issues. Many academic libraries in the United States have faced difficulties related to cloud computing management due to a shortage of technical skills among staff. The study conducted by Smith (2018) recommended providing ongoing technical training for librarians to avoid these problems.

6. Technical Challenges Related to Internet Connectivity:

Reliable and fast internet connectivity is essential for libraries to utilize cloud computing effectively, which poses a challenge in areas where there is a lack of or weak internet access. This situation can lead to problems accessing the required data or services.

Libraries suffer from this issue regardless of their location, whether in Arab countries or even in the United States, especially in remote areas that experience weak internet infrastructure. This hampers the effective implementation of many cloud services (Al-Harbi, Digital transformation in libraries: A case study of King Fahd National Library, 2020). (Armbrust & Griffith, 2019)

6. The Impact of Cloud Computing on the Future of Libraries:

Libraries need cloud computing to provide their digital services and achieve digital transformation, enabling them to meet the needs of users efficiently and quickly. This digital transformation has significant effects on the future of libraries in various aspects, and below we will address the most important impacts of cloud computing in the field of libraries.

1. Improving Access to Digital Resources:

Cloud computing has helped libraries improve access to digital resources in an unprecedented way, allowing them to host vast amounts of information without the need for traditional infrastructure. This facilitates access to information from anywhere at any time. Both (Al-Zahrani, 2021) and (Bandyopadhyay & Zhang, 2020) noted that the use of cloud computing in libraries, whether in Arab countries or the United States, has contributed to making academic resources and e-books available to users outside the library's walls, resulting in a 40% improvement in the utilization rates of digital resources.

2. Reducing Operational Costs and Improving Efficiency:

Libraries have become reliant on cloud service providers to manage and maintain resources remotely instead of investing in costly infrastructure

involving local servers and regular maintenance. Libraries in Saudi Arabia have managed to reduce costs associated with managing local servers by up to 25% by relying on cloud services such as Amazon Web Services (AWS) and Google Cloud (Al-Harbi, Digital transformation in libraries: A case study of King Fahd National Library, 2020).

3. Enhancing Collaboration Among Libraries:

Cloud computing helps enhance collaboration among libraries, allowing them to use resources and share data and services easily through the cloud. This collaboration enables libraries to benefit from shared experiences and achieve access to a broader range of books and resources. Cloud computing in the Gulf Cooperation Council (GCC) countries has facilitated the provision of interlibrary loan services and the exchange of digital resources among libraries, significantly improving library services (Al-Qahtani, Cooperation among Gulf university libraries using cloud computing, 2021).

4. The Evolution of Smart Library Services:

Cloud computing is the fundamental infrastructure for the development of smart libraries that rely on artificial intelligence and big data. It provides massive processing power to analyse user data and their behaviours within the library, which helps in offering services tailored to their personal needs.

According to a study conducted by (Suleiman, 2021), Arab libraries have already begun developing intelligent systems based on cloud computing to analyse data and provide personalized recommendations for users, improving the reading and borrowing experience.

Cloud computing profoundly impacts the future of libraries as it enhances their ability to provide flexible and advanced services. It offers innovative solutions to improve access to resources by reducing operational costs and enhancing collaboration among libraries at a high level.

7. Cloud Computing Services in Libraries:

Many librarians believe that libraries adopted cloud computing even before the concept became widespread. Many libraries rely on programs installed on remote servers to carry out all library operations, such as cataloguing and classification, and to provide services to users without needing those programs to be on the computers located in the library. Below are the most important services that libraries can benefit from (Klo, 2015, p. 7):

● **E-book Lending Service from a Cloud Library:** The e-book lending service from the 3M Cloud Library was first introduced in 2011 during the annual conference of the American Library Association. The 3M Cloud Library provides digital content and devices in the library alongside lending and reading applications.

● **Using Software as a Service (SaaS) in Libraries:** This is the highest level of cloud computing, where software applications or library data are hosted on the internet. This level of cloud computing is the most accessible for non-profit organizations and libraries because it requires relatively little development and training to obtain and operate from within the organization.

Some applications of SaaS in libraries include:

- ✓ Reference services, reader guidance services, etc.
- ✓ Web conferencing software like Hangouts, Google+, Google Voice, Skype.
- ✓ Web publishing tools like WordPress, Google Sites.
- ✓ Web-based shopping and communication such as Facebook, Twitter, YouTube, social mobile apps, Yahoo Mail.
- ✓ Document sharing in libraries like Dropbox, Google Docs, Evernote, SugarSync.

There are other models of cloud computing services that are more suitable for the nature of services provided by libraries, achieving good benefits and services for users, and they are often free. Among them are (Klo, 2015, p. 9):

❖ **Google Drive Cloud Service:** Recently launched by Google, this service has gained global recognition and extensive applications among researchers and information institutions. This service emerged in April 2012 and allows users to store various files on Google's main servers. This enables users to access, modify, add to, and share their files anytime and anywhere through the internet. Google ensures the security and privacy of these files, allowing access only to the owners. Google Drive is considered an extension of Google Docs, which allows for editing, processing documents and texts, and performing many actions on them.

❖ **Google Scholar Services:** It includes two types of cloud services, the most important of which is the publisher support service. This service enhances access to digital content published across various scientific disciplines and from all over the world. It works in coordination with publishers to review scientific information related to research, theses, drafts,

abstracts, and technical reports from all disciplines, making it searchable on Google and Google Scholar. Thus, this service represents an important source of information for every library or researcher.

❖ **Citation Services for Google Scholar:** This service provides authors with a simple way to track citations related to their articles. It allows them to verify and calculate these citations using bibliometric metrics and graphs. Additionally, it enables researchers to:

1. Display their intellectual output to the public by searching for the author's name in Google Scholar results.
2. Add groups of related articles rather than just one item at a time.
3. Calculate the author's citation metrics and automatically update them.
4. Enable the author to choose which materials have been automatically updated or manually review the updates of their materials at any time.

❖ **Research Gate Portal Service:** This service was developed by scientists for scientists. The idea for this portal emerged when two scientists discovered that facilitating communication and knowledge sharing among researchers and friends across distant regions is not an easy task. This service represents a website that functions as a social network and a free collaborative tool aimed at scientific researchers from all disciplines. It provides a variety of cloud and web applications, including:

1. Semantic search (search for complete summaries).
2. File sharing.
3. Database sharing for publications, such as EndNote, forums, methodological discussions, groups, etc.
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8. Examples of Libraries that Adopted Cloud Computing:

1. Princess Nourah bint Abdul Rahman University (PNU) Library:

This university has adopted cloud computing to significantly enhance its services. This is part of its efforts to improve access to academic resources and facilitate library management processes. It utilized the cloud-hosted KOHA system and relied on cloud solutions through the Azure system to host digital repositories and academic projects. This has led to improved operational speed within the library and reduced the need for internal technical support for system maintenance. Additionally, the ease of access to resources via the internet has resulted in a 30% increase in library usage, according to the university's report (Al-Harbi, Applications of cloud computing in public libraries, 2021).

2. Zayed University Library:

Zayed University Library in the United Arab Emirates has adopted cloud computing to enhance and improve its academic services, being one of the leading universities in the UAE. This initiative is part of its digital transformation strategy to provide advanced library services. The library utilizes the cloud-based Ex Libris Primo system, which facilitates easy access to academic resources and digital books. It has relied on a cloud infrastructure through Google Cloud for storing important data and documents. The implementation of cloud computing has led to a 25% reduction in maintenance and infrastructure costs, while significantly increasing operational efficiency (Al-Qahtani, Digital transformation in UAE university libraries, 2020).

3. Australian National University Library (ANU Library):

ANU Library serves as a successful model in adopting cloud computing due to the increasing volume of digital content and the diversity of academic resources it manages to enhance its performance and flexibility. The library has implemented cloud-based solutions to manage its digital resources and provide sustainable, scalable storage solutions as needed. It has also utilized cloud storage for its vast digital repository, which contains millions of academic documents and electronic resources. This technology has improved the speed of information retrieval within digital repositories by 40%, thereby enhancing the experience for researchers and students (Bandyopadhyay & Zhang, 2018, pp. 1-14).

9. Conclusion:

Cloud computing marks a significant shift in how information is stored and managed in libraries. By offering flexible and cost-effective

solutions, it enables libraries to offer improved services to users and strengthens their role as knowledge centres in the digital age. With cloud computing, libraries can overcome traditional challenges related to local infrastructure and storage capacity, adopting a more efficient model for data management that enhances their ability to meet users' needs continuously.

However, security and data protection remain major challenges for libraries when adopting cloud computing. Additionally, there is a need to train librarians to work effectively with this technology. This highlights the importance of libraries developing effective strategies to address these challenges, such as selecting reliable cloud service providers and ensuring that cloud solutions align with their security policies.

It is certain that cloud computing will further advance libraries, not only in terms of information storage but also in improving resource management and offering innovative services. In the future, it may be possible to explore the impact of this technology on other aspects of libraries, such as reference services and user interaction through cloud-based platforms.

Reference

Al-Dasouri, M. (2020). Security challenges in cloud computing in libraries. *Journal of Cybersecurity*, 7 (1).

Al-Hamzawi, J. (2013). Cloud computing. Consulté le October 9, 2024, sur of Libraries and Open Source Software:
http://hassanabdlbar.blogspot.com/2013/09/cloud-computing_5.html

Al-Harbi, A. (2021). Applications of cloud computing in public libraries. *Journal of Libraries and Information*, 1 (31).

Al-Harbi, A. (2020). Digital transformation in libraries: A case study of King Fahd National Library. *Journal of Libraries and Information*, 2 (30).

- Al-Kharinj, N. M., & Al-Muzain, A. A. (2020). The role of cloud computing in developing information services in academic libraries. *Scientific Journal of Libraries, Documents and Information* , 3 (18).
- Al-Khatib, M. (2019). Technology and cloud computing in libraries. *Journal of Information Technology* , 2 (15).
- Al-Qahtani, A. A. (2021). Cooperation among Gulf university libraries using cloud computing. *Journal of Academic Cooperation* , 9 (1).
- Al-Qahtani, A. A. (2020). Digital transformation in UAE university libraries. *Journal of Higher Education and Technology* , 8 (2).
- Al-Zahrani, F. (2021). The role of cloud computing in archiving digital libraries. *Arab Thought House*.
- Armbrust, S., & Griffith, R. (2019). The role of cloud computing in library management systems. Récupéré sur Communications of the ACM: <https://doi.org/10.1145/3308438>
- Bandyopadhyay, S., & Zhang, I. (2020). Cloud security and privacy for librares. Récupéré sur Journal of Information Security: <https://www.exampleurl.com>
- Bandyopadhyay, Z., & Zhang, I. (2018). Cloud computing in Australian university libraries: A case study of ANU. Récupéré sur Journal of Cloud Computing: Advances, Systems and Applications: <https://doi.org/10.1186/s13677-018-0114-2>
- Klo, S. M. (2015). Cloud computing: Its concept and applications in libraries and information centers. *QScience Proceedings* .

- Marston, S., Griffith, R., & Zhang, R. (2020). Cloud computing for e-books and digital collections. Récupéré sur International Journal of Information Management: <https://doi.org/10.1016/j.ijinfomgt.2019.06.001>
- Moawad, M. E.-H. (2012). Cloud computing and its applications in the library environment. King Fahd National Library Journal , 19 (01).
- Sabour, S., & Bizan, M. (2021). Applications of cloud computing in university libraries: Social networks as integrated platforms for greater accessibility and lower costs. Ideas and Horizons Journal , 9 (3).
- Smith, A. (2018). Digital transformation in libraries A case study of the library of congress. Récupéré sur Journal of Library and Information Science: <https://doi.org/10.1016/j.lis.2018.05.001>
- Suleiman, K. (2021). Digital cooperation in libraries: Cloud computing as a driver of change. Journal of Academic Libraries , 12 (3).