Analysis of External Influence on Implementing Innovative Technologies in Higher-Education Institutions of Developing Countries

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Abstract
Technology-enhanced teaching is influenced by numerous and varied factors such as individual characteristics, users' perception of technology, and external factors. External factors usually comprise of four variables: Organizational Characteristics, External Pressure, Technical Support, and Social Influence. To examine these components, a survey was conducted with 384 staff and students across two higher-education institutions in Nigeria. The use of stratified sampling method was applied in gathering information from a broad classification of universities. Correlation and multiple regression analysis were conducted to understand the relationship and impact between external factors for implementing innovative technologies and its adoption in higher-education institutions in Nigeria. The outcome of this study confirmed that three components: Technical Support, Social Influence, and External Pressure are statistically significant as external factors for implementing innovative technologies in higher-education institutions in Nigeria.

Keywords: External Influence, Innovative Technologies, High Education Institution, Nigeria

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Introduction

Cloud computing is a recent technological concept that is still evolving in all facets of life, academia, information technology, industry, Health among others. and had been christened as a disturbance in software copping and technological tools within all sectors of the economy of which education sector is inclusive (Ogunjobi, 2015). Government, Proprietors and Schools managers across the globe are at the cliff's edge upon their realization of the transformation and changes being brought about by the digital phenomena to their individual sector (Oguntala, et al., 2017).

Cloud computing is being viewed as kernel or "imperatives" of the digital transformation technology ecosystem" (Al-Ruthie, Benkhelifa and Hameed, 2018). As against being a buzzword, it currently represents the development direction of Information Technological industry in the recent times which made it a highly sort after innovation. With the rising up of cloud computing adoption worldwide, the research and statistics had shown that the public adoption of cloud service is projected to reach $266 billion in year 2025 and an estimated $623 billion by the year 2028 (Gartner, 2019; Hosting tribunal, 2020). According to Buyya, Yeo and Venugopal (2008) affirmed that cloud computing is perceived as the last utility apart from water, gas, electricity, and telephone which emphasize the importance of cloud computing in today digital world.

In addition, with cloud computing being perceived as a fundamental part of information technology (Senyo, Effah and Addae, 2016, p. 506), cloud computing brings about potential growth for educational institutions, corporate organizations businesses as well as improvements in governmental strategies and regulation of developed countries in a way to improve their rates of performance and services (Senyo, Effah and Addae, 2016).

As obtained from the report of the World Economic Forum in their "Future of Jobs", there is possibilities of disappearance of over five (5) million jobs in the world within the next five years due to automation and redundancy (Dixit & Prakash, 2018). Technological advancement like cloud computing technology will cause or led to disruption in labour market / business model in the next five (5) years (Dincă, Dima, & Rozsa, 2019). The high active working competitive academic environment within the confine today's working world depend on digital communities and applied technology (Fagbolu, & Atoloye, 2018). However, students and staffs in Nigeria higher institution are being confronted with issue such as lack of technological know-how in the optimization and adoption of cloud computing technology for educational programme. Digital education force had been the order of the day for those who want to be in tandem with the modern educational system of the world (Dahunsi, & Owoseni, 2015). Therefore it is imperatives to know the extent of cloud computing technology adoption in the higher education system in Nigeria. The essence of cloud computing technology is to enable all the major players in higher institutions (Colleges of education, Polytechnic and Universities) to access the services being provided by the three (3) platforms; infrastructure-as-a-service (IaaS), software-as-a-service (SaaS) and platform-as-a-service (PaaS) (Fathali, & Okada, 2018). Cloud computing system is now an important and veritable facilitator of online and distance educational programme such as mobile and e-learning (Ferri, Spano, & Tomo, 2020); (Gumuşoğlu,. & Akay, 2017). The interest of both practitioners and academicians are now on studying the factors that aided user's rejection or acceptance of the cloud computing system. The purpose is to unravel more efficient methods towards evaluating and predicting the users' response Comprehensive Technology Acceptance Model (CTRAM) in the educational field is being influenced by varied factors

such as individual characteristics, users' perception of technology, and external factors, as summarized by Yasir (2023). These external factors serve as the central subject of analysis in this study.

The essence of studying external factors is borne out of the significance of environmental and organisational contexts in which technologies operate, ranging from market competition to government regulations, from cultural influence to social impact (Lee, Trimi, & Kim, 2013; Oliveira and Martins, 2010). It is on the premise of this that this study intends to critically conduct analysis of external influence on the implementation of cloud computing technology in higher institution in Nigeria. This paper addresses the external factor / aspects of computing requirements in general, with respect to university settings in developing nations of the world (Nigeria). The paper concludes with proffering some set of recommendations, implication and plans for future work.

The central aim of this research is to investigate the influence of external factor on the implementation of cloud computing technology in higher institution in Nigeria with a view to improve academic performance in Nigeria higher institution. In a view to actualize the above stated aim, the following research questions were addressed by this study:
(i)   What are the variables influencing external factors impact on cloud technology adoption in Nigeria Higher Institution?
(ii)   What are the effects of external Influence on implementing Cloud Technology in Higher-Education Institutions in Nigeria?
(iii)   What are the relative contributions of Technical Support, Social Influence, Organizational Characteristics and External Pressure as external factors for implementing Cloud technologies in higher institutions in Nigeria?

Theoretical Framework

The main rationale and analysis of this article are based on the framework of Comprehensive Technology Readiness Adoption Model (CTRAM) (Yasir, 2023). Several theories were selected for the proposition of the CTRAM model, namely the diffusion of innovation (DOI) as championed by Rogers (1995), technology, organization, and environment (TOE), unified theory of acceptance and use of technology (UTAUT) by Venkatesh et al (2003); the technology acceptance model (TAM) founded by Davis et al (1989), desire framework (DF), and technology readiness (TR). These models have been applied in various fields towards evaluating the adoption of cloud computing as well as other aspects of technology usage and uptake. The derived CTRAM contains eleven variables that are classified into three main groups, namely individual characteristics, perception of technology, and external factors as shown in Figure 1.
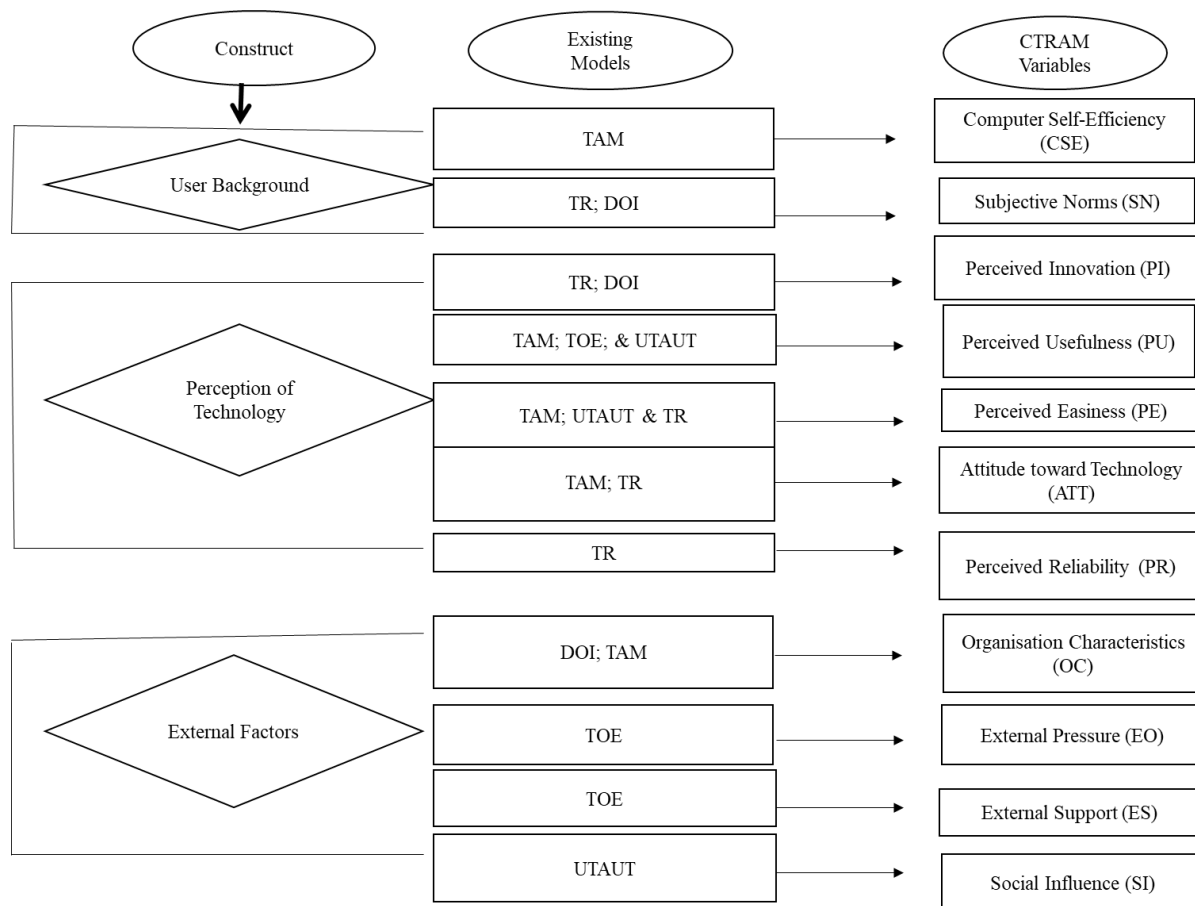
Figure 1: CTRAM Model (Yasir, 2023)

Out of the three factors, external factor is the most significant factor, the essence of studying external factors is borne out of the significance of environmental and organisational contexts in which technologies operate, ranging from market competition to government regulations, from cultural influence to social impact (Lee, Trimi, & Kim, 2013; Oliveira and Martins, 2010). External factors are made up of four variables: First is Organizational Characteristics, which refer to the extent to which an organisation supports the adoption of a technology. Second is External Pressure, which relates to the degree of pressure or influence from external parties such as competitors, peers, or management. Third is Technical Support, that entails the perception of any assistance received from an organisation or colleagues in which the technology is being deployed. Fourth is the Social Influence of how a technology can affect a community as shown in Figure 2.
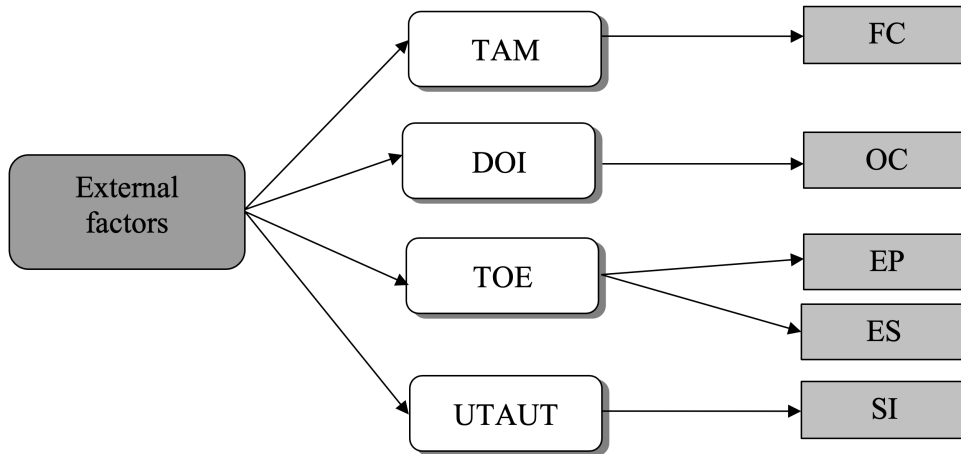
Figure 2: External Factors as Derived from Yasir (2023)

Methodology

A. Survey and Samples

The study participants were made up of staff and students in higher institutions of learning in Nigeria (i.e. universities). At the time of writing, Nigeria had the capacity of about 1.9 million university staff and students (Statista, 2021), which represent a substantial number of respondents that the survey could not aim to target fully. However, the survey employs the use of sample population with the aid of Krejcie and Morgan's (1970) recommendations that centred on an extrapolation from the entire population. Krejcie and Morgan (1970) provided a recommended sample sizes for varying population ranges (as shown in Table 1), this provided the basis that a population of over one million should be based on a sample of 384 participants to achieve meaningful findings. It was on this premise that a total number of 384 questionnaires were served and administered to the target respondents, as represented by the students and staff in selected higher institutions in Nigeria.

N	S	N	S	N	S	N	S	N	S
10	10	100	80	280	162	800	260	2800	338
15	14	110	86	290	165	850	265	3000	341
20	19	120	92	300	169	900	269	3500	346
25	24	130	97	320	175	950	274	4000	351
30	28	140	103	340	181	1000	278	4500	354
35	32	150	108	360	186	1100	285	5000	357
40	36	160	113	380	191	1200	291	6000	361
45	40	170	118	400	196	1300	297	7000	364
50	44	180	123	420	201	1400	302	8000	367
55	48	190	127	440	205	1500	306	9000	368
60	52	200	132	460	210	1600	310	10000	370
65	56	210	136	480	214	1700	313	15000	375
70	59	220	140	500	217	1800	317	20000	377
75	63	230	144	550	226	1900	320	30000	379
80	66	240	148	600	234	2000	322	40000	380
85	70	250	152	650	242	2200	327	50000	381
90	73	260	155	700	248	2400	331	75000	382
95	76	270	159	750	254	2600	335	1000000	384

Table 1. Determining Sample Size of a Known Population (Krejcie and Morgan, 1970)

A primary survey with the aid of questionnaire was designed and implemented. The questionnaire full contents are being outlined in Table 2. The survey contents were classified and grouped into three core categories; of 91 questions in all. The first category depicts the measures for individual characteristics that consists of three sub-group: subjective norms, demographic, and computer self-efficacy. The second category entails the perception of technology, which includes the five sub-group: perceived reliability, attitude towards technology, perceived easiness, perceived usefulness, and perceived innovation. Finally, the third category captures information on external factors through the four sub-groups: social influence, technical support, external pressure and organizational characteristics. The other various practical implementation of cloud computing like infrastructure-as-a-service (IaaS), platform-as-a-service (PaaS), software-as-a-service (Saas), and service models comprise of storage-as-a service (Staas), which are adequately reflected in the questions as observed in Table 2.

B. Analytical Approach

The collected primary data with the use of questionnaire were analyzed using descriptive and inferential statistical techniques like regression, correlation analysis and percentages. The motive of chosen these techniques are borne out of their suitability in answering the research questions which would help in providing objective and measurable insights on the chosen topic.

VARIABLES	SURVEY QUESTIONS
Organizational Characteristics	*Is the university willing to pay for extra storage, computers, and services?* *Are there sufficient computers in the university labs for students to practice with?* *To what extent do you agree that campus Wi-Fi cloud is a good idea?* *Do other universities have far more advanced computers than our university lab?*
External Pressure	*Are there universities in Nigeria that have already adopted cloud computing?* *Various pressure from the university to work with students via digital technology?* *Is there pressure from the government to teach using digital technology?*
Technical Support	*Does the university have enough for routine check and maintenance of computing resources?* *Is IT support team always happy to help?* *Rate the efficiency and promptness of response from IT support team?* *Rate the level of knowledge and skills of the IT support staffs?*
Social Influence	*What is the degree to which a person feels a technology can affect a community?*

Table 2. CTRAM Variables for External Influence (Yasir, 2023)

Data Analysis

Table 3 reveals the contribution of the independent variables to the dependent variable expressed as beta weights. Using the regression coefficients to determine the relative contributions of the independent variables to the explanation of the dependent variable, the positive value of Effect of External Influence (β = 0.534, t = 15.245, P < 0.05), has relative contribution on implementing cloud technology in Higher Institutions in Nigeria

In a nutshell, External Influence has significant effect on the implementation of Cloud Technology in Higher Institutions in Nigeria.

Coefficients[a]

Model	Unstandardized Coefficients		Standardized Coefficients	T	Sig.
	B	Std. Error	Beta		
(Constant)	2.530	.080		31.745	.000
Effect of External Influence	.534	.035	.718	15.245	.000

a. Dependent Variable: Implementing Cloud Technology in Higher-Institutions in Nigeria

Table 3. External Influence on Implementing Innovative Technologies

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Model	Sum of Squares	Df	Mean Square	R	R Square	F	Sig
Regression	50.747	1	50.747			232.425	.000[a]
Residual	47.598	383	.218	.718	.616		
Total	98.345	384					

Table 4. Significance Level of External Influence

Table 4 were used to test for the significance of the relationship using Regression ANOVA which produced (F_{value} = 232.425 > F_{tab} = 3.89; P < 0.05). Since F-value is greater than F-tabulated and P-value (0.000) was less than 0.05 alpha levels, this implies that there is no evidence for the acceptance of H_0 (i.e. H_0 is rejected). The result indicates that there is a

significant effect of External Influence on the implementation of Cloud Technology in Higher Institutions in Nigeria.

Also it can be deduced from the table the degree of relationship between the External Influence and the implementation of Cloud Technology in Higher Institutions in Nigeria, with correlation coefficient R=0.718. This indicates that there was a strong positive relationship between the independent variables and dependent variable. This clearly shows that External factors or variables n R-square is used to know the degree of the implementation of Cloud Technology in Higher Institutions in Nigeria are equal to 0.616. Therefore External influence or factors contributed 61.6% proportion to variation on the implementation of Cloud Technology in Higher Institutions in Nigeria. The other variations accounting for the remaining 38.4% can be explained by other factors which cannot be known by this study. The result of this study is similar to the findings of Abdalrahman et al (2018), Mishra & Yadav (2020) and Malik (2018), as observed in Table 4 show that organisational characteristics as an external factor do explain changes on the cloud computing technology implementation by 61.6%.

Variables	B	SEB	Brta	T	P	Remark
Implementation of Cloud Technologies in higher institutions in Nigeria	54.891	2.270		24.183	.000	
Social Influence had effect on the Implementation of Cloud Technologies	.094	.036	.078	2.626	.009	Sig
Organizational Characteristics had effect on the Implementation of Cloud Technologies	-.029	.020	-.052	-1.450	.147	Not. Sig
Technical Support had effect on the Implementation of Cloud Technologies	.092	.018	.180	4.978	.000	Sig
External Pressure had effect on the Implementation of Cloud Technologies	.0900	.027	.178	3.687	.000	Sig

Table 5. Relative Contributions of Variables to External Factors

Table 5 revealed the relative contribution of each of the independent variables to the prediction of the dependent variable (Implementation of Cloud Technologies in higher institutions in Nigeria). Technical Support had effect on the Implementation of Cloud Technologies (Beta = .180; t = 4.978; p < 0.05) was the most potent predictor out of the four variables; followed by External Pressure had effect on the Implementation of Cloud Technologies (Beta = .180; t = 4.978; p < 0.05) Social Influence had effect on the Implementation of Cloud Technologies (Beta = .078; t = 2.626; p < .05); while Organizational Characteristics (Beta = -.052; t = -1.450; p > .05) was not a potent predictor of Implementation of Cloud Technologies.

This data implied that three out of four variables Technical Support, Social Influence, and External Pressure are statistically significant as external factors for implementing innovative technologies in higher institutions in Nigeria. On the other hand, Organisational Characteristics does not have a statistically significant effect on implementation of Cloud Technology in higher institutions in Nigeria. This result corroborates the view of Charles, Emily and Catherine (2021) on critical success factors of cloud computing in public universities in Kenya which reveal that, factors like management support, technical support

and users' preparedness are key variables contributing to the critical success of cloud computing adoption in universities in Kenya at a significant level. It also supports the finding of Mohamed, Elesanmi and Bushra (2019) and that of Pathak and Sudhir (2018).

Variables	Mean	Std. Deviation	N
Is the university willing to pay for extra storage, computers, and services	**44.98**	0.41	384
There are sufficient computers in the university labs for students to practice with	**44.64**	0.69	384
To what extent do you agree that campus Wi-Fi cloud is a good idea	**44.52**	0.54	384
Other universities have far more advanced computers than our university lab	**44.32**	0.55	384
There are universities in Nigeria that have already adopted cloud computing	43.50	0.61	384
Various pressure from the university to work with students via digital technology	**44.41**	0.41	384
There is pressure from the government to teach using digital technology	44.18	0.39	384
The university has enough for routine check and maintenance of computing resource	44.14	0.41	384
IT support team is always happy to help	43.92	0.57	384
Rate the efficiency and promptness of response from IT support team	44.16	0.42	384
Rate the level of knowledge and skills of the IT support staffs	44.12	0.44	384
Sharing learning resources online have a positive impact on a student's learning ability	44.20	0.40	384
The opportunity to practice another operating system gives students more experience (PaaS)	**44.34**	0.48	384
Using different software add values to knowledge and skills of students (SaaS)	**44.31**	**0.48**	384
Working together in a lab increases the chances of sharing idea with fellow peers (IaaS)	**44.89**	0.46	384
Weighted Mean	**44.31**	0.43	384

Table 6. Influencing Variables on External Factors

Table 6 reveals the respondents' opinion with respect to their perception of external influence on the adoption and implementation of cloud technology in Nigeria higher institution. To answer this research question, the weighted mean was determine and taken as the benchmark.

The weighted mean coefficient is 44.30. The table reveals that some of the items buttress the fact that many variables determine the external factors which in turn depict Cloud computing technology usage and adoption in Nigeria higher institution, as just 8 items out of 15 items used to capture the variables influencing external factors impact on cloud technology adoption in the study area are having mean above the weighted mean (44.30) set as bench mark. For instance, *"Is the university willing to pay for extra storage, computers, and services"* with ($\bar{x}$ = **44.98**), *"Working together in a lab increases the chances of sharing idea with fellow peers (IaaS)"* ($\bar{x}$ = **44.89**), *"There are sufficient computers in the university labs for students to practice"* with ($\bar{x}$ = **44.64**), *"To what extent do you agree that campus Wi-Fi cloud is a good idea"* with ($\bar{x}$ = **44.52**), *"Various pressure from the university to work with students via digital technology"* with ($\bar{x}$ = **44.41**), *"The opportunity to practice another operating system gives students more experience (PaaS)"* with ($\bar{x}$ = **44.34**) and *"Other universities have far more advanced computers than our university lab"* with ($\bar{x}$ = **44.32**). Also *"using different software add values to knowledge and skills of students (SaaS)"* with ($\bar{x}$ = **44.31**). However, there are six items ($\bar{x}$) means that are below the set benchmark including: *"There are universities in Nigeria that have already adopted cloud computing"*; *"There is pressure from the government to teach using digital technology"*; *"There is pressure from the government to teach using digital technology"*; *"The university has enough for routine check and maintenance of computing resources"*, *"The university has enough for routine check and maintenance of computing resources"*, *"Rate the level of knowledge and skills of the IT support staffs"*. The outcome of this study is similar to the work of further investigated the factors affecting the adoption of cloud computing technology in educational institutions in Chandigarh. They argued that despite the mammoth promising advantages of cloud computing for been the latest asset of information technology for various organisation. Evidence from the statistical test outcome of the research indicated that adopting cloud computing in Chandigarh is affected by *"support and integration of institution services with cloud computing and top management tendency to support cloud computing adoption"*. In 2016, Appiahene, Yaw, and Bombie evaluated the cloud computing technology model for teaching and learning of information and communication technology. It was reported that the adoption of cloud computing has eliminated the existed boundary to student learning, while allowing adopters of the technology to access work anywhere, anytime, and share. With this juicy merit, this research work will implement the comprehensive technology readiness adoption model (CTRAM) in higher education in Nigeria.

Factor analysis **(**Grand Bassa) is used to establish the relationship among independents variables of category captures information on external factors via four sub-divisions: organizational characteristics, external pressure, technical support, and social influence.

Variable	1	2	3	4	5	6
Computer Self-Efficacy	1.000					
SN1 (P value)	.229 .000	1.000				
SN2 (p value)	.053 .142	.780 .000	1.000			

SN3 (p value)	.043 .195	.665 .000	.645 .000	1.000		
SN4 (p-value)	.141 .002	.631 .000	.506 .000	.599 .000	1.000	
SN5 (p-value)	.065 .096	.533 .000	.525 .000	.658 .000	.422 .000	1.000
	47.13	18.04	38.66	14.35	51.69	33.55
Standard Deviation	12.61	3.820	6.074	2.627	8.964	6.08

**Correlation is significant at the 0.01 level (1-tailed).
Table 7. Inter-correlation Matrix of Independents and Dependent Variables

Table 7 showed that: there was a significant relationship among independents variables of category captures information on external factors via four sub-divisions: organizational characteristics, external pressure, technical support, and social influence. That is, N1 (r = .229, N= 1266, p < .01, and N2 (r = .200**, N= 1266, p < .01) has significant with Cloud computing adoption while N3 (r = .043, N= 1266, p > .01), and N4 (r = .065, N= 1266, p > .01) has no significant with category captures information. It implies that, there was a relationship among independents variables of external factors via four sub-divisions: organizational characteristics, external pressure, technical support, and social influence.

Conclusions

The results from this study have contributed to the relative paucity of studies specific to Nigeria in this field through the examination of the external factors influencing acceptability of cloud computing in higher education in the country. The findings from the analysis revealed that the perception of cloud computing increases in line with the increase participants' knowledge of the existence of cloud computing. Similarly, the perception of cloud computing also increases in tandem with subject norms. This observation is also consistent for organizational characteristics as an external factor, which was found to explain changes on the feasibility and implementation of cloud computing by 59.1%. Combining the factors for external pressure revealed that it has the potential of inhibiting or creating barriers to the deployment of cloud computing in the Nigerian higher institutions. However, among the external pressure factors.

The study asserted that External factors has a significant effect or relative contribution in implementing Cloud Technology in Higher Institutions in Nigeria at (β = 0.534, t = 15.245, P < 0.05) Some of the implications of this study are: the outcome of this study may serve as a knowledge base from where IT administrators in Nigeria Educational sector for them to address various external factors influencing the challenges connected with cloud computing adoption in Nigeria higher education. Also the outcome of the study further shows that there are many factors that determine the adoption of cloud computing technology in higher institution in Nigeria of which the external factors happened to be the chief factor.

Pertaining to the issue of challenges affecting cloud computing in which the IT administrators are seriously concerned with data availability preservation, integrity and confidentiality preservation which the IT administrators will like to confirm whether the cloud computing adoption in the country can preserve the integrity and confidentiality of the data.

The study findings would serve as valuable information source for the government of Nigeria towards IT administrator knowledge in cloud computing system management. This service improvement from the government would ensure business and citizen benefit tremendously from the government policies. Based on findings of the study, the study recommends the following: Higher institutions in Nigeria should intensify efforts to enable increased and more speedy adoption of cloud computing, as well as to make its usage compulsory for all staff and students, especially given that the results indicate high levels of readiness for the adoption of cloud computing among participants. Finally, the devised CTRAM model has been shown to be effective and accurate as a tool for assessing the broader elements concerning the adoption of cloud computing, and hence may be reliably used in future studies and similar cases.

The study further recommend that IT leaders and researchers should endeavour to make use of this research as a basin of pedestal to have a conduct of more research on cloud computing technology adoption in the country. There is need for understanding of different challenges confronting cloud technology adoption in Nigeria when developing policies, strategic action plans and capacity plan in cloud computing system improvement within the Nigeria contexts.

Some of the limitation recorded during the course of the study was that the study was conducted in Nigeria among the higher educational sectors operators, students and administrators. Another limitation was the sample size used which was relatively small across the two regions (Northern and Southern Nigeria). Therefore, there is need for further studies to increase the sample population scope to include other administrator aside those identified in this study located in other part of Nigeria especially using the political zone of Southwest, Southeast, South-South, Northwest, Northeast, and North Central. This recommendation may help increase the result generalizability and accuracy of the study to that of the target population. Also, this recommendation would equally help in understanding the varying challenges affecting cloud computing adoption in Nigeria private sector should equally be unravelled by future scholar in this cloud computing, adoption in educational sectors. Finally, the researchers in the future can equally be conducted using adoption in Health sector as well as establishing adoption of cloud computing practice performance among other sectors in Nigeria.

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