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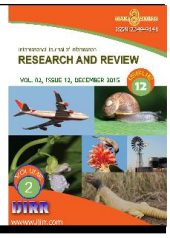

Research Article

A VALIDATED FRAMEWORK FOR CLOUD COMPUTING ADOPTION BY SMES IN UGANDA

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ABSTRACT

ICTS help organisations to leverage on their strength and be competent in the market place to assume leadership. The high capitation required toinvest in Information and Communications Technologies (ICTs) presents constratints to its full scale adoption and usage. Emergency of Cloud Computing on the technology scene presents a resounding solution for organizations to outsource their ICT needs to other companies so as to concentrate on their core activities. This paper presents a validated framework for adoption of cloud computing after exploring the readiness of SMEs in Uganda to adopt the technology. SMEs are Technologically, Organisationally and Environmentally ready for cloud computing despite the slack in its uptake. It became necessary therefore to design and validate a framework that to would facilitate cloud computing adoption by SMEs. Cross tabulation of validation and evaluation parameters were used to yield pearson chi squares. Results indicated that the modified TOE framework is appropriate and applicable to SMEs intending to adopt cloud computing.

INTRODUCTION

The role played by Small and medium enterprises (SMEs) in the global economy is insurmountable, making a sustained contribution to incomes, output and employment. In Uganda's specific case, SMEs contribute enormously to socio economic growth of national economies (Kasse *et al*., 2015). Statistics show that SMEs contribution towards national GDP is over 20% and employ about 90% of total non-farming private sector workers (Earnest and Young, 2011). This undoubtedly shows how important SMEs are to the economy. SMEs would be able to out perform their current levels of performance and production if it were not for many challenges thatgrapple their operations. Studies have suggested the adoption of ICTs as probable solution to information challenges in SMEs. Despite the researches done, SMEs have not fully utilized ICTs and this can be explained by a number of limiting factors like high infrastructure acquisition costs, lack of skilled workforce and the higher licensing fees for software (Kasse *et al*., 2015). These factors have retarded the adoption of ICT by SMEs despite deliberate efforts being undertaken. To that effect, the Cloud computing business model was proposed (Kasse *et al*., 2015) as a measure for SMEs to continue using ICTs with affordability, convenience and flexibility. Cloud Computing is defined by (Chinyao *et al*., 2011) as the application of internet based technologies to conduct business.

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It renders services to individuals and businesses (public and private) to use remote software and hardware to provide or consume computing resources like networks, servers, storage, applications, and services (Roloff *et al*., 2012). CC gives freedom to a company to concentrate on its core activities and competencies because the hardware and software are managed by third parties. Through this innovations and new products for new marketsare created (Marinos and Briscoe, 2009). In the initial paper of this study we examined the concept of CC and rediness of SMEs to adopt it in Uganda using the TOE theory, examined challenges SMEs encounter in its adoption and implementation and, made propositions to challenges. A framework was designed to guide adoption and implementation of CC by Uganda's SMEs based on the original TOE theory (Tornatzky *et al*., 1990).

Findings indicated that the SMEs are technologically, organizationally and environmentally ready for adoption of CC and they were willing to outsource a number of their Business processes in the cloud. However the major draw back was on the issues of uncertainity about the privacy of organizational data and the lack of security in the CC architecture. In this paper therefore, the authorspresent results from the validation and evaluatuion of the modified TOE framework. Figure 1 summarises the modified TOE theory. The TOE theory was modified and customised to support Cloud Computing adoption based on the results of the survey, strategic propositions from the findings authenticated by literature (Kasse *et al*., 2015).

Table 1. Descriptive statistics for validation

	N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
Simple language used	29	1.00	5.00	3.8276	.71058	-2.303	.434	8.732	.845
Localized	29	2.00	5.00	3.7241	.64899	-1.352	.434	2.094	.845
Based on typical organization setting	28	2.00	5.00	3.7143	.65868	-.461	.441	.641	.858
Fewer steps involved	29	2.00	5.00	3.6897	.89056	-.948	.434	.184	.845
Logical arrangement of steps	29	2.00	5.00	3.6207	.82001	-.834	.434	.169	.845
Clear explanation of steps	29	2.00	5.00	3.7241	.84077	-.969	.434	.567	.845
Variables are interrelated	29	2.00	5.00	3.6552	.76885	-.818	.434	.502	.845
Variables are interdependent	29	2.00	5.00	3.6897	.80638	-.672	.434	.294	.845
Steps are interrelated	29	2.00	5.00	3.5517	.78314	-.902	.434	.047	.845
Steps are interdependent	29	2.00	5.00	3.5172	.82897	-.463	.434	-.328	.845
Identifies challenges to adoption	29	2.00	5.00	3.7586	.83045	-1.112	.434	.941	.845
Provides for training	29	1.00	5.00	3.7241	.95978	-1.217	.434	1.506	.845
Provides measures to mitigate challenges	29	2.00	5.00	3.6897	.84951	-1.209	.434	.650	.845
Localized assessment of issues	29	2.00	5.00	3.6207	.90292	-.388	.434	-.460	.845
Valid N (listwise)	28								

Source: Primary Data

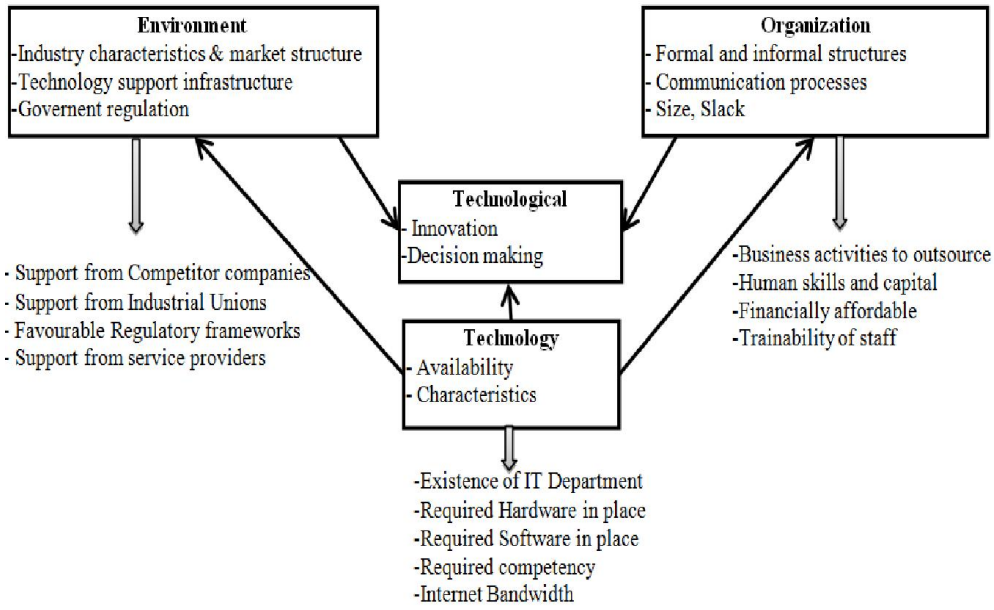

Figure 1. Modefied TOE framework (Kasse *et al*., 2015)

Therefore, the major outcome was a modified TOE framework based on the readiness assessment parameters to present factors to be considered by any SME that may be intending to adopt new technologies like Cloud Computing.

RESULTS

This section presents the methods and tools used by the authors to evaluate and validate the modified TOE framework.

Validation of the Designed Framework

The framework was validated using descriptive statistics involving means and standard deviation and tested using chi square as shown in tables in the sections below;

Demographic statistics

Table 2. Gender

		Frequency	Percent
Valid	Female	4	13.8
	Male	25	86.2
	Total	29	100.0

Source: Primary Data

Table 3. Case organizations

		Frequency	Percent
Valid	Bank	13	44.8
	Telecom	13	44.8
	UCC	3	10.3
	Total	29	100.0

Source: Primary Data

Cross tabulation of validation patterns

The following tables 4-17 present results and analysis from the cross tabulation of framework valiation parameters. The validation parameters include language use, framework localization, typical organizational setting, steps of the framework and interdepence among others (Arbaugh and Ben, 2008).

The findings in the Table6 above show that 60.7% of the respondents agree that the framework is based on organization setting. However, 28.6% were neutral and 3.6% disagreed. There were no significant differences in the positive views of the respondents in regard to the setting of SMEs on cloud computing (Pearson Chi-Square = 3.829, df = 6, Sig =.700). Table7 indicates that 75.8% of the respondents agreed that the steps involved in the framework were few, 17.2% disagreed

Table 4. Cross tabulation of organization and language simplicity

			Organization			Total
			Bank	Telecom	UCC	
Simple language used	Strongly Disagree	Count	0	1	0	1
		% of Total	0.0%	3.4%	0.0%	3.4%
	Uncertain	Count	1	1	2	4
		% of Total	3.4%	3.4%	6.9%	13.8%
	Agree	Count	11	10	1	22
		% of Total	37.9%	34.5%	3.4%	75.9%
	Strongly Agree	Count	1	1	0	2
		% of Total	3.4%	3.4%	0.0%	6.9%
Total		Count	13	13	3	29
		% of Total	44.8%	44.8%	10.3%	100.0%

Source: Primary dataChi square Test (Pearson Chi-Square = 9.092, df= 6, sig =.168)

Table5. Cross tabulation of the localization and type of organization

			Organization			Total
			Bank	Telecom	UCC	
Localized	Disagree	Count	1	1	0	2
		% of Total	3.4%	3.4%	0.0%	6.9%
	Uncertain	Count	3	2	0	5
		% of Total	10.3%	6.9%	0.0%	17.2%
	Agree	Count	8	10	3	21
		% of Total	27.6%	34.5%	10.3%	72.4%
	Strongly Agree	Count	1	0	0	1
		% of Total	3.4%	0.0%	0.0%	3.4%
Total		Count	13	13	3	29
		% of Total	44.8%	44.8%	10.3%	100.0%

Source: Primary Data(Pearson Chi-Square = 2.826, df = 6, Sig = .830)

Table6. Cross tabulation of organizational setting and type of organization

			Organization			Total
			Bank	Telecom	UCC	
Based on typical organization setting	Disagree	Count	0	1	0	1
		% of Total	0.0%	3.6%	0.0%	3.6%
	Uncertain	Count	3	3	2	8
		% of Total	10.7%	10.7%	7.1%	28.6%
	Agree	Count	9	7	1	17
		% of Total	32.1%	25.0%	3.6%	60.7%
	Strongly Agree	Count	1	1	0	2
		% of Total	3.6%	3.6%	0.0%	7.1%
Total		Count	13	12	3	28
		% of Total	46.4%	42.9%	10.7%	100.0%

Source: Primary data(Pearson Chi-Square = 3.829, df = 6, Sig =.700)

The intention was to identify patterns of interaction between the parameters and their substantial relevance. From the findings, 82.8% of the respondents agreed that the language used was simple, 13.8% were neutral and 3.4% disagree that the language used was simple. There were no significant differences in the positive views regarding the simplicity of the language used (Pearson Chi-Square = 9.092, df= 6, sig =.168). From Table5, 75.8% of the respondents agreed that the framework content is localized, 17.2% were neutral and only 6.9% disagreed. There were no significant differences among the respondent's positive views in regard to the localization or tailoring of the framework addressing the needs of SMEs to cloud computing adoption (Pearson Chi-Square = 2.826, df = 6, Sig = .830).

about the steps being few and only 6.9% of the respondents were neutral. There were no significant differences in the positive views of respondents in regard to the fewness of the steps involved (Chi-Square = .413). The findings show that 62.1% of the respondents agreed that the steps of the framework were logically arranged, 17.2% were neutral and 13.8% disagreed. There were no significant differences in the views of respondents (Pearson Chi-Square = 5.693, df = 6, Sig =.458) From the above table, 65.5% of the respondents agreed that the steps of the framework are clearly explained, 13.8% disagreed to that, and only 10.3% were neutral. There were no significant differences in the positive views in regard to clear explanation of the steps (Pearson Chi-Square = 5.760, df = 6, Sig =.451).

Table 7. Cross tabulation of fewness of modified framework steps and type of organization

			Organization			Total
			Bank	Telecom	UCC	
Fewer steps involved	Disagree	Count	3	1	1	5
		% of Total	10.3%	3.4%	3.4%	17.2%
	Uncertain	Count	0	2	0	2
		% of Total	0.0%	6.9%	0.0%	6.9%
	Agree	Count	9	9	1	19
		% of Total	31.0%	31.0%	3.4%	65.5%
	Strongly Agree	Count	1	1	1	3
		% of Total	3.4%	3.4%	3.4%	10.3%
Total		Count	13	13	3	29
		% of Total	44.8%	44.8%	10.3%	100.0%

Source: Primary data(Pearson Chi-Square = 6.095, df = 6, Sig. = .413)

Table 8. Cross tabulation of the logical arrangement of the modified framework steps and type of organization

			Organization			Total
			Bank	Telecom	UCC	
Logical arrangement of steps	Disagree	Count	3	1	0	4
		% of Total	10.3%	3.4%	0.0%	13.8%
	Uncertain	Count	1	3	1	5
		% of Total	3.4%	10.3%	3.4%	17.2%
	Agree	Count	7	9	2	18
		% of Total	24.1%	31.0%	6.9%	62.1%
	Strongly Agree	Count	2	0	0	2
		% of Total	6.9%	0.0%	0.0%	6.9%
Total		Count	13	13	3	29
		% of Total	44.8%	44.8%	10.3%	100.0%

Source: Primary data(Pearson Chi-Square = 5.693, df = 6, Sig =.458)

Table 9. Cross tabulation of clear explanation of the modified framework steps and type of organization

			Organization			Total
			Bank	Telecom	UCC	
Clear explanation of steps	Disagree	Count	1	3	0	4
		% of Total	3.4%	10.3%	0.0%	13.8%
	Uncertain	Count	1	1	1	3
		% of Total	3.4%	3.4%	3.4%	10.3%
	Agree	Count	10	8	1	19
		% of Total	34.5%	27.6%	3.4%	65.5%
	Strongly Agree	Count	1	1	1	3
		% of Total	3.4%	3.4%	3.4%	10.3%
Total		Count	13	13	3	29
		% of Total	44.8%	44.8%	10.3%	100.0%

Source: Primary data (Pearson Chi-Square = 5.760, df = 6, Sig =.451)

Table10. Cross tabulation of interrelationship of variables of the modified framework and type of organization

			Organization			Total
			Bank	Telecom	UCC	
Variables are interrelated	Disagree	Count	2	1	0	3
		% of Total	6.9%	3.4%	0.0%	10.3%
	Uncertain	Count	2	3	1	6
		% of Total	6.9%	10.3%	3.4%	20.7%
	Agree	Count	7	9	2	18
		% of Total	24.1%	31.0%	6.9%	62.1%
	Strongly Agree	Count	2	0	0	2
		% of Total	6.9%	0.0%	0.0%	6.9%
Total		Count	13	13	3	29
		% of Total	44.8%	44.8%	10.3%	100.0%

Source: Primary Data(Pearson Chi-Square = 3.883, df = 6, Sig = .692)

Table10 shows that 62.1% of the respondents agree that the variables in the framework are interrelated, 20.7% of the respondents were neutral and 10.3% of the respondents disagreed about variables being interrelated. There were no significant differences in the positive views of respondents in regard to interrelationship of the variables (Pearson Chi-Square = 3.883, df = 6, Sig = .692). From the findings in Table11, 58.6% of the respondents agreed that the variables used in the framework were interdependent, 20.7% of the respondents were neutral and 10.3% disagreed.

There were no significant differences in the positive views of the respondents in regard to the interdependence of the framework variables (Pearson Chi-Square = 7.902, df = 6, Sig = .245) The respondents agreed that the steps of the framework are interrelated (62.1%), 20.7% of the respondents were neutral and only 13.8% disagreed.

There were no significant differences among the positive views of the respondents in regard to the interrelationship of the steps (Pearson Chi-Square = 5.081, df = 6, Sig =.533).

Table 11. Cross tabulation of the interdependence of the modified framework variable and type of organization

			Organization			Total
			Bank	Telecom	UCC	
Variables are interdependent	Disagree	Count	1	1	1	3
		% of Total	3.4%	3.4%	3.4%	10.3%
	Uncertain	Count	3	2	1	6
		% of Total	10.3%	6.9%	3.4%	20.7%
	Agree	Count	7	10	0	17
		% of Total	24.1%	34.5%	0.0%	58.6%
	Strongly Agree	Count	2	0	1	3
		% of Total	6.9%	0.0%	3.4%	10.3%
Total		Count	13	13	3	29
		% of Total	44.8%	44.8%	10.3%	100.0%

Source: Primary Data(Pearson Chi-Square = 7.902, df = 6, Sig =.245)

Table 12. Cross tabulation of the interrelationship of the modified framework steps and type of organization

			Organization			Total
			Bank	Telecom	UCC	
Steps are interrelated	Disagree	Count	3	1	0	4
		% of Total	10.3%	3.4%	0.0%	13.8%
	Uncertain	Count	2	4	0	6
		% of Total	6.9%	13.8%	0.0%	20.7%
	Agree	Count	7	8	3	18
		% of Total	24.1%	27.6%	10.3%	62.1%
	Strongly Agree	Count	1	0	0	1
		% of Total	3.4%	0.0%	0.0%	3.4%
Total		Count	13	13	3	29
		% of Total	44.8%	44.8%	10.3%	100.0%

Source: Primary Data(Pearson Chi-Square = 5.081, df = 6, Sig =.533)

Table 13. Cross tabulation of the interdependence of the modified framework steps and type of organization

			Organization			Total
			Bank	Telecom	UCC	
Steps are interdependent	Disagree	Count	2	1	1	4
		% of Total	6.9%	3.4%	3.4%	13.8%
	Uncertain	Count	3	4	1	8
		% of Total	10.3%	13.8%	3.4%	27.6%
	Agree	Count	6	8	1	15
		% of Total	20.7%	27.6%	3.4%	51.7%
	Strongly Agree	Count	2	0	0	2
		% of Total	6.9%	0.0%	0.0%	6.9%
Total		Count	13	13	3	29
		% of Total	44.8%	44.8%	10.3%	100.0%

Source: Primary Data(Pearson Chi-Square = 4.362, df = 6, Sig = .628)

Table 14. Cross tabulation of the modified framework's identification of the challenges to adoption and the type of organization

			Organization			Total
			Bank	Telecom	UCC	
Identifies challenges to adoption	Disagree	Count	1	2	1	4
		% of Total	3.4%	6.9%	3.4%	13.8%
	Uncertain	Count	2	0	0	2
		% of Total	6.9%	0.0%	0.0%	6.9%
	Agree	Count	8	10	2	20
		% of Total	27.6%	34.5%	6.9%	69.0%
	Strongly Agree	Count	2	1	0	3
		% of Total	6.9%	3.4%	0.0%	10.3%
Total		Count	13	13	3	29
		% of Total	44.8%	44.8%	10.3%	100.0%

Source: Primary Data(Pearson Chi-Square = 4.610, df = 6, Sig = .595)

Table13 shows that 51.7% of the respondents agreed that the steps used were interdependent, 27.6% were neutral and 13.8% disagreed. There were no significant differences in the positive views of respondents in regard to the interdependence of the steps (Pearson Chi-Square = 4.362, df = 6, Sig = .628).

From Table14, majority of the respondents agreed that the framework identifies challenges to cloud computing adoption (69%). However, 13.8% of the respondents disagreed and 6.9% were neutral.

Table15. Cross tabulation of the modified framework's provision for training and type of organization

			Organization			Total
			Bank	Telecom	UCC	
Provides for training	Strongly Disagree	Count	1	0	0	1
		% of Total	3.4%	0.0%	0.0%	3.4%
	Disagree	Count	1	2	0	3
		% of Total	3.4%	6.9%	0.0%	10.3%
	Uncertain	Count	0	3	0	3
		% of Total	0.0%	10.3%	0.0%	10.3%
	Agree	Count	9	7	2	18
		% of Total	31.0%	24.1%	6.9%	62.1%
	Strongly Agree	Count	2	1	1	4
		% of Total	6.9%	3.4%	3.4%	13.8%
Total		Count	13	13	3	29
		% of Total	44.8%	44.8%	10.3%	100.0%

Source: Primary Data(Pearson Chi-Square = 7.105, df =8, Sig = .525)

Table16 Cross tabulation of the modified framework's provision of measures to mitigate challenges and type of organization

			Organization			Total
			Bank	Telecom	UCC	
Provides measures to mitigate challenges	Disagree	Count	2	2	1	5
		% of Total	6.9%	6.9%	3.4%	17.2%
	Uncertain	Count	0	1	0	1
		% of Total	0.0%	3.4%	0.0%	3.4%
	Agree	Count	10	9	2	21
		% of Total	34.5%	31.0%	6.9%	72.4%
	Strongly Agree	Count	1	1	0	2
		% of Total	3.4%	3.4%	0.0%	6.9%
Total		Count	13	13	3	29
		% of Total	44.8%	44.8%	10.3%	100.0%

Source: Primary Data(Pearson Chi-Square = 2.032, df = 6, Sig = .917)

Table17. Cross tabulation of the localization of issues assessed and type of organization

			Organization			Total
			Bank	Telecom	UCC	
Localized assessment of issues	Disagree	Count	2	2	0	4
		% of Total	6.9%	6.9%	0.0%	13.8%
	Uncertain	Count	2	4	1	7
		% of Total	6.9%	13.8%	3.4%	24.1%
	Agree	Count	6	7	1	14
		% of Total	20.7%	24.1%	3.4%	48.3%
	Strongly Agree	Count	3	0	1	4
		% of Total	10.3%	0.0%	3.4%	13.8%
Total		Count	13	13	3	29
		% of Total	44.8%	44.8%	10.3%	100.0%

Source: Primary Data(Pearson Chi-Square = 4.886, df = 6, Sig = .558)

There were no significant differences in the positive views of the respondents in regard to identification of challenges to adoption (Pearson Chi-Square = 4.610, df = 6, Sig = .595). From Table15, 62.1% of the respondents agree that the framework provides for training, 10.3% of the respondents disagreed and only 10.3% were neutral. There were no significant differences in the positive views of the respondents in regard to provision of training (Pearson Chi-Square = 7.105, df =8, Sig = .525)

Findings in Table16 shows that 72.4% of the respondents agreed that the framework provides measures to mitigate the challenges to cloud computing adoption, 17.2% of the respondents disagreed and only 3.4% were neutral. There were no significant differences in the positive views of the respondents in regard to the provision of measures to mitigate challenges (Pearson Chi-Square = 2.032, df = 6, Sig = .917). From the findings in Table17, 48.3% of the respondents agreed that the framework localized the assessment of issues, 24.1% of the respondents were neutral and only 13.8% disagreed.

There were no significant differences in the positive views of the respondents in regard to the localization of the issues assessed (Pearson Chi-Square = 4.886, df = 6, Sig = .558)

Conclusion

SMEs appreciate the role of Cloud Computing technology towards improvement of their business processes and operations, there is slow uptake of Cloud Computing services for all models that include Infrastructure as a Service (IaaS), Software as a Service (SaaS) Platform as a Service (PaaS), and deploy them as Private, Public, Partner and hybrid clouds. Security, Availability of services and/or data, Integrity of services and/or data, Confidentiality of corporate data, Loss of control of services and/or dataand Intra-clouds (vendor lock-in) migration are challenges SMEs are facing in Clouding Computing adoption. It is hoped that the modified TOE model can make a positive contribution towards adoption of CC by SMEs since it has been validated on grounds of efficacy, appropriateness and userability.

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