Examining librarians' behavioural intention to use cloud computing applications in Indian central universities

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The paper analyses the Technology Acceptance Model (TAM) in order to examine the librarians' behavioural intentions to use cloud computing applications. A questionnaire was developed using three TAM instruments: attitude, perceived ease of use and perceived usefulness to measure the librarian`s behavioural intentions of cloud computing applications use. Four hundred and seven library professionals completed the survey that measured their responses on perceived ease of use, perceived usefulness, attitude and the behavioural intentions on the use of cloud computing applications. Results show that librarians' perceived ease of use had significant impact on the attitude towards use. Further, perceived ease of use severely influenced the perceived usefulness of the cloud computing applications. The findings validate the implications of cloud computing applications in a library setting.

Keywords: Cloud computing applications, Technology Acceptance model, university libraries, behavioural intentions, perceived ease of use, perceived usefulness.

Introduction

Researchers in the area of information technology are keen to investigate theories and models that have competency to predict and explain behaviour across many domains. Virtualization and flexibility offered by cloud computing has made it inevitable to study the usage and prospects of cloud computing from the libraries' viewpoint. Cloud computing is an emerging branch of information technology that has been billed as hot-growth due to its potential benefits. The utilisation of cloud computing applications has the potential to change the nature of library services through hosting services on the web that is accessible via any device having network connectivity. Shifting library core applications to cloud-based services will reduce or eliminate most or the entire local technical needs in managing server hardware and operating systems that underlie the applications[1]. In spite of huge advantages of cloud computing, the rate of its adoption is very low. A survey conducted by Tata Consultancy Services reveals that the rate of adoption of cloud computing applications is 19% in US, 12% in Europe, 28% in Asia Pacific and 39% in Latin American countries[2]. The study is based against this background to assess the cloud computing applications adoption in the university libraries.

Adoption of any computing technology consists of establishing the purpose the system will serve and the functionality the institution requires. Literature and papers on cloud often go to great lengths to explain it conceptually but none to date have analysed the usage and acceptance of cloud computing in a university library setting. Researches are being carried out to analyse the factors that influence the acceptance of cloud computing. Several models have been developed to investigate the factors that catalyse the acceptance of computing technology. Theoretical models used for studying user acceptance, adoption, and usage behaviour include the theory of reasoned action[3,4], theory of planned behaviour[5], technology acceptance model[6,7], decomposed theory of planned behaviour[8], and innovation diffusion theory[9,10,11]. The paper focuses on technology acceptance model (TAM) to investigate the behavioural intention to use cloud computing applications in the libraries. TAM was used to understand the relationship that perceptions (perceived usefulness and perceived ease of technology use) had with the usage behaviour of cloud computing applications. TAM has a sound predictive ability in technology adoption studies.

Literature review

Cloud computing and applications

The most cited NIST definition of cloud computing (2009) reveals that cloud computing is a model for enabling, convenient, on-demand network access to a

shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction[12]. According to Tadwalker cloud computing derives its name from cloud which represents data centres, technologies, infrastructure and services delivered through internet[13]. For the cloud computing services it has been a challenging task in establishing a 'one size fits all' definition or a corresponding set of standard functionalities. However, with an upsurge in the usage of the internet many organizations and educational institutions are either purchasing cloud based services hosted by the provider or building their own from scratch. Some scholars feel that cloud computing was already in practice before the concept ripened and it has an essence of futuristic implications. Hoy asserts that many library patrons are already using cloud products such as Gmail, Google Docs and bibliographic management tools for their daily needs[14]. He further adds that the number of applications available in the cloud has increased substantially in recent years. On the other hand, Romero argues that in the field of library automation there are several commercial suppliers already offering various adaptations of their products which make the use of the cloud possible to a lesser or greater extent[15]. Similarly, Cohn et al. opines that libraries use database vendors or integrated library system providers who provide external servers to host library softwareand data in the cloud[16]. According to Prince some of the cloud-based options for libraries include IaaS (Infrastructure as a Service) or PaaS (Platform as a Service)-hosted ILS systems in which libraries buy their ILS software from one vendor and host it on another vendor's servers[17]. Major ILS vendors exclusively having SaaS (Software as a Service) deployment options for libraries are: ExLibris, VTLS and Cyber Tools. There are various cloud based tools for reference service needs of the libraries such as cloud-based video services (e.g. YouTube, TeacherTube), information collection services (e.g. Google forms) and file sharing services (e.g. Dropbox). The revolutionary development to cloud based library services is WorldCat Local where OCLC along with Google are exchanging data in the cloud to facilitate the discovery of library collections through Google search services in a single interface[18].

Recent searching on Google Trends reveals interest of cloud computing in India. Madhusudhan and Nagabhushanam feel that Indian university libraries have realized the paradigm shift in library services and they are providing better web-based library services to their current techno savvy users[19]. Most important is the fact that cloud computing enables new streamlined workflows for cooperation and community building among libraries[20]. According to Sultan, cloud computing can provide colleges and universities with a means to upgrade software and IT hardware attracting students and keeping pace with digital technological developments[21]. On the other hand, Scale puts forth his view that cloud computing is currently enabling librarians to shift from the paradigm of ownership and maintenance of resources towards the provision of access to information maintained and controlled by others[22]. There is a general misconception that moving the library into cloud will eradicate the need of library IT staff as all works will be done by cloud service provider. Although cloud computing involves more responsibilities and obligations of the service provider yet, cloud based service is not entirely plug and play and the client library need worry only about such things as local bandwidth, hardware client (PCs) and software configuration[17]. According to Sorensen and Glassman cloud-based applications offer libraries new ways to present information or offer services that were previously unaffordable or unavailable[23]. Patel et al. have enlisted four core areas of cloud computing solutions in the libraries: technology, data hosting archives, information and community[24].

Technology Acceptance Models

Adoption and implementation of any new technologies like cloud computing within an institution or an organization depends on technical factors along with the characteristics of the organization that introduces the technology and the feedback to the technological tools obtained from the users. Central to this research has been the influential Technology Acceptance Model[7,25-28]. Technology Acceptance Model originated from the study of social psychology through the Theory of Reasoned Action and the theory of diffusion of innovations. The constructs used to study TAM are: perceived usefulness, perceived ease of use, attitude and the behavioural intentions to use. The TAM posits that individuals' behavioural intention to use IT is determined by two beliefs: perceived usefulness and perceived ease of use[26]. Moreover, they are also considered to be important for the usage and

acceptance of the information technologies. Perceived usefulness is defined as the extent to which a person believes that using IT will enhance their job performance, while perceived ease of use is defined as the degree to which a person believes that using IT will be free of effort[29].

Most of the scholars have applied TAM to find out the relationship of the technology user`s beliefs with that of their behavioural intentions. Yi and Hwang carried out a study of TAM model to predict the usage of web-based environment in their study and found a direct and significant influence ($\beta=0.19$; $p< 0.001$) between the behavioural intention and the actual usage[30]. Use of the TAM model for understanding the librarian`s perceptions of the cloud computing applications and its potential futuristic usage is based on following assumptions:

1) When the librarians perceive the cloud computing applications to be useful and easy to use, then they may have a positive attitude towards its use.
2) When librarians perceive the cloud computing applications as easy to use, then they may have a positive attitude towards the usefulness of the system.
3) When librarians have a positive attitude towards the cloud computing applications, then they may use them frequently and intensively and may develop favourable intentions towards using the cloud computing applications.

Objectives of the study
- To determine the factors responsible for the adoption of cloud computing applications in central university libraries of India;
- To examine the librarians' perceptions of use of cloud computing applications in central university libraries of India;
- To find whether perceived usefulness influences the attitude of using cloud computing applications in central university libraries of India;
- To find whether perceived ease of use influences the attitude of using cloud computing applications in central university libraries of India;
- To find whether perceived usefulness influences the attitude of using cloud computing applications in central university libraries of India; and

- To find whether attitude influences the behavioural intention to use cloud computing applications in central university libraries of India.

Hypotheses
In accordance to the research objectives this study tested the following hypotheses:

Hypothesis 1: Perceived usefulness (PU) will have a significant influence on the attitude towards using (ATU) cloud computing applications.

Hypothesis 2: Perceived ease of use (EU) will have significant influence on the attitude towards using (ATU) the cloud computing applications.

Hypothesis 3: Perceived ease of use (EU) will have significant influence on the perceived usefulness (PU) towards using the cloud computing applications.

Hypothesis 4: Attitude towards usage (ATU) will have a significant influence on the librarian`s behavioural intention (LBI) to use the cloud computing applications.

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 as shown in the Table 1.

A questionnaire survey was used for collection of data from a purposive sample of 488 library professionals drawn from a countrywide population of 29 central university libraries of India. The questionnaire was divided into two parts. Part 1 was designed to record the demographic characteristics of the respondents. Part 2 was based in context of the usage of cloud computing applications and was subsequently developed from the scales used in TAM (adapted from Davis et al.[25] and Venkatesh et al.[28]. TAM model comprised of 20 items which were used to measure perceived usefulness, perceived ease of use, attitude towards usage and the behavioural intentions which was recorded on seven point Likert scale. 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

Table 1—List of participating central universities in India

Sl. 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 and Foreign Languages University (CIEFL), Andhra Pradesh	Ramesh Mohan Library	1977
9	Guru Ghasidas University (GGU), Chhattisgarh	Central Library	1984
10	Hemwati Nandan Bahuguna Garhwal University (HNBGU)	Central Library	1973
11	Indian Maritime University (ITM), Tamil Nadu	University Library	1991
12	Indira Gandhi National Open University (IGNOU), New Delhi	Library Documentation Division	1986
13	Indira Gandhi National Tribal University (IGNTU), Madhya Pradesh	Central Library	2008
14	Jamia Millia Islamia (JMI), New Delhi	Zakir Husain Library	1973
15	Jawaharlal Nehru University (JNU), New Delhi	Central Library	1976
16	Mahatma Gandhi Antarrashtriya Hindi Vishwavidyalaya (MGAHV), Maharashtra	Mahapandit 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	Nagaland University (NU), Nagaland	Central Library	1994
21	North Eastern Hill University (NEHU), Meghalaya	Central Library	1973
22	Pondicherry University (PU), Pondicherry	Ananda Rangapillai Library	1985
23	Rajiv Gandhi 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), Andhra Pradesh	Indira Gandhi Memorial Library	1975
29	Visva-Bharati University (VBU)	Central Library	1901

found incomplete in 17 responses. Finally, 407 (84 per cent of the sample) valid questionnaires were selected for data analysis and interpretation. The data were interpreted, classified and transferred into coded form, entered into Microsoft Excel and transferred in statistical package for social sciences (SPSS). A frequency analysis was run for detection and removal of errors and missing numbers.

Findings

Demographic behaviour

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, and 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. Among 407 respondents, 320 (78.62%) are male library professionals while female respondents are 87 (21.37%).

Descriptive statistics

The descriptive statistics of the study of four factors has been shown in Table 3. All means are above the midpoint of 3.00. The standard deviation ranges between 1.20 - 1.50.

Construct validity

In order to test the reliability of the factors Cronbach's alpha test was used. Table 4 shows the results of Cronbach alpha test of the use of cloud computing applications for the sample of 407 librarians. All the factors used showed a high uniformity that exceeded the reliability estimates (α=0.70) as recommended by Nunnally[31].
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Discriminant validity

Using the correlations between the four factors discriminant validity is assessed[32]. Table 5 shows the variance for each factors used in the study. The

obtained results show acceptable differences between the discriminant and convergent validity of the factors.

Hypotheses testing

Table 6 shows the results of the hypotheses tests. The study revealed that 2 out of 4 hypotheses are supported by the data. In consistent to prior researches[25, 33] perceived ease of use shows a significant effect on the attitude towards using, with p<0.0001. Whereas, perceived ease of use showed a significant effect on attitude towards using while perceived usefulness did not. Perceived ease of use showed a significant influence on the perceived usefulness, with p<0.05.

Moreover, the study used structural equation modelling approach to develop a model that is representative of the relationships among the four

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	6.142	9.336	19.41	65.110		

Note: UL - University librarian, D L- Deputy librarian, AL - Assistant Librarian, IS - Information Scientist, PA - Professional Assistant, SPA - Semi Professional Assistant, TA - Technical Assistant, LA - Library Assistant.

Table 3—Mean and standard deviation (n= 407)

Factors	Question	Mean	Standard deviation
Perceived usefulness of cloud computing applications	Using the cloud computing applications enhanced the efficiency of library works	3.30	1.511
	Using cloud computing applications enhanced library working capabilities	4.20	1.473
	Using the cloud computing applications increased library service productivity	5.23	1.490
	Using cloud computing applications enabled to do library works quickly	3.02	1.470
	Cloud computing applications are useful for the libraries	5.62	1.411
Perceived ease of use of cloud computing applications	Cloud computing applications are easy to use than installing software in desktop computing	3.40	1.422
	Cloud computing applications are easy to handle, painless and less bothering	4.58	1.483
	Cloud computing applications are fool proof operations and do not require skills	3.52	1.260
	Cloud computing applications are customizable and interactive	5.51	1.400
	Cloud computing applications can be used on any system with network connectivity	3.46	1.380
Attitude towards usage of cloud computing applications	Security is a big concern in using the cloud computing applications	3.20	1.225
	Favour and encourage the use of cloud computing applications	5.70	1.460
	Beneficial for the library daily works and services	5.20	1.510
	Using cloud computing applications allowed me to focus on library services then being involved with IT bothering	4.84	1.446
	Prefer to use cloud computing applications than downloading and installing specific software	3.45	1.388
Behavioural intention to use the cloud computing applications	Use cloud computing applications during leisure time	3.12	1.470
	Use cloud computing applications frequently for library works	3.96	1.295
	Use cloud computing applications as often as possible	3.80	1.228
	Planning to introduce cloud computing applications in the libraries in few months	3.92	1.306
	Plan to use cloud computing applications in future	3.20	1.405

Table 4—Croanbach Alpha reliability coefficient

Factors used in the study	Number of items	Alpha
Perceived usefulness of cloud computing applications	5	0.936
Perceived ease of use of cloud computing applications	5	0.952
Attitude towards usage of cloud computing applications	5	0.941
Behavioural intention to use the cloud computing applications	5	0.957

Table 5—Assessment of discriminant validity

	Perceived usefulness of cloud computing applications	Perceived ease of use of cloud computing applications	Attitude towards usage of cloud computing applications	Behavioural intention to use the cloud computing applications
Perceived usefulness of cloud computing applications	0.548			
Perceived ease of use of cloud computing applications	0.284	0.512		
Attitude towards usage of cloud computing applications	0.316	0.295	0.558	
Behavioural intention to use the cloud computing applications	0.256	0.287	0.377	0.425

Note: diagonal entries- average variance, non-diagonal entries-shared variance

Table 6—Hypothesis testing results

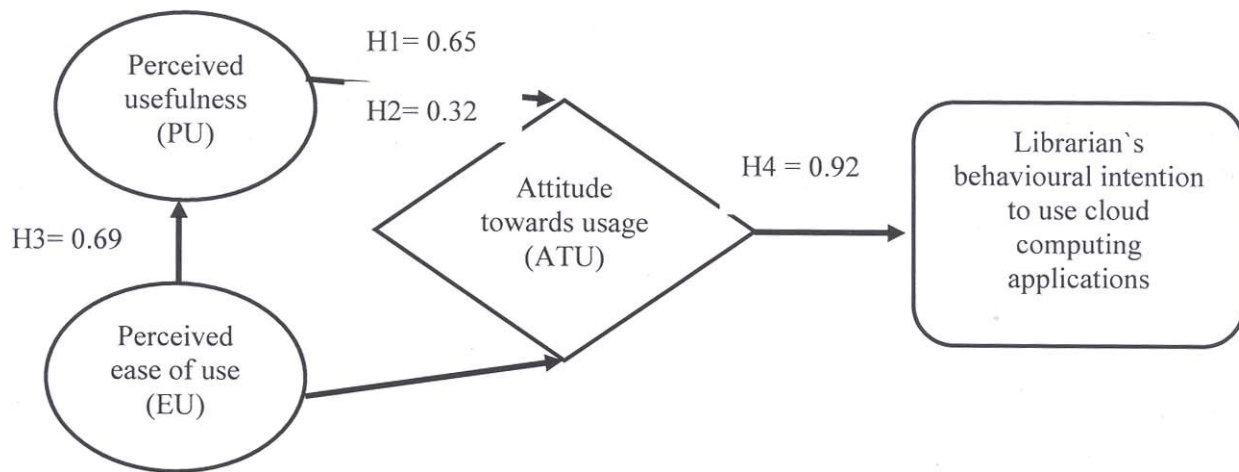| Hypotheses	Path	Path coefficient	t-value	Inference
H1	PU →ATU	0.65	1.09	Unconfirmed
H2	EU →ATU	0.32	3.19*	Confirmed
H3	EU →PU	0.69	6.37**	Confirmed
H4	ATU→ LBI	0.92	1.40	Unconfirmed

Note: *$p<0.05$; **$p<0.001$

Fig.1—Path coefficient results

factors used in the study. The structural model and hypotheses were subjected to verification using the path coefficients.

The path coefficient has been shown in Figure 1.

Discussion

The huge demand for web based applications as well as its popularity has lent a new lease of life to the computing sector catalysing the development of cloud computing services. The technologies that drives the cloud computing have existed for about sixty years however it has evolved as a computing paradigm in the recent decades. Cloud computing has become a common phenomenon in marketing, social networking and information searching. Although, cloud computing offers multifaceted benefits it has been found that users hesitate to use cloud computing services due to concern over internet security, ownership of data in the cloud, invasion of privacy and data leakage. According to Engel, Blackwell and Miniard, usage intention is a psychological decision making process where user judges the product and other alternatives before use[34]. Chen (2003) on the other hand argues that if

the service providers give the technological support and round the clock user interaction the behavioural intention to use a technology will increase[35]. The findings of the present study also supports that the behavioural intentions for wider adoption are significantly related to the ease of use of the system. Hsiao carried out a study on the adoption of cloud computing services in Taiwan through TAM and discovered that the acceptance of cloud computing services was higher even with existence of perceived risks among the users[36]. Other studies using TAM on adoption of cloud computing has been carried out by Shimba[37], Jlelaty and Monzer[38], and Low, Chen and Wu[39] who showed higher level of eagerness to adopt cloud computing applications in various organizations. If the clouds of risks are removed we can nurture a healthy cloud computing landscape in the libraries also.

Conclusion

The study was carried out with a purpose to determine the applicability of the TAM in cloud computing applications by looking into the librarians' intentions in accordance with factors like perceived

usefulness, perceived ease of use and the attitude towards use. The results showed that perceived ease of use had substantial effect on the attitude towards usage and perceived ease of use also had a significant effect on the perceived usefulness. It can be concluded from the observations that cloud computing applications are easy to use and free from the mental efforts for the librarians. Moreover, librarians foresee the usefulness of this technology and are willing to imply the same in the libraries. The study was a step towards examining the librarians' perceptions of using the cloud computing applications. Policymakers and the government agencies need to formulate policies to encourage the acceptance of cloud computing applications in a library setting. Adoption of cloud computing will check the staff redundancies and increase the library efficiency.

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