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Factors Affecting the Adoption of Cloud Computing by Small and Medium-sized Enterprises (SMEs)

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ABSTRACT: This paper investigates the factors affecting the adoption of cloud computing by Small and Medium-sized Enterprises (SMEs) in Ilorin, Kwara State, Nigeria. In particular, the mix and dynamics of performance and technological factors influencing the adoption of cloud computing are explored. The four technological factors considered are relative advantage, complexity, speed of business communication as an advantage, and owning and maintaining IT is expensive while the four performance factors considered are demand service, cost, efficiency, and maintenance and security. A quantitative approach that is based on descriptive survey questionnaire is employed. The data collected are analyzed using descriptive statistics of simple percentages while hypotheses formulated are tested at 0.05 level of significance using Analysis of variance (ANOVA). From the results it is evident that relative advantage, complexity, speed of business communication as an advantage, and owning and maintaining IT is expensive as technological factors influence cloud computing adoption by 80%, 61%, 88% and 58% respectively. On the other hand, demand service, cost, efficiency and maintenance and security as performance factors have 58%, 87%, 86% and 77% effects on adoption of cloud computing respectively. Overall, analysis results reveal that technological factors contribute to the adoption of cloud computing by 66.4% while performance factors have 43.1% effects on adoption of cloud computing.

Keywords: Cloud Computing, SMEs, Adoption, Technological factors, Performance factors.

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INTRODUCTION

Cloud can be referred to in different types of platforms for distributed computing- a cluster of servers, network, software, interface, etc. which users require to execute a particular task. Computing refers to the delivery of this package as a service that users can utilize as they wish (Information Technology & Systems, 2017). With its reliance on the internet and its relationship with virtualization and grid computing, cloud computing has foundations in ideas that are not new. Cloud computing is a general term for anything that involves delivering hosted services over the internet. Cloud-based technology can spur numerous benefits for organizations such as capital investment savings, simplified operations, scalability, improved information visibility, sustainability, and enhanced accuracy and reliability (Hackett, 2016). Cloud computing (CC) is a new way of leveraging the power of the internet to provide software and infrastructure solutions to Small and Medium-sized Enterprises (SMEs) around the world. Nwosu (2017) states that it is important to understand the context of SMEs when investigating the manner SMEs respond to change initiatives such as adopting new technologies.

The advantages of cloud computing cannot be overemphasized as it will have a great impact on SMEs (Rahayu & Day, 2017).There are benefits for all kinds of businesses in the cloud environment, however, the need and usage requirements of small businesses are different

from large ones (Gupta, Seetharamam & Raj, 2013). Babur *et al.* (2019) stated that Technical advance in cloud computing and its adoption has given much capability to SMEs in supporting administrations to accomplish their goals, increase economic benefit and delivering improved facilities to customers. Laishmi (2014) also stated that flexibility, document control, no up-front cost, increased collaboration and security are some of the advantages the adoption of cloud computing offers SMBs and SMEs. SMEs are moving to the cloud to save time and money, increase efficiency and gain a competitive advantage. According to Kevin (2019), the survey conducted showed that both public and private cloud adoption have increased from 89% in 2017 to 92% in 2018, private cloud adoption increased from 72% in 2017 to 75% in 2018. Also, the survey showed that while hybrid cloud usage has decreased as a top priority for enterprises, more enterprises see public cloud as their top priority as public cloud increased from 29% in 2017 to 38% in 2018. A similar study was also conducted by Neicu *et al.,* (2020) on cloud computing usage in SMEs. The study tested how the communication process, perceived benefits, the overall experience of cloud computing services among others influence the perception of cloud computing among SMEs. Findings from the study showed that cloud computing improved and enhanced the capability of SMEs by ensuring all-around digitalization and automation of service and delivery. However, the authors did not investigate if technological factors or performance factors have influence on the adoption of cloud computing. Amini (2014) described the changes brought about by technologies that exist beyond an organization's boundaries which are incremental, synthetic and discontinuous changes but did not investigate if technological factor influences the adoption of cloud computing. Authors (Low, Chen and Wu, (2011), Alshamaila, Papagiannidis and Li, (2013) have also discussed the types of technologies that organizations can use in their business, but failed to investigate if technological and performance factors affect the adoption of cloud computing by SMEs.

The goal of the research is to investigate the impacts of technological and performance factors on the adoption of cloud computing by SMEs.

Research questions

Two research questions were raised for this study

1. To what extent do technological factors influence the adoption of cloud computing by SMEs?
2. What is the effect of performance as a factor in adopting cloud computing?

Hypotheses

Two alternative and null hypotheses were generated and were tested at $p<0.05$.

H0: technological factor does not influence the adoption of cloud computing in SMEs

H1: technological factor influences the adoption of cloud computing in SMEs

H0: performance does not influence the adoption of cloud computing

H1: performance influences the adoption of cloud computing

Technological Factors Influencing the Adoption of Cloud Computing by SMEs

The conceptual model that is adapted in this paper is based on concepts derived from the diffusion of innovation (DOI) theory. DOI was first proposed by Rogers in 1962 and it deals with the way in which new ideas are adopted within organizations over time and how ideas influence change within organizations. DOI identifies five factors that affect the adoption of new ideas: relative advantage, compatibility, complexity, trialability and observability (Alhammadi, *et al.* 2015). Technological context means the internal and external technologies that organizations use in their business (Low, Chen, and Wu 2011). Internal technologies are those that are already in use at the firm while external are those available in the marketplace and not used by the organization (Alshamaila, Papagiannidis, and Li 2013). In this study, technological context adapted from Diffusion of Innovation theory are discussed

from three-point of view which are relative advantage (the level at which a technological factor has more benefits than disadvantages to the organization), complexity (perceived degree of difficulty of understanding and using the technology), and compatibility (the degree to which an innovation is perceived as consistent with the existing values, past experiences, and needs of potential adopters).

Performance as a Factor of Adopting Cloud Computing in SMEs

Performance can be discussed through some parameters like demand service which has to do with users consuming computing resources as required, but according to their needs, and are charged based on the amount they used (Chang 2012; Mahmood 2011; Caroll, Altavander and Paula, 2011). Network: cloud computing has a broad access network. Computing resources reside over the network and can be used on different platforms such as laptops, mobile phones, and cloud services can be used anytime anywhere (Chang, 2012; Caroll, Altavander and Paula, 2011 and Chen 2010). Cost: this consists of purchasing cost and long-term usage cost. The purchasing cost of cloud computing is inexpensive compared to traditional computer technologies (Ayob, 2016). Efficiency and maintenance: companies can save energy, space and also save staff the responsibility of upgrading applications and software. Maintenance is also easier because maintenance processes are held in the cloud rather than on user's computers (Prince, 2011). Security: this deals with how the organizations evaluate cloud computing risks (Caroll, Altavander and Paula, 2011). Cloud users must be sure that their organizational data is more secured in a cloud (Chen and Yang, 2011)

MATERIALS AND METHODS

The study adopted a descriptive survey method. This design was used to be able to describe the characteristics of the variables of interest. The population considered are organizations, businesses, institutes, small and medium-sized enterprises in four (4) cardinal directions of Ilorin (Ilorin central, Ilorin South, Ilorin East and Ilorin west) which use cloud computing and businesses, institutes, small and medium-sized enterprises in Ilorin that do not use cloud computing. Two-stage cluster sampling was employed. Firstly, the cluster random sampling technique was used to draw a sample from organizations where they are grouped differently. Secondly, simple random sampling was used by giving each cluster a random number to randomly choose from all the organizations, industries, and small-medium size enterprises where Ilorin south and Ilorin east were selected. Finally, two-stage cluster sampling was used to select the respondents and a total number of hundred (100) respondents were used for the study. Data were gathered through questionnaires that were distributed among institutions, banks, businesses, and small-medium-sized enterprises based in Ilorin. The questionnaire consists of two sections. The first part deals with demographic variables of the respondents, while the second part contains items on the adoption of cloud computing. The data collected were interpreted, summarized and analyzed using descriptive statistics of simple percentages and regression analysis was used in testing the hypothesis formulated. A multiple regression model analysis was used to express the functional relationship between the dependent and independent variables to make predictions on future events. Statistical Package for Social Sciences (SPSS) was used to analyze the data. Using regression analysis, a theoretical equation of the form $Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4$ is defined.

Where: Y- is the dependent variable (Adoption of cloud computing)

$X_1, X_2, X_3, \ldots X_4$ Are the independent variables that were believed to have effect on Y such as technological factors and performance factors β_0, β_1, $, \beta_2, \beta_3, \beta_4$ are regression coefficients that were estimated.

Table 1: Population and Sample Size

S/N	Organizations, Businesses, Industries, SMEs	Population	Sample size (40%)	Approximated sample size
1.	Banks	32	12.8	13
2.	Information Technologies	14	5.6	6
3.	Supermarkets	9	3.6	4
4.	Showrooms	3	1.2	1
5.	SMEs	115	46	46
6.	Petrol Stations	25	10	10
7.	Hotels	43	17.2	17
8.	Institutions	1	0.4	0
9.	Hospitals	5	2	2
10.	Industries	2	0.8	1
	Total	**249**	**99.6**	**100**

RESULTS AND DISCUSSION

The research considered four factors in respect of technological factors as follows:

1. **Relative advantage** means business has to weigh the benefits that are expected to come from adopting cloud computing
2. **Complexity** means cloud computing allows the organization to keep up with new technology
3. **Speed of business communication is an advantage**
4. **Owning and maintaining IT infrastructure is expensive**

Tables 2 – 8 illustrate the statistical analysis, summary and interpretation of findings obtained in respect of technological factors from the administered questionnaires.

Table 2 shows that 80% of the respondents agree that relative advantage affects the adoption of cloud computing. The results in Table 3 shows that 61% of the respondents are of the opinion that complexity affects the adoption of cloud computing. Majority (88%) of the respondent agreed that that speed of business communication as an advantage is a factor that affects the adoption of cloud computing (Table 4) while 58% of the respondents agreed that owning and maintaining IT infrastructure is expensive therefore affects the adoption of cloud computing (Table 5).

Table 2: Impact of Relative Advantage on the Adoption of Cloud Computing

	Freq.	Percent	Cumulative percent
Strongly agree	28	28.0	28.0
Agree	52	52.0	80.0
Neutral	10	10.0	90.0
Strongly disagree	10	10.0	100.0
Total	100	100.0	

Table 3: Impact of Complexity on the Adoption of Cloud Computing

	Freq.	Percent	Cumulative percent
Strongly agree	19	19.0	19.0
Agree	42	42.0	61.0
Neutral	16	16.0	77.0
Strongly disagree	23	23.0	100.0
Total	100	100.0	

Table 4: Speed of business communication is an advantage

	Freq.	Percent	Cumulative percent
Strongly agree	26	26.0	26.0
Agree	62	62.0	88.0
Neutral	8	8.0	96.0
disagree	2	2.0	98.0
Strongly disagree	2	2.0	100.0
Total	100	100.0	

Table 5: Owning and maintaining IT infrastructure is expensive

	Freq.	Percent	Cumulative percent
Strongly agree	22	22.0	22.0
Agree	36	36.0	58.0
Neutral	34	34.0	92.0
Disagree	8	8.0	100.0
Total	100	100.0	

Table 6 shows the test that technological factor has an effect on the adoption of cloud computing by SMEs. R=0.815, R^2 = 0.664, standard error= 0.275. This implies that technological factors contributed 66.4% to the adoption of cloud computing.

From Table 7, the significance of the p-value gives the result of a hypothesis test. If the p-value is less than 0.05 we reject the null hypothesis but if the p-value is greater than 0.05, the null hypothesis will be accepted. Therefore the p-value is 0.000 which is less than 0.05, the null hypothesis was rejected and technological factor influences the adoption of cloud computing by SMEs.

From the formula $Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \varepsilon$

Technological factor = .741+ (.060) RAD + (.364) SBC+ (.230) OMI+ (.026) CPX + ϵ

Where:

RAD represents "relative advantage"

CPX represents "complexity"

SBC represents "speed of business communication"

OMI represents "owning and maintaining IT infrastructure"

ϵ Represents "standard error"

Table 8 shows that three of the technological factors are significant predictors of the dependent variable for being less than 0.05, having .017 for RAD, .000 for SBC, .000 for OMI.

Table 6: Model Summary

Model	R	R square	Adjusted R square	Standard error of the estimate
1	.815[a]	.664	.650	.275

Table 7: ANOVA

Model	Sum of Squares	Df	Mean Square	F	Sig
Regression	14.241	4	3.560	46.986	.000
Residual	7.199	95	.076		
Total	21.440	99			

Table 8: Coefficients[a]

Model	Unstandardized coefficients		Standardized coefficient	T	Sig.
	B	Std Error	Beta		
(constant)	.741	.118		6.282	.000
RAD	.060	.025	.145	2.428	.017
CPX	.026	.020	.079	1.311	.193
SBC	.364	.036	.605	10.122	.000
OMI	.230	.031	.445	7.337	.000

The results in respect of performance factors are presented based on the cost of purchase, convenience (saving energy, space, and staff), faster analyses, integration of services.

Cost of purchase: users can consume computing resources when required, can only buy according to their needs and are charged based on the amount they used. The result is presented in Table 9 which shows that 58% of the respondents agree that cost affects the adoption of cloud computing

Table 10 shows that 87% of the respondents support that efficiency affects the adoption of cloud computing.

Table 11 shows that 86% of the respondents believe that Demand service affects the adoption of cloud computing

Table 12 shows that 77% of the respondents believe that maintenance and security affect the adoption of cloud computing

Table 9: Cost of Purchase

	Freq.	Percent	Cumulative percent
Strongly agree	25	25.0	25.0
Agree	33	33.0	58.0
Neutral	8	8.0	66.0
Disagree	4	4.0	70.0
Strongly disagree	30	30.0	100.0
Total	100	100.0	

Table 10: Efficiency

	Freq.	Percent	Cumulative percent
Strongly agree	39	39.0	39.0
Agree	48	48.0	87.0
Neutral	8	8.0	95.0
Disagree	3	3.0	98.0
Strongly disagree	2	2.0	100.0
Total	100	100.0	

Table 11: Demand Service

	Freq.	Percent	Cumulative percent
Strongly agree	46	46.0	46.0
Agree	40	40.0	86.0
Neutral	7	7.0	93.0
Disagree	3	3.0	96.0
Strongly disagree	4	4.0	100.0
Total	100	100.0	

Table 12: Maintenance and Security

	Freq.	Percent	Cumulative percent
Strongly agree	35	35.0	35.0
Agree	42	42.0	77.0
Neutral	10	10.0	87.0
Disagree	1	1.0	88.0
Strongly disagree	12	12.0	100.0
Total	100	100.0	

Four variables are related to the technology factor. The analysis shows the items that are lesser than the p-value of 0.05, which means that all challenges to this construct are valid except that Cloud computing allows the organization to keep up with the new Tech. based on the results, the technological factor is one of the factors in the adoption of cloud computing by SMEs. Therefore hypothesis one is reliable and accepted. This is in agreement with (Olveira, 2010) who posit that technology readiness is a facilitator for the adoption of cloud computing. This implies that SMEs employing a specialized IT workforce and developing strategic projects to support business growth are better suited for cloud integration (Alshamaila, 2013).

Hypothesis 2: performance influences the adoption of cloud computing

Table 13 revealed that there is a rate at which the performance can influence the adoption of cloud computing by the SMEs ($r=0.656$, $r^2=0.431$, and std. error of 0.433). This shows that the performance factor contributed 43.1% to the adoption of cloud computing.

From table 14, the significance of the p-value gives the result of a hypothesis test. If the p-value is less than 0.05 we reject the null hypothesis but if the p-value is greater than 0.05, the null hypothesis will be accepted. Therefore the p-value is 0.000 which is less than 0.05, the null hypothesis was rejected which shows that performance influences the adoption of cloud computing by SMEs.

Table 13: Model summary

Model	R	R square	Adjusted R square	Std. error of the estimate
1	.656[a]	.431	.407	.433

Table 14: ANOVA[a]

Model		Sum of Squares	Df	Mean Square	F	Sig
Regression		13.510	4	3.378	17.977	.000[b]
1	Residual	17.850	95	.188		
	Total	31.360	99			

Table 15 shows that three of the performance factors are significant predictors of the dependent variable for being less than 0.05, having .000 for BES, .000 for SAE, .007 for ICS.

Four variables are related to performance. The analysis shows that the items that are lesser than p-value 0.05 mean all performance constructs are valid except the purchase of cloud computing is inexpensive. Based on the results, performance is one of the factors in the adoption of cloud computing in SMEs. Therefore hypothesis two is reliable and accepted. Performance is a facilitator for the adoption of cloud computing which is in support of Chang, 2012 who explained that performance is one of the factors that influence the adoption of cloud computing.

Table 15: Coefficients[a]

Model	Unstandardized coefficients		Standardized coefficient	T	Sig.
	B	Std Error	Beta		
(Constant)	.784	.151		5.199	.000
PCC	.041	.028	.116	1.467	.146
BSE	.193	.052	.295	3.743	.000
SAE	.257	.046	.451	5.623	.000
ICS	.100	.036	.221	2.756	.007

The p-value is less than 0.05, therefore the null hypothesis was rejected which indicates that performance influences the adoption of cloud computing

From the formula $Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \cdots + \beta_\varrho X_\varrho + \varepsilon$

Performance = .784 + (.041) PCC + (.193) BSE + (.257) SAE + (.100) ICS

Where:

PCC represents "cost"

BSE represents "efficiency"

SAE represents "demand service"

ICS represents "maintenance and security"

CONCLUSION

Technology and performance are very important factors in adopting cloud computing by the SMEs. Even though the alternative hypothesis was accepted because both technological factor and performance factor level of significance were less than 0.05.Results show that technological factors contributed 66.4% to the adoption of cloud computing by SMEs and performance factor contributed 43.1% to the adoption of cloud computing by SMEs which implies that technological factor is more important than performance factor.

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