A REVIEW ON COST EFFECTIVENESS OF CLOUD COMPUTING IN LIBRARIES

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ABSTRACT
Libraries are serving society for ages. In the last decade of the 20th century, library funds and services were being asked for their proper utilisation. The efforts are made to find the valuation of the library and its services globally. This study presents a review of literature on the cost effectiveness of cloud computing in libraries. Cloud computing has emerged as a powerful technology in recent years, providing a range of benefits to libraries. The current study is based on exhaustive literature search carried out on the internet. Cost effectiveness of Library services and Cost effectiveness of Cloud Computing in Libraries are focused in this work. It examines various cloud computing applications that libraries have adopted including Software as a Service (SaaS), Platform as a Service (PaaS) and Infrastructure as a Service (IaaS). Several case studies of libraries that have successfully implemented cloud computing solutions are highlighted. This article provides a valuable resource for libraries to consider cloud computing adoption.
Keywords: cost effectiveness, the library, review, cloud computing, SaaS, PaaS, IaaS, operational cost, Information Technology, digital services

Introduction

For centuries the libraries are facing the traditional barrier i.e. getting reduced budget and managing the subscription of the resources within limited budget. In India various commissions viz., University Grants Commission Library Committee, University Education Commission, The Advisory Committee for libraries, National Knowledge Commission etc. have been set up to upgrade the library services and library budgets. Accordingly, commissions have given the recommendations with regards to the budget. On this background many libraries are undertaking studies through which they are trying to find the most cost-effective way to provide services and to build infrastructure so that the library services could be maximized. As the libraries continue to face financial constraints, the adoption of cloud computing can help them to overcome these challenges and provide quality services to their patrons.

In recent years, cloud computing has gained significant attention from libraries as a cost-effective alternative to traditional on-premise IT infrastructure. The study will draw on existing literature to analyse the cost-effectiveness of cloud computing in libraries, including case studies of libraries that have adopted cloud computing and their experiences.The cloud computing can provide increased flexibility and accessibility for library staff and patrons. Cloud computing can also enable libraries to provide online services to patrons, such as e-books, e-journals, and other digital resources, which can increase access and usage while reducing the need for physical space and resources.

While cloud computing can provide significant cost savings, libraries must pay attention to cost of migration, on-going maintenance and support and any potential hidden costs associated with cloud computing, such as data transfer fees or premium service fees.

Cloud computing offers a range of benefits including scalability, accessibility, and reduced operational costs. This has led many libraries to consider adopting cloud-based services for their various functions such as storage and data management. This work focuses on the cost effectiveness of cloud computing, which is one of the key factors driving its adoption in libraries. It discusses the cost savings achieved by libraries through cloud computing, such as reduced hardware and software costs. One of the major benefits of cloud computing is its cost effectiveness, as it offers libraries the opportunity to reduce their IT costs while improving the quality of their services.

This review will provide valuable insights for libraries considering cloud computing adoption and contribute to the broader understanding of cost-effectiveness of cloud computing in different contexts. The findings of this study will be of great significance to libraries considering the adoption of cloud computing. It will provide insights into the potential cost savings associated with cloud computing adoption. Ultimately, the work aims to contribute to the literature on cloud computing adoption in libraries and help libraries make informed decisions about it.

Objectives

- To study literature on cost effectiveness of library services and
- To study literature on cost effectiveness of cloud computing applications in libraries.

Definitions

Collin (2003) defines Cost effectiveness in Dictionary of Economics as, "The most economical way of achieving a desired result, either in the public sector or the private sector. It is essentially using the resources available to the best advantage".

King (1970) defined cost effectiveness as, "Technique for evaluating broad management and economic implications of alternative choices of action with the objective of assisting in the identification of preferred choice"

Above definitions explain that the process is cost effective when it gives more output as compared to the cost used. In the case of libraries, the cost required to provide services can yield more benefit to users may in terms of money or cultural and social upliftment.

Methodology

A comprehensive literature search is conducted for the study. The reference sources such as books, periodicals, research papers and articles, Ph.D. theses, case studies are referred while conducting review of the literature. Along with the printed material, databases such as Shodhganga, Emerald, ProQuest, JSTOR,LISA and LISTA were searched. Google Scholar, Academia and Research Gate access also provided research articles. The identified studies were screened for relevance by examining their titles, abstracts, and keywords. Studies that meet the inclusion criteria have been selected for further review. The inclusion criteria included factors such as the focus on cost effectiveness in libraries and the use of appropriate research methodology. Data from the selected studies have been extracted and synthesized in a systematic way. The extracted data is analysed and synthesized to identify patterns and organized into themes and sub-themes. The comprehensive and reliable review of cost effectiveness studies with special reference to cost effectiveness in cloud computing applications in libraries is made.

Literature Review

The focus of the paper is to review literature on cost effectiveness of cloud computing applications in libraries. It has considered following themes:-

Cost Effectiveness in Libraries

Cost effectiveness of Cloud Computing in Libraries.

Cost Effectiveness in libraries

In the view of Wilson, Stenson & Oppenheim (2019) value of academic libraries is not a financial concept but the improvements in users through the information are the real value. But fund releasers expect cost analysis for proper utilisation of money. Efforts are made to measure cost effectiveness in Academic Libraries.The pioneer study by Payne (1996) at St Patrick's College Library, Maynooth focuses on ownership versus access to subscribed periodicals and articles. It concluded that article supply by mail should continue but few services such as CD-ROM databases should be reconsidered in view of cost effectiveness. Pawan , Gautam (2019a) noted, prices of e journals subscribed in libraries are smaller than benefits of journals received by researchers and faculty. 1:2.9 is the CBR reported by the author for Punjab Agricultural University (PAU) and 1:4.5 for Guru Angad Dev Veterinary And Animal Sciences University(GADVASU). Ahmad (2013) has studied the cost effectiveness of library operations which has included Aligarh Muslim University, Delhi University and Jawaharlal Nehru University. Average time to subscribe journals and time of book processing is studied. Mezick (2007) observed different stakeholders of the Library. This study indicated, positive relationship exists between library expenditure, professional staff and student retention in academic libraries in US and Canada. Study by Bano & Haridasan (2015) at Maulana Azad Library, Aligarh Muslim University, India revealed, cost of current journals and e journals subscribed in library is much lower than benefits of journals and e journals received by Faculty, Research scholars and (CBR) is 1:3.9. Pawan Gautam (2019b) analysed collection of print journals for its cost and benefits subscribed by Nehru Library, Chaudhary Charan Singh Haryana Agricultural University, Hisar, during 2015 which quantified benefits of printed journals referred by researchers and faculty into Indian Rupees and reveals that CBR is 1: 2.

Cost Effectiveness of cloud computing applications in libraries

Cloud computing is a new way of computing. It enables users to work with new avenues-different working environments. Users can access data as per needs. On demand computing services are an important feature of

cloud computing. Libraries can use services, data processing, and preservation tools through the cloud for patrons. The cloud service models and their cost effectiveness are discussed below.

Cloud Computing - Software as a Service (SaaS)

Mell , Grance (2011), defined SaaS as "The capability provided to the consumer is to use the provider's applications running on a cloud infrastructure." Grant (2012) has discussed the future of library systems. He has noted that multiple customers could use one instance of software application at a time. This multi-tenancy could be economical because software maintenance and development costs are shared. SaaS has important implications for libraries. He explained that when vendors run such applications, lesser resources are utilized and ultimately resulted in lowering the cost of SaaS to libraries. The cost of maintaining software and hardware in house is higher than multi-tenant computer architecture. Another economic benefit is observed. While upgrading software, vendors charged individual libraries, but in such cases, vendors used a single instance of software and lowered the cost of each library for up gradation of software. He concluded that in the long run libraries would get cost effective systems with efficient work flow. As compared to proprietary software, Librarika is a cost effective Integrated Library System (ILS) as no cost is required for hardware, software and installation. It also saves training cost and time of library staff and free up to 2000 titles (https://librarika.com/). Stephen (2017) stated, open source cloud based software for library management was adopted by National Institute of Electronics and Information Technology (NIELIT), Itanagar for management of e-books and Periodicals. Above example clearly shows, cloud based library management software is cost effective. Panda , Chakravarty (2021) noted that e Granthalaya eG4 is made available to Government libraries. Rs. 21275 is the amount charged for the software as a one-time payment. This amount is charged for the period of five years. It will provide hosting, maintenance and help-desk support. This is the cost effective use of SaaS applications to Government libraries in India.

Cloud Computing - Platform as a Service (PaaS)

"It allows users to deploy their own applications on the provider's cloud infrastructure under the provider's environment, such as programming languages, tools. The end users can control their own applications" (Mell, Grance, 2011). Such services are implemented in libraries. Roussel, Darmoni , Thirion (2009) conducted study on electronic journals access stating that digital OVID-providing full text electronic journals available directly or through Medline search at Rouen University Hospital France was cost-effective in comparison with inter library loan costs. The electronic versions with limited amount of inter library loans, reduced cost. Virtual Services, Criss Library, University of Nebraska Omaha shared, in the first year with WorldShare Management Service(WMS), USD 150000 saved. This amount was utilised for pilot ebook DDA (demand-driven acquisition) program on campus, well accepted by faculty and students (Erlandson , Ross, 2013). Dula , Ye (2012) have described the case study of Pepperdine University Libraries. They have migrated to OCLC's WorldShare Management Services. They declared that migrating to World Share has reduced total cost of systems and workflow of acquisitions and cataloguing were remarkably efficient. Further they stated that the need for replacing servers after two or three years has ended and systems librarians have more time to work on other projects.

Cloud Computing - Infrastructure as a Service (IaaS) or Hardware as a Service (HaaS)

Mell , Grance (2011) defined it as "capability provided to the consumer is to provision processing, storage, networks, and other fundamental computing resources where the consumer is able to deploy and run arbitrary software, which can include operating systems and applications".

Han (2011) explained the cost of starting an instance on Amazon Web Services (AWS) is USD 0.03 per hour if reserved for the library. Total Cost of Ownership study showed that cost savings was fifty present if the life of the system is assumed to be five years. The Central Connecticut State University Library developed a system using Amazon Simple Cloud Storage (S3) for preserving digital storage. The comparative study by Iglesias & Meesangnil (2010) showed that the cost of Amazon Simple Storage Service (S3) is one third of OCLc's digital archives. For one year, Han (2010) migrated systems to cloud and running satisfactorily in terms of cost. Author shared that USD 480 was the amount to run two nodes while it took USD 4000 for hardware implementation. Hastings (2012) informed about backup service in the cloud. Library was paying USD 60 every 6 months for tapes and buying tape drives for three servers. In the virtualization setup, all contained within one physical server, cutting costs down to two backed up servers for about USD 15 per month. Wilkin (2009) revealed, use of cloud was prolific. At a minimum average 50 libraries holding 33000 public domain titles needing 19 miles of shelf-space regained. The result was aggregate cost avoidance of USD 6.2 M.

The study by Yang (2012) is illustrated here. Amazon Elastic Compute Cloud (Amazon EC2) allows users to pay as per the need, may be per hour. The prices are from USD 0.2 to USD 2.6 per hour. It also depended on

power and server space. Another type of facility is spot instances. In this type users pay as spot price. Another example quoted by the author is explained. The cost of the Amazon EC2 server was in the range of USD 2750 - 3570,while USD 5858 - 7608 was needed for the server which was owned locally. When comparing the cost of 10TB data storage Amazon S3 compared with that of a local storage facility, it was observed that Amazon S3 found to be more expensive at USD 16800. This showed that cloud computing should be considered after financial investigations. Ogbu & Lawal (2013) discussed applications of cloud computing in e-library services in Nigeria. They pointed out that the cost of installing and managing in Nigeria is very high as it included capital cost and high operational cost. They noted that use of cloud computing provided a cost effective way to implement and manage e-library and solved the issues of poor infrastructure, lack of technical knowledge, support and high costs of e-library software development.

Yuvaraj (2013) compared existing Information Technology (IT) systems used in libraries with that of cloud based systems. He pointed out that the server cost of the IT system was USD 19050 and the cloud based system was USD 4500. The Total cost of the IT system was USD 38800 while that of cloud based system was USD 6500. This study is clearly showing that cloud based systems are more cost effective as compared to existing IT systems.

Research Gap

The cost effectiveness studies in libraries are reviewed. It is observed that very few studies are devoted to cloud computing applications in libraries and cost effectiveness of cloud computing is studied rarely.Cloud computing can provide libraries with a way to expand their services, improve accessibility, and reduce costs. However, there is still a need for research that examines the cost-effectiveness of cloud computing in libraries. This paper reviews the existing literature on the cost effectiveness of cloud computing in libraries and identifies gaps in the research.

The existing literature on cloud computing in libraries has mainly focused on the benefits and challenges of cloud computing adoption, including issues related to security and vendor lock-in. While some studies have examined the potential cost savings associated with cloud computing, very few studies are seen in academic libraries.

One area where further research is needed is the cost-effectiveness of cloud-based integrated library systems (ILS). While some studies have examined the benefits of cloud-based ILS, such as improved accessibility and reduced maintenance costs, there is a lack of research that examines the actual cost savings associated with this technology. Additionally, there is a need for research that compares the cost-effectiveness of cloud ILS to traditional, locally hosted ILS.

Another area where further research is needed is the cost-effectiveness of cloud-based digital repositories. Digital repositories can provide libraries with a way to store and preserve digital content, such as research data, e-books, and audiovisual materials. While some studies have examined the benefits of cloud-based digital repositories, such as improved accessibility and reduced storage costs, there is a lack of research that examines the actual cost savings associated with this technology.

This review has taken care to study the cost effectiveness of cloud computing applications in academic libraries. It has also considered few studies of cost effectiveness in libraries such as accessioning, journal cost etc. However the study observed that very few cases have been noted where cost effectiveness of cloud computing applications is discussed. To fill this gap, efforts are made to study the cost effectiveness of cloud computing applications in libraries.

Conclusion

Research work published across the world indicated that efforts are made to calculate traditional library services. The professionals are calculating valuation for acquisition and accessioning, journal collection, processing cost per unit of book and library services. The application of cloud computing in libraries is modern technology use and its valuation is indicating fruitful results.

The cloud computing applications in libraries have become increasingly popular due to its potential cost-effectiveness and flexibility. This paper has reviewed the existing literature on the cost-effectiveness of cloud computing in libraries and found that it offers several advantages over traditional on-premises systems. These benefits include reduced hardware costs, lower maintenance expenses, and the scaling of resources as per the demand of users. However, the use of cloud computing in libraries requires careful consideration and planning.

The review suggests that cloud computing applications will play a vital role in libraries. By adopting these applications, libraries can enhance their services and remain updated in the rapidly changing landscape of library services. Libraries can make extensive use of cloud computing technology to streamline their operations, provide better user experiences, and provide cutting-edge services to library patrons. This review emphasizes the importance of a careful and thoughtful approach to implication of cloud computing use in libraries. The study has highlighted the potential of cloud computing applications to transform library services and provide cost-effective solutions to the challenges faced by libraries.

With cloud computing, libraries can access a wide range of applications and services from a provider's data center, reducing the need for on-site hardware and software. Additionally, cloud providers typically handle software upgrades, maintenance, and troubleshooting, freeing up library staff to focus on other tasks. Cloud computing also gives an opportunity to libraries for scaling the resources, ensuring that they only pay for the resources they need, when they need them. This can lead to significant cost savings compared to traditional on-premises systems, which often require libraries to over-provision hardware to handle peak usage.

The research indicates that cloud computing can be a cost-effective option for libraries, particularly those with limited IT budgets or those looking to modernize their technology infrastructure. By embracing cloud computing, libraries can better serve their patrons while also saving money and increasing efficiency. With careful planning and evaluation, libraries can successfully migrate to cloud computing and reap the benefits of this technology while ensuring the continued delivery of high-quality library services.

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