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MAYANK YUVARAJ
Banaras Hindu University, mayank.yuvaraj@gmail.com

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Cloud Computing Applications in Indian Central University libraries: A study of librarians` use

Mayank Yuvaraj
Junior Research Fellow
Department of Library & Information Science
Banaras Hindu University, Varanasi
Email: mayank.yuvaraj@gmail.com

Abstract
The main purpose of this paper is to explore how librarians in Indian Central Universities are using Cloud Computing tools into their daily library services and works. A structured questionnaire was designed & personally distributed as well as mailed to 407 respondents. Responses show that librarians are heavily reliant on cloud computing tools and majority of them are using various devices and want to imply the same to improve library services. Economics, delivery models and service layers and the user`s preference of cloud computing are the core drivers of this phenomena. However, majority of the librarians showed their concern over the security.
KEYWORDS: Cloud Computing; libraries; use; library services; problems

Introduction & literature review
Cloud computing is a mega change that has robbed IT of its traditional obligations and empowered the end users with on demand utility computing. "Cloud-based services are set to transform the way libraries work, unleashing librarians from the admin burden to focus on services for students and researchers (JISC, 2011)". According to (Stroh et al., 2009) "Cloud Computing is nothing more than the collection of computing software and services that can be accessed via the Internet rather than residing on a desktop or internal server". (Blokdijk & Menken, 2009) stated that "The origins of the term "Cloud" can be traced to the concealing nature of this technology's framework; the system works for users yet they really have no idea the inherent complexities that the system utilizes. The "means of communication between client and cloud have been termed middleware and depend very much on formation of images of virtual machines" (Andrew, 2012) represented as cloud symbol.
The "*Cloud*" element of Cloud Computing can be seen as an acronym that stands for C- *Computing resources*, L- that is *Location independent*, O- can be accessed via *Online* means, U- used as an *Utility* & D- is available on *Demand*. There are three service models of Cloud Computing: Infrastructure as a Service (IaaS), Platform as a Service (PaaS), & Software as a Service (SaaS). IaaS offers necessary computing resources like (processing, storage, networks, and operating resources) over the Internet. PaaS offers platform (Google App Engine) to run the user created or acquired applications on the Internet. SaaS provides applications and software (Google Docs) on cloud which can be accessed through any device having web browser. Usually, "cloud services are based on the Internet which are accessed, transported & used over the Internet in user`s web browsers" (Wang & Huang, 2011). According to (Mavodza, 2013) "libraries have stepped and are increasingly stepping into the realm of digital librarianship as well as platforms that extend IT's existing capabilities, and this extensively depends on using the cloud".
India is the world`s largest leader in computer and information services export (WTO, n.d.). "Demand for cloud computing services in India is growing along with supply and Indian firms in numerous industries are adopting cloud services" (Berry & Reisman, 2012)."The term cloud computing describes how people access and manage digital information" (Martin, Snowden & West, 2009). According to (Hoy, 2012) "most cloud computing applications and infrastructure are built with the assumption that users will access them from the Internet, on multiple platforms and from anywhere in the world".
Cloud Computing has sailed past the consciousness of people and everyone has used it to a larger extent. "Users who have had the experience of using Web 2.0 services like Wikipedia, Blogger, & Flickr etc. have already experienced 'Cloud computing', maybe unknowingly" (Abidi & Abidi, 2012). Some of the heavily used Cloud computing applications are: Web mails (Gmail, Yahoomail, Sifymail), online storage systems (Skydrive, Idrive, Box.net), Web-based office tools (Google Docs &

Zoho), Web-based RSS readers (Bloglines, Google Reader), entertainment (YouTube, Flickr, Hulu), Social networking (Orkut, Facebook, hi5) and Web based useful applications: P&o (sharing large files), Adobe Photoshop Express (online photo editors), Jumpcut (edit videos online). All these activities are being performed in cloud accessible environment via any device having a Web browser with internet connectivity. There are relatively fewer research studies on cloud computing (Jaatmaa, 2010; Sriram & Khajeh-Hosseini, 2010). Ambrose & Chiravuri (2010) studied the factors that influence the use of Cloud Computing. They found that two factors (age and experience) are major drivers of a person`s intention to use Cloud Computing. On the other hand, Saya et. al. (2010) discovered that the characteristics of Cloud Computing like scalability, cost effectiveness, accessibility and lack of security are principal factors in growth, abandonment and deferral.

Researchers at Community colleges (2011) examined the acceptance level of cloud computing technology by the students. They found that it is easier for students to adopt Cloud Computing if it is easy to use and requires little training. Even though many studies have examined the overall concept of Cloud Computing, no previous research has analysed librarian`s usage and acceptance level of Cloud Computing. A lot of researchers have analysed the use of mobile and smart phones to access cloud based services accessed via web browsers. Giurgiu et al. (2009) has used the cloud as the container for mobile applications. Luo (2009) first of all tried to the use cloud computing to enhance mobile devices capabilities. (Liu & Cai, 2013) asserts that "driven by this new technology trend and the benefits of cloud computing, an increasing number of libraries are shifting their key applications and services to the cloud".

Contrary to the above studies (Wu, Lan & Lee, 2013) proposed evaluation framework incorporating duo-theme DEMATEL (decision making trial & evaluation laboratory) with TAM (technology acceptance model) which was tested on Case University, Taiwan. The present paper attempts to explore the usage level & possibilities in Indian libraries.

Objectives

The main concern of the study is to quantify the usage of Cloud Computing applications in Central university libraries of India. The following questions are found to be of central importance in this paper:

- How is Cloud Computing being used in Central university libraries of India?
- What is the level of using Cloud Computing in Central university libraries of India?
- What are the services provided through Cloud Computing in Central university libraries of India?
- What are the obstacles & problems in utilizing Cloud Computing in Central university libraries of India?

Methodology

There are 41 central universities established in different parts of India. Out of 41 universities 12 were established recently in 2009 and are in the process of developing library infrastructure, library services and skilled professionals. Therefore, in the study 29 out of 41 Central universities were considered. A questionnaire survey was used for the collection of data from a purposive sample of 488 library professionals drawn from a countrywide population of 29 central university libraries of India. A 26-question structured open ended and closed ended questionnaire was designed to query their experiences on use of Cloud Computing applications. Questionnaires were mailed and personally administered to the selected 488 library professionals over a period of eleven months. Softcopy of the questionnaire was also available for completion upon request. Out of the 488 questionnaires administered 424 respondents (86 per cent) returned completed questionnaires. On close analysis, the information was found incomplete in 17 responses. Finally, 407 (84 per cent of the sample) valid questionnaires were selected for data analysis & interpretation. The data were interpreted, classified and transferred into coded form, entered into Microsoft Excel & transferred in statistical package for social sciences (SPSS). A frequency analysis was run for detection & removal of errors & missing numbers. The final cleaned and coded data were subjected to analysis using SPSS.

Table 1 List of participating Central Universities in India

S. No	Name of University	Name of Library	Year of establishment
1	Aligarh Muslim University (AMU), Uttar Pradesh	Maulana Azad Library	1875
2	Allahabad University (ALU), Uttar Pradesh	Central Library	1916
3	Assam University (AU), Silchar	Rabindra Library	1994
4	Babasaheb Bhimrao Ambedkar University (BBAU), Uttar Pradesh	Central Library	1998
5	Banaras Hindu University (BHU), Uttar Pradesh	Sayaji Rao Gaekwad Library	1917
6	Central Agricultural University (CAU), Manipur	Central Library	1993
7	Dr. Hari Singh Gour University (HSGOU), Madhya Pradesh	Jawahar Lal Nehru Library	1920
8	English & Foreign Languages University (CIEFL), &hra Pradesh	Ramesh Mohan Library	1977
9	Guru Ghasidas University (GGU), Chhattisgarh	Central Library	1984
10	Hemwati N&an Bahuguna Garhwal University (HNBGU)	Central Library	1973
11	Indian Maritime University (ITM), Tamil Nadu	University Library	1991
12	Indira G&hi National Open University (IGNOU), New Delhi	Library Documentation Division	1986
13	Indira G&hi National Tribal University (IGNTU), Madhya Pradesh	Central Library	2008
14	Jamia Millia Islamia (JMI), New Delhi	Zakir Hussain Library	1973
15	Jawaharlal Nehru University (JNU), New Delhi	Central Library	1976
16	Mahatma G&hi Antarrashtriya Hindi Vishwavidyalaya (MGAHV), Maharashtra	Mahap&it Rahul Sanskritayan Central Library	1978
17	Maulana Azad National Urdu University (MANU), Hyderabad	Central Library	1998
18	Manipur University (MAU), Manipur	Manipur University Library	1972
19	Mizoram University (MIU), Mizoram	Central Library	2001
20	Nagal& University (NU), Nagal&	Central Library	1994

21	North Eastern Hill University (NEHU), Meghalaya	Central Library	1973
22	Pondicherry University (PU), Pondicherry	An&a Rangapillai Library	1985
23	Rajiv G&hi University (RGU), Arunachal Pradesh	Central Library	1984
24	Sikkim University (SU), Sikkim	Teesta- Indus Library	2008
25	Tezpur University (TU), Tezpur	Central Library	1994
26	Tripura University (TIU), Tripura	Central Library	1987
27	University of Delhi (UOD), Delhi	Delhi University Library System	1922
28	University of Hyderabad (UOH), &hra Pradesh	Indira G&hi Memorial Library	1975
29	Visva-Bharati University (VBU)	Central Library	1901

Data analysis & interpretation

The responses received from the librarians are illustrated in the form of tables & figures, and the implications of the findings are discussed below:

Status of the respondents

The frequency distribution of status of the respondents presented in Table 2 shows that (265 out of 407, 65.11%) of the respondents were information scientists or professional assistants or semi-professionals or technical assistant or library assistants engaged in various IT operations in libraries followed by 79 (19.41%) assistant librarians, & 38 (9.33%) deputy librarians, while university librarians were 25 (6.14%). It shows that all level of staff members are part of the implementation and usage of technologies with a heavy domination of middle level staffs.

Gender & Age

With the encroachment of technology into workplaces and homes there is a need to maintain the equilibrium in the library IT workforce to avoid gender disparity. Table 3 shows that among 407 respondents, 320 (78.62%) are male library professionals while female respondents are 87 (21.37%). It is obvious from the study that there is an underrepresentation of women in library IT positions. Henceforth, “understanding why relatively few women enter IT fields will help inform measures to alter the current, male dominated dynamic” (Lamont, 2009). Further, Table 4 shows the age range of the respondents.

Table 2 Status of respondents

University	UL	DL	AL	IS/PA/SPA/TA/LA	Total	Percentage
AMU	1	5	8	16	30	7.371
ALU	1	1	-	3	5	1.228
AU	1	-	1	1	3	0.737
BBAU	1	-	1	3	5	1.228
BHU	1	5	10	18	34	8.353
CAU	-	-	2	4	6	1.474
HSGOU	1	-	2	5	8	1.965
CIEFL	1	-	-	6	7	1.719
GGU	1	-	2	6	9	2.211
HNBGU	1	-	-	3	4	0.982
ITM	1	-	2	3	6	1.474
IGNOU	1	2	1	2	6	1.4742
IGNTU	1	-	-	2	3	0.737
JMI	-	3	2	8	13	3.194
JNU	1	1	10	25	37	9.090
MGAHV	1	-	1	2	4	0.982
MANU	-	1	1	5	7	1.719
MAU	1	1	2	2	6	1.474
MIU	1	2	2	22	27	6.633
NU	1	-	1	3	5	1.228
NEHU	1	1	3	7	12	2.948
PU	1	2	8	30	41	10.073
RGU	-	1	2	4	7	1.719
SU	1	1	1	2	5	1.228
TU	1	1	1	5	8	1.965
TIU	1	1	1	3	6	1.474
UOD	1	5	6	24	36	8.845
UOH	1	3	5	31	40	9.828
VBU	1	2	4	20	27	6.633
Total	**25**	**38**	**79**	**265**	**407**	
Percentage	6.14	9.33	19.41	65.11		

Table 3 Gender distribution of respondents

University	Male	Female	Total
AMU	24	6	30
ALU	4	1	5
AU	3	0	3
BBAU	3	2	5
BHU	27	7	34
CAU	4	2	6
HSGOU	6	2	8
CIEFL	6	1	7
GGU	6	3	9
HNBGU	3	1	4
ITM	4	2	6
IGNOU	5	1	6
IGNTU	3	0	3
JMI	12	1	13
JNU	30	7	37
MGAHV	3	1	4
MANU	3	4	7
MAU	5	1	6
MIU	20	7	27
NU	3	2	5
NEHU	9	3	12
PU	33	8	41
RGU	5	2	7
SU	3	2	5
TU	6	2	8
TIU	5	1	6
UOD	31	5	36
UOH	32	8	40
VBU	22	5	27
Total	320	87	407
Percentage	78.624	21.375	

Table 4 Age distribution of respondents

Age range	n	%
Less than or equal to 30 years	71	17.444
Between 31 & 40 years	173	42.506
Between 41 & 50 years	120	29.484
More than 50 years	43	10.565
	407	100

Computer literacy & skills

Table 5 presents the frequency distribution of the respondent`s computer literacy. Analysis describes that 132 (32.43 %) respondents were having a computer certificate or training in computer operations and 275 (67.56 %) did not have any certificate or computer training. There is lack of technically skilled professionals in the Indian academic libraries. It is high time when the authorities should take it as part of their concern. Since technology has become imperative for the libraries in the recent years (Lamont, 2009) asserts that "librarians may develop more advanced computing skills to address a lack of technical support, to develop new services, or for professional or personal interest". Further, (Mavodza, 2013) argues that "with the current discontinuous IT revolution libraries have become one of the spaces which are using cloud and therefore librarians needs to widen their skill set & think more openly". (Liu & Cai, 2013) have enlisted various IT skills like "desktop and server operating systems administration, programming database management, systems and network designs as well as the Internet technologies" that librarians need to develop for technological needs of libraries.

Table 5 Computer literacy of respondents			
University	**Certificate or training**	**No certificate or training**	**Total**
	BCA/ PGDCA /DCA		
AMU	4	26	30
ALU	1	4	5
AU	0	3	3
BBAU	1	4	5
BHU	14	20	34
CAU	2	4	6
HSGOU	2	6	8
CIEFL	2	5	7
GGU	2	7	9
HNBGU	1	3	4
ITM	2	4	6
IGNOU	3	3	6
IGNTU	0	3	3
JMI	4	9	13
JNU	16	21	37
MGAHV	1	3	4
MANU	2	5	7
MAU	1	5	6
MIU	10	17	27
NU	1	4	5
NEHU	2	10	12
PU	16	25	41
RGU	1	6	7
SU	2	3	5
TU	3	5	8
TIU	2	4	6
UOD	14	22	36
UOH	15	25	40
VBU	8	19	27
Total	132	275	407
Percentage	32.432	67.567	

Investment and concerns of traditional computing needs

It is inevitable to study the areas which are prime concern of investment for computing needs in the libraries in order to understand cloud computing. Traditional computing is completely different from cloud computing. Fig 1 illustrates the core areas of investment in traditional computing needs in libraries. It shows that in order to operationalize computing solutions, libraries were loaded with various expenses. On the other hand, "with cloud computing there is little or nothing to finance" (Gartner, 2009). "Pay-as-you-go" & "Subscription" methods are two modes of payment in cloud computing. "91% of the organizations in US & Europe agree that the reduction of cost is a major reason for them to migrate to cloud environment" (Ranchal et al. 2010).

According to (Romero, 2012) "The amount payable depends on the number of users who use the tool, and user names are not typically in transferable; Functionality – Payment for the use of one feature in particular; Flat rate – Payment of a fixed amount and no limitation on the number of users or use of resources".

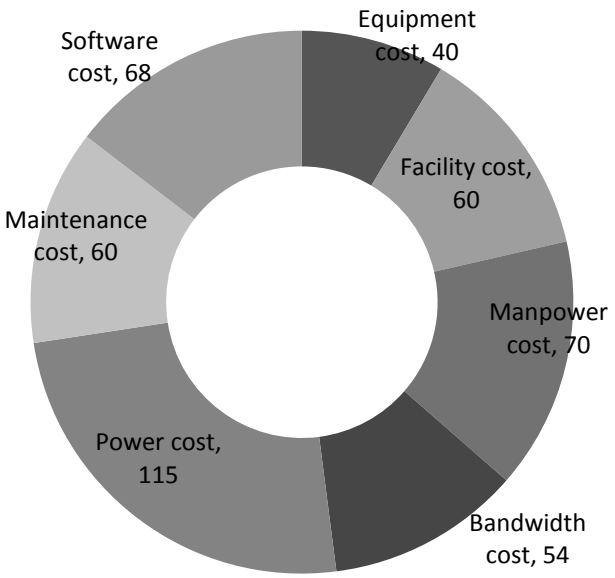

Figure 1 core areas of investment in traditional computing.

Willingness of Cloud technologies in libraries

354 (86.97%) library professionals showed their interest in moving library collections and services in the cloud. Fig 2 presents the various reasons which are the main drivers for librarians interest in cloud computing.

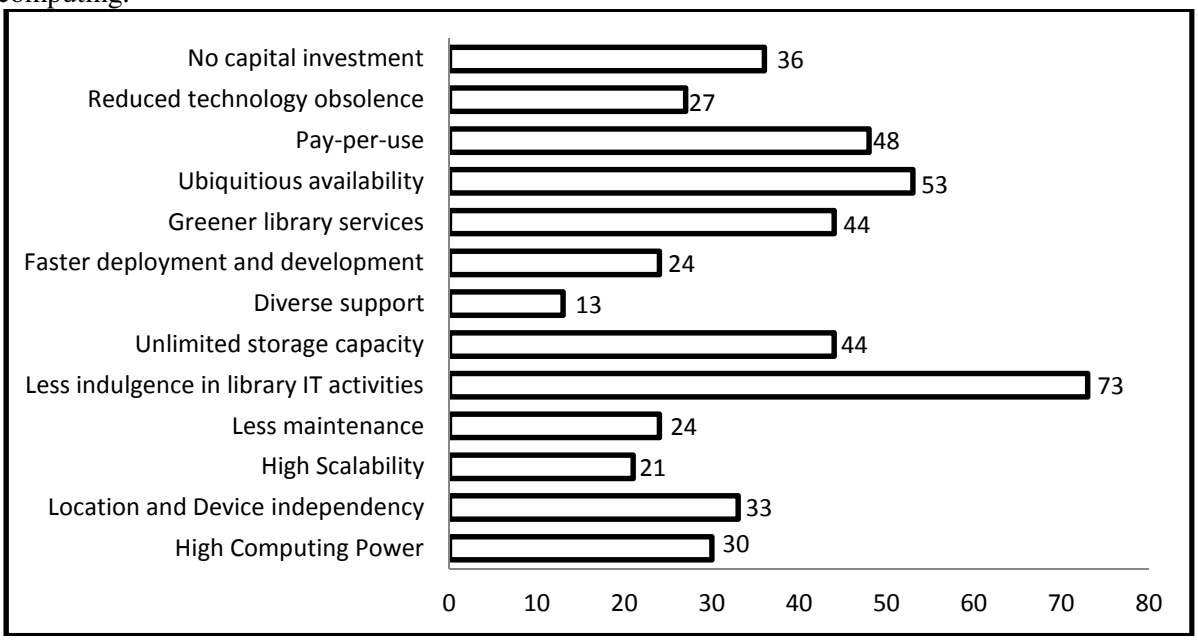

Figure 2 Drivers of cloud computing adoption

Level of Cloud computing

Fig 3 presents the level of cloud computing in libraries. It shows the level at which the cloud computing is in practise in the Indian libraries.

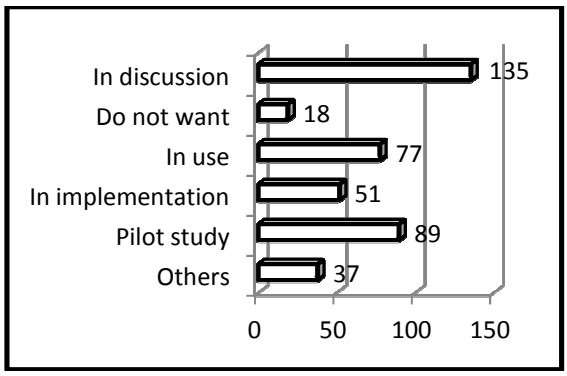

Figure 3 Level of cloud computing in libraries

Use of devices for Cloud computing

Cloud computing paradigm is independent of location and can be accessed on any media having network connectivity. "With cloud computing information is not stranded on individual machines; it is combined into one digital cloud available at the touch of a finger from many devices" (Hamm, 2009). According to (Lowry et al., 2009) "libraries need to deliver services and resources to the virtual environments used by students, faculty & researchers or they risk alienating users". In order to keep pace with technology libraries need to provide services that can run on the media used by the library users. Fig reveals the use of PC, tablets, Mobile devices, tablets, & iPad in libraries to use the cloud computing solutions.

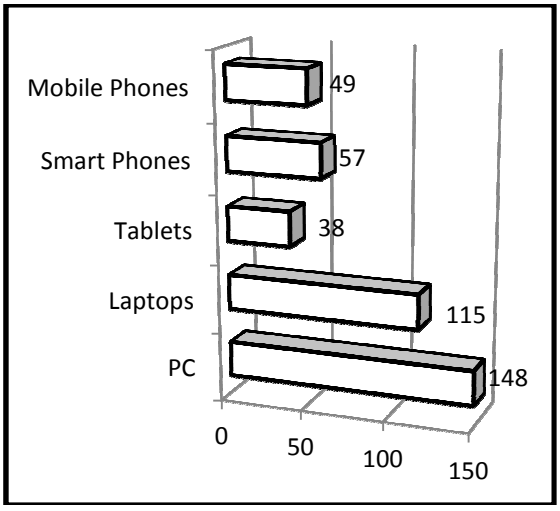

Figure 4 Use of devices for cloud computing

According to The Economist "The plethora of devices wirelessly connected to the Internet will speed up a shift that is already under way: from a 'device-centric' to an 'information-centric' world…. (and) as wireless technology gets better and cheaper, more and more different kinds of objects will connect directly to the cloud."

Use of cloud services

According to (Behrend et al., 2011) "the term cloud computing describes the software applications or other resources that exist online and are available to multiple users via the Internet, rather than being installed on a particular user's local computer". "Cloud computing has created opportunities for IT outsourcing vendors as a great deal of services associated with cloud computing such as cloud services implementation, integration, management, & support are necessary for cloud deployment" (Dhar, 2012). To determine the usage of cloud computing applications by the library professionals various questions on different aspects were asked. Respondents were asked questions about various tools of cloud computing which was expected to be used by them. Fig 5 portrays the arena of cloud computing being used by the library professionals in the Indian libraries which has been further dealt separately in Table 6 .

Apart from above mentioned services cloud computing has rich potentials for cloud based learning and training. According to Ratten (2012) "Cloud learning occurs on the basis of cloud technology as it

supports the use of software in the cloud to learn by providing data, storage & software that can be accessed in an online environment".

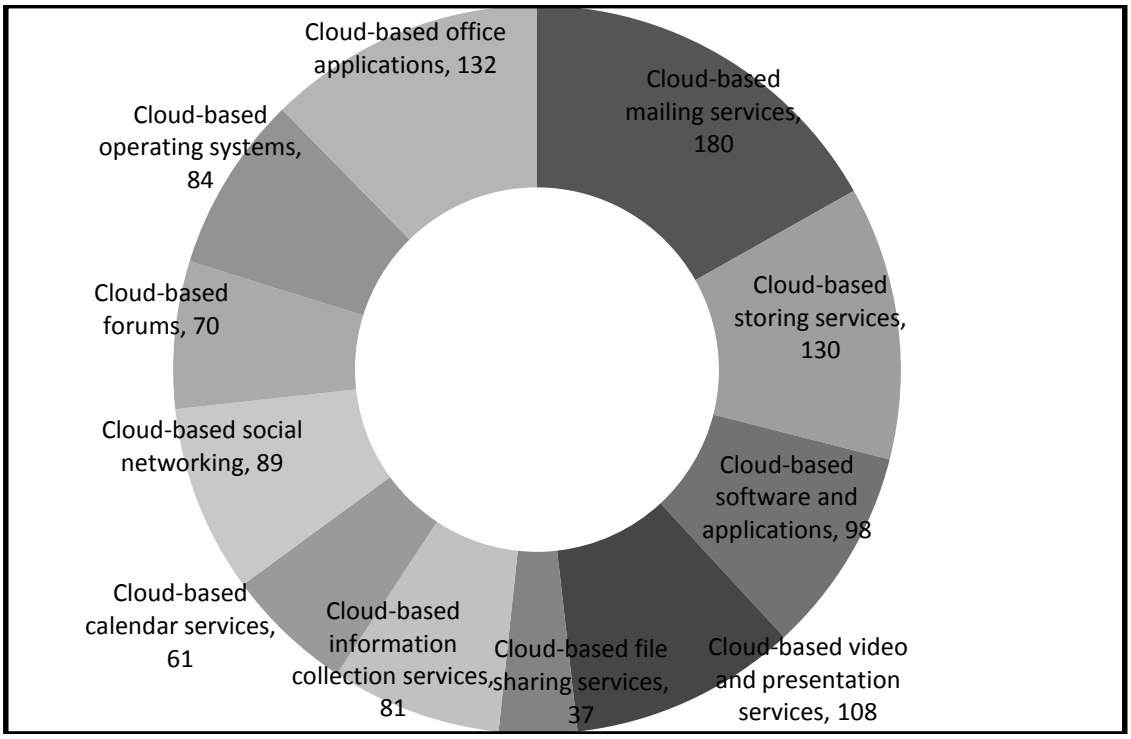

Figure 5 Use of cloud services by librarians

Use of cloud library services

Fig shows the various library services that are being offered in cloud and its usage in the Indian libraries. Predicting the future of cloud computing in libraries (Farkas,2009) argues that it "is becoming an increasingly important phenomenon that should allow many libraries to extend their reach online and enable collaborative work in ways not thought possible just a few years ago".

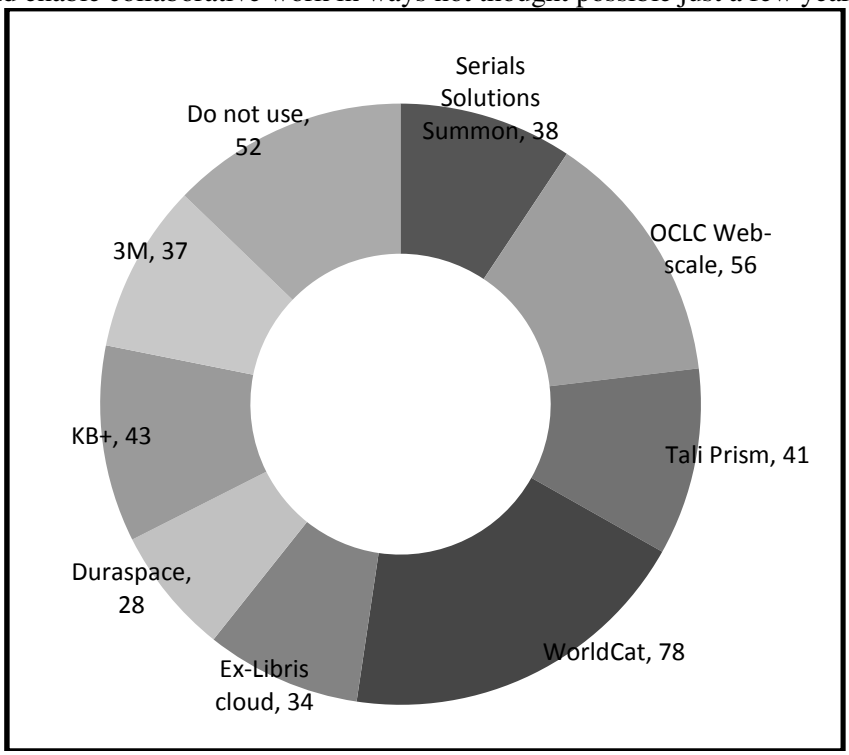

Figure 6 Use of cloud library services

Table 6 Use of cloud services			
Cloud Services	**Popular Service Providers**	**Total number of respondents**	**Percentage**
Mailing services (n=180)	Gmail	55	**30.55556**
	Yahoo	35	19.44444
	India	20	11.11111
	Sify	10	5.555556
	Hotmail	8	4.444444
	Gawab	10	5.555556
	Fastmail	13	7.222222
	Mail	12	6.666667
	Care 2	9	5
	Lycos	8	4.444444
Forums (n=70)	Voice thread	10	14.28571
	Now comment	8	11.42857
	LIS forum	17	24.28571
	LIS links	22	**31.42857**
	India talks	13	18.57143
Custom Social networking (n=89)	Facebook	35	**39.32584**
	Pin interest	11	12.35955
	Twitter	20	22.47191
	Ning	23	25.8427
Information collection (n=81)	Google forms	20	**24.69136**
	Survey monkey	13	16.04938
	Poll everywhere	8	9.876543
	Qualtrics	9	11.11111
	Zoomerang	4	4.938272
	ProProfs	7	8.641975
	Zuhu creator	9	11.11111
	Wu Foo	11	13.58025
Calendar (n=61)	Google Calendar	41	**67.21311**
	Hotmail Calendar	20	32.78689
File Sharing (n=37)	Dropbox	7	18.91892
	SlideShare	13	**35.13514**
	Google Drive	12	32.43243
	Egnyte	5	13.51351
Video & Presentation (n=108)	You Tube	24	**22.22222**
	Vimeo	8	7.407407
	Screen Cast	10	9.259259
	Jing	9	8.33333
	Prezi	12	11.11111
	Slide rocket	16	14.81481
	Google Presentation	17	15.74074
	Time glider	9	8.33333
	Spicy nodes	3	2.77778
Software & Applications (n=98)	QR Stuffs	10	10.30928
	Google Sites	28	**28.86598**
	Zotero	20	20.61856
	Diigo	16	16.49485
	Delicious	13	13.40206
	Bundle Nut	10	10.30928

Storage (n=130)	Just cloud	7	5.384615
	Sugar Sync	9	6.923077
	You Send It	22	16.92308
	Dropbox	19	14.61538
	Open drive	6	4.615385
	Mozy	9	6.923077
	Online storage	17	13.07692
	Carbonite	10	7.692308
	Box	31	**23.84615**
Operating Systems (n=84)	Glide	3	3.571429
	Amoeba	10	11.90476
	My Goya	8	9.52381
	Kohive	15	**17.85714**
	Zimdesk	12	14.28571
	Joli	8	9.52381
	Ghost	6	7.142857
	Cloudo	11	**13.09524**
	Lucid	3	3.571429
	Eye	8	9.52381
Office applications (n=132)	Google Docs	56	**42.42424**
	MS Office Online	32	24.24242
	Cloud-canvas	24	18.18182
	Write	20	15.15152

Economics of cloud computing in libraries

Cloud computing eradicates the investment & commitment to computing resources which in particular is boon for libraries trying to cope with budget cuts and constrained financial resources. (Bushhousen, 2011) asserts that "many providers of cloud-based services offer varying pricing models for their clients who want to utilize certain *as a service* products for a specific project or length of time". A study of current state of cloud computing with focus on cost savings in libraries was conducted by (Han, 2011). Fig shows the cost savings that libraries will be getting after switching to cloud. In cloud computing "major portion of an organization's cost savings are gained by taking advantage of the variable transaction demands most applications have and redistributing unused computing cycles during the slower periods of one application to more demanding applications running at the same time"(Cervone, 2010). "With these efficiency improvements and large savings in operational cost as well as upfront capital costs for tech-startups, cloud computing carries the characteristics of a disruptive general purpose technology with a potential to greatly impact the economy as a whole" (Bayrak, Conley & Wilkie, 2011). (Breeding, 2009) opines that on the way from ground to the cloud, libraries use several options to provide their IT services with each option supporting one or several practises.

Table 7 Cost analysis of traditional vs. cloud computing

Features	Traditional Computing	Cloud Computing
Staff Time	Full involvement & dedicated staff	4-5 hrs. per day
Server Costs	60,000-1,20,000	40,000-55,000
Electricity	22,000 per month	16,000 per month
Software	80,000-1,35,000 per year	70,000 per year on use
Maintenance	40,000-65,000 per year	20,000
Equipment	80,000-2,00,000 per year	60,000-1,40,000 per year

Cloud Computing Layers

"The fact that the users can tap these services from web browsers via the Internet makes them cloud services. (Kim, 2009). "Different service models of cloud computing (NIST, 2011) "renders a variety of possibilities for libraries to engage in this technology" (Luo, 2013). When queried about

the layers of cloud computing there is large variation among librarians. Fig illustrates the different layers of cloud computing that the librarians are willing to use.

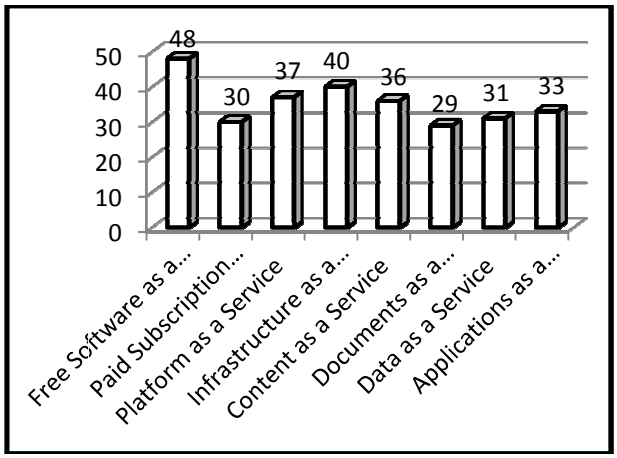

Figure 7 Cloud Computing layers in libraries.

Cloud Computing Deployment models

Library services rests on various data & information. "There are many issues to consider when moving an enterprise application to the cloud environment which are divided into different types of clouds, each with its benefits & drawbacks" (Zhang, Cheng & Boutaba, 2010). Flow of information is perceived as an important asset in libraries which needs to be protected and outsourcing of library data to cloud service provider demands to select from the various cloud deployers. Fig provides a snapshot of perception of librarians about the cloud computing deployment.

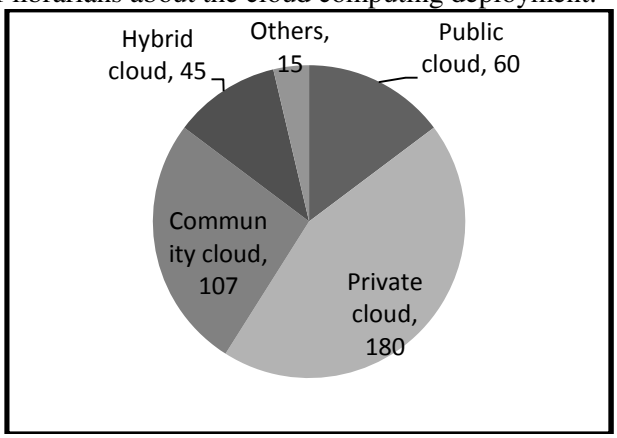

Figure 8 Cloud Computing Deployment models in libraries

Expectations of library services through cloud computing

(Gartner, 2009) opines that cloud computing is ultimately about whether or not service consumers achieve certain outcomes by using cloud services. According to (Liu & Cai, 2013) "The specific impact on libraries by the adoption of cloud computing will differ based on the types and the number of services implemented". The various range of services that librarians wants to offer through cloud computing is presented in fig 9 . Although the word cloud computing came into limelight too late librarians were already engaged in various cloud based tools to facilitate their partnerships and workflows. The pioneering example is the OCLC`s WorldCat catalogue. (Goldner & Birch, 2012) argues that "The (r)evolution of cloud computing now makes it feasible to embed this mixed economy into resource sharing workflow, as web services and APIs provided by Amazon and other booksellers enable the applications themselves to be embedded within the workflow." Libraries have enormous possibilities of resource sharing with cloud computing. Further (Goldner & Birch, 2012) state that "Cloud-based systems are not new in resource sharing as many countries have a national cloud-based resource sharing tool, accessed via a web browser".

Apart from the above arguments some scholars have even argued that cloud computing applications can be used to impart library instructions. Stephens, in Ten Trends & Technologies for 2009, predicted that librarians, information professionals & libraries will be highly influenced by the

ubiquity of the cloud and so to meet the needs educators should incorporate information and use of the cloud into their coursework (Stephens, 2009; Lowry et al., 2009).

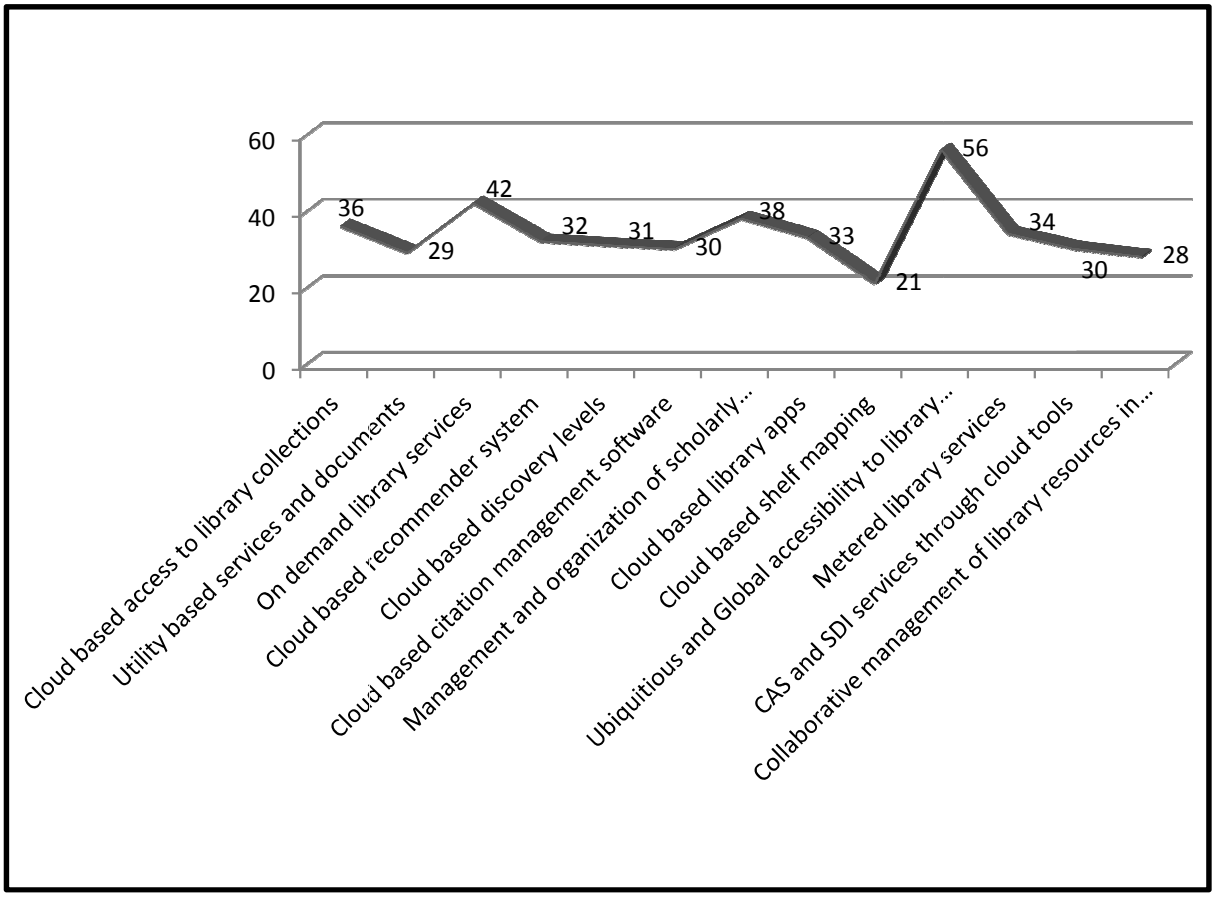

Figure 9 Possible library services through cloud computing

However, there are ample opportunities of library services in cloud computing yet there are various perceptions that hinder its implications in the libraries. Fig 10 presents a snapshot of the impediments of cloud computing in the Indian libraries.

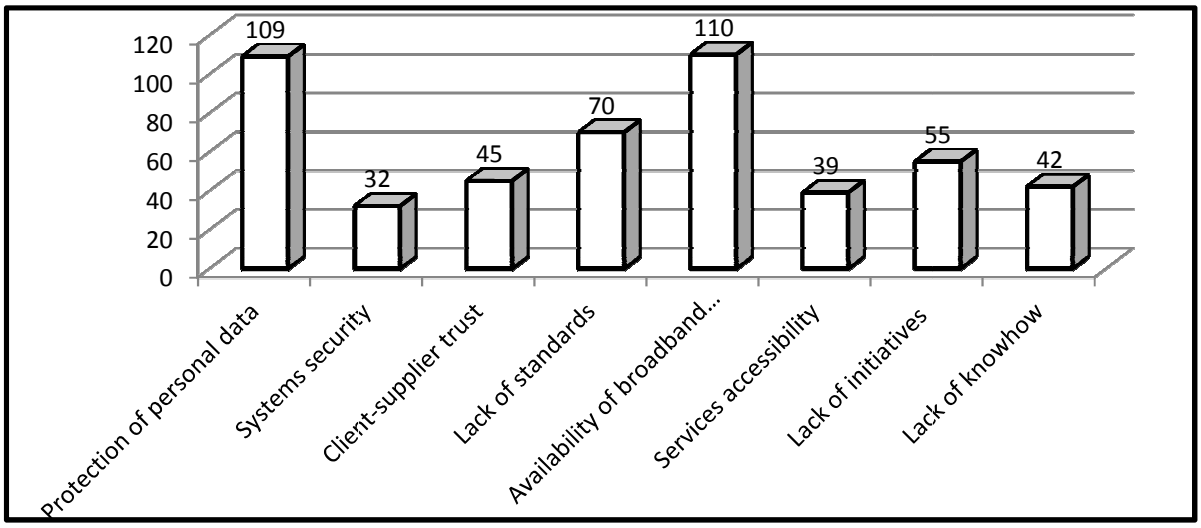

Figure 10: Concerns over cloud computing adoption

Security in cloud use.

"Cloud computing raises a range of important policy issues, which include issues of reliability and liability, security, privacy and anonymity, access and usage restrictions" (Arbabioon & Pilaveri, 2011). According to (IDC, 2009) "security is considered a key requirement for cloud computing consolidation as a robust and feasible multi-purpose solution". The results show that 296 (72.72%) respondents do not feel safe in storing data in the cloud. Moreover, 317 (77.88%) working library professionals fear that their data stored in the cloud can be used by the online service providers for marketing campaigns. Further, a majority of library professionals 301 (73.95%) in India prefer internal IT systems of the library over the cloud-based technologies. (Callowat, 2012) argues that "While the clauses in cloud providers' license agreements are not quite so onerous, they do snatch up rights that most cloud customers would certainly consider important". Librarians were asked various issues that they will consider before moving into the cloud. Table 8 briefs the issues which are core concerns for the librarians for moving from ground to the cloud.

Table 8 Issues of cloud computing in libraries

Issues	Features	Number of respondents	Percentage
Developing the right knowledge base to make sound decisions about cloud computing	Not an issue for us	45	11.0565111
	A minor issue for us	38	9.33660934
	A concern for us	98	24.0786241
	A major concern for us	**226**	**55.5282555**
Fears for data/file privacy & possible loss of confidentiality	Not an issue for us	18	4.42260442
	A minor issue for us	42	10.3194103
	A concern for us	**249**	**61.1793612**
	A major concern for us	98	24.0786421
Fears over the possible need to eliminate staff that had been h&ling IT functions in- house	Not an issue for us	8	1.96560197
	A minor issue for us	46	11.3022113
	A concern for us	41	10.0737101
	A major concern for us	**312**	**76.6584767**
Concerns over high subscription or "pay as you go" costs	Not an issue for us	4	0.98280098
	A minor issue for us	25	6.14250614
	A concern for us	92	22.6044226
	A major concern for us	**286**	**70.2702703**
Fear over data & file loss & lack of adequate safeguards	Not an issue for us	27	6.63390663
	A minor issue for us	64	15.7248157
	A concern for us	140	34.3980344
	A major concern for us	**176**	**43.2432432**

Conclusion

The analysis of this study shows that librarians in Indian central universities are engaged in various cloud computing activities. They show strong willingness to adopt cloud computing technology in the libraries. Irrespective of computer literacy & age they are using various devices to harness the cloud computing tools. Male professionals in the Indian central universities are dominant over their female counterparts when it comes to computing activities in the libraries. Librarians are using various tools provided by OCLC, ExLibris, Duraspace & KB+ which are dedicated to library services. Librarians support the idea of introducing cloud computing into the library and are desirous of various services that can be implemented on the cloud platform. Although, cloud computing is more economic and cost-saving than the traditional computing methods. However, the study identifies the problems that cripple its implementation. The question of trust over the cloud service provider, data protection and broadband accessibility hinders its implementation on a larger scale.

Further research with a broader scope, or using cluster and/or stratified sampling would provide additional information on the topic which is in its nascent stage. No library has yet declared itself to be cloud based.

Appendix

Survey Questionnaire- Cloud Computing Applications in Indian Central University libraries: A study of librarians` use

I. Please fill by clicking in the check box or entering your comments in the text box provided below. *(Multiple answers are permitted)*

II. After finishing it please save this form & mail the same to the address: mayank.yuvaraj@gmail.com

PERSONAL PROFILE

1. Name: Click here to enter text.
2. Position: Click here to enter text.
3. Institution: Click here to enter text.
4. Location: Click here to enter text.
5. Sex: ☐ Male ☐ Female
6. Age: Click here to enter text.
7. Computer literacy: ☐ Certificate ☐ Diploma ☐ Graduation ☐ Post- graduation ☐ Training ☐ No certificate or training
8. email id: Click here to enter text.
9. Marital status: Married/ Unmarried
10. Academic qualification: Click here to enter text.
11. Professional qualification: Click here to enter text.

ADOPTION OF CLOUD TECHNOLOGIES

12. How much do you invest for computing solutions in your library?
Equipments Click here to enter text. Facility Click here to enter text. Manpower Click here to enter text. B&width Click here to enter text. Power Click here to enter text. Maintenance Click here to enter text.

13. Do you want to adopt cloud technology in your library?
☐ Yes ☐ No

14. If YES, what factors are influencing your choice to adopt cloud technologies in the libraries?
Click here to enter text.

15. If NO, why do you not want to adopt cloud technologies?
Click here to enter text.

16. What is the level of introduction of cloud computing in your library?
☐ In discussion ☐ Pilot study ☐ In implementation ☐ In use ☐ Do not want ☐ Others

17. If your library has saved money using cloud computing, subscribing to an online application, or renting server space, estimate how much you have likely saved in the past year for the following:
Staff Time: Server Costs: Electricity: Maintenance: Other:

18. Which cloud service have been using in your library?
☐ Cloud-based mailing services ☐ Cloud-based forums ☐ Cloud-based social networking ☐ Cloud-based information collection ☐ Cloud-based calendar services ☐ Cloud-based file sharing services ☐ Cloud-based video services ☐ Cloud-based software & applications ☐ Cloud-based storing services ☐ Cloud-based operating services

19. For what purpose do you use cloud solutions?
☐ Web-mail service ☐ Store personal photos ☐ Online applications ☐ Store personal videos ☐ Pay to store computer files online ☐ Back-up hard drive to an online site

CLOUD COMPUTING IN LIBRARIES

20. In what areas do you want to implement cloud computing in libraries?
Click here to enter text.

21. Do you agree that adoption of cloud computing will simplify the IT based services? Click here to enter text.

22.Which device do you use for cloud computing?
☐ PC ☐ Laptops ☐ Mobile Phones ☐ Smart Phones ☐ Others

23. What layer of cloud computing do you plan to use in your library?
☐ Free Software as a Service (SaaS), i.e. Google Apps, Skype, Hotmail
☐ Paid Subscription Software as a Service, i.e. Salesforce

- Platform as a Service (PaaS) – Enables end users to build their own applications online, i.e. Windows Azure, Google App Engine & Force.com
- Infrastructure as a Service (IaaS) – Provides computing power & file storage, i.e. Amazon Cloud, Rackspace, Zyinga
- Other

24. Which cloud computing deployment model do you currently use, are planning to use or do you consider the most suitable for your library?

Public Cloud Private Cloud Community Cloud Hybrid Cloud Others:

25. Which of the cloud service provider are you using in your library for cloud computing operations?

Mailing	Forums	Custom Social networking	Information collection	Calendar
Gmail	Voice thread	Facebook	Google forms	Google Calendar
Yahoo	Now comment	Pin interest	Survey monkey	Hotmail Calendar
India	LIS forum	Twitter	Poll everywhere	
Sify	LISLinks	Ning	Qualtrics	
AOL	India talks		Zoomerang	
Hotmail			ProProfs	
Gawab			Zuhu Creator	
Fast Mail			WuFoo	
Mail				
Care2				
Lycos				

File Sharing	Video & Presentation	Software & Applications	Storage	Operating Systems	Office applications
Drop box	You Tube	QR Stuff	Just Cloud	Glide	Google Docs
Slide share	Vimeo	Google Sites	Sugar Sync	Amoeba	MS Office Online
Google Drive	Screen cast	Zotero	You Send It	my Goya	Cloud-canvas
Egnyte	Jing	Diigo	Drop box	Kohive	Write
	Prezi	Delicious	Open drive	Zimdesk	
	Slide rocket	Bundle Nut	Mozy	Joli	
	Google Presentation		Online Storage	Ghost	
	Time glider		Carbonite	Cloudo	
	Spicy nodes		Box	Lucid	
				Eye	

26. Which of the areas in your library operations is prime concern for using cloud computing?

- Cataloging & metadata storage, retrieval & generation
- Hosting &. or distributing special collections
- Acquisitions
- Cloud-based electronic resources
- As an ILS system
- For budgeting, payroll or accounting
- Others

27. Have you used any of the following cloud based library services?

- Serials Solutions Summon

OCLC Web-scale
TalisPrism
WorldCat.org

CLOUD SECURITY & PRIVACY

28. Do you feel safe in storing data online?

Yes No

29. Do you think that a copy of your online files can be kept by the online service providers even if you delete them?

Yes No

30. Are you concerned about the ability to retrieve your data from the cloud?

Yes No

31. Do you bother that the online service providers can use your pictures & other information for marketing campaigns?

Yes No

32. As a factor in choosing to use cloud computing services for major library operations or file storage, how do you rate the following factors as a consideration in your decision making?

Features	Not an issue for us	A minor concern for us	A concern for us	A major concern for us
Developing the right knowledge base to make sound decisions about cloud computing				
Fears for data/file privacy & possible loss of confidentiality				
Fears over the possible need to eliminate staff that had been h&ling IT functions in- house				
Concerns over high subscription or "pay as you go" costs				
Fear over data & file loss & lack of adequate safeguards				

33. Does your library trust internal IT systems over cloud-based technologies & it`s soon to make changes?

Yes No

SIGNATURE

Thanks for your co-operation & time sparing.

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