



Assessing the Challenges that are Confronted Rural-Based SMEs on the Implementation of Cloud Services

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ABSTRACT

The increase of contemporary technologies such as cloud-based services has attracted various institutions, especially in developing countries. Many businesses have started to show interest in migrating to the cloud to expand their businesses, particularly in urban areas. However, it has become challenging for rural-based Small and Medium Enterprises (SMEs) to integrate themselves with ICT innovations such as cloud services as they are facing various challenges like poor development of ICT infrastructure. It is these difficulties that are facing SMEs located in rural areas that are at the core of this study, whose aim is to assess the challenges that rural-based SMEs are facing on the implementation of cloud services. A literature review from the previous studies was used to identify these challenges, which were later transformed into variables that ended up being tested in this paper. These variables include independent variables such as Security, Compatibility, Perceived usefulness, Perceived ease of use, and dependent variable, which are cloud services. A Likert-scale questionnaire-based survey of small business employees was conducted from a small town called Elliotdale, Eastern Cape, South Africa, to assess whether the challenges mentioned above, according to them, have an impact on the implementation of cloud services by SMEs. The data were analyzed to test the reliability and validity of the data-gathering instrument(questionnaires) and inferential statistics such as correlations between independent and dependent constructs, and Regression (predictor). The results indicate that the participants agreed that the challenges mentioned above, such as Security, Compatibility, Perceived Usefulness, Perceived Ease of Use, have a significant impact on the implementation of cloud services by rural-based SMEs.

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CCS CONCEPTS

• Networks-Network services~Cloud computing

KEYWORDS

Cloud-based services, SMEs, ICT, Online businesses

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1 Introduction

The revolution of Information and Communications Technology (ICT), such as the introduction of cloud services, has not benefited only educational institutions or government sectors. It has also provided a better world to Small and Medium Enterprises (SMEs). This is supported by [1], according to whom cloud services allow SMEs to be more flexible in providing services to their customers. Similarly,[2] found that cloud services have shown benefits to small businesses that are struggling with the readiness of a capable workforce. According to [3], cloud services can make a difference in how these businesses can keep their data and deliver services simultaneously, and this is what cloud-based services refer to in this study. However, even though various sectors have utilized cloud services, SMEs in rural areas have not implemented this kind of technology [3]. The main reason for the adoption of this research is the fact that, despite the proven advantages of cloud services, various SMEs in rural areas of South Africa have not migrated to this innovation [4].

There is an absence of research on why these SMEs have not utilized cloud services to improve their businesses despite benefits that have been brought by cloud computing in different sectors. These advantages include business opportunities, consolidation of resources, green IT, and many more [5]. Nevertheless, according to [6], lack of adequate infrastructures in rural areas has affected

the initiation of technological innovations by rural-based SMEs. This is supported by [4] for whom the vulnerabilities posed by threats towards online companies have delayed the adoption of cloud services by SMEs in South Africa. This study is conducted in the belief that, in the challenging economy of South Africa, rural-based SMEs might be the catalyst in providing jobs to those in need or underprivileged if the SMEs can also embrace these technological innovations much.

The objectives of this paper:

The aim of this study is to assess the challenges that are facing rural-based SMEs on the implementation of cloud services. This aim will be achieved through the following objectives: identify challenges that are affecting the implementation of cloud services by SMEs located in rural areas, create a conceptual model from the identified challenges, and empirically test the framework.

2 Literature Review

2.1 Description of Cloud services

According to [7], cloud services can be defined as the capabilities of Information Technology (IT)-related resources to deliver services. It also provides flexibility to many sectors because it does not rely on any location, allowing customers to access different products and services wherever they are situated. This is supported by [8] for whom the advantages of cloud services include adaptability, cost-effectiveness, flexibility, scalability, accessibility.

2.2 Adoption of cloud services by SMEs

There are various reasons why SMEs have to introduce cloud services. This includes the migration of business activities to the cloud and expands its products and services to different customers around the globe. According to [9], "the portability of end-user data to another cloud provider in cloud computing is seen to be extremely crucial since it enhances the reliability of the system and thus ensures that the SMEs often operate even when there are inconsistencies in the system." However, despite the benefits mentioned above of cloud services, SMEs in some parts of rural communities of South Africa have not adopted this platform. Many employees have questioned the reliability of cloud services in various ways, such as security, privacy, and many more [9]. This problem is similar to the concern revealed on the study conducted by [10] for whom SME populations have found a lack of awareness, security, and privacy issues as the primary inhibitors to the implementation of cloud services amongst SMEs in developing countries. The problems facing SMEs have also been indicated by [11], who claim that the majority of small and medium enterprises do not have enough funds to purchase adequate resources that are required to adopt cloud computing. Literature from the reviewed studies has found the impact between security and cloud services, compatibility, and cloud services, as well as ease of use and cloud services, and lastly, perceived usefulness and cloud computing for business purposes.

Eight of these studies were conducted in Asia [12][13][14][15][16][17][18][19], followed by the Middle East with two studies [20][21], Europe with two studies [22][23], Australia with two [24][25], and South America with one study [26]. According to [27], security can be defined as the threats confronted by SMEs when they are executing cloud services. These threats include malware attacks, hacker penetration, and many more that can be dangerous to the businesses' online data. As for compatibility, [27] claim that it can be defined as the extent to which cloud services can be able to work with the existing business resources, and this is what it means in this study. According to [28], perceived ease of use can be defined as the level to which an individual believes that a particular system would be free of effort. Similarly, [29] indicated that perceived usefulness could be defined as the extent to which an individual believes that cloud-based services would improve SMEs.

2.3 Theoretical background and framework

This study is guided by the Innovation Diffusion Theory (IDT) and Technology Acceptance Model (TAM). Both were chosen because their constructs are aligned with factors that have been adopted in this study. These factors include Compatibility, Security, Perceived usefulness, and Perceived ease of use.

2.3.1 Innovation Diffusion Theory (IDT) (1995). According to [30], Diffusion of Innovation is a fundamental theory which states that innovations get expanded through a specific population or social system [31]. According to [32], Diffusion of Innovation comprises relative advantage, compatibility, complexity, trialability, and observability. This theory is aligned with the constructs that have been used in this study.

2.3.2 Technology Acceptance Model (TAM) (1986, 1989). According to [33], Technology acceptance model is generally used to study the acceptance of ICT. This is supported by [34] for whom the technology acceptance model includes the most important factors. This includes the perceived ease of use and usefulness. This model supports this study as the constructs mentioned above are at the center of this present research.

2.4 Conceptual model

After the factors were identified in this study, a conceptual model was adopted to support the second objective: to create a conceptual model from the identified challenges that have an impact on the implementation of cloud service by SMEs. Figure 1 presents this model, which includes independent variables (Security, Compatibility, perceived usefulness, perceived ease) and dependent variable (cloud services). See figure: 1.

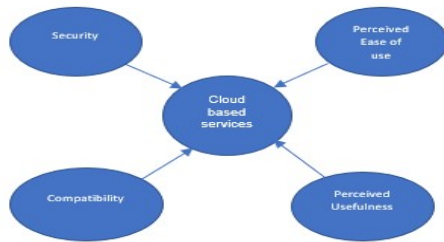


Figure 1: Conceptual model

Each of the variables was broken down into several factors contributing to the construct, as shown in Appendix B & C.

3 Methodology

This study is quantitative. The data was collected through a questionnaire-based survey in a small town called Elliotdale in the Eastern Cape, South Africa. The location of the data collection was chosen because it is one of the deepest rural areas in South Africa, where even hunger or poverty is on high alert. The authors believe that this research can help to change many lives through the adoption of cloud-based services by SMEs. A simple random sampling method was used to select the participants of this study. In a simple random sampling method, the reason for the chosen participants depends entirely on a probability or chance. This method is used to extract a sample from a larger population, and this is the same reason why it is used in the study. These questionnaires were printed, then after, distributed to the participants. The polls were inclusive of four independent constructs and one dependent construct (see figure: 1). Likert-scale, such as strongly disagree, disagree, weakly agree, agree, and strongly agree, was used in this questionnaire to make it easier for business employees to answer them. The data was analyzed using Statistical Package for the Social Sciences (SPSS version 25). The sample size was 50, and all participants have responded to all the questions that were asked (see Appendix: A). The sample size was calculated using the following formula, which was proposed by [35]: Sample size:

$$n' = \frac{NZ^2P(1-P)}{d^2(N-1)+Z^2P(1-P)} \quad (1)$$

where, n' = Sample size, N = Population size, Z = Confidence level, P = Estimated proportion, and d = accuracy. The following parameters were applied: N = 59, p = 0.7, d = 0.05, and Z = 1.96, which ended up giving 50 as the sample size. The questionnaires were tested validity and reliability to measure the internal consistency between the variables, and all the variables were found to have p-value = 0.000, which indicate the statistically significant relationship between themselves

4 Results and Discussion

The data that were collected in the present research was analyzed using SPSS version 25. This includes the results for reliability and validity of the data gathering instrument(questionnaires),

Inferential statistics such as correlations between independents and dependent constructs, Regression (predictor), which include a model summary, and ANOVA results.

4.1 Reliability. Table: 1 present the results of reliability among all constructs and their variables. According to [36], reliability is the level to which “measurements are repeatable” when different individuals perform a measurement, at different times, under different circumstances, with apparently substitute instruments that test the same thing. According to [37], the following guidelines justify Cronbach’s alpha reliability coefficient values: above 0.9 – Excellent reliability, _above 0.8 – Good reliability, _above 0.7 – Acceptable reliability, _above 0.6 – Questionable reliability, _above 0.5 – Poor, and _below .5 – Unacceptable”. The reliability was tested between variables of this study, and Cronbach’s alpha coefficients for this survey’s variables were all greater than 0.7, which confirms their reliability in this research. See Table 1.

Table 1: Reliability of all the research constructs

Research Construct	No of variables or items (Questions)	Cronbach’s alpha (α)
Security	5	0.736
Compatibility	5	0.779
Perceived Usefulness	5	0.940
Perceived Ease of Use	5	0.885
Cloud services	5	0.910

4.2 Inferential statistics (correlations). This section presents the results of the ANOVA and the Pearson correlation tests conducted in this research.

4.2.1 ANOVA results. After the reliability was measured, ANOVA tests were conducted between the demographics and the dependent variable. The study could not find any form of correlation on the one-way ANOVA tests that were done.

4.2.2 Pearson’s correlation test results. As for Pearson’s correlation test, the study found a statistical significance between all the independent constructs (Security, compatibility, perceived usefulness, perceived ease of use), and their dependent construct (cloud services). According to [38], a person’s correlation measures the presence (given by p-value) and strength (provided by the coefficient r between -1 and +1) of a linear relationship between two variables”. This is supported by [39] for whom, if p < 0.05, there is a statistically significant relationship between the two tested variables. The results of the Pearson product-moment correlation and its statistical significance are shown in Appendix A.

The summary of Appendix A results according to each independent variable and its dependent variable.

a) Security: Pearson product-moment correlation was executed to determine the relationship between security (independent construct), and Cloud Services (dependent construct). The results in Appendix A shows a positive correlation between security and cloud services, which was statistically significant ($r = .504, n = 50, p = 0.000$).

b) Compatibility: Pearson product-moment correlation was executed to determine the relationship between compatibility (independent construct) and Cloud Services (dependent construct). The results in Appendix A shows a positive correlation between compatibility and cloud services, which was significant ($r = .455, n = 50, p = 0.001$).

c) Perceived Usefulness: Pearson product-moment correlation was executed to determine the relationship between Perceived Usefulness (independent construct) and Cloud Services (dependent construct). The results in Appendix A shows a strong, positive correlation between Perceived Usefulness and cloud services, which was statistically significant ($r = .767, n = 50, p = 0.000$).

d) Perceived Ease of Use: Pearson product-moment correlation was executed to determine the relationship between Perceived Ease of Use (independent construct), and Cloud Services (dependent construct). The results in Appendix A shows a strong, positive correlation between Perceived Ease of Use and cloud services, which was statistically significant ($r = .752, n = 50, p = 0.000$).

4.3 Regression (predictor). Regression was measured in this study, and Table 2 provides the values of the model summary. According to [40], the model in the model summary allows an individual to specify various models in a particular regression command. As for R,[40] proclaim that R is the square root of R-squared and indicates the relationship between the observed and predicted values for the dependent variable. In this study, R-Square indicates the amount of variance for the dependent variable (cloud-based services) that can be predicted from independent variables (EaseOfUse, Compatibility, Security, Usefulness). As illustrated in Table 2, R-value (under "R" Column) is 0.813 and represents the simple correlation, which signifies a high level of relationship. The R2 value indicates that 0.662 (66.2%) of the variance in cloud services that can be predicted from independent variables such as Ease of Use, Compatibility, Security, and Usefulness. The readers can be reminded that this is only the general measure for the strong association and does not reflect the magnitude of the association between one independent variable and the dependent variable. See Table 2.

The ANOVA results for regression are illustrated in Table 3. This Table indicates how great the regression equation predicts the dependent variable. According to Table 3, the regression model predicts the dependent variable significantly, as p-value <0.000, which is less than 0.05. These results generally mean that the

regression model statistically significantly predicts the independent variables (Security, Compatibility, Usefulness, Ease of use) as a good fit for the data. See Table 3

4.4 Empirically tested framework. After results were found in this study, an empirically tested framework was introduced to support the third objective. Figure 2 illustrates the effect that was obtained after the variables were examined. These results indicate that there is a correlation between all independent variables and the dependent variable of this study. This framework was created in a belief that it might play a significant role in helping the decision-makers to understand the kind of framework that can be used for factors affecting the implementation of cloud services SMEs in Elliotdale, South Africa.

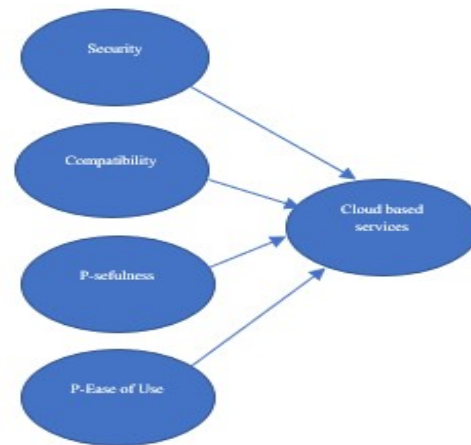


Figure 2: Empirical tested framework

5 Conclusion

The main reason for the adoption of this present research is the challenges that are facing various SMEs in rural areas of South Africa on the implementation of cloud services, and there is an absence of research on why they have not adopted this kind of technology to improve their businesses. In the pursuit of the first objective of this study, a literature review was conducted to assist in identifying the challenges that are facing rural-based SMEs. A conceptual model was created after the factors were identified and empirically tested through a questionnaire-based survey. The purpose was to try to understand what the rural-based SME employees in South Africa think have forced their organizations not to implement cloud services. The results from the empirically tested framework are in agreement with the reviewed literature that Security, Compatibility, Perceived usefulness, and Perceived ease of use are some of the challenges that affect the adoption of cloud services by rural-based SMEs. However, more research that will go in-depth on the growing challenges that are confronted SMEs in rural areas should be conducted, as this might be the catalyst in providing jobs, especially in developing countries where the economy is in jeopardy.

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Table 2: Model Summary for regression

Model Summary ^b									
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.813a	.662	.632	2.93999	.662	22.001	4	45	.000

a. Predictors: (Constant), P-EaseOfUse, Compatibility, Security, P-Usefulness

b. Dependent Variable: CloudBasedServices

Table 3: ANOVA results for regression

ANOVA ^a						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	760.661	4	190.165	22.001	.000b
	Residual	388.959	45	8.644		
	Total	1149.620	49			

a. Dependent Variable: CloudServices

b. Predictors: (Constant), PEaseOfUse, Compatibility, Security, PUsefulness

APPENDIX A: Pearson Correlation (r) between the independent variables and the dependent variables

Independent variables: Security, Compatibility, Perceived Usefulness, Perceived Ease of Use

Dependent variables: Cloud Services

Correlations						
		Security	Compatibility	P-Usefulness	P-EaseOfUse	CloudServices
Security	Pearson Correlation	1	.551**	.455**	.492**	.504**
	Sig. (2-tailed)		.000	.001	.000	.000
	N	50	50	50	50	50
Compatibility	Pearson Correlation	.551**	1	.511**	.421**	.455**
	Sig. (2-tailed)	.000		.000	.002	.001
	N	50	50	50	50	50
P-Usefulness	Pearson Correlation	.455**	.511**	1	.781**	.767**
	Sig. (2-tailed)	.001	.000		.000	.000
	N	50	50	50	50	50
P-EaseOfUse	Pearson Correlation	.492**	.421**	.781**	1	.752**
	Sig. (2-tailed)	.000	.002	.000		.000
	N	50	50	50	50	50
CloudServices	Pearson Correlation	.504**	.455**	.767**	.752**	1
	Sig. (2-tailed)	.000	.001	.000	.000	
	N	50	50	50	50	50

** . Correlation is significant at the 0.01 level (2-tailed).

APPENDIX B: Independent variables against their statements in the questionnaire

Construct	Independent variables statement in the questionnaire
Security	Protect my data from the theft.
	Prevent unauthorized access to my files.
	Have the means to prevent the loss of my data.
	Be a technology leader.
	Encrypt my data.
Compatibility	Cloud services are compatible with the existing technological architecture of my company.
	The changes introduced by cloud computing are consistent with existing practices in my company.
	Cloud computing development is compatible with my firm's existing format, interface, and other structural data.
	There is no difficulty in importing applications/ data from cloud services.
	There is no difficulty in exporting applications/ data to cloud services.
Perceived Usefulness	Using cloud computing allows me to manage the business operation in an efficient way
	Using cloud computing allows me to increase business productivity
	Using cloud computing allows me to accomplish my organizational task more quickly.
	The use of cloud computing services improves the quality of business operations.
	Using cloud computing advances my competitiveness
Perceived Ease of Use	Employees and their bosses use applications via cloud computing.
	It is easy for community members to learn how to use applications via cloud computing.
	Get help troubleshooting issues with the cloud.
	Online systems are easy to use
	It will be easy to use mobile technology devices to access cloud-based services.

APPENDIX C: Dependent variables and statements in the questionnaire

Construct	Dependent variables statement in the questionnaire
Cloud Services	People purchase products online
	People to buy items cheaper
	Business to expand their data storage
	Company to expand its services across the globe.
	The disabled people to access their desired products without having to travel to get adequate services.