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Determining the Factors Influencing Cloud Computing Implementation in Library Management System (LMS): A High Order PLS-ANN Approach

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Abstracts: The principal component of this paper is to ascertain the prominent variables of technological, organizational, environmental, and financial constructs that influence library cloud computing (LCC) among the library users and professionals in the selected universities of India. This paper discusses the advantages, opportunities, challenges, and Models of Smart Library in the ICT age library management system. The study also commissioned tools viz. EFA, CFA, and structural equation assess the degree to which selected factors were associated with LCC adoption. Empirical research proposed four hypotheses by selecting the technological, organizational, environmental, and financial constructs and 16 manifests in the specified model. The model was then tested on a sample of 510 respondents of 26 major states, central and private universities of India using SEM-ANN. First, SEM was employed to find out which variables had a meaningful influence on LCC. Secondly, the output of ANN outlined the rank of influencing predictors obtained from SEM. It is evident that technological factors, greater scalability (TF_1), tech-readiness (TF_2), and easier back-up (TF_3), are the most robust antecedents of LCC. Whereas in organizational factors- recognized usefulness (OF_1), are the robust manifest, but in environmental factors-geographical reach (EF_1), administrative support (EF_2), conducive application interface (EF_4), are the significant predictors. Eventually, financial factors- cost-saving (FF_1) and better return on investment (FF_2) are the considerable predictors obtained from ANN. The findings further indicate that behavioural intention to adopt the library cloud yielded novel insights that significantly benefit users and stakeholders.

Keywords: Cloud Computing Implementation (CCI), Cloud Computing Adoption (CCA), RFID, Financial factors, Scalability, LMS.

1. Introduction

Documented knowledge is now shifting from the desktop to cloud platform through smart user-friendly internet applications, computers, servers, and software (Ali et al., 2018; Amron et al., 2019). There is a phenomenal transformation of notes-based content to web-linked material with the help of revolutionary techniques, i.e., cloud computing. Thus, users access all web material, documents, programs, contents, and records from any computer connected to the particular server and internet (Butler et al., 2021; Changchit & Chuchuen, 2018). The implementation of CC in libraries has turned it from a physical house of books to a virtual place (Yuvaraj, 2016). Similarly, cloud services storage, server, and deployment have dramatically changed the learning scenario and reduced owner costs. CC has also come out with a dear resolution to the current financial calamity to sustain the services provided by organizations (Goel et al., 2020).

The study conducted by (Houssein et al., 2021; Phaphoom et al., 2015) elaborated that cloud computing is used at a technical level due to its user-friendliness, cost-effectiveness, and ease of interaction with viewers. Indian libraries, on the other hand, have also been planned to implement these cloud modules (Raut, 2017). Any institution considering the implementation of CC must begin by defining the kind of cloud service components conducive to the ultimate users (Tella et al., 2020). Furthermore, in the word of (Amron et al., 2019; Atiyah et al., 2015), there should be rational preparedness for its adoption to introduce any technology.

According to (Makori, 2016; Shaw & Sarkar, 2019; Wasike, 2015), CCT collects and access data and programs in a private storage hosting space over the network. (Library, 2010) elucidated CC as "a model for empowering universal, expedient, on-demand web access to a collective pool of configurable computing reserves that can be instantly provisioned and unconfined with minimal management effort or service provider interaction" (Md. Gulnawaz Azam, 2019)**.** (Manish Dadhich, Hiran, et al., 2021) abridged CC as a framework for delivering on-demand educational content to figuring services through the internet. The data is kept on a server cloud that is aligned through a web, where the users need software packages and appliances to access the contents.
However, (González-Gómez et al., 2016; Tong et al., 2020) mentioned that "cloud computing is the blend of pre-existing knowhows and these skills have mellowed at an unlike pace and were not designed as a whole, they have originated together to produce a knowledge ecosystem for cloud computing." As a result, it demonstrates that CC is a modern medium to know-how current technology shaping the entire world.

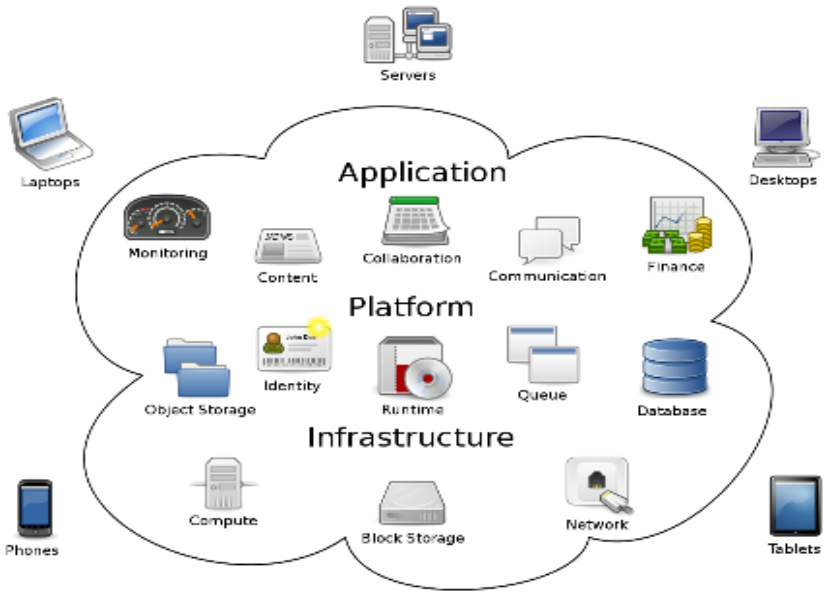

Fig. 1: Cloud Computing Structure

1.1 Cloud Computing and Libraries

The cloud can be a powerful tool for conducting and managing research in the domain of library science (Schneider & Sunyaev, 2016). The evolution of CC is an outstanding task towards next-level integrated library systems. For the guidance for academic research, the availability of LCC is a vital source of content, and with the advent of CC, libraries are no longer left in the dark. (Helali & Omri, 2021). Many businesses are embracing the cloud as a digital technology model for ICT infrastructure and services emergencies. (Md. Gulnawaz Azam, 2019).
CC allows libraries to evade locally hosting servers that require software installation, upgrade, and compatibility issues. Besides, it can synchronously make workflow greener and enable the libraries to render improved end-user searching and retrieving services (Njenga et al., 2019). Presently, a developed library assists the users to search any content through an extensive network of cloud collaborated librarians. There are many integrated library systems and software viz. Koha, New-Gen-Lib, Emilda, Open-Biblio, and Php My-Library acts as a cloud resource system (Anabel Gutierrez, 2015; Rudansky-kloppers & Bergh, 2019). This software supports CC in identifying, collecting, organizing, and broadcasting digital resources for the users and the

library professionals. CC delivers many captivating possibilities for libraries, comprising the potential to diminish technology costs while increasing consistency, capacity, and efficiency for automation actions (Mansouri, S.A., Lee, H. and Aluko, 2015).
In the word of (Ali et al., 2018; Qasem et al., 2019), "CC has made strong incursions into other commercial sectors and is now commencing to find more application in library science".
It is pertinent to discuss that OCLC, a non-profit computer association library service and research group devoted to the community purpose of facilitating the world information on fingertips (Manish Dadhich, 2017). Now, OCLC has acted as a CC vendor providing cataloguing tools over the internet and permits member organizations to get on with their unified data access (Butler et al., 2021; Qasem et al., 2019). These centralized databases distribute catalogue records among many libraries, thereby reducing the time spent cataloguing and indexing contents. Development of CC for integrated LMS and retrieval system is based on global recommendation including Service-Oriented Architecture, Open Library Environment Project, and Integrated Library System for Discovery Interface (Changchit & Chuchuen, 2018; Roux & Evans, 2011).

1.2 Opportunities of Library Cloud

The usage of the library cloud renders the following prospects:

- It allows for the use of resources without knowledge of their infrastructure.
- The use of economic scale cloud computing works.
- Regulation and access are also a matter of great concern.
- Seller and service provider asserts costs for a permanent revenue stream by creation.
- The data and service are centrally stored but can be accessed from anywhere.

There are a lot of advantages of CC in the present context, viz. save hardware cost, easier maintenance, easy to deploy & replace and upgrade, easy back up for the library, and the essential attribute is single server multiuser (Rudansky-kloppers & Bergh, 2019; Yuvaraj, 2016)

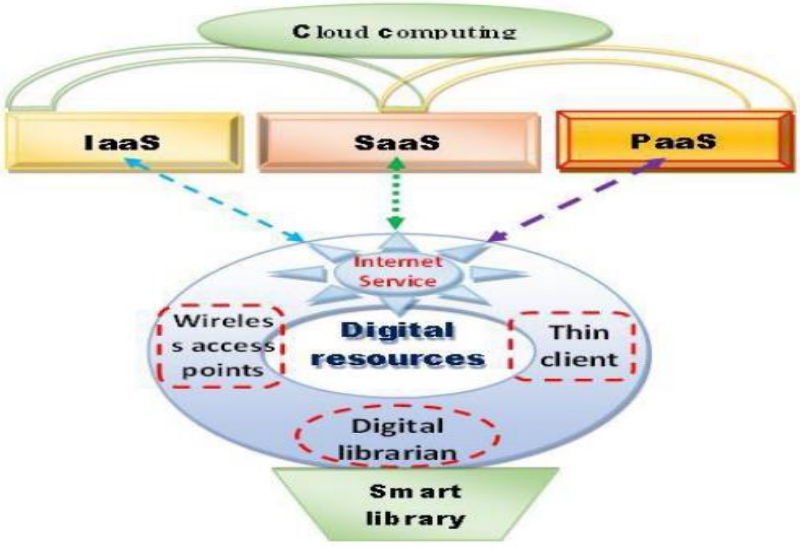

Fig. 2: Model of Smart Library in ICT Age

The architect of a cloud-based library is intended as a modern notion of library structure. The planned model supports cloud platforms, wireless access, and hardware solutions for arraying and managing IAAS, SAAS, PAAS for libraries (Modisane et al., 2021). The CCL framework gives librarians the ability to operate library systems both on and off-locations. It facilitates the

libraries from frequent system update management (Shiju & Pramila, 2021). CC has four major types of service models:

- Public Cloud - A platform where the service provider makes services accessible through the internet medium. Storage competencies, software, and virtual devices are few cases of resources that differ by service provider. The public cloud enables individuals' atomicity and resource sharing facilities, making it impossible for a single enterprise to achieve it.
- Private Cloud - This framework offers one organization committed services and renders a very high control measure on stored data and restricted access. This style is appropriate for corporations that keep confidential or R&D evidence.
- Hybrid Cloud - It is an IT architecture that combines public and private cloud at one platform. The system allows for instrumentation, governance, and application portability between users to create a single, scalable, and optimal cloud environment for running a company's computing workloads.
- Community cloud - A community cloud is an infrastructure that enables organizations to exchange information through accessing systems and services. One or more voluntary groups, a third party, or a blend of them own, administer, and run it. Thus, equipment is shared among numerous institutions in a distinct group with shared computer needs and objectives.

The idea of CC, enabled by virtualization technologies, has arisen as a modern computing model and revolutionizes information and communication technology (Goel et al., 2020; Kathuria et al., 2018). Cloud computing uses the internet as a medium for capturing, storing, and processing data. All TNCs and other small domestic companies use CC to make themselves competent in the present competitive era of the IT revolution over the Internet (Phaphoom et al., 2015).

In a nutshell, this study attempts the research questions:

RQ.1: How the internal and external factors influence cloud computing implementation in Library Management System (LMS)?

RQ.2: How to establish the model and validate CCA-LMS for HEIs of India?

1.3 Objectives of the Study

Scientists and academics have always been drawn to technological developments and its dissemination to the public. Similarly, the purpose of this research is to determine the value of cloud computing applications in academic libraries, with a particular focus on determining the manifests of integrating cloud computing in academic libraries of India.

The contribution of the study to explain why cloud hosting is not extensively accepted in Indian university libraries by examining librarians and users' perceptions on CC. The study is carried out with following explicit objectives:

- To determine the vital factors accountable for the CCA by the academic libraries of HEIs.
- To analyze the perception of end users towards cloud adopting model of LMS.
- To establish and validate a model representing core drivers of TOEF for the adoption of CC in academic libraries of India.

The paper is meticulously framed to get inside factors influencing cloud adoption in LMS of Indian educational institutions. To fulfil the objectives of the research, the following section is conducive to comprehend. Section 2 portrays the review of literature, research gap, theoretical constructs, and development of hypotheses. Section 3 outlines the research frame and methodology to assess the model. Section 4 illustrates data analysis, SEM, testing of hypotheses, followed by a procedure of ANN modelling, sensitivity analysis and interpretation with the help

of statistical tools. The last section considers theoretical implications, limitations, future scope, and conclusions.

2. Review of Literature

Two previous studies (Raut, 2017; Tella et al., 2020) have enumerated six constructs extricated from TOE and DoI theories to determine the responses of CC among IT executives in the public sector of Malaysian. The statements were a virtual benefit, compatibility, intricacy, trialability, ICT knowledge, security, and innovativeness. The same context has also been tested by (Amron et al., 2019) in their purported model for identifying the tolerability of CC among small and medium companies.

(Kumar & Dadhich, 2014; Tong et al., 2020) asserted the maximum contribution of CC was to focus more on LMS, reduce the complexity of IT Applications, lower the managing costs, undermine risks, conduct broader-range distribution, and 24x7 services.

(Schneider & Sunyaev, 2016) articulated the ideology of limited to unlimited data sharing concept, which was based on cloud interface. They also discussed philosophical and technical obstacles while implementing cloud networks in libraries and concluded that the digitalization of libraries with the cloud could serve the user at best with no regional boundaries.

(Tripathi, 2019) outlined many social functions of a library with two fundamental aspects, i.e., satisfying social reading and deployment of knowledge. As a result, hybrid libraries may replace the physical bookkeeping system, and the future would be based on new-styled automated libraries for researchers and readers.

(M. Dadhich et al., 2018; Md. Gulnawaz Azam, 2019) focused that human potential for generating and processing information has vastly outstripped their ability to manage, operate, and use it in the era of ICT. Thus, it is pertinent to put everything on one platform, i.e., the cloud.

(Helali & Omri, 2021; Rakesh Kumar Birda & Manish Dadhich, 2019) articulated that people can get a lot of information, but the search costs in time, human resources, and money were extremely high. People no longer want their library to be a one-stop shop for all kinds of information; instead, they want a tailored or personalized cloud service.

(Modisane et al., 2021) talked about cloud environment where the users may order customized and corresponding cloud services which can be availed through the internet. (Yuvaraj, 2016) studied that apparent comfort of use, effectiveness, and universal accessibility of the supporting expertise are robust handlers of the embracing of CC in the libraries.

2.1 Research Gap and Conceptual Model

Cloud in the context of library science will also transform traditional learning practice to cloud/e-content services rendered in the libraries. With the advent of time, the growth of cloud-based education has begun to see a subsumed change in the higher education system. Numerous determinants have also been discussed above in the context of LMS at various educational institutions across the globe.

Over a period, researchers in the information system domain have established several theoretical frames to filter out the major determinants that work as catalysts and act as robust drivers for embracing new technologies. The current work employs one such theory given by (Tornatzky, L.G., Fleischer, 1990), which was again modified/utilized by current studies viz. (Anabel Gutierrez, 2015; Hiran & Henten, 2020) for CCA technology in libraries. Thus, the study intends to fill the following academic gaps:

- The present study seeks to determine factors influencing cloud management systems for Indian libraries using high order SEM-ANN approach. This dual approach in LMS has yet not been observed in the previous research.

- The research on cloud and LMS using a combination of Technological, Organizational and Environmental factors is very limited, further adding one more construct, i.e., financial factors (Bhardwaj et al., 2021; Changchit & Chuchuen, 2018) made the theoretical frame distinct. This frame may delineate the preparedness of Indian academic libraries in CCA.
- The model's constructs were evaluated using artefacts found in the existing literature.
- Many emerging educational institutions have not realized the full advantage of implementing cloud management systems. There is still limited multi-factors decision-making studies in comparison to single objective investigations on areas like LMS.

Further, a literature review of previous works was used to create the measurement constructs. The present study pursues to identify and determine the factors influencing cloud computing implementation in LMS. The CCI was evaluated using 16 items (five-point scale of Likert) referred from published sources. As suggested by past studies, all selected constructs, such as technological, organizational, environmental, and financial, comprise four items each (see table 1).

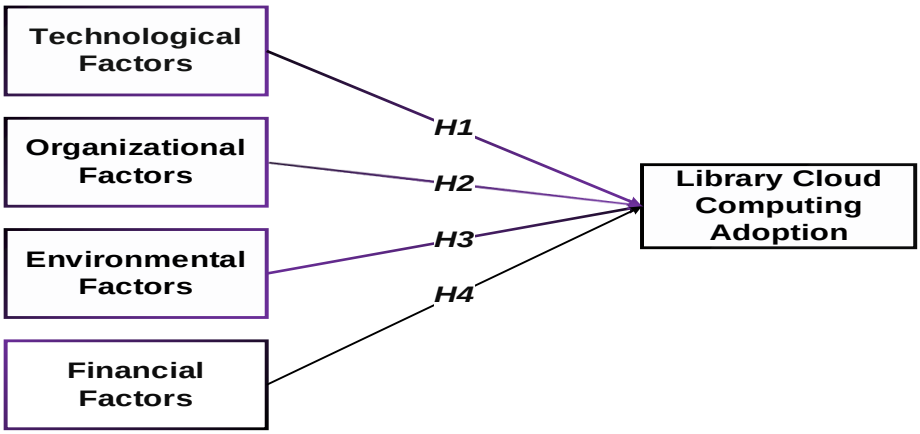

Fig. 3: Conceptual Framework

3. Theoretical constructs and development of hypotheses

Physical libraries are needed to be transformed from a book-oriented approach to a user-centred system (Tong et al., 2020). Few studies viz. (Butler et al., 2021; Yu, 2021) also discussed that code the readable classification system has created incredible contribution contributions managing books in libraries, but implementing cloud cloud-based has revolutionized LMS. Thus, R&D in the field of library science has been evoked in the recent past. Eventually, CC will lead the librarianship into a new age of the techno-cloud library system that is transforming the face of the library. The past research work viz. (Qasem et al., 2019; Roux & Evans, 2011) also emphasized that in the future, the users can access the library as a service, a friend, a portal, a social leveller, a memory, an experience, and a network, among other items.

Table 1: Cloud Computing and Execution Measures

Constructs	Sources for CCA in Library	Finding and Executive Measures

Technological Factors	(Ali et al., 2018; Ibrahim et al., 2021; Modisane et al., 2021; Shiju & Pramila, 2021)	Cloud provides greater availability and scalability, equips the library tech-readiness, gives competitive advantages over the traditional system, renders easier back up for users.
Organizational Factors	(Amron et al., 2019; Kumar & Dadhich, 2014; Makori, 2016; Shaw & Sarkar, 2019; Wasike, 2015)	Very cost saving of organizations, recognized usefulness during the covid scenario, recognized usability, security issues, unlimited storage capabilities
Environmental Factors	(Chauhan et al., 2021; Kathuria et al., 2018; Njenga et al., 2019; Rana et al., 2018; Tripathi, 2019)	Furnish geographical reach to end-users; administrative support is pivotal, vendor supports in pre-requisites, understandable application interface.
Financial Factors	(Changchit & Chuchuen, 2018; Mansouri, S.A., Lee, H. and Aluko, 2015; Yuvaraj, 2016)	Financial freedom, cost-saving, better return on investment, subsidies

Hypotheses for the Research

H_1: There is a connotation between the technological factors and CCA in libraries.

H_2: There is subsume association between organizational factors and CCA in libraries.

H_3: Cloud computing implementation in libraries is influenced by environmental factors.

H_4: Financial factors have a strong association with CC of libraries.

4. Research Layout

Primary and secondary data were designed in a systematic frame to simplify the procedure of research. The surveys helped to gather the raw data from ultimate sources and the collection of secondary data outlined from unswerving sources (Manish Dadhich, Purohit, et al., 2021; Dubey, R., Gunasekaran, A., Childe, Stephen J., Papadopoulos, T., Luo, Z.,Wamba, S.F., 2019). The first phase entailed EFA and CFA trailed by SEM in the subsequent level. With the assistance of SPSS-21 and AMO-22, the collected data was processed, scrutinized, and construed in the system framework. Having measured 510 respondents from India's state, central and private universities, the research framework implied a lucid pattern. Besides, the questionnaire is divided into two segments. The first segment consists of seven questions about the demographic feature of the panellists and librarians. The second section contains four constructs made up of 16 variables. The research was performed from January to April 2021.

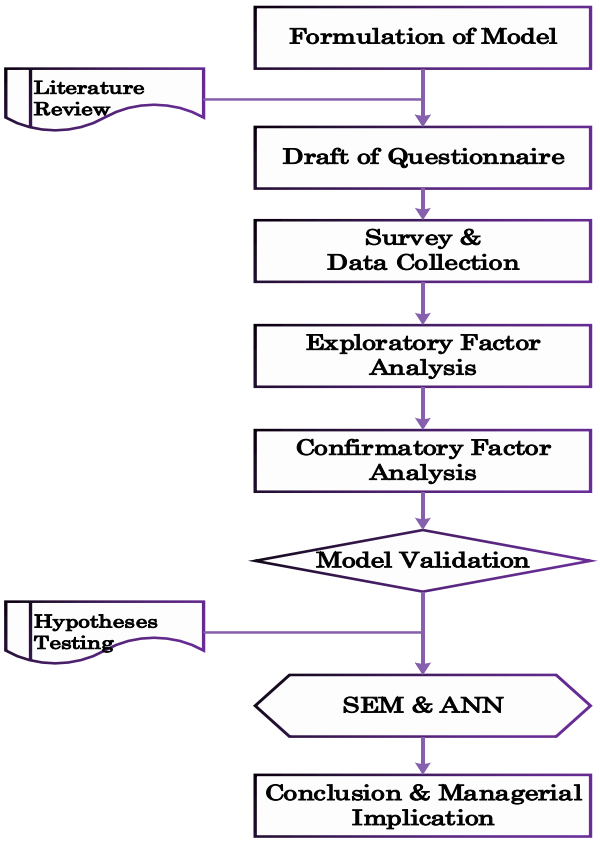

Fig. 4: Methodology of Research

The research framework consists of a literature review, formulation of the model, drafting of a valid questionnaire, data collection, Application of statistical techniques (EFA, CFA), hypotheses testing followed by model validation, and SEM-ANN.

Sampling Design & CMV

Literature typically urges the idea of 1:6 sample size, where five samples per manifest are satisfactory for the structure equation assessment (Hair, J. F., Jr., Black, W. C., Babin, B. J., & Anderson, n.d.; Langevin et al., 2020). In the words of (Lepore & Spigarelli, 2020), a sample size of 510 is likewise sufficient for a model with 25 or more manifest. The number of elements and levels of commonality of every gauge in a model also influence the sample size.

Common Method Variance (CMV) evokes spurious support for the tested ideas. In research of behavior and social science, the effect of CMV is a vital validity issue (Hair Jr, Joseph F., G. Tomas M. Hult, Christian Ringle, 2016). The researchers applied statistical tests to reduce CMB by putting the dependent and independent factors in different portions of the questionnaire. In addition, the researchers ensured that the assertions in the items are clear, simple, and unambiguous. The analysis also demonstrates that most manifests have a correlation of less than 0.5, indicating that the data sets are not affected by multicollinearity. It signifies that the study's constructs were not redundant in nature.

5. Data Analysis and Explanation

The component of the demographic indication pertaining to the respondents of the CC users in the library is delineated in table 2.

Table 2: Demographic feature of the respondents

Categories	Respondents	Freq.	%
Gender	Male	295	57.80
	Female	215	42.20
		510	100
Handler	Library Professionals	265	51.90
	Library Users	245	48.10
		510	100
Numbers of Computers in Library and Information Centre	10-50	80	15.70
	50-100	100	19.60
	100-200	120	23.50
	Above 200	210	41.20
		510	100
Internet Bandwidth of Library	Less than 50 m.b.p.s.	90	17.60
	51 to 100 m.b.p.s.	180	35.30
	101 to 200 m.b.p.s.	190	37.30
	Above 200 m.b.p.s.	50	09.80
		510	100
RFID Technology	Yes	315	61.80
	No	195	38.20
		510	100
Cloud Computing Services in Library	Yes	425	83.30
	No	85	16.70
		510	100
Total User Strength of Library	100-200	110	21.60
	200-300	170	33.30
	Above 300	230	45.10
		510	100

Table 2 outlines that the cloud survey elaborated 57.80 % males and 42.20 % female respondents. Most of the defendants were library professionals (51.90%) whereas (48.10%) were library users from different Indian universities. Numbers of computers in library & information Centre 10-50 (15.70%), 50-100 (19.60%), 100-200 (23.50%), Above 200 (41.20%). Internet bandwidth of library of selected libraries- less than 50 m.b.p.s. (17.60%), 51 to 100 m.b.p.s. (35.30%), 101 to 200 m.b.p.s. (37.30%), Above 200 m.b.p.s. (09.80%). RFID technology was available in various universities viz. 315 (61.80%), whereas such technology did not become available in 195 (38.20%) units. When asked about the cloud computing services in the library, most of the respondents agreed 425 (83.30%), whereas these services did not become accessible in 85 (16.70%) universities. Total users' strength of library in various institution were 100-200 (21.60%), 200-300 (33.30%), and above 300 (45.10%).

Table 3: Summary of Factors and Codes

Constructs	Codes	Statements	X	σ

Technological Factors	TF_1	Greater scalability	3.59	0.996
	TF_2	Tech-readiness	4.10	0.851
	TF_3	Competitive advantage	3.78	0.955
	TF_4	Easer Back up	3.95	0.859
Organizational Factors	OF_1	Recognized usefulness	4.02	1.023
	OF_2	Recognized usability	4.12	1.056
	OF_3	Security issues	3.80	0.856
	OF_4	Unlimited storage	3.94	0.956
Environmental Factors	EF_1	Geographical reach	4.06	0.899
	EF_2	Administrative Support	4.20	0.896
	EF_3	Vendor support	3.95	0.994
	EF_4	Conducive application interface	4.09	0.894
Financial Factors	FF_1	Cost-saving	4.02	1.023
	FF_2	Financial freedom	3.96	0.877
	FF_3	Provision of Subsidies	4.02	1.023
	FF_4	Better return on investment	3.56	1.250

All items spotted mean values of more than 3.40 and less than 5.00. Most of the values of σ were less than 1.0, suggesting not a wide dispersion from the mean. Besides, the Kaiser-Mayo-Olkin score was used to measure the adequacy of the sample size. The measured score of 0.864 proposed that the samples were sufficient to accomplish the factor analysis. Determinants of CCA were analyzed, and table 4 articulated the G'F'I (0.926), A'G'F'I (0.802) along with N'F'I (0.856), and R'F'I (0.823) whereas C'F'I (0.910), Tucker-Lewis delineates 0.908 and the value of RMSEA was 0.025 that specifies that the anticipated model is in a good fit (Manish Dadhich, Purohit, et al., 2021; Gupta & Nagpal, 2020).

Table 4: Goodness-of-Fit for CCA.

Particulars	G'F'I	A'G'F'I	N'F'I	R'F'I	C'F'I	T'L'I	RMSEA
Ceiling value	>0.900	>0.901	>0.995	>0.900	>0.900	>0.901	>0.01
Achieved value	0.926	0.802	0.856	0.823	0.910	0.908	0.025

The model revealed a good fit statistic i.e., λ^2 =273.59, df=110, CMIN/df =2.48, at significant level p=0.38. As exemplified in table 5, the factor loading, Cronbach alfa, AVE, and CR of all factors were highly significant (Modisane et al., 2021).

Table 5: Validity and Reliability test of Standards

Statements	FL.	Cron. α	A-V-E	C-R

TF_1	0.856	0.912	0.765	0.952
TF_2	0.902			
TF_3	0.825			
TF_4	0.795			
OF_1	0.785	0.890	0.896	0.860
OF_2	0.805			
OF_3	0.856			
OF_4	0.720			
EF_1	0.802	0.881	0.765	0.829
EF_2	0.792			
EF_3	0.759			
EF_4	0.795			
FF_1	0.702	0.856	0.796	0.836
FF_2	0.892			
FF_3	0.902			
FF_4	0.895			

The factor correlation among latent items has to be less than the SQRT of the average variance explained of each factor (Anil & K.P., 2016). With all figures, it has been inferred that the model meets the criteria of reliability, the validity of substance, convergent validity, and discriminant validity. In this way, it was succeeded by the testing of the structural equation model.

Table 6: Discriminant Validity of the Constructs

Variables	AVE	Tech. Factors	Org. Factors	Environ. Factors	Fin. Factors
Tech. Factors	0.765	0.695			
Org. Factors	0.896	0.634	0.682		
Environ. Factors	0.765	0.536	0.523	0.642	
Fin. Factors	0.796	0.689	0.758	0.689	0.655

The discriminant validity infers the degree to which dormant items are diverse from other dormant variables in the selected frame. Besides, the construct correlation among dormant items must be less than the square root of AVE of every factor (Mashelkar, 2018). With these all standards, it has been confirmed that the model estimates reliability criteria, the rationality aligns with convergent validity. In this way, it was accomplished by the perusing of the SEM.

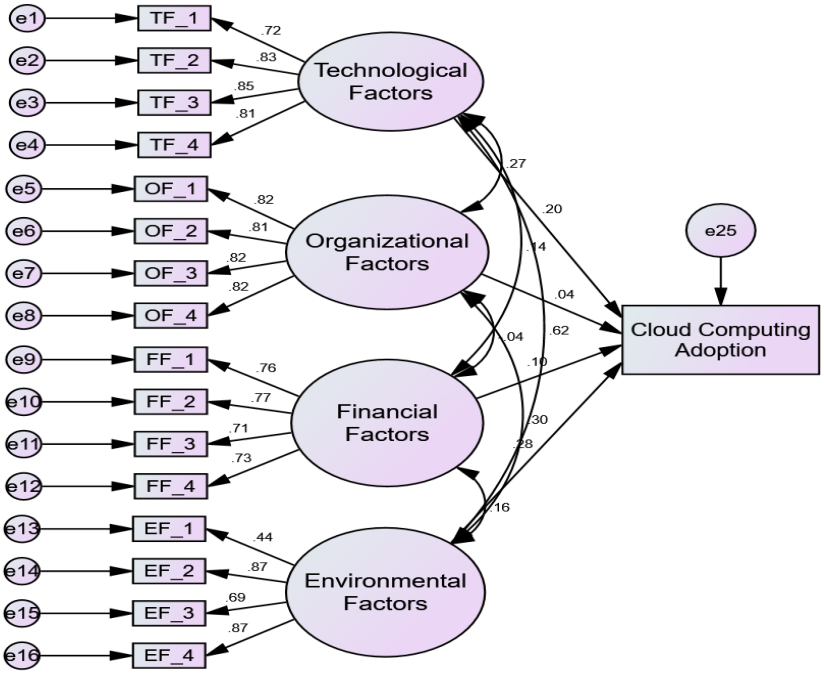

Fig.: 5 Standardized Estimates of CFA Frame

Figure 5 revealed the confirmatory model's standard estimates and eventually examined the proposed hypotheses, structural model fit, and path analysis.

Table 7: Summary of Standard Regression Weights of Constructs

Items		Direction	Esti.	St.-Er.	Cri. Ratio	P
TF_1	<---	Technological Factors	1.000			
TF_2	<---	Technological Factors	1.046	0.062	16.794	accepted
TF_3	<---	Technological Factors	1.160	0.068	16.952	accepted
TF_4	<---	Technological Factors	1.244	0.073	17.074	accepted
OF_1	<---	Organizational Factors	1.000			
OF_2	<---	Organizational Factors	1.071	0.055	19.411	accepted
OF_3	<---	Organizational Factors	1.078	0.066	16.223	accepted
OF_4	<---	Organizational Factors	1.169	0.061	19.175	accepted
FF_1	<---	Financial Factors	1.000			
FF_2	<---	Financial Factors	2.063	0.210	9.810	accepted
FF_3	<---	Financial Factors	1.541	0.168	9.148	accepted
FF_4	<---	Financial Factors	2.069	0.211	9.818	accepted
EF_1	<---	Environmental Factors	1.000			
EF_2	<---	Environmental Factors	1.061	0.060	17.832	accepted
EF_3	<---	Environmental Factors	1.037	0.055	18.902	accepted
EF_4	<---	Environmental Factors	1.044	0.056	18.491	accepted

Items		Direction	Esti.	St.-Er.	Cri. Ratio	P
C.A.	<---	Technological Factors	.235	0.067	3.488	0.040
C.A.	<---	Organizational Factors	.030	0.034	.882	0.038
CA	<---	Financial Factors	.092	0.043	2.146	0.032
C.A.	<---	Environmental Factors	.446	0.105	4.250	0.026

Table 8: Estimation of the Hypotheses

SN	Hypotheses	Results
H-1	Technological factors influence CCA in selected universities. (β = 0.235, S. Er = 0.67, Cri. ratio = 3.488)	Confirmed (p<0.05)
H-2	There is subsume association between organizational factors and CCA in library. (β = 0.030, S. Er = 0.034, Cri. ratio = 0.882)	Confirmed (p<0.05)
H-3	Cloud computing of library is influenced by environmental factors. (β = 0.446, S. Er. = 0.105, Cri. ratio = 4.25)	Confirmed (p<0.05)
H-4	Financial factors have strong association with CC of library. (β = 0.092, S. Er. = 0.043, Cri. ratio = 2.14)	Confirmed (p<0.05)

The rationalized SEM model exhibits theorized connotation among the latent variables. The assessment of standardized regression loads was applied to fetch an appreciation concerning the proposed disposition, as signified by (Agrawal, 2019; Rakesh Kumar Birda & Manish Dadhich, 2019; Singhal, 2020). As mentioned in the above table that βeta, S. Er, Cri. ratios were positive, and null hypotheses can be rejected because the computed p-values of all four projected hypotheses were technological factors (0.040), organizational factors (0.038), environmental factors (0.032), and financial factors (0.026) were significant as p<0.000. Hence, expressed hypotheses were supported and accepted. The established model makes a substantial contribution to the literature in this field. Similarly, few studies concentrate on adopting CC from the perspective of users, which has entirely transformed the LMS in Indian universities.

5.1 LMS Analysis of ANN

By combining SEM with artificial intelligence methodologies, this work signifies a multi-analytical strategy. SEM and Multiple Regression are linear statistical techniques that can only find linear relationships, potentially simplifying complex decision-making processes (Omar et al., 2015). To overcome this challenge, an ANN model that can recognize non-linear correlations is proposed. An advantage of this practice is that the NNM may learn multifaceted linear and non-linear correlations between predictors and adoption choice (Manish Dadhich, Hiran, et al., 2021).

Further, neural networks do not test hypotheses and analyze causal relationships due to their 'black-box' nature. As a result, a two-stage strategy is adopted in this work, similar to (Sadasivam & Lakshme, 2016). In the first order, a structural equation is employed to evaluate all the hypotheses and extract pivotal predictors in the model that are further subsumed as inputs to the ANN in the second order to measure the status of each manifest.

ANN acquires knowledge during the learning process and stores it in synaptic weights, which are interneuron connection strengths like those found in the human brain. Based on the research for

this study and previous work on technology adoption, a concept for calculating the number of latent neurons in one hidden stage and one output is proposed (Naresh Kumar, 2016).
Simulation experiments demonstrate that increasing the sum of neurons in the hidden layer improves estimation accuracy to some extent (R. D. Raut et al., 2018); nevertheless, taking too many of them dramatically increases the computational weight. Assume that the number of concealed neurons is excessive. In that circumstance, the network may memorize all training instances and not generalize or produce adequate output with data not used during training. Trial-and-error is widely used because there is no heuristic technique for calculating the number of hidden neurons.

5.2 Results of ANN

Python & SPSS was used to evaluate the NN approach. At this step, the statistically imperative elements from the SEM were included in the model. Four hypotheses have been identified as critical for future investigation based on the structural equation's findings. As a result, these elements were represented as input variables in the input layers; in this case, the output layer's dependent variable was library cloud management adoption. A cross-validation technique was also employed to solve the model's over-fitting problem. Both the hidden and output layers use the sigmoid function to activate neurons (Foo et al., 2018). All inputs and outputs were standardized to improve training efficacy and give shorter training times and higher performance [0,1]. To avoid overfitting, ten-fold cross-validation was executed, with 90% of the data being used for network training and 10% for testing and determining the accuracy of the trained network (Dwivedi et al., 2021). The RMSE of both the training and testing data and the mean and standard deviation for both data sets are computed for determining the model's prediction accuracy. The ANN model comprises four constructs as input neurons in terms of variables, followed by one output- LMS.

Table 9: RMSE for Training and Testing Data (N-510)

Sample size (Tr.)	SSE	RMSE	Sample size (Tt)	SSE	RMSE	RMSE(Tr)-(Tt.)
452	292.827	0.805	58	21.534	0.609	0.196
447	440.043	0.992	63	54.351	0.929	0.063
453	436.921	0.982	57	53.002	0.964	0.018
458	409.603	0.946	52	38.171	0.857	0.089
453	333.218	0.858	57	57.081	1.001	0.143
461	447.211	0.985	49	42.827	0.935	0.050
451	310.816	0.830	59	48.658	0.908	0.078
457	384.181	0.917	53	38.869	0.856	0.060
461	361.007	0.885	49	39.246	0.895	0.010
449	435.961	0.985	61	56.195	0.960	0.026
Mean	385.17	0.911	58	44.99	0.891	0.073
σ	57.78	0.07	**σ**	11.09	0.101	0.05

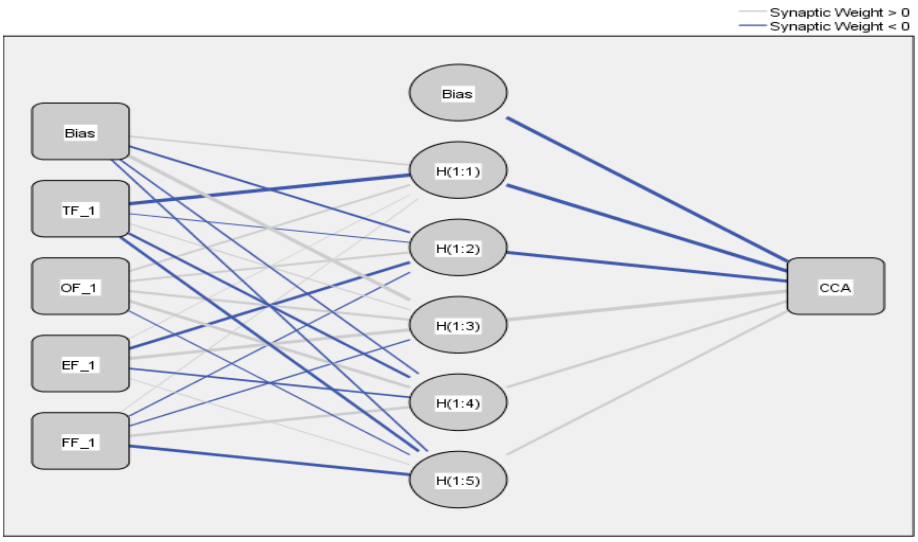

Fig.: 6 ANN Model for CCA-LMS

Table 9 depicts the RMSE statistics for both training and testing data and the mean and standard deviation. The outputs show that the mean RMSE figure for the training and the testing model are 0.911 and 0.45, respectively, whereas σ of training data is 0.07 and 0.10 for testing data which indicate a precise prediction of selected data (Leong et al., 2020; Tella et al., 2020).

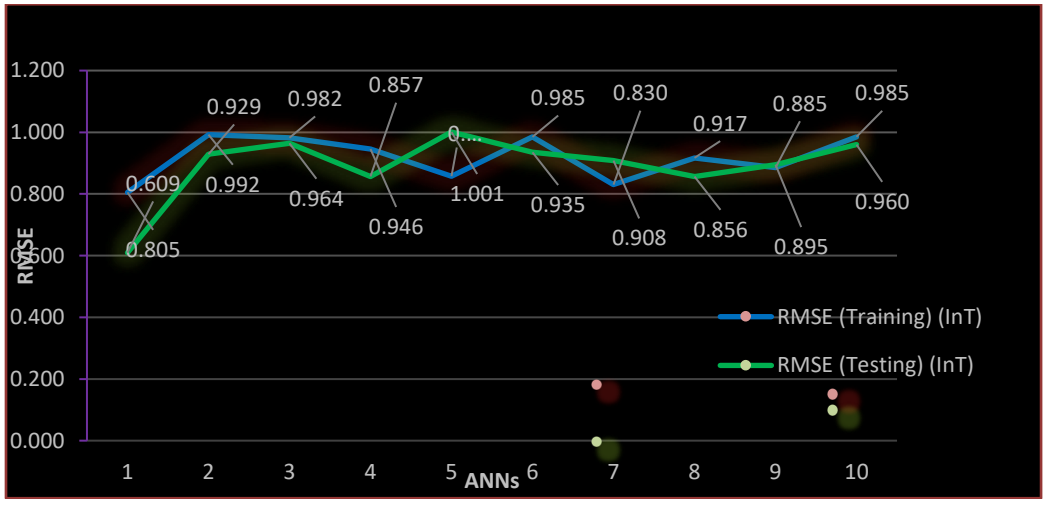

Fig.: 7 RMSE Statistics of Training and Testing

The significance of each independent manifest indicates how much the network model's predicted value differs from the independent variable's changing values (Bartlett, J.E., Kotrlik, J.W.K.J.W., Higgins, 2001; Nair & Choudhary, 2016). Table 10 delineates the Normalized and Sensitivity Assessments for each predictor. The ratio of each predictor's relevance to the most outstanding value is the normalized importance. The ANN's results show how important each input variable is in predicting the value prophesied by the neural network with varied valves of

independent components. It is evident from the table that TF_1 (99%), TF_2 (96.1%), TF_3 (63%), TF_4 (77%) is the highest instructive factor in LMS. Organizational construct is explained by OF_1 (71%), Environmental factors consist of EF_1 (75%), EF_2 (100%), EF_4 (68%) that were catalyst for adoption of LMS cloud. Eventually, FF_1 (49%), FF_2 (63%), item scored highest to enunciate the adoption of cloud for HEIs of India.

Table 10: Normalized and Sensitivity Analysis

Neural Network	TF_1	TF_2	TF_3	TF_4	OF_1	OF_2	OF_3	OF_4	EF_1	EF_2	EF_3	EF_4	FF_1	FF_2	FF_3	FF_4
NI (i)	100.0%	95.8%	53.4%	56.9%	57.2%	49.3%	46.1%	31.3%	68.6%	85.2%	28.8%	45.5%	45.1%	33.0%	28.9%	26.5%
NI (ii)	78.4%	70.1%	43.3%	87.6%	37.8%	54.7%	38.5%	46.0%	94.4%	100.0%	20.0%	59.7%	31.8%	32.5%	64.6%	31.6%
NI (iii)	96.9%	100.0%	33.9%	70.7%	43.7%	38.3%	40.7%	33.1%	46.8%	81.9%	44.7%	54.4%	58.6%	33.0%	35.2%	36.4%
NI (iv)	82.3%	100.0%	53.0%	64.7%	71.3%	66.3%	39.9%	37.0%	64.3%	87.4%	59.1%	68.4%	41.5%	56.6%	64.1%	52.6%
NI (v)	92.7%	100.0%	62.1%	34.2%	59.8%	76.5%	60.4%	42.7%	67.2%	90.9%	39.3%	42.3%	31.3%	31.1%	48.9%	44.9%
NI (vi)	100.0%	74.9%	62.3%	56.2%	60.9%	63.9%	53.0%	48.8%	59.4%	83.5%	64.0%	72.4%	59.5%	60.3%	62.8%	47.4%
NI (vii)	90.4%	46.0%	69.1%	61.4%	33.3%	75.1%	37.8%	31.6%	79.0%	96.1%	35.0%	100.0%	30.7%	52.4%	50.2%	38.4%
NI (viii)	83.3%	100.0%	67.4%	86.2%	58.3%	77.7%	52.0%	78.3%	73.9%	83.3%	72.0%	82.9%	44.5%	62.3%	80.0%	50.4%
NI (ix)	95.8%	100.0%	45.2%	89.3%	59.6%	74.2%	40.4%	31.3%	72.2%	89.4%	39.9%	47.4%	53.5%	32.6%	71.5%	57.7%
NI (x)	69.3%	76.1%	76.2%	86.8%	28.1%	63.9%	48.4%	22.8%	53.5%	100.0%	38.1%	39.3%	36.1%	51.9%	65.3%	36.2%
Average	88.9%	86.3%	56.6%	69.4%	51.0%	64.0%	45.7%	40.3%	67.9%	89.8%	44.1%	61.2%	43.3%	44.6%	57.2%	42.2%
Normalized Value	**99.0%**	**96.1%**	**63.0%**	**77.3%**	56.8%	**71.3%**	50.9%	44.9%	**75.7%**	**100.0%**	49.1%	**68.2%**	48.2%	**49.7%**	**63.7%**	47.0%

6. Theoretical Implications

At the outset, the integration of financial factors in this research model has provided a novel theoretical contribution to adopting library cloud management systems. With incorporating typical features of the panellists/users viz. internet bandwidth, usages of RFID technology, and user strength of library, scholars may better understand their effect on LCC. This theoretical outcome may be conducive to fetch groundwork for imminent researchers in the field of technology adoption. The research may shed light on several new manifests by adopting TOE theory in LMS at the university level. Thus, the cloud being at a budding stage has been exposed to scholarly argument and relevance in the field of LCC.

These outcomes help CSP to understand how cloud content can entice user willingness and adoption at one end. Similarly, data on the cloud can be beneficial for users, but assuming privacy and security is vital for service providers. Further, few studies have also demonstrated that CCA is positively associated with the institutions' performance. Our findings also validate that the factors TOEF influence CCA in LMS in education institutions. Cloud provides greater availability, scalability and equips the library for tech-readiness. It also elasticities competitive advantages over the traditional system and renders easier back up for users. The study strongly endorses CC as possibly communicating and extending the opportune time for the shifting from the brick-and-mortar to the system of the cloud-based LMS.

7. Limitation and Future Scope

There is nothing ideal in this universe because shortcomings and weaknesses are part of a system. This research is no exception. The use of past-reported instruments for data collection and the small sample size are two notable drawbacks. As a result, instead of the restricted, potential researchers should consider expanding the reach of the analysis to include more librarians from other universities. The study only looked at specific factors for LCC, but several other constructs may also be explored further. As a result, budding researchers should glance at other variables to see how they influence CCA and indulge in comparative studies using snowball sampling. The findings of this research can be a firsthand option as a reference point for further research.

Further, these investigations are declarative; they are prone to human error. Thus, certain interesting future research topics would perform a longitudinal study to identify changes in LCC adoption among educational institutions with specific needs. Besides, other constructs viz. cloud service provider, vicinity, users' attitude, and compliances may be vital in this subject matter but were not merged in this study.

8. Conclusion

Cloud computing servers are available in several different forms. The study discusses how the variables of technological, organizational, environmental, and financial factors exhibited the adoption of library cloud networks in the present pandemic scenario. The study portrays that all four dimensions have a notable impact on the CCA of the Indian universities and how CC expertise leads to change in delivering content for HEIs. This attempt replies to the current hums for empirical research in library cloud computing and its implications for future advancement in the education industry. The paper employed tools viz. EFA, CFA, and Structural Equation casting assess the degree to which selected factors to LCC espousal and their relative significance. An empirical study planned four hypotheses by selecting the constructs viz. technological, organizational, environmental, and financial aspects and 16 variables in the model specified. The model was then tested on a sample of 510 respondents of 26 major states, central and private universities of India using SEM-ANN. The consequences emphasized the relative

importance of selected constructs for enhancing the LCC's better access cloud contents. The calculated p-value of all four projected hypotheses was TF (0.04), OF (0.03), EF (0.03), and FF (0.02) were momentous as $p<0.000$.

These constructs are again used as inputs to the ANN to govern the relative position of each predictor in a second stage. The results of the ANN outline the importance of every input variable to predict how much the value is predicted by the neural network with the unlike figure of independent items. It is evident that TF_1 (99%), TF_2 (96.1%), TF_3 (63%), TF_4 (77%) is the highest explanatory factor in LMS. Organizational construct is explained by ORF_1 (71%); environmental factors consist of EF_1 (75%), EF_2 (100%), EF_4 (68%) that were vital enough for the adoption of LMS cloud. Eventually, FF_1 (49%) and FF_2 (63%) items scored highest to explain cloud adoption for higher education institutions in India.

This study furnishes a clear indication of the pluses of identifying the vital elements of LCC and efficient cardinal technology adoption. These technologies provide a platform for sustainable learning through a resource management system. These results may offer valuable insights to technocrats toward digitalization and the knowledge deployment in the campus and off the campus. However, previous studies (Anabel Gutierrez, 2015; Goel et al., 2020; Kathuria et al., 2018; Phaphoom et al., 2015; Tong et al., 2020) acknowledged the constructs and were in line with few principal components viz. LCC, adoption, and knowledge performance in HE. The findings of the study reveal that CC is an incredible notion for academicians, librarians, and other users on various fronts and delineated an extreme level of acquaintance with the cloud concept.

Declaration of competing interests

The authors declare that they have no tangible and intangible interest or personal relationship that could influence this paper's content.

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