"Libraries through Cloud: reinventing Library Services through Cloud-Based Platforms"

A Dissertation for course code and course title: LIS 651 & dissertation

Credits: 16

Submitted in partial fulfilment of masters / bachelor's degree in MLISc

By

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Seat Number: 22P0010017

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April 2024

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DECLARATION BY STUDENT

I hereby declare that the data presented in this Dissertation report entitled **"Libraries through Cloud: Reinventing Library Services through Cloud-Based Platforms"** is based on the results of investigations carried out by me in the **Library and Information Science** at the **D.D. Kosambi School of Social Sciences and Behavioural Studies, Goa University** under the Supervision of **Mr. Rohan L. Parab** and the same has not been submitted elsewhere for the award of a degree or diploma by me. Further, I understand that **Goa University** or its authorities will not be responsible for the correctness of observations/experimental or other findings given in the dissertation.

I hereby authorize the University authorities to upload this dissertation on the dissertation repository or anywhere else as the UGC regulations demand and make it available to any one as needed.

Date: 19th April 2024 **Miss. Tanvi Jayhind Naik**

Place: Taleigao, Goa Seat Number: 22P0010003

COMPLETION CERTIFICATE

This is to certify that the dissertation report **"Libraries through Cloud: Reinventing Library Services through Cloud-Based Platforms"** is a Bonafide work carried by **Miss. Tanvi Jayhind Naik** under my supervision in partial fulfilment of the requirements for the award of the degree of **MLISc.** in the Discipline **Library and Information Science** at the **D.D. Kosambi School of Social Sciences and Behavioural Studies, Goa University.**

Mr Rohan L. Parab

Date: 19th April 2024

Signature of Dean of the School/Programme Director School/Programme Stamp

Date: 19th April 2024

Place: Taleigao, Goa

ACKNOWLEDGEMENT

I have received generous help from many people in the process of compilation of this dissertation. Here I would like to appreciate and acknowledge their kind generosity and sincere help.

In a very way, I would like to appreciate and thank my research guide and coordinator, Mr. Rohan L. Parab. From the very outset, he has taken interest in the study and provided the necessary encouragement and guidance.

This work would not have seen he light of day without sincere cooperation of all my friends and colleagues, to whom I owe a debt of gratitude.

In a very special way, I am thankful to my parents for their immense trust and persistent support in all my endeavours.

MISS. TANVI JAYHIND NAIK

Library and Information Science Programme

Goa University

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CHAPTER I

INTRODUCTION

1.1. INTRODUCTION

Cloud computing is a web- and server-based technology that utilizes the internet and remote servers to manage and organize data and applications, connecting numerous computers. Cloud computing is a well-known concept. Although the term “cloud computing” may seem new, the notion is something that we have all been utilizing for quite some time. Examples include YouTube, Google Docs, social networking sites, e-Granthalaya, etc. Cloud computing is the internet-based distribution of computer resources such as servers, storage, databases, networking, software, analytics, and more. Cloud computing can be defined as the integration of technology with a platform that offers online hosting and storage services. This server-based solution is quite useful in the modern era. Internet access and a distant server are necessary for cloud computing. Cloud computing is an idea in outsourcing where services, infrastructure, and software are stored virtually.

The concept of cloud computing is an improved version of grid computing, in which thousands of computers are networked to exchange information. However, with cloud computing, thousands of devices are linked to a virtualized server that is situated remotely and shared globally. These advanced, high-end servers are maintained by service providers. The majority of the massive corporations, like Amazon, Google, IBM, Salesforce, and others, are engaged in this industry. (Yudah & Geoffrey, 2019)All of his consumer devices that have an internet connection are connected to the server by the cloud service provider (CSP). Customers can use the browser or any other intermediary app that the CSP offers to access the necessary services to which they have subscribed. Cloud computing is an idea in outsourcing where services, infrastructure, and software are stored virtually. The use of cloud computing implies that libraries can utilize any software, infrastructure, and services without having to install them on their premises. Because of this, the technology spares libraries the monetary and budgetary cost of setting up and maintaining cloud computing infrastructure. It provides on-demand access to online computer services. The technology's users don't worry as much about storage because they just need to access the infrastructure, software, or service that is necessary when needed.

The use of cloud computing implies that libraries can utilize any software, infrastructure, and services without having to install them on their premises. Because of this, the technology spares libraries the monetary and budgetary cost of setting up and maintaining cloud computing infrastructure. It provides on-demand access to online computer services. Cloud computing can be divided into three categories: “storage,” “connection,” and “application.” Every segment offers various products to organizations and individuals worldwide, each with its own unique purpose.

The academic world is constantly evolving, becoming more global, and attracting new competitors. Libraries are vital community centers that offer services, resources, and information to individuals. Budget cuts, declining circulation, and the need to adapt to rapidly advancing technologies are just a few of the difficulties libraries are currently confronting. Cloud computing can assist libraries in reimagining their services and overcoming these obstacles. Delivering IT resources and services online is known as cloud computing. This implies that libraries don't have to spend money on software and technology they don't already have access to.

Cloud-based services offer advanced features to libraries with fewer IT skills, but librarians sometimes struggle to manage servers without IT staff assistance. Technological advancements have significantly impacted educational systems, causing resource overload and limiting the focus of learning institutions. However, sharing resources among institutions can help focus on research and core academic activities. The library and information science professions are facing challenges due to the application of new technologies and concepts. Libraries are becoming automated, and efforts are being made towards virtual and cloud computing. Cloud computing has become prevalent in libraries and information centers, offering a range of new technology tools and allowing librarians to access technologies and related services that might otherwise be beyond their reach. As cloud computing becomes more prevalent, many librarians are considering new ways to adopt third-party tools in their work. Cloud computing is an important tool in the world of information technology due to its ability to solve IT issues, be cheaper, and provide a pool of easily usable and accessible virtualized resources. (Rotich & Muthee, 2021)

1.2. OBJECTIVE OF THE STUDY

In this time of rapid technological advancement, it is critical to investigate the possibilities presented by cloud-based platforms to redefine and improve library services in the academic libraries of Goa.

Specifically, the study is designed to

1. To determine the impact of cloud computing on library services.
2. To study the awareness about cloud-based library services among users.
3. To identify opportunities in employing cloud services in libraries.

1.3. STATEMENT OF THE STUDY

Professionals at libraries are less familiar with cloud computing technologies available for libraries. To determine the benefits and drawbacks of cloud computing for libraries and its successful implementation, research needs to be done.

1.4. SCOPE OF THE STUDY

The scope of the study was restricted only to the selected academic libraries of Goa. The researcher will investigated the use of cloud computing technology in libraries to transform the way libraries delivered their services. The study will also try to ascertain the different Cloud Computing techniques available for library systems.

1.5. LIMITATIONS OF THE STUDY

The study is limited only to the selective college libraries operating in the state of Goa. The study has been conducted on 44 college libraries. Namely-

SR.NO.	NAME OF THE INSTITUTION
1.	GVM's Dr. Dada Vaidya College of Education Ponda Goa
2.	Parvatibai Chowgule College of Arts and Science Madgaon Goa
3.	Sant.Sohirobanath Ambiye Government College of Arts and Commerce, Virnoda Pernem, Goa
4.	Dnyanprassarak Mandal's College Assagao Bardez Goa

5.	Goa University
6.	V.M. Salgaocar College of Law
7.	St.Joseph Vaz College Sankval Goa
8.	Mandre College Pedne Goa
9.	Dhempe College of Arts and Science, Miramar Goa
10.	Narayan Zantye College of Commerce Bicholim Goa
11.	Vidya Prabodhini College of Commerce, Education, Computer, and Management, Parvari Goa
12.	Central Library Agnel Institute of Technology and Design Assagao Goa
13.	DPM's Shree Mallikarjun and Shri Chetan Manju Desai College
14.	SES's Sridora Caculo College of Commerce and Management Studies Mapusa Goa
15.	Government College of Khandola
16.	P.E.S.'s College of Education Ponda Goa
17.	D. C. T's S. S. Dempo College of Commerce and Economics Goa
18	Cuncolim Education Society Quepem Goa
19.	VVMs: Shree Damodar College of Commerce and Economics Goa
20.	Don Bosco College of Engineering Fatorda Goa
21.	Goa Engineering College Ponda Goa
22.	All India Institute of Ayurveda, Goa
23.	Goa College of Agriculture Goa
24.	Government College of Commerce and Economics, Borda Margao, Goa
25.	Government College of Arts, Science, and Commerce Sakahli Goa
26.	Rosary College of Commerce and Arts Naveli Goa
27.	BITS Pilani Goa

28.	Goa College of Theatre Arts
29.	Don Bosco College, Panaji Goa
30.	P.E.S.'s Ravi S. Naik College of Arts and Science, Farmagudi, Ponda, Goa
31.	Ganpat Parsekar College Harmal Pedne Goa
32.	Goa Institute of Management
33.	Fr. Agnel College of Arts & Commerce, Pilar, Goa
34.	Goa Multi-Faculty College, Library
35.	MES-TB Cunha Information Center
36.	Shree Rayeshwar Institute of Engineering and IT, Shiroda, Goa.
37.	PES's RTB College of Pharmacy
38.	Institute of Nursing Education, Bambolim
39.	Bharateeya Sanskriti Prabodhini's Gomantak Ayurveda Mahavidyalaya & Research Centre
40.	Government College of Arts, Science, and Commerce, Quepem (GCQ)
41.	St. Xavier's College library
42	Institute of Hotel Management (IHM), Goa
43	Swami Vivekanand Vidyaprasarak Mandal's College of Commerce
44	Goa Dental College and Hospital Bambolim

1.6. HYPOTHESES

1. The fundamentals of cloud computing technology are yet to be fully realized by libraries in Goa.
2. Some library personnel are skilled in cloud computing technology.
3. There is a lack of infrastructure in libraries for cloud computing.

1.7. RESEARCH METHODOLOGY

The researcher has read the majority of the available literature on this topic. Additionally, the researcher has visited many relevant websites. The researcher has determined libraries' susceptibility based on the assessment of the literature. The research design adopted for this study was a survey method. Because of the time limit, the researcher was not able to visit all the libraries. That is the reason the research instrument employed was a questionnaire in the form of Google Forms to gather the data. In this questionnaire, both open-ended and closed-ended types of questions were included according to the nature of the objectives. The researcher has made use of suitable statistical techniques in finalizing the data and made use of charts and graphs in the presentation of results to make the interpretation clear and precise.

1.8. POPULATION OF THE STUDY

The study surveyed Goa's academic library professionals, involving approximately 50 college librarians, but only 44 responded to a questionnaire. The response rate to this leads to a high of 88%.

1.9. ORGANIZATION OF THE STUDY

Chapter 1: Introduction

Chapter 2: Literature Review

Chapter 3: Overview

Chapter 4: National/International Scenario

Chapter 5: Data interpretation and analysis

Chapter 6: Findings, Suggestions, Hypothesis Testing, and Conclusion

1.10. CONCLUSION

Cloud-based platforms are revolutionizing library services, offering enhanced accessibility, increased collaboration, and the ability to innovate in response to community needs, transforming the landscape of library services. Using the cloud is a smart move to reinvent libraries and make sure they continue to be vital, important members of their communities in the digital era, rather than just a technical advancement.

1.11. REFERENCES

Rotich , V. J., & Muthee, D. W. (2021). Examining Privacy Issues Associated with Cloud Computing Practices in Kenyan Public Libraries. *International Journal of Research in Library Science, 7*(2), 45-53. doi:10.26761/IJRLS.7.2.2021.1395

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CHAPTER II

REVIEW OF LITERATURE

A review of the literature is crucial for scholars to understand the extensive amount of information published on a particular topic in the past. A literature review examines a range of books, articles, research papers, and scholarly publications that are pertinent to the particular subject you are studying and gives you the quantity of citation information they offer. A literature review is essentially a summary that lists the sources you have looked up, studied, and cited when researching a certain subject. It is useful to know what others have stated about the topic, what theories have been addressed to it, and what the failures in previous studies are so that others do not repeat the same research. As a result, the literature review is critical to research operations.

1. **(Munavalli, 2023)** "Cloud Computing: A New Way of Information Management in Academic Libraries" The literature highlights the impact of ICT on the globalization of information and knowledge resources. With budget constraints and increasing user demands, libraries are embracing cloud computing and web collaboration. The paper predicts a significant increase in cloud deployment, enhancing services through enhanced collaboration and computing capabilities. Academic libraries will leverage cloud computing to deliver various information services, fostering meaningful exploration of knowledge resources.

2. **(Kalyani & V, 2023)** "Significance of Cloud Computing in Libraries" The literature emphasizes cloud computing as a new technology that will have a big impact on information technology (IT) strategies, especially for businesses and society at large. The paper highlights how cloud computing has revolutionized the field of information and communication technology (ICT) by offering benefits like cost savings, accessibility, and flexibility. It defines cloud computing and looks at how libraries might benefit from it, especially when it comes to organizing online video content and outsourcing data to provide better library services. According to the paper, cloud computing can promote social interaction, data reuse, and library collaboration. It also

mentions how big businesses have embraced cloud computing, highlighting how appealing it is to organizations and libraries because it makes the transition from on-site infrastructure to cloud providers easier.

3. **(Okike & Omali, 2023)** "Leveraging cloud computing for enhanced library services and efficient information delivery in the digital age" The literature explores the impact of cloud computing on library services, highlighting its role in delivering digital information resources. It discusses various cloud computing services and deployment models, highlighting benefits like real-time access, collaboration, and resource sharing. The study also highlights the cost savings, flexibility, scalability, and accessibility of cloud-based applications in education, business, and data storage. It advocates for embracing cloud computing to enhance library services, offering a service-oriented architecture, reducing IT overhead, increasing flexibility, and lowering total ownership costs.

4. **(Akhtar, 2023)** "Cloud Computing: An Innovative Tool for Library Services" Cloud computing offers benefits like lower costs, remote access, and flexibility. Libraries are increasingly adopting this technology for digital libraries, social networking, and information exchange. The author says libraries must consider cloud-based technologies to provide reliable and quick services to patrons. LIS professionals must make cloud-based services a trustworthy medium for delivering library services with ease of use and time savings.

5. A study by **Nazmul , Islam, Antora, & Alam (2023), Cloud** computing applications in library services of Bangladesh: a study on librarians' perceptions," found that librarians in Bangladesh have a positive perception of cloud computing. However, the study also found that there are some challenges to implementing cloud computing in libraries, such as high subscription rates and unreliable online payment systems. Overall, cloud computing has the potential to transform library services in Bangladesh. By adopting cloud computing, libraries can improve their efficiency, accessibility, and collaboration. However, it is important to address the challenges of

implementing cloud computing, such as high subscription rates and unreliable online payment systems. Cloud computing has several potential benefits for libraries, including cost savings, scalability, accessibility, and collaboration. It is important to address these challenges to reap the benefits of cloud computing for library services in Bangladesh. The author concludes that the study provides valuable insights into the use of cloud computing by university libraries in Gujarat, India. The study's findings suggest that cloud computing is playing an increasingly important role in university libraries and that it can help libraries improve their services and efficiency.

6. **(Hase & Ahirrao, 2023)** "Opportunities and Constraints of Using Cloud Computing to Enhance Academic Library Operations" The study explores the integration of cloud computing in academic libraries, focusing on its potential to enhance library services and make them more user-friendly, professional, and efficient. Despite financial constraints and limited technological expertise, cloud computing is seen as immature and poses security risks. The authors anticipate that cloud computing will contribute to national knowledge improvement by offering high-quality services, facilitating resource utilization in digital libraries, and addressing regional development disparities.

7. **(Kumari, 2022)** "Cloud Computing and its Application in Libraries" The literature explores the transformative impact of cloud computing on internet services, emphasizing its cost-effectiveness and outsourcing of hardware, software, and platform services. It highlights the benefits for organizations, particularly libraries, and their service, platform, and infrastructure components. The paper covers the characteristics, types, advantages, and disadvantages of cloud computing, exploring its role in libraries and potential areas for deployment. Despite being in their developing stages, cloud services are seen as beneficial for automating library services and enhancing organizational efficiency.

8. **(Naxie, 2022) "**Construction and Promotion of the Reading Service Platform of the University Library Based on a Computer Network Cloud Platform". The study examines the development of cloud service platforms for digital reading

promotion in university libraries, focusing on personalized service virtualization and big data analysis. It proposes strategies for building and promoting these platforms, advocating for standardized management and efficient resource allocation. The study uses clustering and rule-mining algorithms for user information. Despite achieving effective personalized recommendations, the study acknowledges limitations and calls for further exploration to refine and streamline the evaluation process. Overall, it provides insights into the evolving digital reading promotion landscape in university libraries.

9. **(Velmurugan S. V., 2022)** "Cloud Computing: An Overview" This paper explores the development of cloud computing since its debut, highlighting its importance for Hong Kong because of the city's enormous data processing needs. It is expected that local firms will progressively utilize cloud services, notwithstanding a modest start. It is said that the term "cloud computing" is a modern IT buzzword that signifies a revolutionary change in computing from both a technological and social standpoint. The paper describes the goals of cloud computing, emphasizing the provision of greater flexibility, availability, reliability, and scalability in IT services that are available on demand. The report acknowledges the potential advantages but also points out drawbacks, including worries about data security and the lack of international laws. When global regulations are harmonized, it has a revolutionary effect on the future.

10. **(Solomon, 2022)** The article "Application of Cloud Computing to Library Processes: The Nigerian Perspective" discusses the potential of cloud computing to transform library services in Nigeria. It highlights its benefits, such as improved accessibility, collaboration, and resource management. However, it also discusses challenges such as security concerns and the need for training and infrastructure development. The article concludes that cloud computing offers a promising avenue for modernizing library services in Nigeria but requires adequate security and data privacy issues to be addressed. It also suggests that government support can facilitate cloud adoption.

11. **(Shivaleela & Bharathi, 2022)** "Cloud Computing and its Applications and Services in the Library and Information Center" authors say that cloud computing is a new trend that uses the internet to deliver creative virtual and IT-related apps and services. It is essential to library services and applications, especially in information centers and libraries. This article explores the uses and offerings of libraries and information hubs throughout the cloud computing era, stressing both its benefits and drawbacks. The study's objectives are to categorize and promote further advancements in cloud computing for information centers and libraries. With an emphasis on development and enhancement, this study investigates cloud computing applications in libraries and information centers. It highlights affordability and ease of usage while addressing privacy, safety, and legal concerns.

12. This paper **(Sarkar & Shaw, 2021),** "A model approach to cloud implementation in public libraries with a focus on West Bengal, India, "explores the use of cloud architecture in public library systems, proposing a SaaS model library management system. It highlights the status of library automation and networking and aims to improve workflow, reduce costs, and enhance coordination. The author concludes that implementing a cloud-based library management system in West Bengal would significantly enhance the accessibility and affordability of library services for all residents of the state.

13. **(Rotich & Muthee, 2021) "**Examining privacy issues associated with cloud computing practices in Kenyan public libraries" conducted a study to address privacy issues associated with cloud computing services in Kenya. The research found that library users are not aware of privacy threats and trust providers with their information unknowingly. The study suggests a need for training on privacy implications and measures to take when using cloud computing services. The findings suggest that management should focus on frequent user training, upgrading technological measures, and raising awareness of privacy issues among library patrons.

14. **(Jalamneh & Khder, 2021)** "Challenges of Implementing Cloud Computing in the Arab Library Environment" This paper explores the challenges faced in

implementing cloud computing in libraries and information institutions in the Arab environment. The study uses the Delphi method and expert consulting to identify main challenges such as professionalism, training, technical issues, availability of applications, storage capacity, data volume, privacy, and information security. The study analyzed the availability of educational materials, equipment, and technological innovations in Arab libraries in a digital environment. The importance of cloud computing in the digital environment was emphasized by the experts.

15. **(Ansah, Budu, & Budu, 2021)** The chapter "Developing a Cloud Computing Framework for University Libraries" examines the increasing use of cloud computing in academic institutions and suggests a five-component architecture: cloud service types, cloud service deployment models, cloud security, cloud cost management, and cloud governance. To ensure successful efforts, the framework intends to assist institutions in making informed decisions about adopting cloud computing. The authors also mentioned important elements to remember, such as the advantages of cloud computing, the necessity of giving security and privacy serious thought, and the creation of a cloud governance plan.

16. **(Zubairu, John Olugbenga, & Hamzat, 2021)** The use of cloud computing in Nigerian libraries is examined in the paper "Awareness and Adoption of Cloud Computing in Nigerian Libraries: An Aid to Library Services." According to the author, staff members at libraries are generally aware of cloud computing, and personal usage of the technology is more common than professional use. Mailing services, social networking applications, and library management software are the main areas of usage. However, there are a lot of obstacles, including security and data privacy concerns. According to the paper, to improve cloud computing literacy, Nigerian libraries should give priority to training and sensitization programs, assess cloud providers, put strong security measures in place, and get government backing to promote cloud usage. The author suggests that Nigerian libraries might offer assistance by tackling these issues and encouraging a cloud-adoption culture.

17. **(Fakir & Waghchoure, 2020) "**Applications of Cloud Computing for Library Management" In this article, they pointed out that libraries are altering their offerings with the addition of networking and the cloud, reducing the limitations of the time and place for service delivery. They stated that cloud computing can be used in library automation systems, scholarly material searches, frameworks for repositories and digital libraries, hosting of library websites, storage of sensitive documents, community building, and browsing of library data. They also noted that cloud computing can be used in libraries to store sensitive documents. The study suggested that library professionals adopt cloud-based services as a consistent channel for distributing library services to their clients and making them easy to use in this digital age.

18. In "**(Idhalama & Fidelis, 2020)**" by Cloud Computing, five research objectives were identified, including awareness, perception, and attitude. The study found that librarians are aware of cloud computing technology, have a positive perception of it, and are receptive to it. It recommends library heads encourage staff to adopt new technologies and sponsor further studies, seminars, and conferences. The study suggests that librarians at the University of Dar es Salaam are open to new technologies, such as cloud computing, to enhance modern education systems. It emphasizes the importance of the full adoption of computerization and new technologies in 21st-century libraries. Library heads should encourage staff to embrace new technologies and send them for training, seminars, and conferences to boost their effectiveness and efficiency.

19. The article by **Aiyebelehin, Makinde, Odiach, & Mbakwe (2020)** "Awareness and Use of Cloud Computing Services and Technologies by Librarians in Selected Universities in Edo State," investigates the awareness and use of cloud computing services and technologies by librarians in selected universities in Edo State, Nigeria. The study found that librarians in Edo State have a high level of awareness of cloud computing services and technologies. However, their use of cloud computing is still relatively low. The most common cloud computing services used by librarians in Edo State are OCLC, WorldCat, and Google Docs. The study also found that librarians in Edo State

use cloud computing for a variety of purposes, including collection development, cataloging, reference services, user education, research, and development.

20. **(Cao, 2020)** "Design of a Digital Library Service Platform Based on Cloud Computing" provides a comprehensive and well-designed architecture for a cloud-based digital library service platform. The article also discusses the security framework of the platform in detail. The research results align with the cloud service model of today's social development and promote service reform in digital libraries. The paper's solutions can be adjusted and improved based on user needs, making digital book services in the cloud environment an academic center for modern human knowledge dissemination.

21. **(Salih, 2020)** "The Impact of Cloud Computing and Its Applications on Libraries and Information Centers" explores the transformative impact of cloud computing on libraries and information centers, highlighting its potential for scalability, cost-effectiveness, and enhanced accessibility. It covers various applications, including data storage, management systems, digital repositories, and user-centric services. The authors highlight the positive implications but acknowledge potential challenges like security and data privacy. The article also highlights the significant role of cloud computing in shaping the future of libraries and information centers, offering valuable resources for library professionals to utilize cloud technologies.

22. **(Rahoo & Khan, 2020)** "Usage and Awareness of Cloud Computing Applications by Library Professionals of Sindh Province" explores the adoption and awareness of cloud computing applications among library professionals in Sindh. It probably goes over how these experts use cloud-based products and how much they know about cloud computing. The article highlights significant discoveries encountered or advantages realized, providing insight into the present situation of cloud computing integration in library settings in the designated area.

23. **(Kantharaja & Bharathi, 2020) "**Awareness of cloud-based library management software (LMS) in VTU engineering college libraries" The article explores the impact of information and communication technology (ICT) on libraries, focusing on cloud computing adoption. Library automation enhances efficiency and in-house processes. The study highlights the global acceptance of cloud computing and its cost-effective benefits. Survey results show most librarians are aware of cloud-based library management systems. The paper recommends academic libraries develop a centralized cloud-based LMS for efficient and economical service delivery.

24. **(Chudasma, Bhat, & Trivedi, 2019)** The article Application of Cloud Computing in University Libraries: A Case Study of Selected University Libraries in Gujarat" examines the use of cloud computing by university libraries in Gujarat, India. The study found that cloud computing is being used for a variety of purposes, including the storage and sharing of digital resources, the hosting of library websites and online catalogs, the provision of access to online databases and journals, and the development and delivery of library services. The study's findings suggest that cloud computing can help university libraries improve their services and efficiency. For example, cloud computing can help libraries reduce costs, improve scalability, increase accessibility, and enhance collaboration. Additionally, cloud computing can help libraries adopt new technologies more quickly and easily and provide more innovative and personalized services to their users.

25. In this paper by the author **(Azam, 2019),** "Application of cloud computing in library management: innovation, opportunities, and challenges," the assertion is made that cloud computing permits a sizable shift away from the traditional methods of library administration services and toward more technological and user-oriented methods. Given its capacity for growth, he thinks employing cloud computing will dramatically lower the cost of maintaining the library. Cloud computing applications also benefit from security as they are hosted on a worldwide network that compiles with the most modern security

requirements. However, the author noted that there are several obstacles to successfully implementing cloud computing in libraries. The research concluded by recommending that libraries collaborate to overcome the challenge of cost, leading to the sharing of e-resources together.

26. The article “Cloud Computing: Applications of New Technology in Libraries of Bangladesh” by **Sakib, Haque, and Farabi (2019)** provides a comprehensive overview of cloud computing and its potential applications in libraries in Bangladesh. In this paper, the authors cite several relevant sources to support their arguments, and they do a good job of discussing the challenges and opportunities of cloud computing for libraries in Bangladesh. The author concludes by discussing some of the challenges that libraries in Bangladesh face in implementing cloud computing, such as limited financial resources and a lack of awareness of cloud computing technology. They also argue that the benefits of cloud computing outweigh the challenges and that libraries in Bangladesh should adopt cloud computing to improve their services and meet the needs of their users in the digital age.

27. **Yudah & Geoffrey (2019)** studied “Cloud Computing in Libraries: Prospects and Challenges from Kenyan Perspectives." They listed the following benefits of cloud computing: lower costs, more scalability, lower risks, higher security, and accessibility. However, they pointed out that there are several obstacles to embracing cloud computing, including a lack of control over software choices; unauthorized data mining; statutory constraints on where data can be stored; functionality issues such as incompatibility; insufficient bandwidth; and security and privacy concerns, regarding the use of cloud computing in libraries, the researchers pointed out that PaaS permits use of the integrated library system and SaaS permits use of the Lib-Guide and Library catalogs. But authors pointed out that no definite lines are separating Paas and Saas in library cloud computing applications. The authors concluded by urging libraries to work together in the field of cloud computing to lower costs.

28. This research **(Bhardwaj, 2019) “**Cloud Computing and Libraries” explores cloud computing ideas and applications in libraries, highlighting their potential

for improving efficiency and building digital libraries. Cloud computing technology (ICT) offers libraries numerous opportunities and services to connect with clouds, transforming information retrieval systems. Libraries no longer require software, operating systems, or applications, which are provided by service providers. Cloud computing is divided into application, storage, and connectivity, each serving different purposes and offering different products globally. This study discusses cloud computing's origin, types, security, and challenges in library science. However, it also addresses privacy and security concerns. It calls for libraries to seriously consider using cloud technologies and making them reliable for user distribution.

29. The paper by **Onu, Okorie, and Onwubiko (2019)** "Cloud Computing for Information Service Delivery in Public Libraries in Nigeria," explores the application of cloud computing in Nigerian public libraries, focusing on information access, preservation, storage, retrieval, and dissemination. It explores the principles, setbacks, and sustainable ways for library managers and professionals. The paper suggests that the application of cloud computing technology in Nigerian public libraries could revolutionize library and information services.

30. **(Kumar, 2019)** The paper "Migrating the Libraries of Rural Educational Institutions to the Cloud: An Indian Perspective" examines how cloud computing may help teachers and students in rural locations have better access to resources and information. It draws attention to issues including inadequate staffing, a lack of resources, and subpar infrastructure. By automating tasks and granting access to a larger range of resources, cloud computing may free up staff time for greater support. On the other hand, staff training and dependable internet connectivity present obstacles. The authors nevertheless think cloud computing has the power to completely transform rural library operations.

31. **(Gandotra, Tyagi, & Tiwari, 2019)** "Application of Cloud Computing Technology in Libraries" emphasizes its affordability, improved usability, easier administration, ability to foster collaboration, availability of cutting-

edge technologies like artificial intelligence and machine learning, safe storage options, capacity for disaster recovery, and affordable experimentation. By enabling libraries to access resources on any device, at any time, and from any location, cloud computing promotes inclusivity and increases the reach of library services. Additionally, it lessens the workload for library employees by streamlining IT duties. Cloud-based platforms boost innovation in the LIS industry by facilitating information sharing. The importance of cloud computing in LIS innovation—which enables programmers and librarians to work together on creative solutions—is emphasized in the article's conclusion.

32. **(Bhagat, 2019)** "Cloud Computing Technology for Library Services: A Big Boon" The study explores the impact of cloud computing on library management, focusing on data aggregation, security, and the shift from physical to electronic resources. It highlights the growing role of cloud technology in addressing resource management challenges and its potential for cost-cutting and efficient service delivery. The paper also emphasizes the significance of cloud computing for universities and colleges, particularly in research and development. Overall, it provides a comprehensive view of the evolving landscape of library services in the context of emerging cloud computing technology.

33. **(Ruhela & Hasan, 2018)** "Implementing of Cloud Technology in Libraries and Information Systems" This paper explores cloud computing, a virtual environment that libraries can use to provide web-based services. It explores the types, potential areas, and advantages of cloud computing systems, focusing on their integration with library services. The author concludes that in the last decade, virtualization of services has gained popularity, particularly in higher education institutions and private organizations. Cloud technology offers efficient and flexible services, making libraries increasingly adopt cloud technology, particularly in virtual libraries.

34. This paper **(Mohammad, 2018),** "Recent Trends of Cloud Computing Applications and Services in Medical, Educational, Financial, Library, and Agricultural Disciplines," explores how cloud computing is revolutionizing

various industries by providing scalable, elastic, and on-demand computing resources. It enhances healthcare access through telemedicine and secure data sharing while enhancing education through online course management and diverse digital resources. Financial services are provided through online and mobile banking, while digital libraries offer vast content and improved management. Agricultural tools optimize resource utilization and provide real-time insights.

35. **(Wada, 2018)** The article "Cloud Computing Implementation in Libraries: A Synergy for Library Services Optimization" proposes that cloud computing can significantly improve library services and operations. To optimize library services, the paper highlights the synergistic benefits of integrating cloud computing into libraries. It probably discusses how library operations have become more collaborative, accessible, and efficient, demonstrating the benefits of cloud computing for total service delivery. The article likely highlights how cloud computing is revolutionizing library processes and improving user experiences.

36. **(G & Biradar, 2017)** "Application of Cloud Computing Technology in Libraries" It was claimed that cloud computing was a blessing for libraries and provided them with several options to connect their services to the cloud. According to the researchers, cloud computing technologies can be used in the library to build digital collections and repositories, search academic literature, store files, automate libraries, host library websites, harness community power, and search library data. They noted various advantages of cloud computing in libraries, such as cost savings and simple installation. Additionally, there is maintenance, more storage capacity, high automation, flexibility, improved mobility, and shared resources. However, they pointed out that some drawbacks include concerns about security and privacy, the need for high bandwidth and connectivity, and reliance on outside organizations. The study concluded that libraries should embrace cloud computing since it gives them a chance to enhance their offerings and increase their relevance in the modern information society. It may assist libraries in many ways and open up new opportunities for them in the future.

37. The paper **(Basavanna & Mamatha, 2017) Cloud** Computing in Libraries: A Study "discusses how cloud computing improves corporate software, data storage, and resource management by separating service provisioning from end-user services, while libraries utilize it for managing servers and data backups. This study explores the potential of cloud computing in libraries to enhance services, address security, privacy, trustworthiness, and legal issues, and ensure reliable and efficient use.

38. "Emerging Trends of Cloud-based Services in Libraries: anywhere, anytime, any device" by **Singh & Kumar (2017)** This article examines how cloud-based services, which have advantages including lower prices, more scalability, and enhanced accessibility, are being used in libraries more and more. It encompasses a range of cloud-based services, such as software as a service (SaaS), platform as a service (PaaS), and infrastructure as a service (IaaS). The author thinks that as cloud computing gains more traction, libraries will be able to enhance their offerings and management. For librarians thinking about augmenting their library services with cloud-based services, this paper is a great resource.

39. **(Kishore, 2017)** article "Present Methods in Libraries With Cloud Computing" explores the transformative impact of cloud computing on library services. It highlights its role in enhancing accessibility, fostering collaboration, and streamlining resource management. Cloud computing offers benefits like scalability, flexibility, and cost-effectiveness, enabling libraries to provide remote access to resources, facilitate seamless collaboration, preserve digital content, and manage data efficiently. However, challenges include addressing security concerns, investing in training and infrastructure development, and securing data privacy. Kishore concludes by highlighting the potential of cloud computing in transforming library services and meeting the evolving needs of users in the digital age. By embracing cloud technologies and overcoming challenges, libraries can become hubs of innovation and accessibility in the ever-changing information landscape.

40. **(Kritikos & Zimmer, 2017)** "Privacy Policies and Practices With Cloud-Based Services in Public Libraries" Cloud-based and Library 2.0 technologies are being used by public libraries to provide interactive, user-friendly platforms for users to explore library content. Similar to Biblio Commons, these networks frequently depend on gathering patron data, which may violate moral standards. A pilot study looks into how libraries are using third-party cloud computing services, how it affects patron privacy, and how libraries are responding to that. The results can help direct the deployment of cloud-based Library 2.0 systems in public libraries in the future.

41. **(Kumar B., 2017)** In "Cloud Computing Technology and its Application in Libraries," the author explores the use of cloud computing technology in libraries in his article. It examines the different ways that cloud computing improves library services, highlighting advantages like lower costs, easier accessibility, and better resource management. Kumar talks about how cloud computing might make it easier to store, retrieve, and collaborate on projects in library settings. The article emphasizes how important it is to use cloud computing as a revolutionary instrument to modernize library operations and increase their efficiency and flexibility in response to the changing information environment.
42. **(Jadhav, Lohangade, Jangam, & Chavan, 2016) "**Cloud Computing: Platform and Applications" This literature provides an in-depth analysis of cloud computing, a shift from local servers to shared data centers, emphasizing cost reduction and operational efficiency. It explores applications like email, e-learning, and data backup, focusing on real-time implementations. The paper highlights cloud computing's widespread application in various sectors, advocating for its widespread adoption for cost-effective global access to personal information.
43. **(Velmurugan & Manjula, 2016)** The Cloud Computing in Library Service" discusses the benefits and applications of cloud computing in the library service sector. It highlights various cloud computing models, such as Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS), and their relevance to library operations. Cloud computing can streamline library processes, improve collaboration among

librarians, and expand access to library resources. Applications include library management systems (LMS), digital repositories, and e-learning platforms. To adopt cloud computing, libraries should evaluate their needs, ensure data security and privacy, and train staff on cloud-based technologies. The article concludes that cloud computing has the potential to revolutionize library services, enabling them to provide more efficient, accessible, and innovative services to users.

44. **(Wang, 2016),** "Study on Construction of the Digital Cloud Services Platform of the College Library" This article proposes a digital cloud service platform architecture for college libraries, focusing on efficient information services and intensive resource management. It explores the operation mechanism of this platform, aiming to provide more convenient and efficient information for readers.

45. **(Kattimani, 2016) "**Cloud Computing Libraries in the Era of ICT." This paper examines the impact of cloud computing on library services and the basic knowledge about cloud computing in the era of information and communication technology (ICT). Cloud computing is a platform that allows access over the internet using desktop computers, laptops, tablets, and smartphones without any software or storage units. The author also discusses the three types of cloud service models: infrastructure as a service, platform as a service, and software as a service. The author concludes that rapid advancements in information, communication, and technology (ICT) have transformed libraries, enabling automation and digital library functions. Cloud computing helps institutions meet growing resource requirements and energy costs by centralizing computing resources on the internet, enabling simultaneous multiple access to resources for users.

46. The paper **(Suman & Singh, 2016)** "Cloud Computing' in Libraries: An Overview" provides a comprehensive analysis of the possible advantages of cloud computing for libraries. It talks about the various kinds of cloud computing services, such as software as a service (SaaS), platform as a service (PaaS), and infrastructure as a service (IaaS). Additionally, it offers

illustrations of cloud-based services such as Google Cloud Platform, Microsoft Azure, and Amazon Web Services. The significance of cost analysis, data security, and provider selection are emphasized in the paper.

47. **(Tian, XU, Ji, & Scholer, 2015)** "CloudTree: A Library to Extend Cloud Services for Trees" is a new library called CloudTree that expands cloud services to include tree data structures. Developers can make use of the scalability and flexibility of cloud computing for tree-based applications by using the extensive range of APIs it provides for building, maintaining, and querying tree data structures on the cloud. With its ability to completely transform the management and processing of tree data structures, it could pave the way for large data processing, distributed databases, and machine learning. The paper offers a noteworthy development in tree data management and cloud computing, which makes it an important resource for researchers and developers dealing with cloud-based tree data.

48. **(Sahu, 2015)** "Cloud Computing: An Innovative Tool for Library Services" examines how cloud computing is revolutionizing library services. It demonstrates how cloud computing improves resource management in libraries, speeds up collaborative work, and increases accessibility. It is said that cloud computing adoption spurs innovation by allowing libraries to adjust to changing technology environments and provide better services to their users by facilitating effective data storage, retrieval, and collaboration. The paper emphasizes how cloud computing helps libraries run more efficiently and creates an environment where information is more responsive and dynamic.

49. **(Tyagi, Passi, & Baberwal, 2015)** The article "Cloud Computing and Its Applications in Library Systems" explores the benefits of cloud computing in libraries, including cost-effectiveness, flexibility, and scalability. It highlights different types of cloud computing services, such as Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS), and provides examples of their practical applications. It concludes that cloud computing's applications in library systems guide librarians through the decision-making process and equip them with the necessary knowledge.

50. **(Dutt, 2015)** "Cloud computing and its application in libraries" He stated that cloud computing has changed the way the power of the computer is used. The author claimed that OCLC's Web Scale, which is used for online library cataloging; Ex-Libris Cloud, which offers solutions to automate library operations; Dura Space's Dura Cloud, which offers open source repository solutions; and OSS Lab, which will provide reliable open-based solutions to demanding customers, are all examples of cloud computing applications in libraries. He also mentioned certain places where library services could be improved thanks to cloud computing tools. These include, among others, document download services, digital preservation and scanning services, article delivery services, current awareness services (CAS), document sharing, bulletin board services, file sharing, and e-learning. He recommended that librarians should up-skill and become ICT competent.

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CHAPTER III

LIBRARIES THROUGH CLOUD: REINVENTING LIBRARY SERVICES THROUGH CLOUD-BASED PLATFORMS: AN OVERVIEW

3.1.INTRODUCTION

This chapter explores various concepts and their connections to cloud computing and library services. It covers history, definition, components, benefits, and library services through cloud-based platforms. This chapter examines various concepts and their relevance to cloud computing.

3.2. HISTORICAL OF CLOUD COMPUTING

The concept of cloud computing dates back to the 1960s with ideas such as the “intergalactic computer network," introduced by J.C.R. Licklider while presenting ARPANET through a memo to the scientific community. The concept of a cloud didn’t exist at that time, but it was the birth of the Internet and the abstraction of the networking layer that gave birth to the concept of an abstract path between different computer systems. Not much later, John McCarthy suggested that “Computing may someday be organized as a public utility just as the telephone system is a public utility” while speaking at MIT’s centennial celebration in 1961. He also described the potential for this technology as a system where “each subscriber needs to pay only for the capacity he uses, but he has access to all programming languages characteristic of a very large system. Certain subscribers might offer services to other subscribers. The computer utility could become the basis of a new and important industry." These words prophetically describe what we’re experiencing today in modern cloud computing. Mainframe technology was the foundation of computing. Everyone used "dumb" terminals to connect to the large mainframes. The folks seated at the dumb desk found this outdated type of corporate computing to be annoying terminals since their scope of action was limited to what they were "authorized" to perform. They depended on the computer administrators' approval or assistance to solve their issues. They were unable to keep up with the most recent advancements. The invention of the personal computer was an uprising against the oppressive nature of centralized computing. The use of personal computers allowed for a certain amount of flexibility.

However, later server designs, such as corporate servers and others, took their place in the field. This ensured that the calculations were completed and did not deplete any of the resources carried by him. Every computation was done on servers. Under these servers, the Internet flourished. Returning to the centralized computer infrastructure. However, this time, it's something that can be accessed over the internet and something we are completely in charge of.

3.3. CLOUD COMPUTING

Libraries are transitioning from traditional operations to digital resource centers, offering information in various formats like text, image, video, and audio. Advancements in information communication technologies have improved access and distribution, leading to the concept of cloud computing. Cloud computing refers to the practice of storing, accessing, and sharing data, applications, and computing power in a secure and centralized environment. Cloud computing is an advanced ICT phase that allows for the pooling of resources on remote servers, enabling access to a large number of computers over the internet. Cloud computing is the practice of using the internet to access and store data and programs, rather than a personal computer or hard drive, from any location or device. When we keep information or an application on the hard drive of our local computer, the drive is referred to as local computing and storage; nevertheless, cloud computing necessitates internet connectivity to our data or applications.

Cloud computing is a new style of computing that allows for the sharing of resources and services over the Internet, rather than on local servers or personal devices. It can transform the way systems are built and services are handed over, providing libraries with a favorable environment to extend their influence. Cloud computing is internet-based, where essential shared servers provide software, infrastructure, platforms, devices, and resources on a pay-as-you-use basis. Cloud computing enables the separation of service provisioning infrastructure and end-user service provision. It allows for the sharing of distributed resources and services from various organizations or sites via an internet-connected virtual pool of computing resources. This enables more efficient and accessible resource management and sharing across multiple sites. Moving library systems to the cloud would improve interoperability. In this way, it

makes it easier for libraries to provide their services or resources on third-party websites and platforms.

3.4. DEFINITION OF CLOUD COMPUTING

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 rapidly be provisioned and released with minimal management effort or service provider interaction. This cloud model is composed of five essential characteristics, three service models, and four development models.”

According to Google Cloud, “cloud computing is the on-demand availability of computing resources (such as storage and infrastructure) as services over the internet. It eliminates the need for individuals and businesses to self-manage physical resources themselves and only pay for what they use.”

According to Gartner IT Glossary, “Cloud computing is a style of computing in which scalable and elastic IT-enabled capabilities are delivered as a service using Internet technologies.”

According to Buyya, “Cloud 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-level agreements (SLA) established through negotiation between the service provider and consumers.”

According to Forrester, cloud computing is "a pool of abstracted, highly scalable, and managed compute infrastructure capable of hosting customer applications that are billed by consumption.”

3.5. CLOUD COMPUTING IN LIBRARIES

Libraries, a vital component of education and learning, promote economic growth, particularly in developing nations. As learning increasingly employs cutting-edge technology daily, library patrons are becoming more familiar with technology.

Libraries can benefit from several interesting possibilities presented by cloud computing, including lower technology costs, increased capacity, reliability, and performance for certain automation tasks. Since their introduction, cloud apps have grown in importance to the point where academic journals and the software that gives users access to these contents are increasingly built on the cloud. Cloud computing is thought to have occurred anytime data resources are kept apart from physical IT equipment and accessed remotely via the internet. Certain organizations provide library services through the use of cloud computing platforms. Libraries leverage cloud computing technologies to automate housekeeping tasks with third-party applications and generate a digital library. Librarians can now share dispersed resources and services that are part of several places or organizations.

The Online Computer Library Center WorldCat, which has been operating for decades, is the ultimate example of cloud computing in libraries. It says that cloud computing is currently extremely important to research libraries. It's surprising how little of a difference cloud computing makes in their endeavors until they are involved in and devoted to completing their transactions via the cloud, like using the Internet to obtain materials and send emails. The advantages of cloud computing for services like libraries and libraries are being drawn more and more to providing specialists as well as librarians. The theories of traditional libraries have changed in this technological age. Libraries can now offer better services to the user community with the aid of cloud technologies for online databases and large union catalogs. The library community can further use cloud computing to strengthen library service on the global network. Libraries are constantly improving through the adoption of numerous new IT technologies.

Following are a few of the cloud applications found in the library and information center:

1. **Hosting of the Website:**

Using cloud computing technology makes it easier for libraries to create their own websites. A lot of libraries would rather have their websites hosted by a third-party service provider because maintaining servers requires technical labor. This is the best example of a website hosted by Google Sites.

2. **Library Automation:**

At present, library automation is maintained by IT teams or library professionals and is done on local servers using commercial or open-source library administration software. Nowadays, a lot of software companies offer cloud-based library software, such as Ex-Libris and Polaris, which eliminates the need to purchase hardware or software and saves money on upkeep, software updates, and backups.

3. **Data Storage:**

Cloud computing now provides a solution to the primary data storage issue facing libraries. The advent of cloud computing has given rise to new and creative businesses that provide free or very inexpensive storage for documents, files, folders, images, and videos. To save and synchronize data across numerous devices, some examples include Dropbox, One Drive, Google Drive, and Apple iCloud.

4. **Digital Library Services:**

Libraries offer digital materials through locally hosted digital library software, such as Fedora, Dspace, and Greenstone, among others. Currently, cloud service providers such as Duraspace offer digital library services on the cloud to assist libraries with server maintenance, technical staffing, software updates, and backup.

5. **Searching library data:**

Cloud computing is used by OCLC to deliver library data; among the greatest services for accessing the library OPAC online is OCLC World Cat. OCLC uses an online share management system to provide services on a cloud platform.

6. **Searching Academic Content:**

Academic content refers to information, knowledge, and scholarly material produced for educational purposes and formal research. It encompasses a wide range of formats, including articles, books, research papers, and conference proceedings, created by experts in various fields. Example: Knimbus (K=knowledge + nimbus=cloud) is a collaborative knowledge platform that connects you to relevant content and communities. It is a cloud-based research tool that makes it easy to locate and distribute academic content online.

7. **Build Community:**

By utilizing social networking capabilities, cloud computing offers libraries and information centers the greatest way to create networks among library professionals. Communities are strengthened via the use of Facebook, Twitter, academia, and other such platforms.

8. **User Survey:**

Online survey platforms like Google Forms and Survey Monkey can be used to gather information from library users. These cloud-based applications are easy for library professionals to utilize to gather user responses.

3.6. LIBRARY SERVICES THROUGH CLOUD COMPUTING

Cloud computing is gaining significant attention as it has the potential to revolutionize librarians' approaches to providing users with new technologies and information needs. Various services can be offered in cloud computing to libraries, as under:

1. **Social networking (ex., Facebook, Twitter):** social networking platforms are one way that libraries have expanded their offerings in the digital age. Libraries have evolved from their historical function as static physical repositories to dynamic online hubs that use social media sites like Facebook, Twitter, Instagram, and others to interact with their communities.

2. **Calendar Services (ex., Google Calendar, Doodle):** This service allows a script to access and modify the user's calendar, including additional calendars that the user is subscribed to.

3. **File storage services (ex., Dropbox, Google Drive):** Numerous online file access services, including Flicker, Dropbox, Jungle Disk, Google Docs, Sky Drive, and others, are made possible by cloud computing. Without the need for specialized hardware or software, these services enable file sharing remotely via the Internet and offer access from anywhere at any time.

4. **Online representation (ex., YouTube, Google presentation):** An online presentation is a prepared speech or talk delivered by video conference by an

individual or organization disseminating information, making a pitch, or introducing an innovative product or service.

5. **Information literacy and orientation**: Cloud-based information literacy and orientation programs can be offered by libraries. For user orientation, they can store the files, presentations, videos, and lessons on the cloud.

6. **Federated search via the web using OPAC:** Federated searching is the capacity to conduct a single search across a variety of resources, including the local library, nearby libraries, other libraries, databases, encyclopedias, and the internet.

7. **Integrated Library System (ILS):** A complex application or database called an integrated library system (ILS) unites various library operations in an (ideally) seamless way. The distinct functions, sometimes referred to as "modules,"

8. **Web hosting:** A web hosting service is a kind of Internet hosting service that allows users to develop and manage websites for their clients. It also makes the websites available on the World Wide Web.

9. **Global OPAC:** A Global Online Public Access Catalog (OPAC) is a centralized online database that enables users to access the combined library catalogs of multiple libraries worldwide, providing a unified interface for discovering and locating books, journals, multimedia, and other resources.

10. **Information Delivery:** The cloud offers a platform for storing all data, which is accessible from any location at any time. For researchers, this makes finding and delivering information quick and simple, and it is tremendously helpful.

11. **Online resource sharing:** resource sharing is the practice of select participating libraries exchanging resources among themselves based on the cooperative principle. This applies to the sharing of personnel, space, equipment, services, and documents.

12. **Digital library interlibrary and intralibrary loan:** Books not available in a library may be made available from any of the connected public libraries via the interlibrary loan feature on the cloud LMS since the OPAC on the union catalogue provides details of all public library holdings. Delivery of documents via cloud LMS in the form of soft copies or scanned copies is possible.

13. **Bulletin board services:** Bulletin board services are online platforms that allow users to communicate, share information, and engage in discussions through text-based messages. With this technology, it can offer new bulletin board services.

14. **Document download service:** by utilizing cloud technology, libraries store and manage their collections online, allowing patrons to access and download documents remotely. One can download documents easily if they have access to the network.

15. **Collection development:** Collection development is the methodical and planned process used by libraries, archives, and other information institutions to gather, assess, and maintain resources for their collections to better serve their patrons. During this process, materials that support the mission and objectives of the business are chosen, taking into account aspects like relevance, quality, and diversity.

16. **Current Awareness Service (CAS):** Current Awareness Services (CASs) are used by information professionals and organizations to provide users with timely and relevant information about the latest developments, advancements, and trends in their specific sector or area of interest.

17. **Duraspace** is a cloud-based open-source solution that enhances library services by enabling efficient management and sharing of digital resources. It leverages platforms like DSpace and Fedora, enhancing accessibility, scalability, and collaborative capabilities, enabling libraries to build robust digital repositories and foster a dynamic information exchange landscape in the digital age.

18. **Exlibris:** Exlibris assists libraries with collection management, workflow optimization, and enhancing the patron experience in general. They offer software tools such as Primo for resource discovery and Alma for library services.

3.7.COMPONENTS OF CLOUD COMPUTING

Users can utilize cloud computing technology at any time and from any location by connecting to the internet. This facilitates the storage of information and access to services for both small and large organizations.

The following are the main components that are vital to the delivery of services:

1. **Cloud network**

Users and cloud services are connected through this entity. It safeguards data transmitted over networks using technologies for encryption and decryption.

2. **Data centres**

Applications that users subscribe to are hosted on a group of servers known as a data center. The software can be put on the primary physical server in a data center, but it will appear to the user as a different server identity if the server is virtualized.

3. **Distribution servers**

It is not always necessary for the data center to have a single server at our location. Servers are occasionally positioned throughout the world in widely separated geographic areas. However, the data appears to be coming from a central server when viewed through the eyes of the end user. In this technique, the other services come online to serve the customers if one server goes down or is instantly unavailable to them, possibly as a result of congestion or some other issue. These servers regularly synchronize their data to offer the client a flawless service.

4. **Client computers**

In a cloud computing architecture, clients resemble those on a regular local area network (LAN). These are the PCs that end consumers have sitting on their desks. The front-end programs are installed in this location. These could be PDAs, laptops, tablets, or cell phones. To put it briefly, clients are the devices that are utilized by users to manage client data.

5. **Consumer**

This is an entity that negotiates between the user and the service provider. Additionally, it enables the user to send a service request to the cloud from any location on the globe. Additionally, it ensures that data transferred between the supplier and the client is secure.

6. **Resource allocator**

This component acts as an interface between the user and the cloud infrastructure. It also emphasizes how resources should be distributed so that the final user can access them with the least amount of management work.

7. **Navigator**

To complete the service level agreement (SLA) and establish fees and penalties, it works with the broker.

8. **Service analyzer**

To determine whether or not to accept user-provided services, it must interpret, evaluate, and make a decision about them. As a result, to make such a judgment, the most recent load or other kinds of VM data could be needed.

9. **Energy monitor**

This entity decides which physical machine needs to be switched on and off to cut down on carbon emissions. The tool used in cloud computing to measure and analyze computing resource energy consumption is an energy monitor. By ensuring servers run at maximum efficiency, minimizing needless energy consumption, and efficiently managing and allocating resources, cloud service providers can optimize data center efficiency.

10. **VM manager**

It monitors the availability of virtual machines (VMs) for services. It also monitors the migration of the VMs across the physical machine. A pricing monitor in cloud computing helps users track and manage costs associated with cloud services, providing real-time insights into resource usage, alerting users about potential cost overruns, forecasting future expenses, and offering recommendations for cost savings.

11. **Pricing monitor**

A pricing monitor in cloud computing helps users track and manage costs associated with cloud services, providing real-time insights into resource usage, alerting users about potential cost overruns, forecasting future expenses, and offering recommendations for cost savings.

3.8. CLOUD COMPUTING DEPLOYMENT MODELS

Cloud computing can be deployed based on different models as per requirements.

1. **Public cloud**

This is the first kind of cloud that is implemented and available to everyone, from anywhere and anytime, through the internet. Clients from several organizations typically share the same infrastructure in public clouds. A third-party service provider sells shared computing resources under this paradigm. Applications and storage are provided to consumers via the Internet by public cloud service providers. Cloud computing is available to the general public, and the computing. The service providers offer their services on a pay-per-use or complimentary basis.

2. **Private cloud**

It's like a public cloud, but its supply of resources is limited to an organizational boundary. In a private cloud, all resources are shared exclusively for the advantage of the organization exercising that control, and the infrastructure is configured so that only that organization or entity has control over it. For organizations, this is dedicated cloud infrastructure. Only designated users can host programs in secure cloud-based environments due to their private cloud surroundings. A private wiki site that is only accessible by those in the same group could serve as an example of this structure.

3. **Hybrid cloud**

Hybrid clouds combine elements of the three cloud models listed above or share traits with them. Transportation clearinghouses serve as an example, wherein certain information is shared with affiliated members, such as trip booking websites, but not with individual customers. Other information is private. Hybrid IT, or hybrid cloud, offers organizations scalability, privacy, and cost-effectiveness for their applications, enhancing their overall IT infrastructure. The hybrid cloud deployment model is a

combination of public and private clouds, with security prioritized in the private cloud. This model is used to control business-critical data and services in the private cloud, while less critical processing is transferred to the public cloud.

4. **Community cloud**

This consists of integrating the services of different clouds to solve the needs of the business sector or community. An assembly cloud is a collective brought together by a shared goal or cause. Many organizations with comparable cloud requirements collaborate to share these clouds to accomplish their objectives. One instance might be a website run by a public-private partnership that facilitates joint initiatives to assist airlines in enhancing their maintenance procedures. Industry and government are the only membership categories available; however, an industry trade association hosts the portal as a whole.

3.9. CLOUD COMPUTING SERVICE MODELS

1. **IaaS (infrastructure as a service)**

Cloud computing infrastructure, including servers, storage, networks, and operating systems, is provided as an on-demand service under Infrastructure as a Service (IaaS). The apparatus utilized in IaaS to support operations, such as servers, storage, hardware, etc. Organizations outsource networking components. The apparatus is possessed by the service provider, who is also in charge of housing, operating, and maintaining it as the supplier of services. Usually, the client pays according to the amount used. The following list of IaaS providers and their services

- Google's Compute Engine
- Mirosoft's Azure Vms
- Amazon's EC2, or Elastic Compute Cloud
- Rackspace's Cloud Servers
- Flexiant's Flexiscale

2. **PaaS (platform as a service)**

Platform-as-a-Service (PAAS) is a computing platform that allows customers to develop and test new applications as well as run existing ones quickly and easily without having to buy and maintain the necessary infrastructure and software.

Customers can hire hardware, operating systems, storage, and network capacity through the Internet. Customers can also rent virtualized servers and related services for running existing applications or developing and testing new ones. PAAS is a software distribution model that makes hosted software applications available to customers over the Internet. The following are a few PaaS providers:

- Microsoft's Azure
- Google's App Engine
- Com's Force.Com
- Engine Yard

3. **SaaS (software as a service)**

A cloud service that offers remote access to software and its features is called Software as a Service (SAAS). Programs are hosted remotely. Users don't need to buy extra hardware. Organizations don't need to manage the setup, installation, and frequent daily maintenance and upkeep. Software-on-demand, or SAAS, as it is commonly known, can be described as renting it out rather than buying it. When using conventional software programs, before being used, the software must be installed on the computer after being purchased and capable of being used. The data is sent, stored, and backed up using the software widely used in SAAS due to the lack of initial fees in most cases. Businesses simply have to pay for the storage space they use. Examples of SAAS are Google, Twitter, Facebook, Flicker, etc. SaaS providers and their services are as follows:

- Apple's iCloud
- Google's Google Apps (Gmail, Google Sites, Google Docs)
- Dropbox
- Microsoft's Office 365
- Microsoft One Drive
- SalesForce CRM
- DeskAway
- Impel CRM
- Wipro w-SaaS

3.10. FEATURES OF CLOUD COMPUTING

1. **Elasticity and Scalability**

One of the fundamental features of cloud systems is elasticity. This is a crucial component of the service since it allows for quick and simple modifications and enhancements, which increases its scalability and resilience. The necessary processing speed, bandwidth, data storage, and license count may all be quickly and simply added up. Project costing, procurement, implementation, and closer planning are no longer necessary; instead, a purchase order must be placed with the service provider to receive the service on schedule.

2. **Multi-tenancy**

In cloud systems, where code and/or data locations are mostly unknown and resources might be allotted to different users (perhaps simultaneously), multi-tenancy is an extremely important problem. This impacts shared resource-hosted data, applications, and services, as well as infrastructure resources that must be made available in numerous isolated instances.

3. **Energy consumption**

Energy usage matters to lower additional energy consumption expenditures. When using a traditional system, all of the servers must be kept up-to-date because the data is put onto them for continuous access. Because the cloud is built in a network environment, it primarily enables energy consumption reduction.

4. **Reliability**

It's a truly remarkable feature of cloud computing. One essential component of cloud computing is reliability, which rises with the number of redundant websites accessible. Having multiple sites for the same service increases reliability since one can take over the load in the event of an outage at the other.

5. **Security**

Any system that handles potentially sensitive data or code must have security. A group of IT specialists oversee and maintain the cloud. As a result, the data will be safe from system crashes and data loss.

6. **Consumption-based billing**

One important aspect of cloud systems is their flexibility to scale costs based on actual resource utilization. Pay-per-use, where particular standards must be completed by the system for it to be paid for, is closely correlated with the level of service support. The fact that you pay nothing for cloud resources when you're not using them is one of their many wonderful qualities.

7. **Data Management**

When it comes to storage, where data is freely dispersed across several resources, data management is crucial. It is implicit that maintaining data consistency over a large range of duplicated data sources is necessary. Simultaneously, when duplicating data between data centers, the system must always know where the data is. As a result, one of the best aspects of the cloud environment is data management.

8. **Managing cloud activities**

The management and monitoring of cloud applications is one of the cloud's most important functions. Since a cloud manager operates inside a dispersed wide-area network architecture, it is globally monitorable. The fact that all data is now handled, stored, and governed in the cloud is one of the largest departures from the traditional data center.

9. **Self-Service Model**

Self-service models are among the factors contributing to the popularity of cloud-based environments. Users may be able to upload files, create programs, plan, deploy, administer, and provide reports in certain situations. Users can access this service on demand.

10. **Performance**

The largest cloud computing services are powered by a global network of safe datacenters that are updated frequently with the newest models of quick and powerful computing gear. Compared to a single corporate datacenter, this provides several advantages, including increased economies of scale and decreased network latency for applications.

3.11. CLOUD PLATFORM SERVICE PROVIDERS

A cloud service provider is a third-party firm that provides a cloud-based platform, infrastructure, application, or storage service. Companies often have to pay just for the quantity of cloud services they utilize, as business circumstances necessitate.

1. MicrosoftAzure

Microsoft Azure is a comprehensive set of cloud computing services that allow you to create, deploy, monitor, and manage applications across a worldwide network of Microsoft-managed datacenters. Microsoft offers this service through its data centers. This platform enables enterprises to design and execute applications with unlimited scalability. Users only pay for the services they choose. Windows Azure enables developers to swiftly create and deploy apps, utilizing their existing abilities. Options include.NET, PHP, and Java 10. Windows Azure offers several scenarios for businesses and organizations, including SaaS, storage, compute, and database administration.

2. IBM Cloud

IBM Cloud is a complete cloud platform that provides sophisticated data and AI technologies across public, private, and hybrid settings, all supported by industry knowledge. The IBM Cloud platform gives users access to a variety of IBM tools and services, including IBM Watson and IBM Cloud Functions for serverless computing, as well as those provided by third-party suppliers. IBM offers various IaaS, PaaS, and SaaS services, including scalable PaaS solutions for cloud native application development and modernization.

3. Oracle Cloud Infrastructure

Oracle Cloud Infrastructure (OCI) provides more than 100 services for IT migration, development, and operation, ranging from existing workloads to new cloud-native apps and data platforms. It improves business applications without the need for costly rearchitecture, produces and operates apps using open standards and tools, and utilizes data through services such as Oracle MySQL Heatwave and Oracle Autonomous Database. Oracle Cloud Infrastructure (OCI) is a public cloud built to host corporate applications, including tools that help business leaders speed processes and make strategic choices. OCI systems also enable the development of new cloud-native, open-source, and mobile apps over a single network interface.

4. Rackspace

The cloud platform provides three services for companies and businesses: cloud servers, cloud files, and load balancers. It provides free architectural advice with each account. Cloud servers are accessible for businesses of various sizes. Akamai's content delivery network (CDN) enables worldwide distribution of stored media and data. The third service, Cloud Balancer, enables enterprises to increase server capacity and balance traffic on-demand.

5. Amazon Web Services (AWS)

Amazon Web Services (AWS) is a leading platform that provides online services across several domains, responding to digital IT trends and optimizing services ranging from computing to storage. It serves a diverse spectrum of consumers and extends commercial activities.

6. RedHat

Red Hat is a software company that integrates open source Linux components with related programs into a distribution package. It operates on an open-source ecosystem, focusing on quality assurance, testing, and customer support. Red Hat offers a range of open source software, including operating system platforms, storage, middleware, management products, training, support, and consulting services, used by DevOps engineers and businesses.

3.12 PRIVATE AND OPEN SOURCE CLOUD COMPUTING PLATFORMS

3.12.1. Private cloud computing platforms

1. Eucalyptus:

Eucalyptus is free, open-source software that uses IaaS-style private and hybrid clouds, utilizing a modular and extensible web services-based architecture. It can dynamically scale up or down based on application workloads, making it ideal for enterprise clouds and higher education. The system supports multiple hypervisors, ensures internal communication through SOAP and WS-Security, and offers administrative features like user and group management and reports.

3.12.2. Open source cloud computing platform

1. OpenStack:

Cloud computing makes use of OpenStack. Infrastructure as a Service (Iaas) is utilized. Both public and private clouds may be created with the program. The goal is to use open source software to create a cloud computing platform that can run on standard hardware, offering a user-friendly dashboard for managing storage, networking, and compute resources. A web front-end, big data processing framework, container orchestration engine, messaging, containers, clustering, computing, identity, metadata indexing, events, workflows, DNS, governance, benchmarking, optimization, and deployment are among the capabilities offered.

2. OpenNebula

OpenNebula is an open source package designed for building various cloud deployments, including public, private, hybrid, and community cloud, and is one of the oldest private cloud infrastructure providers. The system offers robust administration capabilities, supports APIs like AWS EC2 and OGF OCCI, and provides security features like SSH and X.509, including token login functionality.

3. Cloud Stack

Cloud Stack is an open-source cloud deployment that effectively manages large networks of virtual machines. Virtual machine networks are managed by Apache CloudStack as an Infrastructure as a Service (IaaS). CloudStack is a high-availability cloud management platform that runs several hypervisors. This program automates the provisioning, creation, and configuration of Infrastructure as a Service (IaaS) components using a cloud orchestration layer. The self-service user interface offers AJAX console access, network virtualization, multi-role usage metering, virtual routers, and LVM support, including block storage volumes, LDAP integration, OpenStack Swift integration, and domain and delegated administration.

4. Nimbus

Nimbus is an open-source software package that enables users to build infrastructure as a service (IaaS) and outsource their services to others. It supports various virtualization types like Xen and KVM hypervisors and focuses on building private or

community IaaS clouds, allowing users to experiment and customize IaaS clouds, and developing custom community-specific solutions.

3.12. CONCLUSION

Chapter 3 explores the transformative impact of cloud computing on library services, highlighting its ability to enhance accessibility, resource management, and interoperability. By utilizing cloud-based platforms, libraries can adapt to the digital landscape, providing users with more flexible access to information resources, reducing technology costs, and improving efficiency and performance.

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CHAPTER IV

CLOUD COMPUTING AT NATIONAL AND INTERNATIONAL LEVEL

4.1. INTRODUCTION

In the era of rapid digital transformation and globalization, libraries are compelled to adapt and innovate to meet the changing needs of their patrons. Cloud computing technology offers libraries a unique chance to revolutionize services and improve accessibility, efficiency, and collaboration on a national and international scale. Cloud-based platforms provide libraries with a flexible and scalable solution for managing resources, disseminating information, and engaging with their communities in innovative ways.

4.2. CLOUD COMPUTING IN INDIAN ACADEMIC LIBRARIES

Academic libraries are linked to higher educational institutions like universities, polytechnics, colleges, and science and technology institutes, tasked with supporting teaching, learning, and research to fulfill the missions of their parent institutions. In India, cloud computing in academic libraries is in its development phase and yet to reach its true potential as it lacks service providers and technical skills. Successful services include digital libraries, web documentation, and web 2.0 technologies like Dura Cloud, OCLC services, and Google-based cloud services. Commercial and open-source vendors are also incorporating cloud computing technology into their services and products, despite not being fully accepted in Indian libraries.

4.3. NATIONAL STUDY OF CLOUD COMPUTING

4.3.1. DESIGN AND IMPLEMENTATION OF THE WORKFLOW OF AN ACADEMIC CLOUD AT IIT DELHI

The study focuses on the development and implementation of an academic cloud workflow at IIT Delhi. It investigates the integration of cloud technologies into academic processes with the goal of improving institutional efficiency, accessibility, and resource management. The study looks at the workflow paradigm, implementation tactics, and the effects of cloud computing on academic services

through Baadal, IITD's private cloud management and orchestration software, which allows administrators and researchers to construct infrastructure for numerous VM instances that can be operated by web or command line on existing resources. Its modular design with well-defined APIs promotes experimentation and innovation in cloud computing solutions that use a virtualization stack. Baadal bridges the gap between private cloud configurations and academic requirement**s.**

4.3.2. MEGHRAJ—INDIA'S CLOUD INITIATIVE

The MeghRaj program, commonly known as "The Indian Cloud," is a government initiative in India that seeks to transform government services and applications through cloud computing. It was established in 2013 and provides a secure, robust cloud infrastructure to encourage innovation, improve citizen services, and drive economic growth. MeghRaj provides a variety of cloud services, including infrastructure-as-a-service (IaaS), platform-as-a-service (PaaS), and software-as-a-service (SaaS), which enable fast data processing, disaster recovery, and business continuity. The plan aspires to make India a prominent digital nation. The MeghRaj initiative in India is leveraging cloud services to revolutionize IT resource access and utilization for government organizations and stakeholders, aiming to improve efficiency, collaboration, and innovation across various sectors.

4.4. SCENARIO OF CLOUD COMPUTING AT INTERNATIONAL LEVEL

Cloud computing is increasingly being adopted by organizations worldwide due to its cost-effectiveness, real-time provisioning, and pay-as-you-go services. This adoption is driven by the evolution of computing paradigms, from standalone to parallel, distributed, and grid-based systems.

4.5. INTERNATIONAL STUDY OF CLOUD COMPUTING

4.5.1. CLOUD COMPUTING: APPLICATIONS OF NEW TECHNOLOGY IN LIBRARIES OF BANGLADESH

The study explores the challenges and potential benefits of cloud computing in Bangladeshi libraries, highlighting both its current adoption and potential future

enhancements. It is advised that the government handle cloud computing safety and privacy issues in a proactive manner. This entails setting up a new team to examine current laws and taking action to guarantee a supportive regulatory atmosphere. To lower obstacles to cloud computing adoption, commercial providers' broadband pricing and regulations should be addressed. The benefits of cloud computing for libraries of all sizes include scalability, resource efficiency, and flexibility. Cloud computing security, privacy, and dependability concerns are recognized. To solve these issues and yet take advantage of cloud computing's advantages, the hybrid cloud model—which blends private and public cloud resources—is suggested. Building and operating data centers together is advised for digital libraries, which might result in the creation of cloud services tailored specifically for libraries. (Sakib, Haque, & Farabi, 2019)

4.5.2. CLOUD COMPUTING FOR INFORMATION SERVICE DELIVERY IN PUBLIC LIBRARIES IN NIGERIA

Cloud computing is a highly scalable platform that offers quick access to hardware and software over the internet, utilizing technologies like digitization, virtualization, and load balancing. It enables the on-demand provision of information technology resources and reduces management complexity. Cloud computing also bridges the gap between digital libraries and IT by facilitating data sharing among libraries in a geographic workstation or database, reducing overall costs. Therefore, it is recommended that libraries, especially public ones, choose their own cloud computing model. This approach is particularly beneficial for bridging the gap between digital and IT. The paper suggests that the application of cloud computing technology in Nigerian public libraries could revolutionize the provision of library and information services. Cloud computing is considered the most effective model for supporting libraries in terms of effective service provisioning, long-term preservation, and perpetual access to data. It is crucial to find a cloud computing service provider who can host, run, and maintain the library data system. Public libraries in Nigeria would be better equipped to manage complex data storage, information, access sharing, and consumption. The paper calls on library managers, librarians, and their libraries to adopt cloud computing as a platform for running library consortiums on a private

cloud computing model and on the service layer of Software as a Service (SaaS). (Onu, Okorie, & Onwubiko, 2019)

4.5.3. LIBRARIANS' AWARENESS AND ATTITUDE TOWARDS DEPLOYMENT OF CLOUD COMPUTING TECHNOLOGIES IN UNIVERSITY LIBRARIES IN SOUTH-SOUTH NIGERIA

In the age of technology, libraries must adapt to user needs and provide the best service using information and communication technology (ICT). In south-south Nigeria, cloud computing is relatively new, and librarians need to focus on providing proactive services and personalizing information services for the university community. Advanced training for librarians is needed for the effective deployment of cloud computing. By allowing IT companies to handle computer hardware and software, libraries can focus more directly on services and materials for patrons. To respond to this trend, university libraries should make their services easily accessible via web-enabled devices and make conscious choices about what they want to offer, enabling them to become round-the-clock service providers. The study analyzed the awareness and attitude of 246 South-South Nigerian university librarians towards cloud computing technologies. Results showed a low level of awareness but high attitudes towards deployment. The study recommends organizing workshops on cloud computing technology for library professionals and providing adequate funding, training, and re-training for librarians. (Idhalama & Fidelis , 2020)

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CHAPTER V

DATA ANALYSIS AND INTERPRETATION OF DATA

This chapter deals with the analysis and interpretation parts. The researcher used the survey method for data collection, wherein 50 questionnaires were sent out to the respondents through Google Forms, and 44 responses were received. The response rate to this leads to a high of 88%. The data was obtained from librarians of academic college libraries in the state of Goa. Data analysis is carried out under the objectives of this study. The data is represented using appropriate charts, tables, and graphs.

5.1. Experience in the Field

A question was asked to the librarians to know their experience in the library field.

Experience in the library field	Respondents
0-5	13
6-10	12
11-20	8
More than 20 years	11

Table 5.1: Experience in the library field

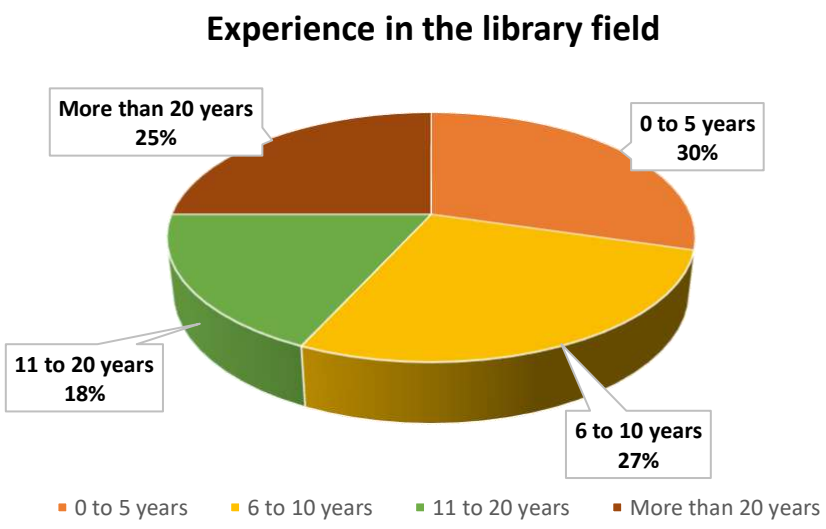

Fig. 1: Experience in the library field

Fig.1 Shows the experience of librarians in the library field the data indicates a diverse distribution among respondents. The majority of respondents fall within the 0–5 year and 6–10 year categories, with 13 and 12 respondents, respectively. Additionally, there are 8 respondents within 11–20 years of experience and 11 respondents with more than 20 years of experience.

5.2. Familiarity Levels with Cloud Computing in Libraries

A question was asked to know how much knowledge and insight the respondents have regarding the incorporation of cloud computing technology into libraries.

Familiarity levels	Respondents	%
Very familiar	27	61.4
Somewhat familiar	13	29.5
Not so familiar	4	9.1
Unknown	0	0
Total	44	100

Table 5.2: Familiarity levels

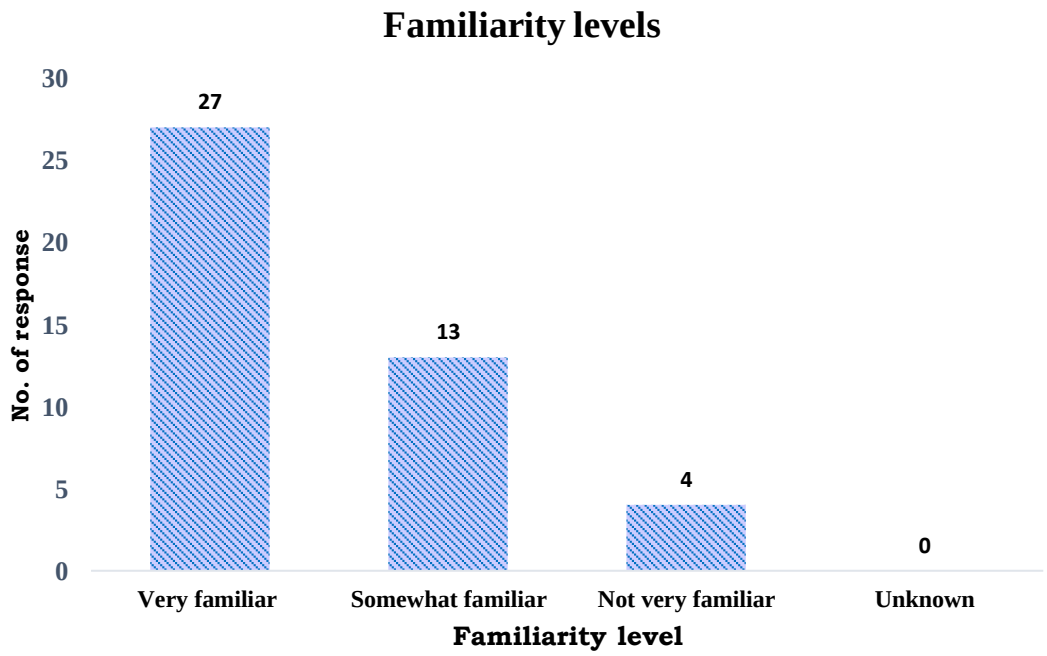

Fig. 2: Familiarity level

Figure 2 depicts the familiarity levels of respondents with cloud computing in libraries. Accordingly, 61.4% of respondents reported being very familiar with the incorporation of cloud computing technology into libraries. Followed by, 29.5% respondents stating some level of familiarity. While the remaining 9.1% of respondents indicated that they were not so familiar with cloud computing technology for libraries, this shows that all the respondents have some understanding of cloud-based technologies for libraries.

5.3. Use of a Cloud-Based Platform for Library Services.

A question was asked about which libraries are currently using a cloud-based platform for providing library services.

Use of the cloud-based platform	Respondents	%
Yes	40	90.9
No	4	9.1
Total	44	100

Table 5.3: Use of the cloud-based platform

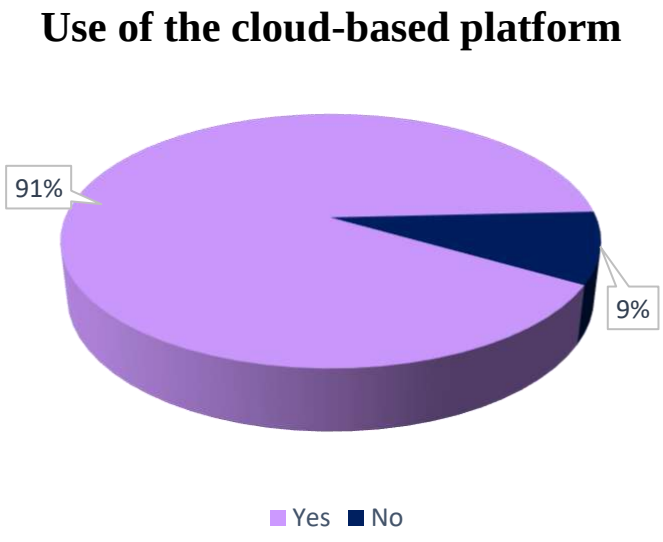

Fig. 3: Use of the cloud-based platform

Figure 3 reveals the utilization of a cloud-based platform for library services. According to the data received, 90.9% of respondents reported that their libraries currently employ a cloud-based platform for providing services. Conversely, 9.1% of respondents do not utilize such technologies. This suggests that a significant majority of libraries have adopted cloud technology for their services, while it remains noteworthy that some libraries have yet to make this transition.

5.4. Cloud Services Available for Library Users

When asked about which cloud services can be used by library users from the point of view of leveraging cloud computing technology in libraries concerning accessibility and service quality

Sr.no.	Services	Respondents	%
1.	Social Networking (ex., Facebook, Twitter)	18	40.9
2.	Calendar Services (ex., Google Calendar, doodle)	9	20.5
3.	File sharing Services (ex., dropbox, Google Drive)	25	56.8
4.	Online representation (ex., YouTube, Google presentation)	16	36.4
5.	Federated search via web using (OPAC)	27	61.4
6.	Integrated Library System (ILS)	29	65.9
7.	Web hosting	14	31.8
8.	Global OPAC	17	38.6
9.	Document download service	19	43.2
10.	Collection development	19	43.2
11.	Information literacy/orientation	15	34.1
12.	Online resources sharing	27	61.4
13.	Digital library interlibrary and intralibrary loan	21	47.7
14.	Online file editing services (ex., Picasa)	11	25

Table 5.4: Cloud services available for library users

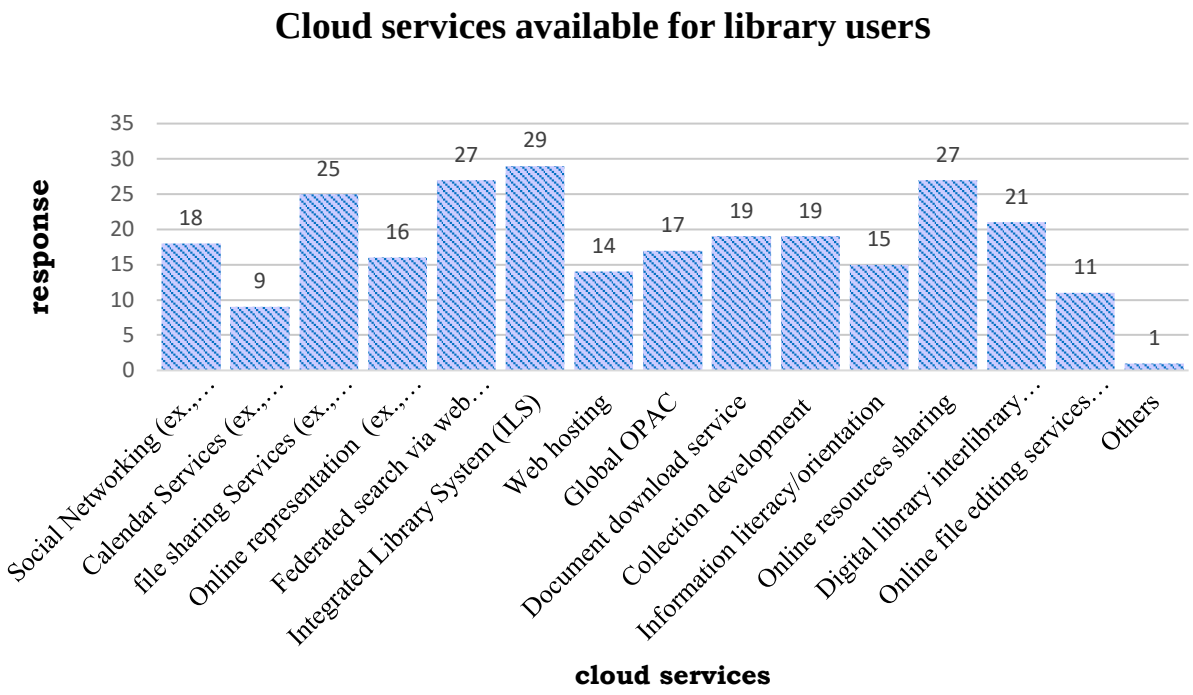

Fig. 4: Cloud services available for library users

Figure 4 depicts the cloud services available for library users. The respondents were given the choice to choose multiples options as per their requirements. About 65.9% of respondents endorsed the Integrated Library System (ILS), 56.8% recognized the value of platforms like Dropbox and Google Drive in facilitating seamless sharing and collaboration among library users, around 61.4% respondents acknowledged the importance of cloud-based platforms in sharing digital resources effectively, enabling broader access for patrons, and 61.4% expressed their interest in leveraging cloud-based federated search capabilities, indicating a strong desire for efficient resource discovery. Document download service and collection development both garnered substantial attention, with 43.2% of respondents endorsing each, highlighting the significance of cloud platforms in managing and disseminating library collections. Digital library, interlibrary and intralibrary loan 47.7% of respondents identified the importance of cloud technologies in streamlining interlibrary loan processes. Social networking and online representation, while not as highly ranked, still received notable attention, with 40.9% and 36.4% of respondents, respectively, indicating an interest in leveraging platforms like Facebook, Twitter, and YouTube to enhance

library outreach and engagement. Calendar services and web hosting, with 20.5% and 31.8% of respondents endorsing them, respectively. 2.3% of respondents have suggested Canva as another option. The results highlight the increasing significance of cloud computing in libraries, providing chances to improve customer service quality, accessibility, and collaboration.

5.5. The Reasons Behind Not Using Cloud Computing

The researcher through this question, tried to find out the reasons behind not using cloud computing operations.

Sr. no.	Reasons	Respondents	%
1.	Lack of awareness	11	25
2.	Security of Data	4	9.1
3.	Fear of loss of Control	1	2.3
4.	Internet connectivity issues (bandwidth)	6	13.6
5.	Administrative Constraints	6	13.6
6.	Insufficient/ lack of funding	9	20.5
7.	Not applicable	27	61.6
8.	Others	1	2.3

Table 5.5: Reasons behind not using cloud computing

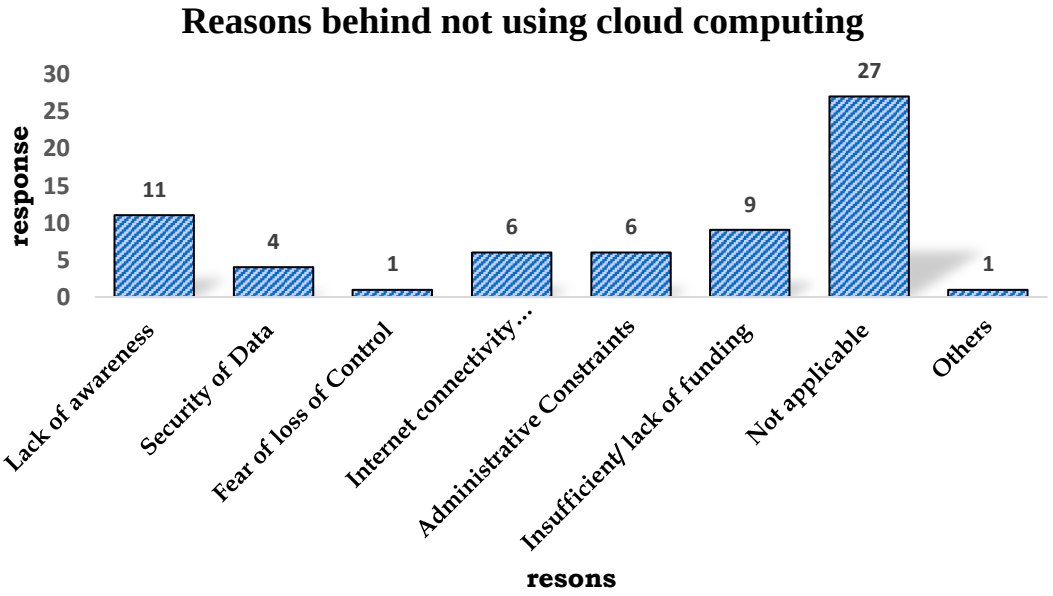

Fig. 5: Reasons behind not using cloud computing

Figure 5 depicts the reasons behind not using cloud computing. Approximately 25% of respondents cited lack of awareness as a barrier to adopting cloud computing operations. Security concerns were mentioned by 9.1% of respondents. A small percentage (2.3%) expressed fears regarding loss of control over data and operations when transitioning to cloud computing. Approximately 13.6% of respondents cited internet connectivity issues, particularly bandwidth limitations, as a barrier. Similarly, 13.6% mentioned administrative constraints as an obstacle to adopting cloud operations. 20.5% of respondents identified insufficient or a lack of funding as a barrier. A significant majority (61.6%) indicated that this question is not applicable as per the above question. A small portion (2.3%) mentioned other libraries in the phase of establishment. The result highlights that addressing barriers such as awareness, security concerns, connectivity issues, administrative constraints, and funding limitations is crucial for promoting wider adoption of cloud computing operations in libraries.

5.6. Willingness to Provide Cloud-Based Library Services to Users.

A question about willingness to provide cloud-based library services to users was asked to librarians in the course of the study to understand their perspectives, concerns, and readiness regarding the adoption of cloud-based technologies within library services.

Willingness to provide cloud-based library services to users	Respondents	%
Yes	43	97.7
No	1	2.3

Table 5.6: Willingness to provide cloud-based library services to users

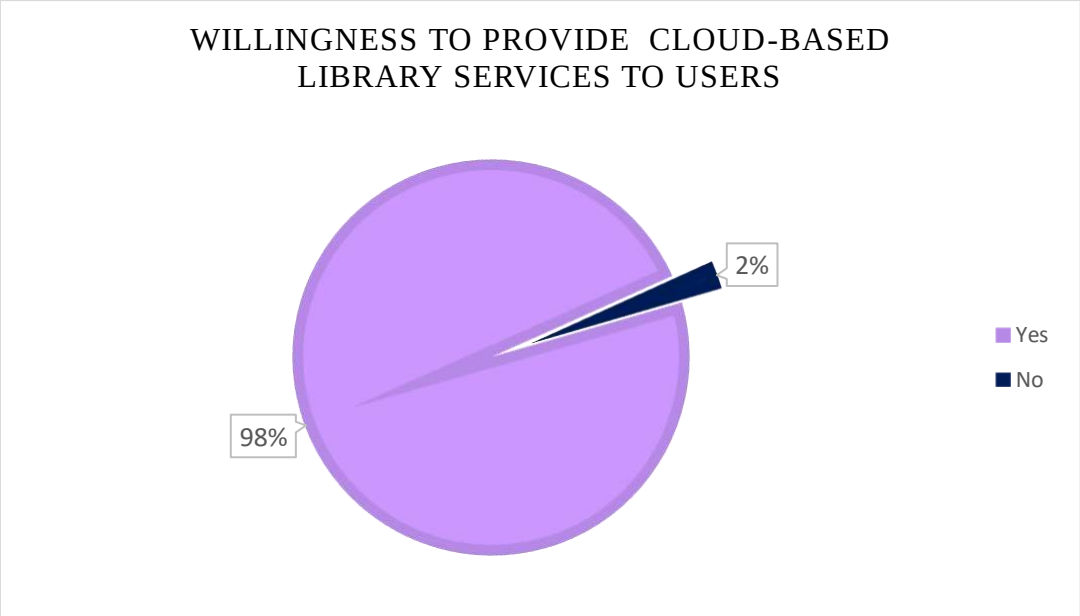

Fig.6: Willingness to provide cloud-based library services to users

Above figure 6 Shows that the majority of librarians surveyed, 97.7% are willing to provide cloud-based library services to users. Only a very small minority 2.3% expressed unwillingness. This indicates a strong positive inclination towards adopting cloud-based technologies within library services among the respondents

5.7. Purpose of Using Cloud-Based Services.

A question was asked to librarians about the use of cloud-based services in research, which resonates with understanding the potential benefits and motivations behind adopting cloud technology in library settings.

Sr.no.	Purpose	Respondents	%
1.	To assist users in the identification of information sources through a federated search along with their economic aspects	32	72.7
2.	To store the output of collaborative research	23	52.3
3.	To use it for file-sharing services for users (ex: Google Drive, Dropbox)	30	68.2
4.	To store newly created documents in the office	28	63.6
5.	To enable library users in information retrieval (ex., web search)	32	72.7
6.	To assist in providing document delivery services to users.	27	61.4
7.	To create, upload, and save newsletters, new arrivals, and forthcoming events for the user community	24	54.5
8.	To record maintenance, storage, or create alerts for users based on SDI	21	47.7
9.	To provide web-based tutorials for library users.	20	45.5
10.	To Information literacy/orientation	22	50

Table 5.7: Purpose of using cloud-based services.

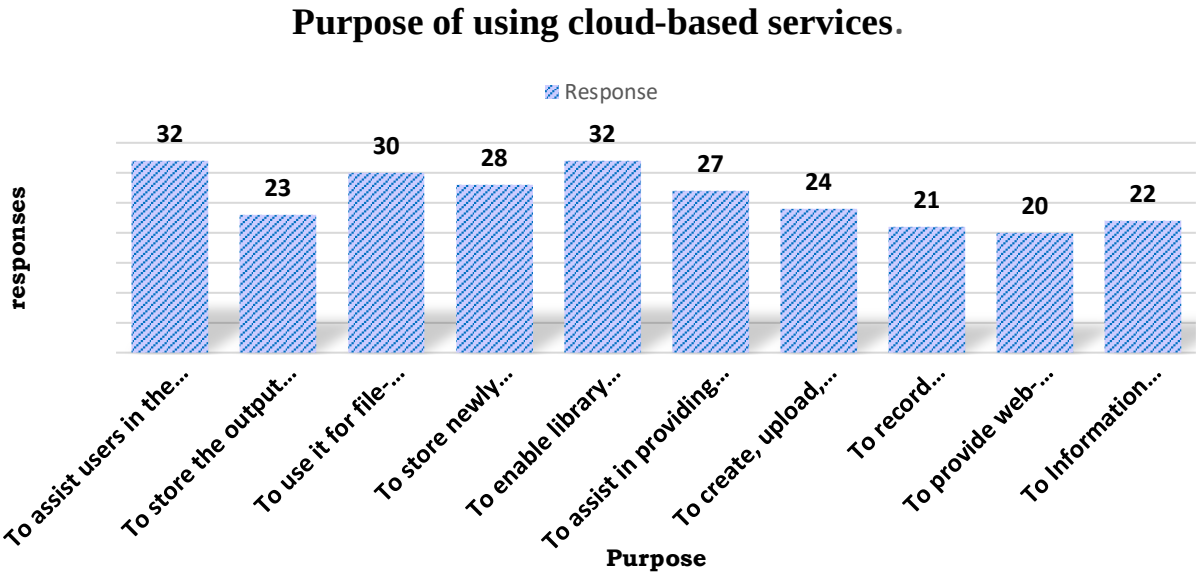

Fig. 7: Purpose of using cloud-based services.

In Figure 7, numerous reasons why librarians use cloud-based services in research-oriented library contexts are highlighted. The majority of respondents (72.7%) emphasized the value of cloud-based federated search tools for assisting users in identifying information sources. Over half of the respondents (52.3%) highlighted the significance of cloud storage for storing outputs from collaborative research endeavors. A substantial percentage (68.2%) emphasized the use of cloud-based file-sharing services like Google Drive and Dropbox. Moreover, a majority of respondents (63.6%) recognized the value of cloud storage for storing newly created documents within the office. Additionally, 72.7% emphasized the role of cloud technologies in enabling efficient information retrieval, including web search capabilities. Furthermore, 61.4 percent highlighted the importance of cloud-based systems in assisting with document delivery services for users. A proportion of respondents (54.5%) emphasized the use of cloud platforms for creating, uploading, and saving newsletters, new arrivals, and event announcements for the user community. Moreover, the respondents (47.7%) highlighted the potential of cloud-based systems for recording maintenance activities, storage management, or creating user alerts based on selective dissemination of information (SDI). For providing web-based tutorials and information literacy/orientation sessions, a significant percentage of respondents (45.5% and 50%, respectively) emphasized the value of cloud-based

platforms. The analysis highlights the diverse ways in which librarians leverage cloud-based services to enhance research support, collaboration, information access, communication, and user education within library environments.

5.8. The Main Challenges in Delivering Library Services via Traditional Methods.

A question was asked about the difficulties faced when providing library services using conventional approaches. It seeks to understand the obstacles encountered in delivering library services through traditional means.

Sr. No.	challenges in delivering library services via traditional methods	Respondents	%
1.	Limited storage space	33	75
2.	Difficulties with resource management and sharing	18	40.9
3.	Lack of scalability	10	22.7
4.	High infrastructure costs	24	54.5
5.	Obsolete technology	10	22.7
6.	Security concerns	19	43.2
7.	Data accessibility issues	19	43.2
8.	Others	0	0

Table 5.8: Challenges in delivering library services via traditional methods

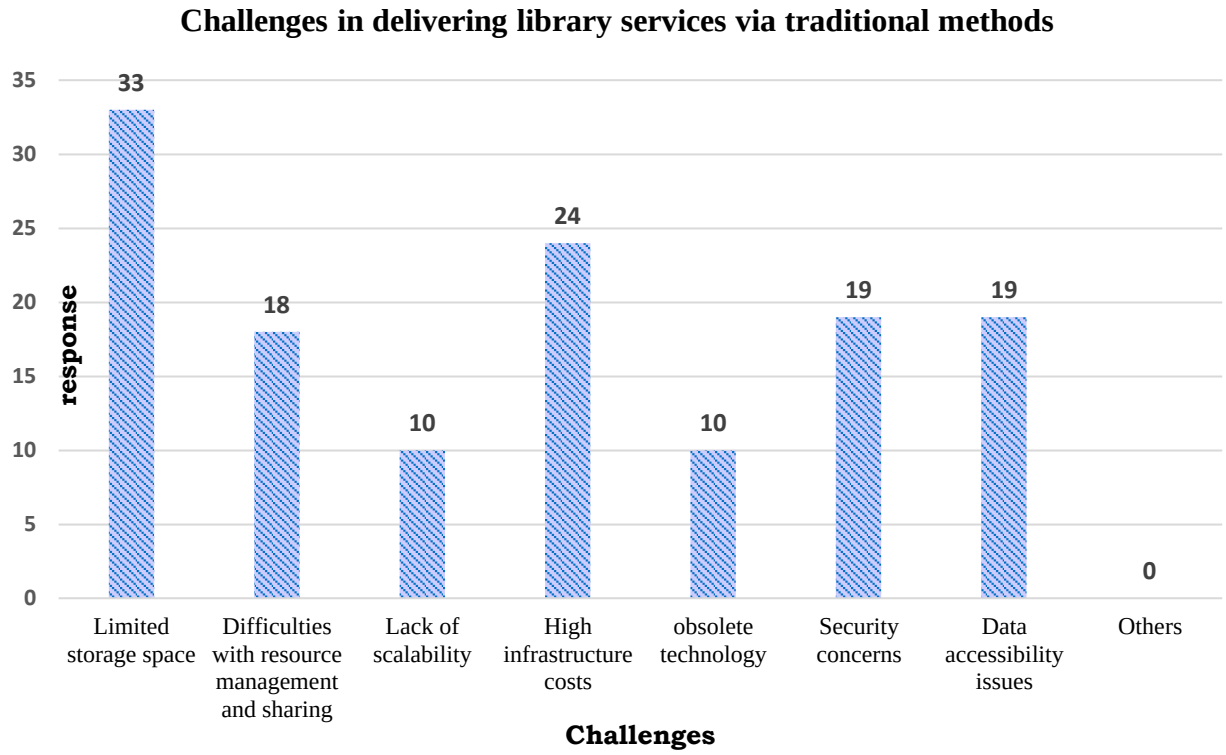

Fig. 8: challenges in delivering library services via traditional methods

Figure 8 indicates the main challenges in delivering library services via traditional methods. Limited storage capacity was the most frequently cited difficulty, with 75% of respondents identified the same it. Followed by 40.9%, who reported challenges in effectively managing and sharing resources, 54.5% cited high infrastructure costs as a significant challenge, and 43.2% expressed concerns about security. Another 43.2% of respondents highlighted difficulties in ensuring data accessibility; 22.7% said scalability remains a noteworthy challenge; and 22.7% said outdated technology poses a barrier to delivering efficient library services.

5.9. Scalability of Library Services

A question was inquiring about the ability of library services to expand or adapt to accommodate larger numbers of users or increasing demands over time.

Sr. no.	Scalability of library services	Respondents	%
1.	Flexibility in resource allocation	28	63.6
2.	Remote access to resources	38	86.4
3.	Collaborative resource sharing	32	72.7
4.	Scalable database management	19	43.2
5.	Quick implementation of new services	26	59.1
6.	Cost-effective scaling	23	52.3
7.	Others	0	0

Table 5.9: Scalability of library services

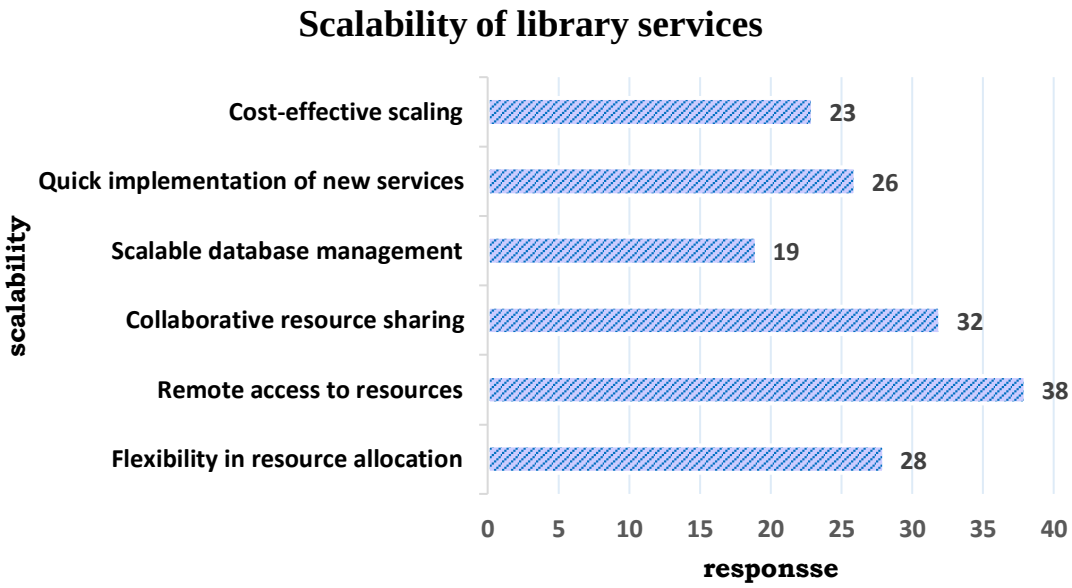

Fig. 9: Scalability of library services

Fig. 9 shows the scalability of library services. 52.3% of respondents recognized the significance of cost-effective scaling in library services. Whereas 59.1% of respondents emphasized the importance of quick implementation of new services. 43.2% of respondents mentioned scalable database management as essential to the

scalability of library services. 72.7% of respondents highlighted a strong consensus on the value of partnerships and cooperation among libraries and other institutions. 86.4% of respondents indicating the importance of remote access to resources for scalability. 63.6% of respondents believed that libraries should be able to dynamically allocate resources in order to effectively meet changing demands.

5.10. Training or Assistance in Implementing Cloud-Based Library Services.

A question is about whether they received any training or assistance in implementing library services that are based on cloud computing technology. It seeks to understand whether training or assistance is available to help libraries transition to and effectively utilize cloud-based solutions for their services.

Training or assistance in implementing cloud-based library services	Respondents	%
Yes	9	20.5
No	35	79.5
Total	44	100

Table 5.10: Training or assistance in implementing cloud-based library services.

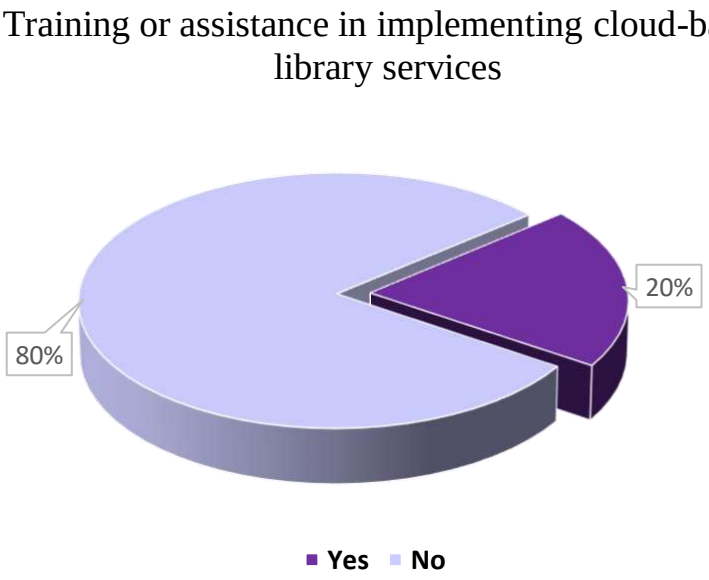

Fig. 10: Training or assistance in implementing cloud-based library services.

Fig. 10 is about whether they received any training or assistance in implementing library services that are based on cloud computing technology 20.5% of respondents indicated that they received training or assistance in implementing cloud-based library services, followed by 79.5% of respondents who stated that they did not receive any training or assistance in implementing cloud-based library services. This proves that majority of the respondent need training program for proving better cloud based services to the users of the library

5.11. Regular Upskilling of Staff to Adopt Cloud-Based Library Services

A question is about finding out whether librarians believed that staff members' regular upskilling was required for the acceptance and efficient use of cloud-based library services.

Regular upskilling of staff	Respondents	%
Yes	**44**	**100**
No	**0**	**0**
Total	**44**	**100**

Table 5.11: Regular upskilling of staff to adopt cloud-based library services

Table 5.11 showed that all 44 respondents agreed that regular staff training is necessary for the acceptance and efficient use of cloud-based library services.

5.12. Library Services that Cloud Technology Could Improve or Enhance

This question was asked in a research context to explore the potential impact of cloud technology on various library services. By identifying specific areas where cloud technology could improve or enhance library services, researchers can gain insights into the potential benefits and challenges associated with implementing cloud-based solutions in libraries.

Sr. no.	Description	Respondents	%
1.	Library management system	34	77.3
2.	Digital collections and resources	38	86.4
3.	Research tools	31	70.5
4.	User authentication	21	47.7
5.	Data analytics and reporting	28	63.6
6.	Collaboration	27	61.4
7.	Mobile app services	28	63.6

Table 5.12: Library services that cloud technology could improve or enhance

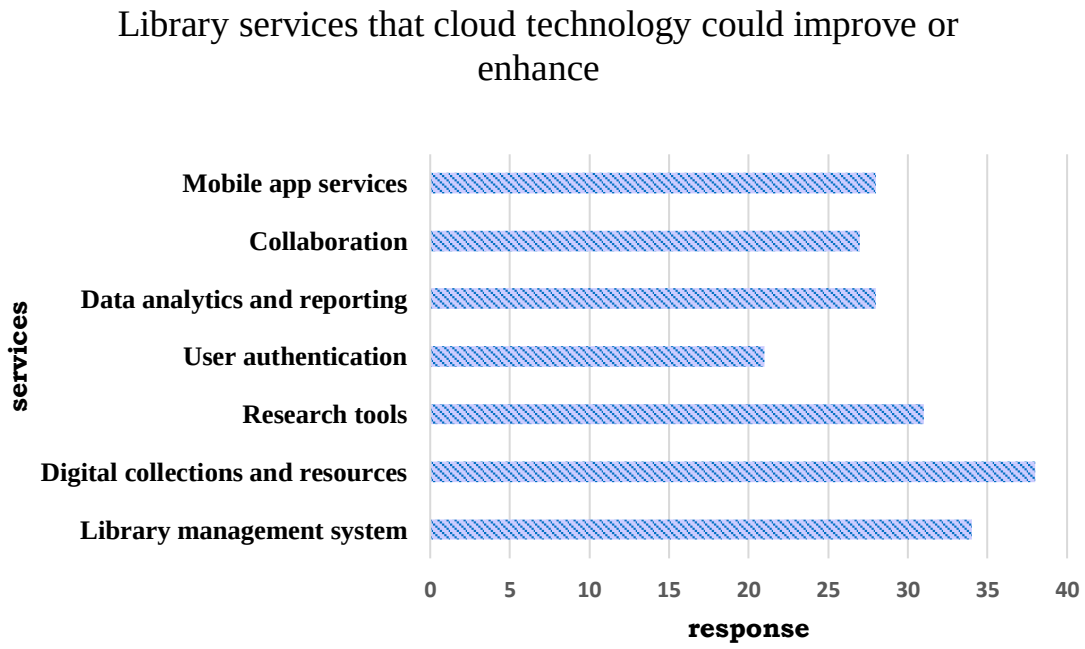

Fig. 11: Library services that cloud technology could improve or enhance

Fig.11. shows Library services that cloud technology could improve or enhance. With 77.3% of respondents identifying LMS as an area where cloud technology could enhance library services, substantial 86.4% of respondents see the potential for cloud technology to improve digital collections and resource management in libraries, bout 70.5% of respondents recognize the potential of cloud technology to enhance research tools in libraries. 47.7%, the recognition of cloud technology's potential to improve user authentication processes in libraries is still significant, 63.6% of respondents acknowledging the potential of cloud technology in data analytics and reporting, similarly, 61.4% of respondents see the potential for cloud technology to enhance collaboration among library staff and patrons, with 63.6% of respondents identifying mobile app services as an area where cloud technology could make a difference, it indicates a recognition of the importance of providing library services on mobile devices. The responses highlight a broad acknowledgment of the potential benefits of cloud technology across various library services, including management systems, digital resources, research tools, authentication, analytics, collaboration, and mobile services.

5.13. Entities or Capabilities in an Ideal Cloud-Based Library Platform

A question was asked to gain insights into the desired features and capabilities that librarians seek in an ideal cloud-based library platform. Understanding librarians' preferences helps researchers and developers design platforms that meet the specific needs and challenges faced by libraries transitioning to cloud technology.

Sr. no.	Description	Respondents	%
1.	Ease of use and intuitive interface	35	79.5
2.	Scalability to accommodate future growth	25	56.8
3.	Multi-language support	26	59.1
4.	Integration with existing library systems	27	61.4
5.	Customizable features and workflows	26	59.1
6.	Robust security features	17	38.6
7.	Data backup and disaster recovery	34	77.3
8.	Open-source technology	32	72.7
9.	Others	0	0

Table 5.13: Entities or capabilities in an ideal cloud-based library platform

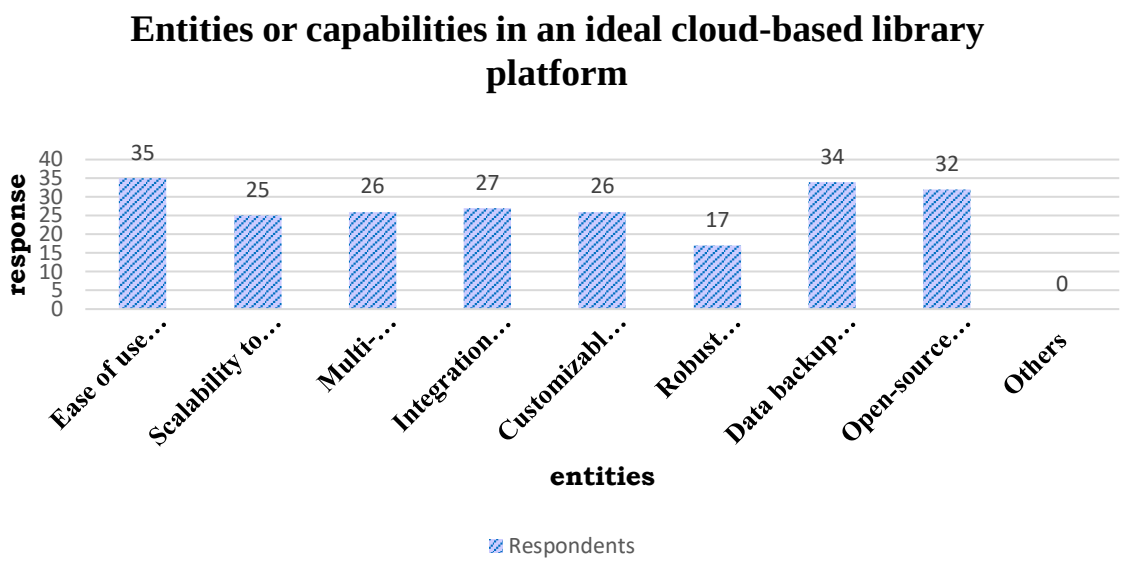

Fig. 12: Entities or capabilities in an ideal cloud-based library platform

Fig. 12 provides valuable insights into the key entities and capabilities that librarians prioritize in an ideal cloud-based library platform. With nearly 79.5% of respondents emphasizing the aspect of "Ease of Use and Intuitive Interface," it is clear that librarians highly value a platform that is easy to navigate and user-friendly. Over half of the respondents (56.8%) highlighted the importance of scalability, indicating a need for platforms that can grow and adapt to meet evolving demands for services, resources, and users. A significant portion of respondents (59.1%) expressed the importance of multi-language support, reflecting the diversity of library users and the need for inclusivity. Integration with existing systems was identified as a critical capability by 61.4% of respondents. Nearly 60% of respondents emphasized the need for customizable features and workflows. While not as highly prioritized as other capabilities, robust security features were still valued by 38.6% of respondents. The majority of respondents (77.3%) highlighted the importance of data backup and disaster recovery capabilities. A significant portion of respondents (72.7%) expressed a preference for platforms built on open-source technology. By understanding librarians' preferences and needs, researchers and developers can create solutions that effectively address the challenges and opportunities associated with transitioning to cloud technology in the library setting.

5.14. Opportunities to Connect with Goa's Underprivileged Users through Cloud Services

A question was asked to explore the potential benefits and opportunities of leveraging cloud services to connect with underprivileged users in Goa.

Sr. no.	Opportunities	Respondents	%
1.	Providing access to library resources and services beyond physical library walls	40	90.9
2.	Bridging the digital divide	30	68.2
3.	Offering online learning and literacy programs	34	77.3
4.	Promoting cultural heritage and local languages	24	54.5
5.	Serving people with disabilities	30	68.2
6.	Promote distinct education programme	30	68.2
7.	Others	0	0

Table 5.14: Opportunities to connect with Goa's underprivileged users through cloud services

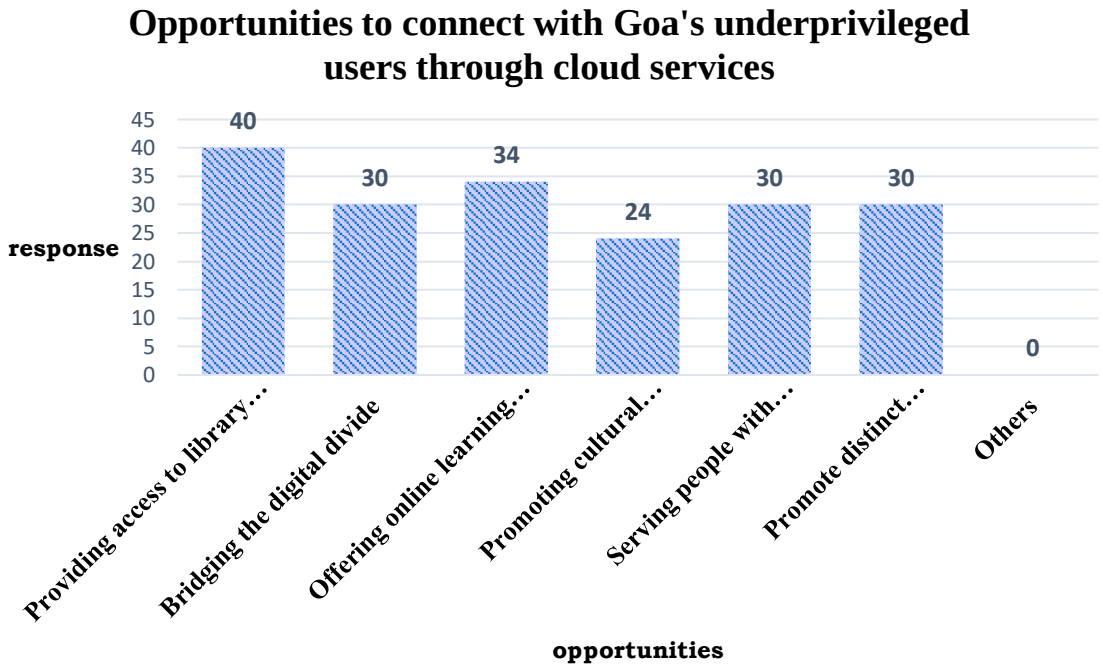

Fig. 13: Opportunities to connect with Goa's underprivileged users through cloud services

Fig. 13 shows the significant opportunities for leveraging cloud services to connect with underprivileged users in Goa. An overwhelming 90.9% of respondents recognize the potential of cloud services to extend access to library resources and services beyond the confines of physical library spaces, whereas 68.2% of respondents see cloud services as a means to bridge the digital divide. Cloud services present an opportunity to offer online learning and literacy programs, as highlighted by 77.3% of respondents. A significant portion of respondents (54.5%) recognize the potential of cloud services in promoting cultural heritage and local languages. Cloud services can be leveraged to create inclusive digital environments that cater to the needs of people with disabilities, as identified by 68.2% of respondents. 68.2% of respondents see an opportunity to promote distinct education programs through cloud services. It demonstrates that cloud services offer a multitude of opportunities to connect with underprivileged users in Goa. These initiatives have the potential to empower underprivileged communities, enrich lives, and foster inclusive growth and development in the region.

5.15. Alliances that Encourage Goan Libraries to Use Cloud-Based Services

A question was asked to librarians in a research context to understand the potential partnerships and alliances that could be leveraged to promote the adoption of cloud-based services in Goan libraries.

Sr. no.	Description	Respondents	%
1.	Government agencies	29	65.9
2.	Library associations	37	84.1
3.	Technology companies	16	36.4
4.	Educational institutions	36	81.8
5.	Non-profit organizations	13	29.5
6.	Others	0	0

Table 5.15: Alliances that encourage Goan libraries to use cloud-based services

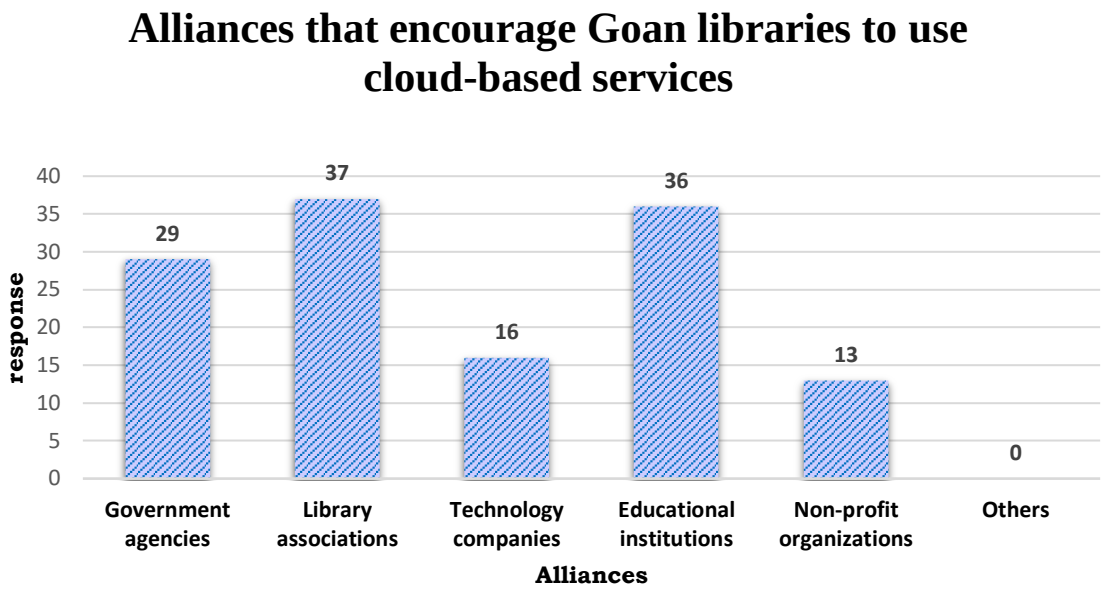

Fig. 14: Alliances that encourage Goan libraries to use cloud-based services

Fig. 14 shows the alliances that could encourage Goan libraries to adopt cloud-based services. A significant majority of respondents (84.1%) identified library associations as potential partners. 81.8% of respondents see educational institutions as important allies in promoting the adoption of cloud-based services. Nearly two-thirds of respondents (65.9%) identified government agencies as potential partners. While not as highly prioritized as other entities, technology companies still represent a valuable resource. According to 36.4% of respondents and a smaller percentage of respondents (29.5%), non-profit organizations can still play a valuable role in supporting libraries' transition to cloud-based services. It suggests that building strategic alliances with library associations, educational institutions, government agencies, technology companies, and non-profit organizations can facilitate the adoption of cloud-based services in Goan libraries.

5.16. Methods to Increase the Awareness and Use of Cloud Computing

The researcher tried to find out what remedial steps may be taken to popularize and maximize the use of cloud services in the academic libraries under survey.

Sr.no.	Methods to increase the awareness and use of cloud computing	Respondents	%
1.	A sufficient number of computers in the Library	28	63.6
2.	High bandwidth Internet connectivity	32	72.7
3.	Tutorials/Demonstrations/Training on the use of Cloud Computing	40	90.9
4.	Seminars/Workshops	36	81.8

Table 5.16: Methods to increase the awareness and use of cloud computing

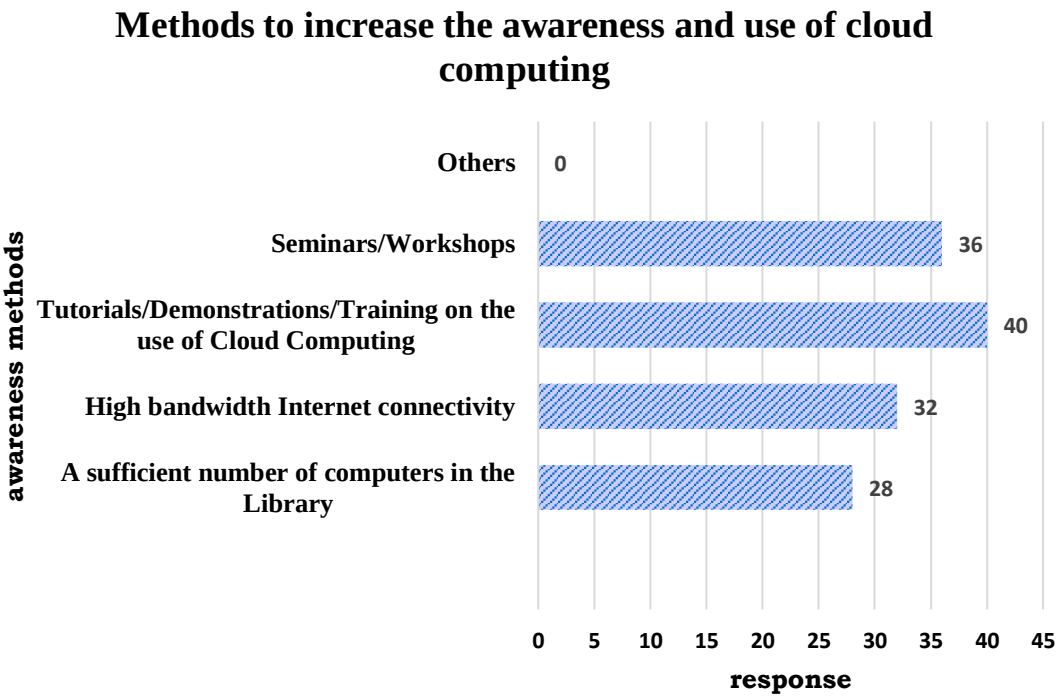

Fig. 15: Methods to increase the awareness and use of cloud computing

Fig. 15 shows the methods to increase awareness and usage of cloud computing in academic libraries. The majority of respondents (90.9%) identified tutorials, demonstrations, and training sessions as essential methods for increasing awareness and use of cloud computing. Similarly, 81.8% of respondents emphasized the

effectiveness of seminars and workshops in promoting awareness and adoption of cloud computing. A significant majority of respondents (72.7%) highlighted the importance of high-bandwidth internet connectivity in facilitating the use of cloud computing. Additionally, 63.6% of respondents emphasized the need for a sufficient number of computers in the library to promote the use of cloud computing. It suggests that providing tutorials, demonstrations, and training sessions, organizing seminars and workshops, ensuring high-bandwidth internet connectivity, and maintaining a sufficient number of computers in the library are crucial methods for increasing awareness and use of cloud computing in academic libraries.

5.17. Benefits Using of Cloud Computing

A question was asked about the advantages of employing cloud computing technology in library services. It aims to understand the benefits and advantages that cloud computing can offer to libraries.

Sr. no.	Benefits	Respondents	%
1.	Reduced Costs	33	75
2.	Ease of Use/ Implementation	31	70.5
3.	Avoiding Hardware/ Software	28	63.6
4.	Easy Collaboration	27	61.4
5.	Auto-made of functioning	19	43.2
6.	Higher access and usability	34	77.3
7.	others	0	0

Table 5.17: **Benefits Using of Cloud Computing**

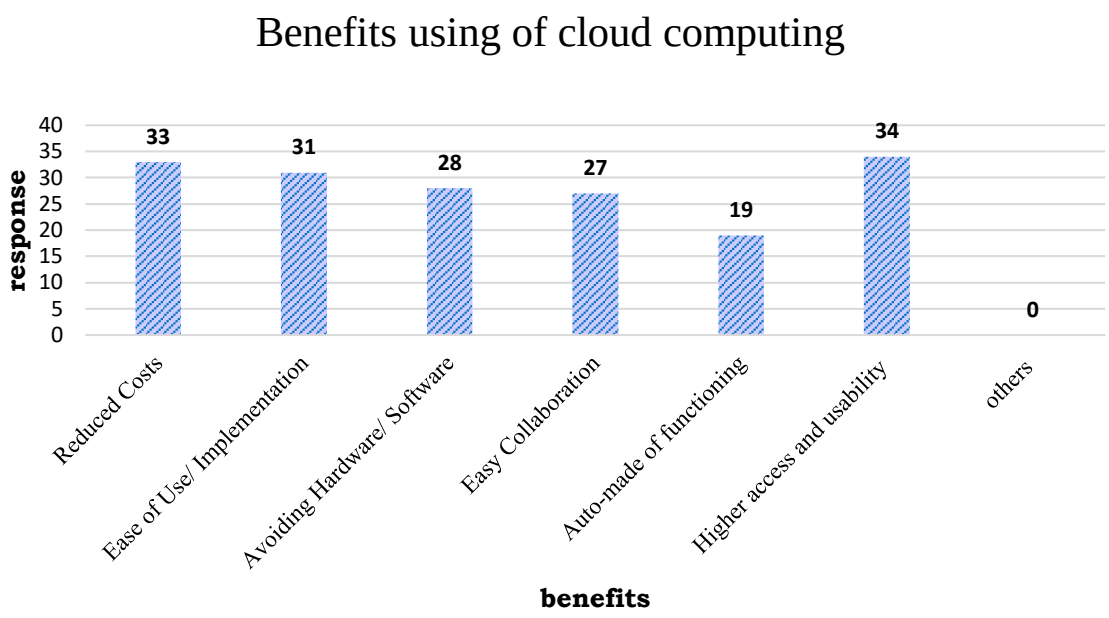

Fig. 16: Benefits using of cloud computing

Fig. 16 shows several advantages of employing cloud computing technology in library services. The majority of respondents (75%) recognize cost reduction as a significant benefit of cloud computing. A significant portion of respondents (70.5%) cited ease of use and implementation as a key advantage of cloud computing. Over 60% of respondents (63.6%) identified avoiding the need for hardware and software procurement as a benefit of cloud computing. Cloud computing facilitates easy collaboration among library staff and patrons, as highlighted by 61.4% of respondents. While slightly less emphasized, 43.2% of respondents recognized the benefit of automation in cloud computing. The majority of respondents (77.3%) identified higher access and usability as a significant advantage of cloud computing. The survey findings demonstrate that cloud computing offers several benefits to libraries, including reduced costs, ease of use and implementation, avoidance of hardware and software procurement, easy collaboration, automation of functions, and higher access and usability.

5.18. Levels of Technical Expertise

Librarians were asked to assess their level of technical expertise in key areas relevant to the adoption and implementation of technology in libraries.

Technical expertise	Respondents	%
I. Cloud computing concepts		
Expert	2	4.6
Intermediate	30	68.1
Beginner	10	22.7
No knowledge	2	4.6
II. Data security and privacy		
Expert	1	2.3
Intermediate	23	52.2
Beginner	15	34.1
No knowledge	5	11.4
III. System Administration		
Expert	2	4.5
Intermediate	29	65.9
Beginner	8	18.2
No knowledge	5	11.4
IV. User support		
Expert	9	20.45
Intermediate	26	59.09
Beginner	7	15.91
No knowledge	2	4.55

Table 5.18: **levels of technical expertise**

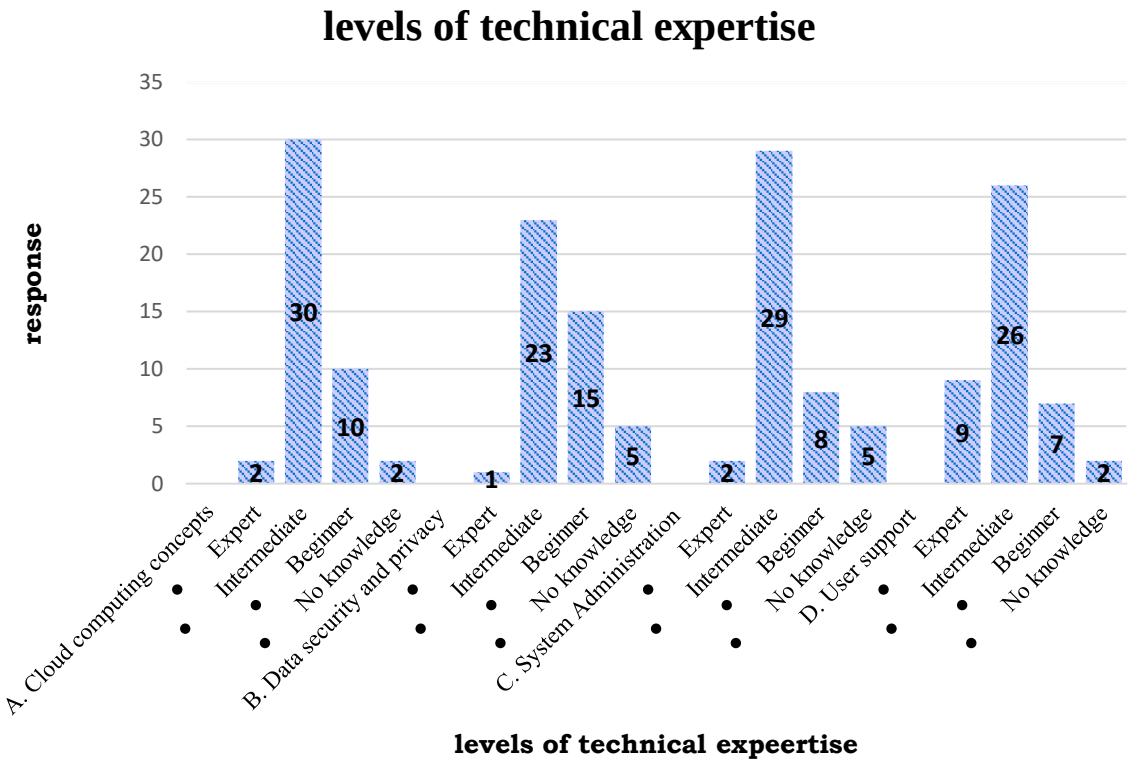

Fig. 17: **levels of technical expertise**

Fig. 17 shows insights into the levels of technical expertise among librarians in key areas relevant to the adoption and implementation of technology in libraries:

Cloud Computing Concepts: A majority of respondents (68.1%) self-identified as having intermediate-level expertise in cloud computing concepts, a smaller proportion identified themselves as beginners (22.7%). Only a minority claimed to be either experts (4.6%) or had no knowledge (4.6%) of cloud computing.

Data Security and Privacy: Similar to cloud computing, the majority of respondents (52.2%) considered themselves to have intermediate-level expertise in data security and privacy. A significant portion of respondents also identified themselves as beginners (34.1%). A smaller proportion claimed expertise (2.3%) or no knowledge (11.4%) in data security and privacy.

System Administration: Again, the majority of respondents (65.9%) rated themselves as having intermediate-level expertise in system administration; a notable portion of respondents identified themselves as beginners (18.2%); a smaller proportion claimed expertise (4.5%) or no knowledge (11.4%) in system administration.

User Support: The majority of respondents (59.09%) considered themselves to have intermediate-level expertise in user support. A significant portion also identified themselves as experts (20.45%) in user support. A smaller proportion rated themselves as beginners (15.91%) or claimed to have no knowledge (4.55%) of user support. While many librarians demonstrate intermediate-level expertise in key technical areas relevant to library technology adoption, there is still a need for additional training and support, particularly among those who consider themselves beginners.

CONCLUSION

The chapter explores the use of cloud computing in Goa's academic college libraries and discovers a considerable preference for cloud services. However, obstacles such as a lack of awareness, security concerns, and financial constraints remain. Strategic connections with government agencies, educational institutions, and technology corporations could be beneficial. Cloud computing provides advantages such as cost savings, improved collaboration, and resource availability. However, continual training and support are required for beginners to properly exploit cloud technologies in library environments.

CHAPTER VI

FINDINGS, SUGGESTIONS, HYPOTHESIS TESTING, CONCLUSION

6.1. FINDINGS

This chapter explores the key findings. Based upon the data analysis carried out on collecting data with respect to the libraries through the cloud: reinventing library services through cloud-based platforms in academic libraries in Goa. The major findings have been summarized as follows:

1. The survey asked librarians about their experience in the library field. Majority of respondents were between 0 to 5 years and 6 to 10 years, with 13 and 12 respondents, respectively. There were also 8 respondents with 11–20 years of experience and 11 respondents with more than 20 years of experience.

2. The survey revealed that 61.4% of respondents were very familiar with the integration of cloud computing technology into libraries, followed by 29.5% who have some familiarity and 9.1% who are not so familiar. This indicates that all respondents have some understanding of cloud-based technologies for libraries, indicating a high level of familiarity with the technology.

3. A question was asked about which libraries are currently using a cloud-based platform for providing library services. The results show that a significant majority, i.e., 90.9% of libraries, have adopted cloud technology for their services, while it remains noteworthy that some libraries have yet to make this transition.

4. When asked about which cloud services can be used by library users, the results show the integrated library system stands out, with the highest percentage of respondents endorsing it at 65.9%, highlighting its significance in libraries.

5. When asked about the reasons for not using cloud computing. A significant majority (61.6%) indicated that this question is not applicable as per the above question.

6. A question about willingness to provide cloud-based library services to users was asked of librarians in the study to understand their perspectives, concerns, and readiness regarding the adoption of cloud-based technologies within library services. The study shows a strong positive attitude towards cloud-based technologies in library services, with 97.7% of respondents willing to offer such services.

7. Librarians were surveyed on the use of cloud-based services in research, with 72.7% highlighting the importance of federated search tools for identifying information sources and efficient retrieval, including web search capabilities.

8. The study explores the challenges faced in providing traditional library services, focusing on limited storage capacity, a concern cited by 75% of respondents. This highlights the need for improved storage capacity in traditional library services.

9. This research aimed to assess the scalability of library services, with 38 respondents (86.4%) emphasizing the importance of remote access to resources for accommodating larger user numbers or increasing demands, highlighting the need for adaptability in library services.

10. The study aims to determine if libraries have received any training or assistance in implementing cloud-based library services. 20.5% of respondents reported to have received such training, while 79.5% did not. This indicates that most respondents need training programs to provide better cloud-based services to library users. The majority of respondents need training to transition to and effectively utilize cloud-based solutions for their library services.

11. The study reveals that all 44 respondents (100%) agreed that regular staff training is necessary for the acceptance and efficient use of cloud-based library services, indicating that librarians believe this training is crucial.

12. The research question explores the potential impact of cloud technology on library services. The majority of respondents (77.3%) identified the Library

Management System (LMS) as an area where cloud technology could improve library services. 86.4% saw it as improving digital collections and resource management, while 70.5% recognized it as enhancing research tools. 47.7% recognized it as improving user authentication processes, while 63.6% see it as improving data analytics and reporting.

13. This study aimed at understanding librarians' preferences for ideal cloud-based library platforms. Nearly 79.5% of respondents prioritized "Ease of Use and Intuitive Interface," indicating a strong preference for user-friendly cloud-based library systems, helping researchers and developers design platforms that meet specific library needs and challenges.

14. This research study revealed that 90.9% of respondents acknowledged the potential of cloud services to expand library access beyond physical spaces, bridging the information gap and reaching underprivileged users.

15. The research surveyed librarians to identify potential partnerships and alliances for promoting cloud-based service adoption in Goan libraries. The majority (84.1%) identified library associations as potential partners, emphasizing the need for collaboration within the library community to facilitate this transition.

16. The researcher surveyed academic libraries to identify remedial steps to increase cloud service usage. The survey revealed that 90.9% of respondents deemed tutorials, demonstrations, and training sessions crucial for raising awareness and usage of cloud computing.

17. The study explores the benefits of cloud computing in library services, with 77.3% of respondents identifying higher access and usability as significant advantages, highlighting the potential benefits of cloud computing in library services.

18. A survey of librarians revealed that they have moderate technical expertise in key areas related to technology adoption in libraries. The majority (68.1%) identified as having intermediate-level knowledge of cloud computing

concepts, while 52.2% considered themselves to have moderate understanding of data security and privacy. The majority (65.9%) rated themselves as having intermediate-level expertise in system administration, indicating a fair level of proficiency in managing library systems. The majority (59.09%) considered themselves to have intermediate-level expertise in user support, suggesting a moderate level of proficiency in assisting library users with technical issues.

6.2 SUGGESTIONS

1. There is a need to pursue a course on such upcoming concepts of cloud computing for libraries.
2. The government has to organize hands on training for all the libraries regarding cloud-based services.
3. Awareness needs to be created among professionals about cloud computing.
4. There is a need for more coverage when it comes to AI tools, which are part of cloud computing.
5. There is a need for a lot of awareness and tutorials to train the librarians to keep them updated and prepare for future libraries.
6. Cloud computing is a must for libraries to grow and expand their services in remote locations.
7. There is the need to prepare cloud model like GI-Cloud (Meghraj), Baadal (IIT-Delhi) and also promote them for adopting.

6.3. HYPOTHESES TESTING

Hypothesis I: The fundamentals of cloud computing technology are yet to be fully realized by libraries in Goa.

Testing: The data in figure 5.2 and 5.5 supports Hypothesis I, The data after being analysed contradicts the above statement as 61.4% of respondents were found to be very familiar with cloud computing, similar trend was also seen when respondents were asked reasons behind not using cloud computing only 25% attributed to lack of awareness as a barrier to adopting cloud computing operations, suggesting library personnel in Goa are were aware of cloud computing in libraries Therefore the above hypothesis was found to be incorrect and hence rejected.

Hypothesis II: Some library personnel are skilled in cloud computing technology.

Testing: The data in Figures 5.3 and 5.17 supports Hypothesis II, suggesting that 90.9% of respondents reported that their libraries are currently utilizing a cloud-based platform for providing services. This high adoption rate suggests that there are personnel in libraries who are skilled in managing and utilizing cloud-based systems, and many respondents stated that they have intermediate-level expertise in cloud computing concepts, data security, privacy, system administration, and user support. Therefore the above hypothesis was found to be true and hence accepted.

Hypothesis III: There is a lack of infrastructure in libraries for cloud computing.

Testing: The hypothesis that libraries lack infrastructure for cloud computing is not supported by the data presented. Most surveyed libraries are using cloud-based platforms for library services, and respondents emphasized on the importance of high-bandwidth internet connectivity and sufficient computers for promoting cloud computing services. Therefore, results suggests that adequate infrastructure for cloud computing is present in libraries, there the above hypothesis found to be incorrect and hence rejected.

6.4. CONCLUSION

As majority of participants exhibited awareness of cloud-based technology, and a significant section has already employed cloud-based platforms for library services. This indicates that cloud computing use in Goan academic libraries is trending positively. The study found that libraries in Goa generally have adequate infrastructure for cloud computing. The majority of surveyed libraries have already adopted cloud-based platforms for their library services. This suggests that academic libraries in Goa are well-positioned to leverage cloud computing technologies to enhance their services. The study identified numerous potential benefits of cloud computing for library services, including improved accessibility, collaboration, scalability, and cost-effectiveness. Cloud-based platforms offer libraries the flexibility to adapt to changing user needs and technological advancements, thereby enhancing their relevance and effectiveness in the digital age. The study suggests several recommendations to improve the adoption and utilization of cloud computing in academic libraries in Goa. These include investing in training and skill development programs for library personnel, increasing awareness and education initiatives to promote cloud computing benefits, collaborating with library associations for knowledge sharing and resource pooling, and ongoing evaluation and monitoring of cloud computing initiatives. The study emphasizes the potential of cloud computing to transform library services in Goa, enabling them to meet user needs and remain relevant in a digital world.

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APPENDIX

I am Miss Tanvi Naik, a student at Goa University pursuing a degree in Masters of Library and Information Science. As a part of the coursework, I have to conduct minor research, and for the same, I am conducting research on the topic entitled "Libraries through Cloud: reinventing Library Services through Cloud-Based Platforms" under the guidance of Mr. Rohan Parab, Assistant Professor, Library and Information Science Program, Goa University. The purpose of this survey is to learn more about the experiences and viewpoints of librarians and library professionals regarding the use of cloud-based platforms to improve services offered in libraries as a whole.

Concepts of cloud computing

Cloud computing is a web- or server-based technology that utilizes the internet and remote servers to manage and organize data and applications, connecting numerous computers. Although the term "cloud computing" may seem new, the notion is something that we have all been utilizing for quite some time. Examples include YouTube, Google Docs, social networking sites, e-Granthalaya, etc. This server-based solution is quite useful in the modern era. Internet access and a distant server are necessary for cloud computing.

Name of the Institution:

Professional qualifications of librarians:

Experience in this field:

Email Id:

Questionnaire

1. **To what extent is the concept of cloud computing in libraries familiar to you?**
   - ☐ Very familiar
   - ☐ Somewhat familiar
   - ☐ Not very familiar
   - ☐ Unknown
2. **Is your library currently using a cloud-based platform for providing library services?**
   - ☐ Yes
   - ☐ No
3. **If yes, which are the cloud services that can be used by library users (please tick)?**
   - ☐ Social networking (ex., Facebook, Twitter)
   - ☐ Calendar Services (ex., Google Calendar, Doodle)
   - ☐ file-sharing services (ex., Dropbox, Google Drive)
   - ☐ Online representation (ex., YouTube, Google presentation)
   - ☐ Federated search via the web using OPAC
   - ☐ Integrated Library System (ILS)
   - ☐ Web hosting
   - ☐ Global OPAC
   - ☐ Document download service
   - ☐ Collection development
   - ☐ Information literacy/orientation
   - ☐ Online resource sharing
   - ☐ Digital library interlibrary and intralibrary loan
   - ☐ Online file editing services (ex., Picasa)
   - ☐ Other (please specify): _____
4. **If not, what are the reasons for not using cloud computing? (please tick)**
   - ☐ Lack of awareness
   - ☐ Security of Data
   - ☐ Loss of Control

- Internet connectivity issues (bandwidth)
- Administrative Constraints
- Insufficient or lack of funding
- not applicable
- Other,(please specify):_____

5. Are you willing to provide cloud-based library services to users?

- Yes
- No

6. What is the purpose of using cloud-based services? (please tick)

- To assist users in the identification of information sources through a federated search, along with their economic aspects
- To store the output of collaborative research
- To use it for file-sharing services for users (ex: Google Drive, Dropbox)
- To store newly created documents in the office
- To enable library users in information retrieval (ex., web search),
- To assist in providing document delivery services to users
- To create, upload, and save newsletters, new arrivals, and forthcoming events for the user community
- To record maintenance, storage, or create alerts for users based on SDI
- To provide web-based tutorials for library users.
- Other, please specify: _____

7. What are the main challenges that you're facing in delivering library services via traditional methods? (please tick)

- Limited storage space
- Difficulties with resource management and sharing
- Lack of scalability
- High infrastructure costs
- obsolete technology
- Security concerns
- Data accessibility issues
- Other, please specify: _____

8. **According to you, how can cloud computing enhance the scalability of library services? (please tick)**

- □ Flexibility in resource allocation
- □ Remote access to resources
- □ Collaborative resource sharing
- □ Scalable database management
- □ Quick implementation of new services
- □ Cost-effective scaling
- □ Other, please specify: _____

9. **Did you receive any training or assistance in implementing cloud-based library services?**

- □ Yes
- □ No

10. **If yes, please elaborate on the type and effectiveness of the training received (please specify).**

_____

_____

_____

11. **Do you think regular upskilling of staff would be necessary to adopt cloud-based library services?**

- □ Yes
- □ No

12. **Which library services do you think cloud technology could improve or enhance? (please tick)**

- □ Library management system
- □ Digital collections and resources
- □ Research tools
- □ User authentication
- □ Data analytics and reporting
- □ Collaboration
- □ Mobile app services

- Other (please specify):_____

13. Which combination of entities or capabilities are you looking for in an ideal cloud-based library platform? (Please tick)

- Ease of use and intuitive interface
- Scalability to accommodate future growth
- Multi-language support
- Integration with existing library systems
- Customizable features and workflows
- Robust security features
- Data backup and disaster recovery
- Open-source technology
- Other (please specify) _____

14. What opportunities do you see for connecting with Goa's underprivileged users through cloud services? (please tick)

- Providing access to library resources and services beyond the physical library walls
- Bridging the digital divide
- Offering online learning and literacy programs
- Promoting cultural heritage and local languages
- Serving people with disabilities
- Other (please specify): _____

15. What possible alliances could be formed, in your opinion, to encourage Goan libraries to use cloud-based services? (please tick)

- Government agencies
- Library associations
- Technology companies
- Educational institutions
- Non-profit organizations
- Other, please specify: _____

16. Methods to increase awareness and use of cloud computing? (please tick)

- A sufficient number of computers in the library
- High-bandwidth Internet connectivity
- Tutorials, demonstrations, and training on the use of cloud computing

- Seminars/Workshops
- Other, please specify: _____

17. What are the benefits of using cloud computing? (please tick)

- Reduced Costs
- Ease of Use and Implementation
- Avoiding Hardware and Software
- Easy Collaboration
- Auto-made of functioning
- Others, please specify: _____

18. Indicate your level of technical expertise in the following areas:

1) **Cloud computing concepts**

- Expert
- Intermediate
- Beginner
- No knowledge

2) **Data security and privacy**

- Expert
- Intermediate
- Beginner
- No knowledge

3) **System Administration**

- Expert
- Intermediate
- Beginner
- No knowledge

4) **User support**

- Expert
- Intermediate
- Beginner
- No knowledge

19. Please provide any additional comments or suggestions you have.

_____

_____

_____

_____

Thank you for taking the time to answer these questions.