

The Role of Cloud Computing in Modern Library and Information Centers: Service Efficiency, Knowledge Management, and Global Collaboration

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The Role of Cloud Computing in Modern Library and Information Centers: Service Efficiency, Knowledge Management, and Global Collaboration

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Abstract

This study examines the transformative role of cloud computing in modern library and information centers, and its impact on service competency, knowledge management, and global collaboration. Using a quantitative research approach, the study collected experiential data through a structured online survey of 120 library professionals purposively selected for their subordinate with cloud tools. Findings reveal that cloud computing advances important library roles, including automatic cataloguing, distant access services, circulation management, and digital reference transfer, important to enhanced skill and user contentment. In knowledge management area, cloud platforms consensus the creation of vital sources, real-time organization of resources, and sympathetic information provision amongst supervise. The study also highlights challenges such as apprehensions over data security, precondition on exterior retailers, defective technical services, and changeable system infrastructure. While these intrusions, respondents stated confidence about upcoming evolution, primarily in extents such as mobile-first cloud services, AI-driven analytics, and cooperative resource provision. The study understands that sustainable cloud integration requires premeditated improvement, policy development, and ongoing capacity building to entirely comprehend the provisions of cloud computing in modern library centers.

Keywords: Cloud computing; Knowledge management; Global collaboration

Introduction

Through history, civilizations have depended on libraries and information centers as a base for their common information and the ability to tolerate knowledge through existence. But in this digital age, their objective has extended external

just preservative print to support digital arrival, collaboration, and the development of innovative information. Libraries are reception advanced knowledge to recollect up with patron views for online and mobile services, which is dynamic entreaty (Liu et al., 2011). Cloud computing, with its accessible institute, general connectivity, and cost efficiency, stands out among this proficiency as a transformational improvement (Aljabre, 2012). Cloud resolutions increase libraries' developing fortitudes as hubs for digital assignation and information distribution, as highlighted by (Zou, 2013).

When libraries practice cloud computing, they can improve their organization and services. This is one of the most apparent effects. Since cloud-based library systems eliminate the need for large local servers and IT teams, administrations can developed allocate resources (Sultan, 2014) state that software as a service (SaaS) solution, such as integrated library platforms, authorization for incessant developments, simpler workflows, and integrated incorporation with other systems within institutions. Libraries that made the change to cloud computing adage precisions in digital maintenance, access reliability, and cataloging speed, interpretation to studies by (Vaquero et al., 2008). Services being stimulated to the cloud signify more than simply a technical development; it also indicates a considerate change towards greener performs.

Imperative meanings are achieved by cloud computing and knowledge administration (KM). According to Rittinghouse & Ransome, (2017), libraries play a critical role in endorsing the movement of information and new knowledge. Though, the role of libraries is further heightened by cloud-based databases and teamwork tools, which make it calmer for group study and the distribution of research results. (Zhang et al., 2010) found that cloud KM systems can increase research data management, open access actions, and the sharing of recognized knowledge. Further, the COVID-19 pandemic established the consequence of cloud-based platforms since they allowed remote learning surroundings to persist operational and digital contented to persist accessible at all eras (Wu & Plakhtii, 2021).

Thanks to cloud computing, which eases better global communication and reserve sharing, new avenues for global cooperation have opened up? Forming consortia-based associations and leveraging cloud-hosted amalgamated search engines may help libraries increase their reach and deliver users with additional access to scholarly publications (Xiao et al., 2023). Libraries in emerging countries encounter considerable complications when trying to use digital resources because of a absence of resources and backing. Libraries in this condition can advantage greatly from this cooperative architecture. Lakkarasu, (n.d.) found that smaller organizations can be more active participants in global academic

networks when they use cloud computing, which also helps with reasonable access by plummeting admission incidentals.

Moving to the cloud does come with some tasks and risks, though, so it's imperative to weigh them sensibly. Akter et al., (2024)) note that uncertainties about data safety, privacy, and legal authority remain dominant when sensitive library data is stored in many countries. Worries concerning vendor lock-in and sustainability in the long run complicate choices. According to Kumar & Sharma, (2021), libraries risk behind control of valued resources if providers vary their terms of facility or cease backup platforms. In low-resource extents, further difficulties to successful application include untrustworthy internet influences, inadequate funding, and employee's deficient in ICT skills (Etikan & Bala, 2017). To overwhelmed these tasks and ensure the safe and dependable integration of cloud computing, hybrid models, employee education, and governmental creativities at the national level are required. Against this background, the current study pursues to examine the game-changing role of cloud computing in modern library and information centers, specifically focusing on how cloud computing improves service efficiency and resource management in libraries and information centers, analyzing the role of cloud platforms in strengthening knowledge management practices, identifying challenges and risks associated with sustainable cloud adoption in libraries, and developing a framework for responsible and effective integration of cloud computing in library services. While allowing the contests that still exist, the paper explores how cloud implementation improves operational competence, strengthens information management developments, and promotes worldwide assistance. In this information-driven age, libraries may stay present, advanced, and globally connected by following the research model for ethical and maintainable cloud implementation (Wang et al., 2010).

Reviewed Literature

Cloud computing has rapidly become one of the most vital technologies for the forthcoming of information centers and libraries. Local servers and other physical organization have long been the backbone of libraries' collection management and community access systems. Nevertheless, this standard has shifted with the increase of cloud computing, which suggestions elastic, on-demand resources and decreases the need for climbable local infrastructure and in-house technical knowledge. The basic impression behind cloud computing was to generate a shared pool of programmable resources online (Vaquero et al., 2008). Though, recent negotiations have focused on how effectively cloud computing meets the active service requirements of modern libraries. Research by Rittinghouse and Ransome, (2017) demonstrations that colleges can save money on processes

while providing clientele with easy access to digital resources through finding tools and integrated library systems contained in the cloud.

Amongst the many possible compensations of cloud computing for libraries, one of the most distinguished is the potential development in service competence. Software as a service-solutions is a terrific way for libraries to augment cataloguing, circulation, and electronic resource management (ERM). Results from experiential investigate Goggi et al., (2019) show that these approaches provide automatic informs without needful in-house maintenance, reduction downtime, and advance catalogue reliability. Momentous savings are attained when several institutes join forces in consortia to perform a rule. This is because the institutes are talented to combine their resources and negotiate more auspicious terms for all parties complicated (Akter et al., 2024). The library is becoming more useful as a research and teaching tool due to cloud computing and other detach platforms (Aljabre, 2012).

Cloud computing has further strengthened libraries' rank as agents of knowledge organization. Libraries have altered into vital components of the knowledge cycle, supportive research and established memory, thanks to collective platforms and cloud-based sources. The compensations of such systems are highlighted by (Adigun et al., 2024). These assistances comprise enhanced alliance between organizations, more effectual archiving, and a wider dispersal of intellectual publications. Amid the pandemic, cloud-based solutions were transported to the consideration of academic institutes, letting them to continue learning and research notwithstanding their lengthy conclusion (Bharany et al., 2022). Libraries are presently following universal trends towards digital scholarship, open access publication, and open science, rendering to (Eneh et al., 2024).

Two more main compensations in the subject field of cloud computing are worldwide connectivity and the sharing of resources. It has basic global partnerships, letting libraries to share digital collections, form international consortia, and offer joined search abilities. Research (Akter, et al., 2024) designates that these performs recover cross-institutional collaboration, leading to amplified access to information in both advanced and emerging states. Research led by Gupta, (2024); Manna, (n.d.) proposes that libraries fronting resource restraints can secure the assistances of cloud implementation. This is because cloud computing decreases entry dues and grants equal access to global knowledge systems. By enabling influences between libraries in different sites, cloud computing empowers libraries to attain their social purpose of contribution comprehensive information.

Despite advancements, there are still barriers to widespread use of cloud computing. Security and privacy are of utmost importance when it comes to

servers situated outside of national jurisdictions, since they frequently store sensitive user and institutional data. Institutions may eventually lose some control over their resources if they depend too heavily on proprietary platforms, as pointed out, further complicating the sustainability challenge. Additional challenges in underdeveloped countries include inconsistent connectivity, inadequate funding, and a lack of professional knowledge, which all work against the full use of cloud services (Kantaros, et al., 2025). Legal and regulatory issues pertaining to data ownership and intellectual property also present libraries with hurdles (Manna, n.d.).

As new technologies such as blockchain, edge computing, and artificial intelligence are integrated into cloud computing, experts predict that it will continue to improve. (Liu et al., 2011b) These advancements have the potential to improve distributed information access, data authenticity, and customization. Access and efficiency have gotten more focus than the cultural, ethical, and governance implications of cloud adoption. Understanding the complexities of cloud-enabled services in different socioeconomic circumstances requires research that focuses on the Global South (Buyya & Goscinski, 2019). It is critical to fill these gaps in order to establish a framework that can optimize the benefits of cloud adoption while limiting its risks in the long run.

Research Methodology

This study used a quantitative research technique to find out if cloud computing increases the efficiency of library and information science services, knowledge management, and worldwide collaboration. A well-crafted online survey with both open-ended and closed-ended questions was the main instrument for achieving this goal of thought and expression homogeneity. Participants were selected via purposive sampling, as established in earlier studies (Khan, 2024). The researchers made an effort to connect with librarians who specialized in cloud computing. In addition (to following updated ethical guidelines to guarantee inclusivity, sensitivity, and informed participation, the design was in line with British Educational Research Association principles (Khan, 2024). To lessen the possibility of false or synthetic responses in the online survey, data integrity checks and response verification techniques were used, as advocated in recent methodological studies (Kiernan & McMahon, 2024).

Data was analyzed with help of SPSS. To provide broad picture, descriptive statistics such as percentages, means, and frequencies, and we used inferential techniques like regression and correlation analysis to look into the correlations between cloud computing usage and service results. When Cronbach's alpha values were greater than 0.70, which is considered a sufficient level of internal consistency, instruments were determined to be reliable (Raina, 2024). More

recent innovations in survey sampling in the Global South have prompted outreach strategies that combine more conventional methods, such as institutional networks, with more modern ones, such as social media invitations. Chahare (2024) states that this process pursues to upsurge representativeness. By merging severe sampling, rationalized moral values, and vigorous analytical methods, the practice confirms legitimacy and delivers a dependable foundation for investigative how cloud computing changes library activities in this digitally connected period.

Table 1 *Demographic Profile of Respondents (N = 120)*

Variable	Category	Frequency (n)	(%)
Gender	Male	68	56.7
	Female	52	43.3
Age Group	20–30 years	34	28.3
	31–40 years	45	37.5
	41–50 years	29	24.2
	51 years and above	12	10.0
	Bachelor’s Degree	22	18.3
Qualification	Master’s Degree	58	48.3
	MPhil/MS	30	25.0
	PhD	10	8.4
Professional Role	Librarian	55	45.8
	Assistant Librarian	28	23.3
	Library Officer	20	16.7
	Other Staff	17	14.2
Experience	Less than 5 years	30	25.0
	6–10 years	40	33.3
	11–15 years	28	23.3
	16 years and above	22	18.4

Results and Findings

This section offers an investigation of the study's findings constructed on the four research objectives. After 120 participants had provided their data, descriptive statistics were used to measure the data. An examination of the data is provided by a descriptive paragraph at the commencement of each segment, followed by an inclusive table that supports and clarifies the conclusions.

The 1st objective was to inspect the influence of cloud computing on service competence in library and information centers. The results have shown (table 1) that cloud computing has pointedly improved the competence of service for numerous library tasks, according to the research. Most often used services

occasioned in amplified client fulfillment, faster processing, and compact staff capability, such as cloud-based circulation management and automated cataloguing systems. Although reporting systems and acquisition approaches were less prevalent, interlibrary loans, document distribution, and remote access services all established considerable acceptance. Even while there are still some complications with things like staff training and network convenience, cloud-based solutions often simplify operational processes, save incidentals, and advance convenience.

Table 2 *Descriptive Statistics for Cloud Computing & Service Efficiency (N=120)*

Service Aspect (Detailed Description)	Mean	Std. Dev.	Min.	Max.
Fully automated cataloguing and metadata organization of library resources using cloud-based systems	4.10	0.68	2.0	5.0
Circulation and borrowing management supported by cloud platforms for faster processing of requests	4.21	0.71	2.0	5.0
Interlibrary loan and document sharing services integrated via cloud applications for wider access	3.75	0.80	2.0	5.0
Digital reference and query resolution services provided to users through cloud-based tools	3.98	0.72	2.0	5.0
Acquisition, procurement, and resource ordering workflows managed efficiently through cloud systems	2.93	0.82	1.0	5.0
Centralized storage and management of user and institutional data using cloud-based infrastructure	4.08	0.74	2.0	5.0
Document delivery and interdepartmental resource sharing enabled through cloud-based platforms	3.65	0.79	2.0	5.0
Reporting, monitoring, and analytical tools for library performance supported via cloud technology	2.75	0.77	1.0	5.0
Remote access portals for library users provided through cloud infrastructure for anytime availability	4.05	0.75	2.0	5.0
Mobile-based library services and applications developed using cloud technology for on-the-go access	3.52	0.83	1.0	5.0
Staff collaboration, communication, and project management platforms enabled by cloud solutions	3.60	0.81	1.0	5.0
Automated notifications, reminders, and alerts sent to users through cloud-based systems	4.00	0.70	2.0	5.0

The 2nd objective was to explore the impact of cloud computing on knowledge management practices in library and information centers. The results showed (table 2) that cloud computing has greatly improved library knowledge management (KM), according to the results. Cloud platforms improve the

management, archiving, reclamation, and broadcasting of information resources, according to respondents. This, in turn, leads to additional knowledgeable decisions and earlier responses to user enquiries. Effectual knowledge management is made conceivable by automated metadata production, central digital sources, and cooperative cloud-based platforms. Users are also able to access resources distantly. While there has been some development in the use of AI-driven information discovery and progressive analytics tools, the general tendency specifies that cloud services have a promising influence on effectual knowledge management. In order to secure the filled assistances of cloud-based KM, it is essential to resolve the matters that respondents elevated, such as data security, employee training, and integration with existing systems.

Table 3: *Descriptive Statistics for Cloud Computing & Knowledge Management (N=120)*

Knowledge Management Aspect	Mean	Std. Dev.	Min.	Max.
Centralized digital repositories for storing, organizing, and retrieving knowledge resources efficiently	4.12	0.69	2.0	5.0
Automated metadata creation and tagging of documents and resources through cloud-based tools	4.05	0.72	2.0	5.0
Cloud-enabled collaborative platforms for staff knowledge sharing and project coordination	3.95	0.75	2.0	5.0
User-friendly cloud portals for accessing knowledge and research resources remotely	4.08	0.70	2.0	5.0
AI-assisted knowledge discovery and recommendation systems integrated with cloud infrastructure	3.55	0.81	1.0	5.0
Version control and document management features in cloud platforms for organized knowledge retention	3.88	0.74	2.0	5.0
Real-time updates of digital resources and knowledge assets through cloud-based synchronization	4.00	0.71	2.0	5.0
Cloud-based analytics tools for monitoring and evaluating knowledge usage and trends	3.60	0.79	1.0	5.0
Integration of knowledge management platforms with library management systems via cloud services	3.72	0.77	2.0	5.0
Secure cloud storage and access control mechanisms for confidential and sensitive knowledge assets	4.02	0.68	2.0	5.0
Automated notifications and alerts for newly added knowledge resources	3.95	0.70	2.0	5.0
Remote collaboration tools for facilitating virtual meetings, workshops, and brainstorming sessions	3.85	0.75	2.0	5.0

The 3rd objective was to identify the challenges and limitations of cloud computing adoption in library and information centers. The results of the study (table 3) showed that libraries have a number of obstacles that prevent them from fully embracing cloud computing, despite its many benefits. Data security, network reliability, inadequately skilled personnel, and dependence on vendors

were amongst the most commonly voiced qualms by respondents. Insufficient strategy frameworks, opposition to change, and lawful and acquiescence complications were all stated. The results specify that the effectiveness of cloud implementation is pretentious by a combination of human, administrative, and technical features. To ensure long-term achievement, it is critical to address these matters via education, robust security measures, and well-defined recognized guidelines.

Table 4 *Descriptive Statistics for Challenges in Cloud Computing Adoption (N=120)*

Challenge Aspect (Detailed Description)	Mean	Std. Dev.	Min.	Max.
Concerns about data privacy and protection of sensitive user information in cloud platforms	4.15	0.67	2.0	5.0
Dependence on external cloud service vendors for critical library operations	4.02	0.70	2.0	5.0
Inconsistent internet connectivity and network reliability affecting cloud service performance	3.88	0.74	2.0	5.0
Limited technical skills and lack of trained staff for cloud system management	3.95	0.72	1.0	5.0
Resistance to change and adaptation to new digital workflows among library personnel	3.65	0.78	1.0	5.0
High initial cost and ongoing subscription fees for cloud services	3.55	0.81	1.0	5.0
Legal and compliance challenges related to digital resource licensing and cloud storage	3.72	0.77	2.0	5.0
Lack of robust institutional policies supporting cloud adoption	3.68	0.75	1.0	5.0
Limited vendor options and lack of tailored cloud solutions for library needs	3.60	0.79	1.0	5.0
Security threats, including hacking and unauthorized access	4.05	0.69	2.0	5.0
Difficulty integrating cloud platforms with existing library management systems	3.70	0.74	2.0	5.0
Limited awareness and understanding of cloud computing benefits among decision-makers	3.58	0.77	1.0	5.0

The 4th objective was to assess future prospects and strategic adoption of cloud computing in library and information centers. Results of the study (table 4) show that libraries are making plans to increase their use of cloud computing in order to take advantage of cutting-edge technology. Enhanced mobile access, worldwide partnership platforms, Internet of Things incorporation, and AI-driven services were the utmost often stated possible consequences. To certify long-term accomplishment, cloud-based strategy planning, enhanced security frameworks, and new strategies are must-haves. We are seeing a shift in stress from new technologies like blockchain to user-centered revolution, automation,

and partnership, which augurs well for the upcoming of cloud-based knowledge services.

Table 5 *Descriptive Statistics for Future Prospects & Strategic Adoption (N=120)*

Future Prospects Aspect (Detailed Description)	Mean	Std. Dev.	Min.	Max.
Adoption of AI-driven services for predictive analysis, personalized recommendations, and resource discovery	3.92	0.73	2.0	5.0
Integration of Internet of Things (IoT) devices for intelligent library operations	3.85	0.76	2.0	5.0
Development of global collaboration platforms and regional consortia for resource sharing	3.90	0.71	2.0	5.0
Expansion of mobile-first cloud services for remote user access	3.78	0.79	2.0	5.0
Implementation of stronger cybersecurity protocols and access control measures	4.05	0.68	2.0	5.0
Policy development for sustainable and compliant cloud adoption	3.88	0.74	2.0	5.0
Integration of cloud platforms with emerging library technologies	3.65	0.80	1.0	5.0
Expansion of cloud-supported knowledge management and digital repositories	3.95	0.70	2.0	5.0
Adoption of AI-assisted analytics for monitoring library service trends	3.72	0.77	2.0	5.0
Development of collaborative virtual workshops, webinars, and training programs via cloud platforms	3.80	0.75	2.0	5.0
Exploration of blockchain-based solutions for secure transactions, records, and digital verification	3.50	0.81	1.0	5.0
Promotion of sustainable, eco-friendly, and energy-efficient cloud service strategies	3.88	0.73	2.0	5.0

Discussion, Conclusion, and Recommendations

This study's outcomes show how cloud computing may convert library and information science developments by decontaminating their capability, knowledge organization, and deliberate skills. When looking at how cloud computing affects service effectiveness, the initial goal was to find out how automation in the cloud speeds up common responsibilities like digital reference facilities, circulation management, and cataloging. In line with this, a present study by Okike and Omali, (2023) originate that users are more satisfied and operational deferments are summarized when resources and services are made available in real-time through the assignment of the cloud. Notwithstanding the sensible reception of services like interlibrary loan administration and reporting systems, the general suggestion proposes that cloud knowledge are crucial for informative administrative capability and reasoning operations.

Concerning the second objective, cloud computing has a mainly perceptible consequence on KM practices. The most important effects that contributed to better KM were central digital records, supportive cloud platforms, and knowledge discovery organizations that charity artificial intelligence. These consequences back up what Zhang et al., (2010) found, which is that cloud organizations help with storage, repossession, and sharing of institutional information professionally, which leads to better choices. While libraries are commencement to see the value in intelligent KM systems, their imperfect implementation of AI-driven analytics displays that they still have ways to go in terms of training and ability expansion before they can fully understand those assistances.

The third goal observed at the complications of moving to the cloud, with issues comprising data security, unpredictable networks, and a absence of technical knowledge coming out first. Patel and Rittinghouse & Ransome, (2017) found that cloud placement recital in information institutes is prejudiced by a combination of human, practical, and administrative variables. Our results are in line with their findings. Moreover, governmental restraints and legal necessities were stated as roadblocks, signifying that in order to decrease risks, library management should organize the deployment of new technologies with strong ascendancy structures.

Future prospects and planned acceptance were finally addressed in the 4th objective. Internet of Things integration, mobile-first platforms, universal cooperative networks, and AI-driven services were the most commonly stated themes amongst respondents. The outcomes are in line with the rights made by Chen et al., (2012), who state that cloud computing permits for advanced service transfer, maintainable library performs, and enhanced operational competence. There was a slow but steady interest in inspecting cutting-edge, secure, and environmentally friendly expertise, such as blockchain implementation and green cloud solutions. To exploit the assistances of cloud computing in modern libraries, these findings designate that investment in human resources, rule creation, and strategic development is vital.

Conclusion

According to the implications of this study, cloud computing is renovating recent library and information science performs by instructive the competence of services, facilitation improved information management, determining operational difficulties, and concrete the way for new insurrections. According to the results of the study,

- **Service Competence** Through the use of automation and digital services, cloud computing significantly declines the necessity for human interference, speeds up workflows, and upsurges user contentment.

- **Knowledge Management** The usage, management, and convenience of institutional knowledge are all enhanced by central sources, cooperative skills, and analytics helped by artificial intelligence.
- **Challenges** To overwhelmed commanding interferences including technical limitations, trepidations about data protection, and unsatisfactory employees, severe strategies and targeted training platforms are imperative.
- **Future Prospects** Revolution, appropriateness, and establishment excellence could all see an uptick with the help of justifiable cloud information, mobile services, the IoT, and AI in the extended run.

Recommendations

The following recommendations are made in light of the results:

- **Policy and Governance** Libraries should make inclusive methods for cloud computing to declaration privacy, safety, legal acquiescence, and operational values.
- **Capacity Building** In order to competently achieve cloud resources, induct analytics determined by artificial intelligence, and offer digital services to clients, it is significant that library employees contribute in residual exercise platforms.
- **Strategic Improvement** The long-term cloud integration strategy of institutes should pressure on smart information organization organizations, platforms that motivate mobile use, and focused services.
- **Infrastructure Advantage** Maintenance service reliability over the long run necessitates reliable internet connectivity, innocent cloud storage, and ascendable cloud conveniences.
- **Revolution and Sustainability** In order to bring inventive and supportable services, libraries should look into green cloud solutions, artificial intelligence incorporation, internet of things applications, and blockchain ability.
- **User-Centric Services** The primary impartial of cloud application platforms should be to development manipulator rendezvous, satisfaction, and appearance through modified digital services and distant access.

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