Opportunities and Challenges for Libraries in the Changing Education and Social Construct

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Cloud Computing Technology in Academic Libraries

Dr. D.D. Lal* & Dr.YogitaTalwar**

ABSTRACT

Library services have changed significantly since computers and other communication technologies were introduced. Libraries are right now being transformed into virtual or digital libraries through automation, networking, and other changes. Numerous facets of cloud computing, including varieties and uses, are covered in this page. In academic libraries, people are having an ongoing discussion over the benefits and limitations of cloud computing.The essay also offers suggestions on how to make the most of the benefits of cloud computing for academic and professional librarians worldwide. The creation of cloud-based services for academic libraries might benefit from this article. The article makes the case that future improvements to academic library resources should be facilitated by the high quality of service provided by cloud providers, the growth of Internet capacity, and the speed at which information is transferred.

KEYWORDS

Cloud Computing, Service Model, IaaS, PaaS, SaaS, Deployment Model, Application of cloud computing, Cloud Librarian.

INTRODUCTION

Due to the fact that library patrons' methods of searching for information have been greatly impacted by information and communications technology (ICT). In today's environment, students are highly acquainted with their smartphones, tablets, laptops, and personal computers with intelligence built in. It is anticipated that consumers would purchase fewer multipurpose devices, like smart phones, and that their usage of cloud-based services and apps, such virtual mailboxes, will increase dramatically. The fourth concept proposed by Dr. Ranganathan is quite relevant when discussing cloud computing. We save the user's time by providing information that is accessible from anywhere at any time. It should be possible for users to

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access the services seven days a week, twenty-four hours a day, provided they have a strong internet connection. Instead of concentrating on developing new technologies to offer services to users, librarians must now focus on providing proactive services and shifting towards standard services to personalize information resources for the betterment of academic society.

We will define a "cloud" as the fittings, arranging software, and information centers in a seamless conversation. A flawless example of cloud estimation is Gmail, Yahoo Mail, and so forth. Nobody wants to be a member of the ruling class in any way. These services are cost-effective for all customers up to a certain amount, and they also provide additional depository expertise and oversight responsibilities for the stock exchange.

Cloud computing is a computer network that is primarily used to calculate unknown areas. Its assets, requests, and dossiers are provided to a collection of calculations and alternate designs based on cutting edge computer network technology. Consequently, the process of cloud computing is carried out via a series of approved computer network queries that are dependent on the corresponding appropriate access rights.

What is cloud computing? Generally speaking, cloud computing is described as an ascent computer, where tasks and information are located in arduously ascendable information centers within the cloud and may be accomplished by various connected computer systems schemes. Cloud computing may be the practice of offering copious assistance on machines that are essentially allotted over a large virtual system pool that is housed inside the cloud. However, cloud computing provides a superior decision-making ability due to its diverse reasoning capabilities and storage capabilities, which are housed inside the cloud's provided environment.

A shared pool of adaptable computing assets (such as networks, servers, storage, apps, and services) that are able to quickly provisioned and released via minimal service provider or management interaction is made possible by the cloud computing model. This approach makes network access everywhere, accessible, and upon request.

Cloud computing "is a phrase that is being used today to describe the act of storing, accessing, and sharing data, applications, and computing power in cyberspace." -Pew Internet Trust.

(NIST) "cloud computing as a style of computing in which scalable and elastic IT-enabled capabilities are delivered as a service using Internet technologies" -Gartner IT Glossary.

It's a system that makes use of virtual servers for its infrastructure and makes things available online to outside parties.

Characteristics of Cloud Computing:

Most likely through the use of managerial tools Cloud computing aligns with a set of characteristics, the most important of which are:

1. On-Demand /Instantaneous Self-Service

You may automatically provision computer resources with cloud computing, such as network storage and server time. There won't be any communication between you and the provider. Using a web-based self-service portal, cloud users may access their services, keep an eye on their consumption, and provision and de-provision services.

2. Wide-ranging Network Connectivity

An additional crucial feature of cloud computing is extensive network accessibility. Through the network and on portable devices like laptops, desktop computers, tablets, and mobile phones, users may utilize cloud services. The private cloud makes use of a local area network, while a public cloud leverages the internet. Since latencies and bandwidth have an impact on service quality, they are important factors in cloud computing and wide network access.

3. Pooling of Resources

Using a multi-tenant design, resource pooling allows several customers access to physical resources. According to demand, this approach redistributes both offline and online resources. Users may access similar infrastructure or apps while preserving security and privacy thanks to multi-tenancy. Users can be able to designate the exact position of their resources at a greater degree of abstraction, like a nation, state, and data center, even though users cannot determine the exact location of the resources they have. Users may share resources like memory, processing power, and bandwidth.

4. Quick Adjustment

In order to enable clients to scale swiftly in response to demand, cloud services are able to flexibly provided and released-sometimes autonomously. There are essentially infinite capabilities that can be provisioned. Consumers can use these features in any number and at any time. Users don't need to pay more for subscriptions or other fees to grow cloud application, ability, or cost. Rapid flexibility will eliminate the requirement for hardware purchases. Can utilize the cloud computing resources provided by the cloud provider alternatively. 5. Service Metrics

A metering feature in cloud systems improves resource utilization at an abstraction level suitable for the kind of service. You can utilize a measured service, for instance, for users, processing, bandwidth, and storage. Pay-for-what-you-use pricing is calculated on the consumer's actual consumption. Both service providers and customers benefit from a transparent experiences that is established through resource consumption monitoring, control, and reporting.

6. Availability and Resilience

In cloud computing, resilience is the capacity of a service to bounce back fast from any setback. The speed at which a cloud's networks, servers, and databases restart and recover after damage is a key indicator of its resilience. Cloud services make a copy of the data they save in order to prevent data loss. The copied version from the other server recovers data in the event that one server loses data for whatever reason. Another important topic in cloud computing is availability. One advantage of cloud services is that they may be accessed remotely, meaning that employing cloud resources is not limited by geography.

7. Flexibility

Businesses must expand as their operations do. Customers have more flexibility with the cloud to scale as needed without having to restart the server. Additionally, customers have a variety of payment alternatives to pick from, preventing them from splurging on unnecessary resources.

8. Remote Work

Cloud computing facilitates remote work for users. Employees who work remotely can swiftly and securely access company data using laptops and cell phones. Using the cloud, distant workers can efficiently do their tasks and interact with one another.

Types/Models of Cloud Computing

You have varying degrees of control, flexibility, and management depending on the kind of cloud service you choose and how it is deployed. Deployment methodologies and the distinctions between the three conventional cloud computing models (Infrastructure as a Service, Platform as a Service, and Software as a Service) will help you determine which set of services best suits your requirements.

- **Service Models**
- Infrastructure as a Service (IaaS)
- Platform as a Service (PaaS)
- Software as a Service (SaaS)

- **Deployment Models**
- Private Cloud
- Community Cloud
- Public Cloud
- Hybrid Cloud

Infrastructure as a Service (IaaS)

The fundamental components of cloud computing are found in Infrastructure as a Service (IaaS), which also offers accessibility to networking capabilities, computers (virtual as well as real hardware), and data storage. Providers of infrastructure as a service (IaaS) can offer you the greatest degree of customization and management control over the IT assets you have and are largely comparable to the resources that are currently in use and are well-known to numerous IT departments and developers.Example: Amazon Web Services, Joyent.

Platforms as a Service (PaaS) By managing the infrastructure that underlies the application (often hardware and operating systems), platforms as a service (PaaS) providers free up enterprises to concentrate on the development and administration of their applications. As a result, you can operate your application more efficiently because you won't have to deal about generic heavy lifting such as capacity planning, maintenance of software, updating, or resource acquisition. Example: Google App Engine.

Software as a Service SaaS

Software as a Service (SaaS) providers give you access to software programs that they host, maintain, and operate. When most people talk about Software as a Service, they're talking about end-user apps that are developed by third parties. With a software as a service (SaaS) product, your only concern should be how you intend to utilize the specific piece of software-you don't need to worry regarding how the product or service is maintained or the method by which the underlying infrastructure is maintained. Web-based email, which allows you to send as well as receive emails without having to handle feature changes to the email service or manage the operating system and server that the email program is operating on, is a usual instance of a software as a service (SaaS) application. Example: Google mail, Sales Force.com

Public Cloud Third-party suppliers offer cloud services via the internet under a public cloud deployment paradigm. The resources, which include servers, storage, and applications, can be utilized by multiple individuals and are open to the public. In general, public clouds provide less control and customisation than private clouds, but they are more scalable, flexible, and economical.Examples of Public Cloud: Google App Engine, Microsoft Windows Azure, IBM Smart Cloud, Amazon EC2

Private Cloud

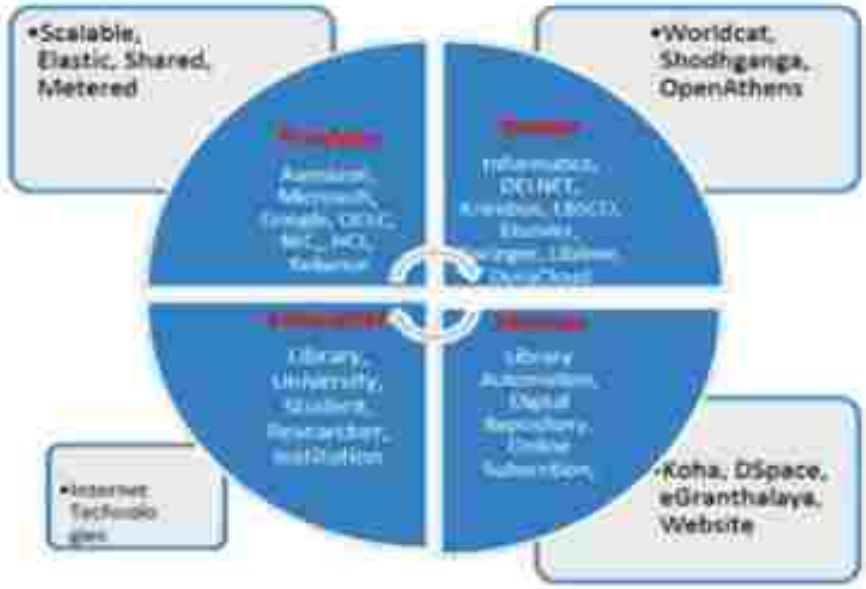
A private network that is usually owned and run by a single company is used to host cloud services in a private cloud deployment paradigm. In comparison to public clouds, private clouds provide more customization, security, and control. They are especially appropriate for confidential information handling enterprises or those with stringent security and compliance. Examples of Private Cloud: Eucalyptus, Ubuntu Enterprise Cloud, UEC (powered by Eucalyptus), Amazon VPC (Virtual Private Cloud), VMware Cloud Infrastructure Suite, Microsoft ECI data center needs.

HybridCloud

Public and private cloud components are combined in a hybrid cloud deployment approach. By keeping sensitive data and important apps in private clouds, it enables enterprises to benefit from the scalability and affordability of public clouds. Smooth data and application portability between environments is made possible by hybrid clouds.Examples of Hybrid Cloud: Windows Azure (capable of Hybrid Cloud), VMware vCloud (Hybrid Cloud Services)

Community Cloud A community cloud deployment strategy shares cloud infrastructure across multiple enterprises who have similar goals, industry-specific specifications, or adherence to regulations. Community clouds meet particular requirements within a given community or business and facilitate sharing of resources and cooperation.Examples of Community Cloud: Google Apps for Government, Microsoft Government Community Cloud.

Library Services in Cloud



Enhancement of Library Service

1. **Lending Service for E-Books:** Cloud platforms are increasingly being used to lend E-Books.
2. **Union/Shared Catalogue/OPAC:** Network libraries have access to their collection on a single platform and can share the same platform. The union catalogue can be created relatively easily with cloud computing.
3. **Document Download Service:** If network access is allowed, downloading documents is simple.
4. **Digital preservation/Scanning Service:** One can minimize repetition of this kind of tedious tasks by centralizing the digitization and scanning processes.
5. **Article Delivery Service:** Libraries can leverage cloud computing to provide users with an article delivery service. Publishers have already provided libraries access to this new technology.
6. **Current Awareness Service:** Cloud computing has made it simple to offer current awareness services to all users.
7. **Document Sharing:** Cloud computing has made it simple to share documents.
8. **Bulletin board service:** Using this technology, we may offer novel amenities on bulletin boards.

Advantages of Cloud computing

1. **Cost-effectiveness:** It is arguably the most economical technique to employ, upgrade, and maintain.
2. **Scalability:** "Pay as you go" enables more effective cost control.
3. **Increased security and accessibility:** Resources may be accessed from any location, and they can be tested and assessed for free.

4. **Portability:** Because the service is accessible via the internet, anyone can use a browser to access it from anywhere in the globe.

5. **Adjustable Storage:** If the server is smaller compared to what is available in the conventional system. The freshly installed server ought to take the place of the old one. While storage space in this computing is managed by the service provider, its capacity for storage may be changed to suit the requirements of the libraries.

6. **Unlimited Storage:** The cloud offers nearly limitless storage space.

7. **Cloud OPAC:** Online catalogs are available for the majority of libraries worldwide. These catalogs can be accessed online through their local server within the library. Users will benefit more from being able to access the library's catalogue via the cloud if that information is made public.

8. **Backup and Recovery:** The majority of cloud service providers are typically capable of managing information recovery. As a result, compared to other conventional methods of data storage, it makes the backup and recovery procedure more simpler overall.

9. **Essay Information Accessibility:** Users can access the information from any location with an internet connection as long as they register in the cloud. services, particularly with the creation of digital libraries. In this digital age, LIS professionals play a crucial role in developing cloud-based systems that users can rely on to deliver library services in a user-friendly and trustworthy manner.

10. **Automatic Updates:** Due to cloud computing technological advances, service providers may perform routine software updates and maintenance automatically, relieving IT and library personnel of these tasks.

Disadvantages of Cloud Computing

1. **Concerns regarding data security and privacy:** It is very concerning that there may be a risk to data security and privacy. It is more dangerous whenever the data is highly sensitive, such consumer credit card information, and can be accessed by others over the cloud. In the event of a system failure or an inadequate backup, there is also a chance that data will be lost.

2. **Network bandwidth and connectivity:** The fact that this service is directly connected to the internet raises serious concerns as well. A user is unable to access if there is an internet connection failure.

3. **Service providers have ultimate power:** Because these services are delivered by outside parties, companies rely heavily on the service providers and have very little control over them.

4. **Knowledge and integration:** Having in-house IT personnel with familiarity with cloud computing is a crucial prerequisite for enterprises. If not, the service provider is in charge.

5. **The problem of cloud interoperability:** The "Hazy Cloud" phenomena is caused by the fact that every cloud provider has a unique method for users, apps, and clients to communicate with the cloud.

6. **Service level agreement:** When customers move their essential business operations to their trusted cloud, they still need to guarantee the quality, availability, dependability, and functionality of these resources even when they possess no control over the computer's fundamental resources.

Role of Cloud Librarian

- To monitor member data and activity
- To define validity and give students access to Access Pins. (The software has the option to define validity and produce pins automatically.)
- To keep in touch with the participating libraries that are sharing their resources on the cloud.

- To interact with database providers, consortiums, publishers and distributors of journals, and e-books
- To discuss creating various packages for various faculties and classes with librarians, subject matter specialists, and faculty members.
- To keep up with technology
- To provide member libraries with technological assistance
- To carry out reader education and awareness campaigns
- To maintain cloud resource consumption records;
- To offer interlibrary loans;
- To create digital collections
- To maintain documentation of tangible resources in order to offer referral services.
- Handling Cloud resources and players and choosing the best deal
- To keep up one's own online persona by starting a blog or social media account and engaging with other users. The same platform can be used to teach customers how to use cloud infrastructure and provide reference services for cloud resources.
- To apply their capacity for strategic planning and decision-making at various phases of creating a cloud library.

Notably Popular Service Provider

- Amazon Web Services (AWS)
- Google Cloud Platform (GCP)
- Microsoft Azure
- Digital Ocean
- Rockspace
- Red Hat
- Citrix Systems
- Salesforce.com
- Linode VM Ware

Cloud Computing Libraries

- Private Cloud like that of IIT Delhi's High Performance Computing or HPC
- Community Cloud like Central Library, IITD's Baadal
- OCLC
- Library of Congress (LC)
- Worldcat Community Cloud like e-Granthalaya
- Exlibris
- Polaris
- Scribd
- Discovery Service
- Google Docs / Google Scholar

- Encore
- Dura Cloud, etc.

Cloud computing applications and services

Few cloud computing services and apps that our library community thinks would enhance what it provides:

- **Google Apps:**

Google is a strong competitor of Microsoft and Amazon when it comes to cloud computing and apps which the public can utilize to enhance their core services.

Sites: Use Google Sites to build a fully working website. Researchers can have access to a rare collection by having it digitized into searchable papers. You can scan and upload any institutional document or news item for free to Google Sites.

Calendar: An events-filled year-round library calendar can be created.

Form: Use Google Form to plan events, send out questionnaires, assess students, or collect data. Excel sheets and forms can be connected. Answers are instantly sent to a worksheet if the form is linked to one. Chat: To assist people in finding information ONLINE, a reference librarian may make use of this chat feature.

Doc: You can create and share documents with others. View, alter, or subscribe to it.

- **Mendeley (Reference Management Software)** offers open social networking and reference management for academia. Mendeley is an organizing tool for research that lets you engage with others online and explore novel research.
- With **Dropbox**, you may use consumer apps to save, coordinate, and retrieve data in the cloud. Organizations can use Dropbox to run a certain folder on every single computer, which Dropbox subsequently syncs to make it appear as the similar folder irrespective of the system it is operated on (with the same information), in order to assure uniformity. This directory's contents might be accessed through mobile apps and a website. (Wikipedia)
- The most widely used website for sharing and watching videos via email, mobile devices, and the internet is now **YouTube.** It makes it possible for you to effectively create and share YouTube videos. You may also utilize YouTube video content on a website, app, or device by using the YouTube API. Most of the NPTEL videos are hosted on YouTube.
- A free, open-source email and calendar application is available for desktop computers running Windows, Mac OS, and Linux. It can be synced using the iPhone and BlackBerry and operates both offline and online.
- **iBookshelf** serves as your library, a comprehensive book database compiled and updated by individuals just like you. Decide on the book display setup. You can look through the books in your library and keep note of who you've borrowed or lent them, the process of manually or automatically adding a fresh title (by entering its ISBN). It also includes information on the amount that it costs, where to buy it, and where to find it at the library! It even provides you with information.
- Facebook allows users to stay in touch with friends, family, and coworkers by creating profiles, uploading images, and sending messages. The website has public features and is available in 37 languages. You might create and market your own page as well. News and events can be shared by the library via the Facebook app. A live Facebook chat service could be offered by a library.
- Office 365 from Microsoft One can subscribe to Microsoft Office and use it whenever and from wherever. There is IM, audio, and video conferencing accessible. A free trial is available on the

website.

CONCLUSION

When it comes to cloud computing, security and privacy are crucial concerns, particularly when handling sensitive data like credit card numbers. The data stored in the cloud could be attacked by viruses, theft, and other types of identity theft and fraud when there is still no suitable security template. Furthermore, since services are provided over the Internet, it is impossible to identify the new locations of servers and software and to conduct a security audit. In addition, there is a chance of data loss due to insufficient backup and failure of the system. How our users engage with the cloud, and whether our services need to be adjusted to accommodate new user behaviors? What would occur in the event of a cloud burst? Libraries should consider whether they may require changes to their services to properly adapt to the way that users interact with the cloud, as it is already a reality.

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