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ABSTRACT

Organizations in developed economies use the software-as-a-service (SaaS) model to improve performance and efficiency. However, its adoption in developing economies such as Tanzania is very low due to limited research on its adoption. This study enhances the adoption of SaaS in Tanzanian small and medium enterprises (SMEs) by proposing a conceptual framework based on the diffusion of innovation theory and the technology-organization-environment framework and recommending strategies for improving adoption. The framework was tested using regression analysis on data collected from 139 SMEs. Findings show that eight factors, relative advantage, compatibility, awareness, cost, perceived security and privacy risk, reliability and availability, top management support and trading partners' pressure, significantly affect adoption of SaaS by SMEs in Tanzania. The study recommends that cloud service providers address security challenges and software compatibility issues and ensure SaaS systems are available, and SMEs' top management provide support in implementing SaaS solutions to enhance their adoption.

Keywords

Cloud service provider, diffusion of innovation theory, small and medium enterprises, software-as-a-service, technology-organization-environment framework.

INTRODUCTION

Software-as-a-service (SaaS) is a cloud computing service delivery model which enables users to use cloud-based applications which are owned and managed by third party companies (application service providers [ASPs]). The application is not physically installed on computers, rather client side tools such as a web browser are used to access the application (Namasudra, 2018). In SaaS, computing resources are provided by a service provider who takes sole responsibility for owning, servicing, and maintaining the infrastructure, thereby relieving users of the burden of buying and maintaining their own infrastructure. As a result, users are able to focus on their core business activities and are able to perform better (Akande & Van Belle, 2015).

SaaS provides plenty of benefits to small and medium enterprises (SMEs) such as improving efficiency and performance of a firm while reducing operational costs. SMEs refer to non-farming economic activities mainly manufacturing, mining, commerce, and services. There is no universally accepted definition of SMEs. Different countries use various measures of size depending on their level of development. Other commonly used yardsticks are total number of employees, total investment, and sales turnover. In the context of Tanzania, small enterprises are those firms employing between 5 and 49 employees or with a capital investment from Tshs.5 million to Tshs.200 million. Medium enterprises employ between 50 and 99 people or have a capital investment from Tshs.200 million to Tshs.800 million.

SMEs are the most dynamic economic growth force in almost all countries and, as a result, SMEs are performing an important role in economic growth and are considered a backbone of industrial development (Karkonasasi et al., 2016). In sub-Saharan Africa, 90% of all businesses are SME's, contributing significantly to the countries' gross domestic product (Khanda & Doss, 2018). In Tanzania, SMEs provide a significant contribution to economic growth and employment opportunities. According to the Tanzania Chamber of Commerce, Industry and Agriculture, 95% of the businesses in Tanzania are SMEs and they represent about 35% of the country's gross domestic product. Thus SMEs are the driving engine behind economic growth of the country (Pasape, 2018).

Generally, cloud computing technology enables SMEs to become as technologically advanced as their larger counterparts, without significant financial outlays (Attaran & Woods, 2018; Senarathna et al., 2018). Among cloud services, SaaS is the most viable solution for SMEs, as it has a wider array of solutions convenient for SMEs than platform-as-a-service or infrastructure-as-a-service (Attaran & Woods, 2018; Mokwena & Hlebela, 2018). However, its adoption is very low among SMEs in developing economies (AlBar & Hoque, 2019).

RESEARCH MOTIVATION

SMEs face numerous challenges in identification, setting up and making use of information technology (IT) as an enabler for business. Cloud computing could solve this problem by offering ready and low cost of entry IT solutions (Attaran & Woods, 2018; Matias & Hernandez, 2019; Wambugu & Ndiege, 2018). However, its adoption is very low in many organizations in developing economies (Al-Hujran et al., 2018; Yaokumah & Amponsah, 2017). This low rate of adoption is a result of limited research on cloud computing adoption in developing economies (Gamage, 2019; Senyo et al., 2016). Thus, the motive of this study is to address the challenge behind the lack of access to modern IT applications facing many SMEs in Tanzania due to limited resources as SaaS provides state-of-the-art IT solutions which are scalable and flexible at a relatively low operational cost (Ayoobkhan & Asirvatham, 2019). The study focused on the SaaS model because this model has a wider array of solutions which are more convenient for SMEs than other cloud computing services such as platform-as-a-service and infrastructure-as-a-service. "Most SMEs only need to use SaaS tools, unless they have more complex IT requirements, PaaS or IaaS might be used" (Attaran & Woods, 2018, p. 97).

LITERATURE REVIEW

Cloud Computing Technology

Cloud computing is a cutting-edge technology that provides users with computing resources and services from external providers rather than building their own information systems (Kim et al., 2017). Cloud computing addresses two major challenges in the IT sector; achieving IT efficiency through better

utilization of IT resources, and business agility by being able to respond to business changes and fluctuating needs in a timely manner (Wease et al., 2018).

Cloud computing has four deployment models (Simmon, 2018):

- Public cloud, where the cloud infrastructure is owned by a third-party organization and is made available to the general public. It offers cost effective IT solutions and is very suitable for SMEs (Attaran & Woods, 2018).
- Private cloud, where the cloud infrastructure is provisioned for exclusive use by a single organization. It has high costs; however, it offers greater control and security of the infrastructure. Private cloud is more suitable for large firms with several geographically separated data centers (Wease et al., 2018).
- Hybrid cloud where the cloud infrastructure is a composite of public and private cloud. Public cloud is utilized for non-critical information while sensitive information is kept on private cloud (Attaran & Woods, 2018).
- Community cloud, where the cloud infrastructure is utilized by a different number of institutions that have the same core business or shareable concerns such as security requirements, policy and compliance considerations (Diaby & Rad, 2017).

Cloud computing technology has three service delivery models (Namasudra, 2018); infrastructure-as-a-service, in which a cloud service provider (CSP) provides fundamental computing resources such as processing, storage and networks, where cloud service customers can deploy and run arbitrary software including operating systems and applications (Simmon, 2018). Platform-as-a-service is where a CSP provides an environment including operating systems, databases, programming languages, execution environments and web servers for users to create, run and deploy applications (Namasudra, 2018). SaaS is where a licensed version of application software is provided by ASPs. Customers can pay for use of this software on demand. The application is accessible from various client devices through either client software such as a web browser or a thin client interface. Thus, users do not need a physical installation of the application (Attaran & Woods, 2018).

SaaS has many benefits for SMEs which may help a firm in attaining competitive advantages. Key benefits include reduction of operating cost (Kumar & Samalia, 2017), increased scalability (Akande & Van Belle, 2015), reliability of software (Kumar et al., 2017; Priyadarshinee et al., 2017), and a reduction in the time needed to launch a product to market (Kumar & Samalia, 2017; Priyadarshinee et al., 2017). However, SaaS has some risks if due diligence is not well done prior to its adoption (Mokwena & Hlebela, 2018). The risks include security and privacy as customers no longer have control of their data (Alassafi et al., 2017), challenges in integrating SaaS tools with other existing systems (Priyadarshinee et al., 2017), and limited customization options since source codes are proprietary to the CSP.

Theoretical Framework on Information Systems Adoption

There are several theories and models of technology adoption and acceptance used in information systems (IS) research, thus selection of an appropriate theory or model of technology adoption is a critical task for IS adoption research (Tarhini et al., 2015). This study employed two theoretical frameworks; diffusion of innovation theory and the technology-organization-environment framework, to propose a conceptual framework for SaaS adoption by SMEs in Tanzania. These theories have been extensively used in cloud computing adoption research and have produced significant results.

Diffusion of Innovation Theory

Diffusion of innovation theory (DOI) proposed by Rogers (1995) is a theory about technology adoption explaining innovation adoption at the individual level in terms of innovation factors that are divided into five categories (Maqueira-Marín et al., 2017):

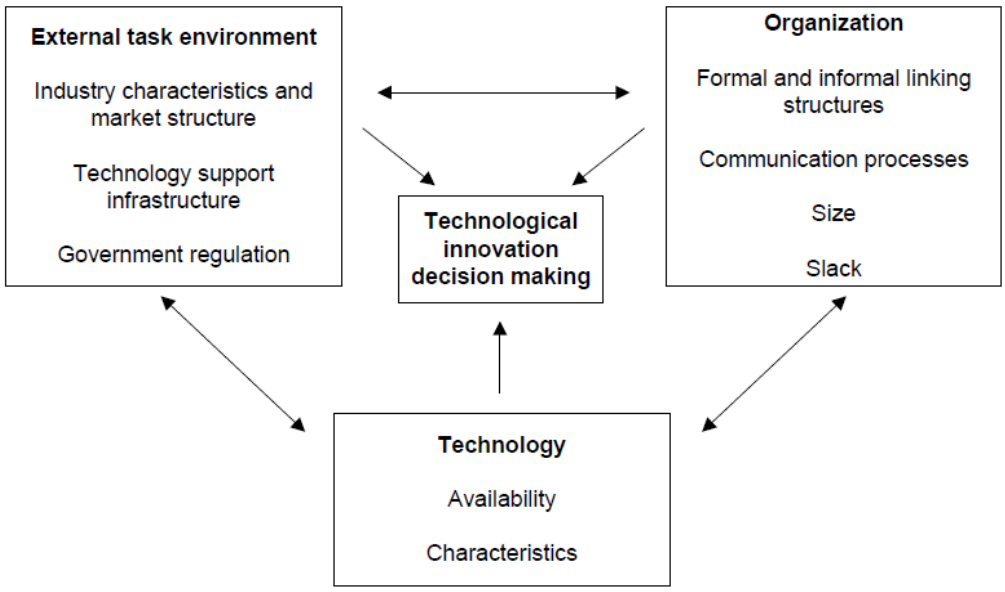
- relative advantage; the degree to which an innovation is perceived as being better than its precursor,
- compatibility; the degree to which an innovation is perceived as being consistent with the existing values and needs of potential adopters,
- complexity; the degree to which an innovation is perceived as relatively difficult to understand and use,
- trialability; a measure of how easy it is to use the innovation in practice, and
- observability; inspecting how the innovation under study has been efficiently used within an organization (Tarhini et al., 2015).

Technology-Organization-Environment Framework

Technology-organization-environment (TOE) framework is an organization-level and multi-perspective framework of technology adoption proposed by DePietro et al. (1990). Based on this framework, the adoption process of a technology innovation is influenced by technological, organizational and environmental dimensions of an organization (Oliveira & Martins, 2011). The technological context describes both internal and external technologies relevant to the firm which includes current practices, equipment internal to the firm as well as the set of available technologies external to the firm. Organizational context refers to descriptive measures about the organization such as scope, size, and managerial structure. The environmental context is the arena in which a firm conducts its business, for example its industry, competitors, and dealings with the government. Figure 1 shows how adoption of technological innovation is influenced by technological, organizational, and environmental factors.

Figure 1

Technology-Organization-Environment Framework



Note. Adapted from DePietro et al. (1990).

CONCEPTUAL FRAMEWORK AND RESEARCH HYPOTHESES

Diffusion of Innovation Context

Relative Advantage

Relative Advantage is the degree to which an innovation is perceived as being better than the idea it superseded (Al-Shboul, 2018). In the context of this study the new innovation is the SaaS model and the predecessor is the on-premises model of acquiring and using software. Cloud-based software has several advantages for SMEs such as payments based on usage, improved scalability, and an easier installation and upgrade process. These features were not possible in the on-premises software thus Relative Advantage is an essential factor in the SaaS adoption decision (Kumar & Samalia, 2017; Stieninger et al., 2018). Therefore, the study hypothesizes that:

H1: Relative Advantage affects adoption of SaaS by SMEs in Tanzania

Compatibility

Compatibility is the extent to which an innovation or new technology is recognized as harmonious with current values, past experience and the requirements of potential adopters (Al-Hujran et al., 2018). Technology is considered compatible if it is easy to deploy and integrate with existing infrastructure and applications with no or just a few technological challenges (Yaokumah & Amponsah, 2017). When organizations realize that technology is compatible with their existing working applications then firms are more likely to adopt it (Pathan et al., 2017). Conversely, innovations considered incompatible with the organizations' values, practices or norms may not be adopted as rapidly as an innovation that is compatible (Jianwen & Wakil, 2019; Mokwena & Hlebela, 2018). Therefore, the study hypothesizes that:

H2: Compatibility issues affects adoption of SaaS by SMEs in Tanzania.

Complexity

Complexity refers to the degree to which an innovation is perceived as relatively difficult to understand and use (Stieninger et al., 2018). The longer it takes to understand or implement an innovation, the more likely this becomes a barrier to adoption of that technology (Mokwena & Hlebela, 2018). According to Ayoobkhan & Asirvatham (2019) a SMEs' prospect to implement SaaS solutions is increased by the decreased complexity of SaaS solutions. Therefore, the study hypothesizes that:

H3: Complexity of SaaS products affects adoption of SaaS by SMEs in Tanzania.

Awareness

In the context of this study, Awareness refers to the extent to which an individual is aware of the availability of cloud-based applications relevant to specific domains of operation and the associated risks and benefits of using the applications (Amron et al., 2019). The individual's awareness and understanding of the innovation and how best the organization can benefit from that innovation is the key to its adoption (Tarhini et al., 2015). Equally, lack of awareness about the benefits of options such as SaaS has demonstrably limited adoption (Senarathna et al., 2018). Therefore, the study hypothesizes that:

H4: Awareness affects adoption of SaaS by SMEs in Tanzania.

Cost

In the context of this study, Cost includes both capital expenditure (CAPEX) and operational expenditure (OPEX). Organizations usually invest huge capital in IT infrastructure where just a few of their resources are utilized. Adoption of a SaaS model helps to reduce capital investment because CSP takes care of the administration and maintenance of the IT infrastructure which decreases the total cost of IT operations (Raut et al., 2017). Cost is an essential aspect for SMEs in adoption of any technological innovation, according to Mokwena and Hlebela (2018). Al-Dwairi et al. (2018) perceived lower total cost of ownership offered by SaaS solutions continues to be the dominant reason why SMEs consider adoption of a SaaS model. Therefore, the study hypothesizes that:

H5: Cost reduction affects adoption of SaaS by SMEs in Tanzania.

Technological Context

Perceived Security and Privacy Risk

In the context of this study, a security risk is the possibility that a threat agent takes advantage of technological vulnerability and the corresponding business environment to cause harm to the information system or data (Gangwar & Date, 2016). SMEs' fear about safety, security and confidentiality of their data is a major concern in cloud computing adoption (Bhuiyan et al., 2019; Khan & Al-Yasiri, 2016; Kumar & Samalia, 2017). According to Karkonasasi et al. (2016), Alanezi (2018), and Mrhaouarh et al. (2018), security and privacy issues are the most critical obstacles for cloud adoption. However, security and privacy of cloud computing is a two-sided sword. Large CSPs can offer strong security mechanisms to the cloud data by deploying the latest technologies (Al-Dwairi et al., 2018). Therefore, the study hypothesizes that:

H6: Perceived Security and Privacy Risk affects adoption of SaaS by SMEs in Tanzania.

Reliability and Availability

Reliability refers to the ability of a system to fulfil its intended function in a proper and expected manner. This involves ensuring a high quality of service to end users with a high transmission rate, minimum rate of errors and fast recovery (Alkhater et al., 2015). The cloud computing services are very reliable as they are available around the clock. The disaster recovery services offered by CSPs are more automated and secured compared to organizational disaster recovery strategies (Raut et al., 2017; Veigas & Heraje, 2019). Reliability and Availability of cloud-based software is an influential factor in an organization's decision to adopt a SaaS model. Therefore, the study hypothesizes that:

H7: Reliability and Availability of SaaS solutions affects adoption of SaaS by SMEs in Tanzania.

Technological Readiness

Technological Readiness of the organization refers to the availability of technological infrastructure and IT human resources necessary for the adoption of a new technology (Bhatti, 2017; Sandu & Gide, 2018). Although the architecture of SaaS shifts responsibility for the maintenance, availability and security procedures from the customer to the CSP, the diversity of SaaS solutions and industry-specific requirements may require continuous monitoring of legal and organizational compliance. Thus, technologically competent human resources are essential to ensure legal and organizational compliance is addressed appropriately when adopting the technology (Oliveira et al., 2019). According to Hassan et al. (2017) organizations which are technologically ready are better positioned for the adoption of cloud computing services. Therefore, the study hypothesizes that:

H8: Technological Readiness affects adoption of SaaS by SMEs in Tanzania.

Organizational Context

Top Management Support

Top management is an executive group that creates the policies and makes decisions within the organization. Its support plays a vital role in determining the successful implementation of cloud computing in the organization (Amron et al., 2019). It is crucial to have top management support for building a positive organizational climate and to provide sufficient resources for adoption of new technological innovations by SMEs (Karkonasasi et al., 2016). According to Kim et al. (2017) top management support is considered to be more important than resources or IT capacity for the adoption of SaaS. Thus, without top management support it is unlikely that the decision to adopt SaaS will be effective (Martins et al., 2016). Therefore, the study hypothesizes that:

H9: Top Management Support affects adoption of SaaS by SMEs in Tanzania.

Industry Type

The industry sector within which organizations operate can have influence on IT adoption because different business needs in different industry sectors may affect the innovation uptake of any technology (Lee, 2019; Senarathna et al., 2018). Cloud computing adoption differs from industry to industry mainly because of dissimilar levels of security and IT capability in the industry (Tripathi, 2019). Therefore, the study hypothesizes that:

H10: The Industry Type within which a firm operates affects adoption of SaaS by SMEs in Tanzania.

Environmental Context

Internet Infrastructure

Reliable internet connectivity, its speed and availability is the most crucial requirement for utilization of cloud computing services (Kumar & Samalia, 2017). According to Sabi et al. (2016), good telecommunication networks and high speed internet networks play a vital role in the process of innovation diffusion especially if such innovation depends on those infrastructures for its operation. Since SaaS primarily relies on the internet in its operation as the backend systems are accessed remotely from cloud servers, the quality of internet infrastructure is key in its adoption. Therefore, the study hypothesizes that:

H11: Internet Infrastructure affects adoption of SaaS by SMEs in Tanzania.

Competitive Pressure

In this study, Competitive Pressure refers to the intensity of competition among firms in an industry. It can precipitate adoption of a technology as firms will strive to gain competitive advantage through adoption of an innovation (Alkhater et al., 2015; Senyo et al., 2016). Competitive Pressure can influence firms to adopt cloud computing. SMEs and large companies can compete significantly with their competitors in the market place by adopting cutting edge technologies (Karkonasasi et al., 2016). According to Safari et al., (2015) in competitive environments, companies are highly dependent on modern IT technologies such as SaaS to stay competitive. Therefore, the study hypothesizes that:

H12: Competitive Pressure affects adoption of SaaS by SMEs in Tanzania.

Trading Partners' Pressure

Trade partners are individuals or organizations whom a firm conducts business with. Since most firms rely on inputs and collaboration from partners to satisfy their customers, pressure from these partners can influence a firm to adopt an innovation in order to maintain their working relationship (Senyo et al., 2016). According to Al-Jabri and Alabdulhadi (2016), business partners should adopt comparable and compatible technologies in order to facilitate data sharing and interchangeability. Thus, if one business partner adopts a SaaS solution it is likely that other business partners will adopt the compatible SaaS solution. Therefore, the study hypothesizes that:

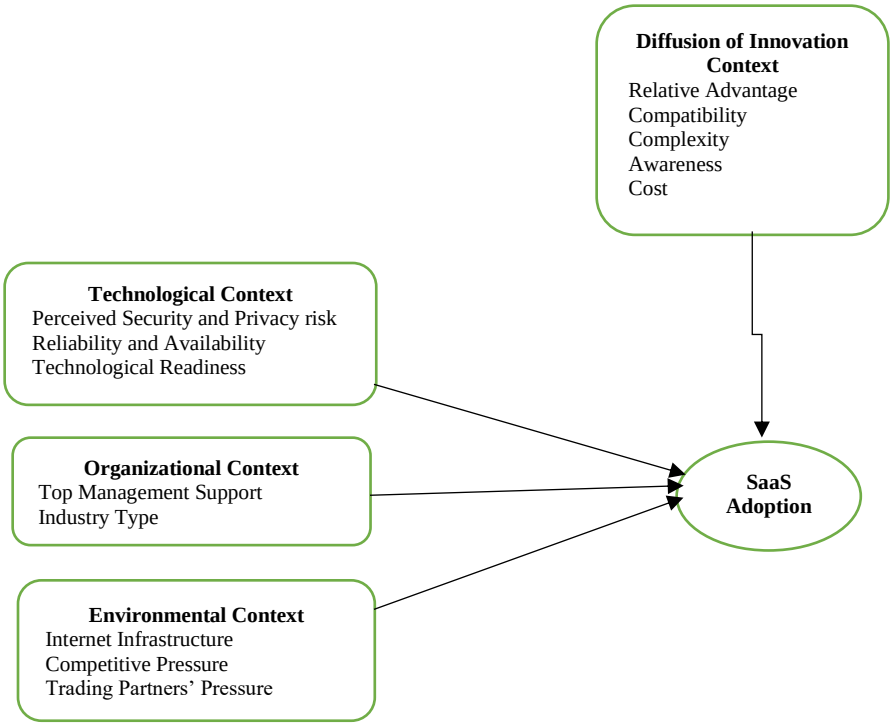
H13: Trading Partner' Pressure affects adoption of SaaS by SMEs in Tanzania.

Proposed Conceptual Framework for SaaS Adoption by SMEs in Tanzania

Figure 2 depicts the proposed conceptual framework for adoption of SaaS by SMEs in Tanzania based on factors affecting the adoption described in this paper.

Figure 2

Conceptual Framework for SaaS Adoption by SMEs in Tanzania



Note. SaaS = software-as-a-service; SMEs = small and medium enterprises

METHODOLOGY

This study adopted a mixed approach where quantitative data were collected and analyzed before collecting qualitative data. The qualitative data were used to provide insights about quantitative results. The study was conducted in the Dar es Salaam region. In obtaining sampling elements the study used a non-probability sampling technique called judgmental sampling or purposive sampling method. The sample size was obtained through the use of a sample size estimation table computed by Israel (1992) with a precision level of ± 10 percent at 95% confidence level. Thus, the recommended minimum sample size for this study was 100 SMEs, since the SMEs sector in Tanzania is estimated to consist of more than three million enterprises. However, to ensure reliability of the data this research collected data from 139 SMEs.

The study used a structured questionnaire self-administered to executive managers and information and communication technology managers of selected SMEs, as they are persons who can make IT strategic decisions for their firms. The questions in the questionnaire were adapted from Martins et al. (2016) and Oliveira et al. (2019) to capture the information from each construct in the proposed conceptual framework for SaaS adoption by SMEs in Tanzania. The questionnaire was distributed in both online and physical form. The online version was created in the open-source tool Google Forms and it was distributed via e-mail to the respondents. A five-point Likert scale ranging from strongly disagree (1) to strongly agree (5) was used to measure the respondents' opinion on factors affecting the adoption of SaaS by SMEs in Tanzania.

In this study, quantitative data analysis was done by using a statistical package STATA (Version 15.1) while thematic analysis was used as a qualitative method to analyze data collected through interviews.

FINDINGS

Characteristics of Surveyed Firms

Among the SMEs that participated in the study, 25.9% were technology firms, 40.3% were commercial firms, 23.7% were firms involved in the service sector and 10.1% were firms from other sectors. This study involved small and medium enterprises. As per invested capital expenditure, 59.7% of the firms that participated in this research were small enterprises and 40.3% were medium enterprises. Furthermore, the study found that only 31.65% of SMEs in Tanzania use SaaS solutions in their business operations. Interviews revealed that financial and accounting (record keeping) tools and backup and recovery are the most used SaaS tools by SMEs in Tanzania.

Testing Reliability of Data Collection Tool

A reliability test is a measure of the internal consistency of the test items or scale. Internal consistency describes the extent to which all the items in a test measure the same concept or construct (Tavakol & Dennick, 2011). This study used Cronbach's alpha coefficients to test for reliability of items in the constructs of the conceptual framework. Cronbach's alpha coefficient values normally range between 0 and 1; the closer the coefficient is to 1.0 the greater the internal consistency of the items in the scale (Gliem & Gliem, 2003). Nunnally (1978) proposed a rule of thumb that Cronbach's alpha coefficient value greater than or equal to 0.7 indicate good reliability. The Cronbach's alpha coefficient values for the constructs ranged from 0.7275 to 0.9469 as shown in Table 1. This indicates internal consistency of the items in the constructs and thus the data collection tool was reliable.

Table 1

Cronbach's Alpha Coefficients Values

Factor	Cronbach's alpha value
Relative Advantage	0.8340
Compatibility	0.7275
Complexity	0.7599
Awareness	0.7432
Cost	0.7811
Perceived Security and Privacy risk	0.8649
Reliability and Availability	0.7595
Technological Readiness	0.9184
Top Management Support	0.7722
Industry Type	0.8994
Internet Infrastructure	0.9469
Competitive Pressure	0.8323
Trading Partners' Pressure	0.7363
SaaS Adoption	0.7520

Note. SaaS = software-as-a-service

Test of Sample Adequacy and Bartlett's Test of Sphericity

Prior to performing factor analysis, the study investigated the input data to find its suitability for such a method through tests such as Kaiser-Meyer-Olkin (KMO) and Bartlett's test of sphericity. KMO is a measure of sampling adequacy with values varying between 0 and 1. Values closer to 1 are better and the value of 0.6 is the suggested minimum (Ul Hadia et al., 2016). From the collected data, the study calculated a KMO value of 0.853 which is above the threshold. Therefore, the sample was adequate and factor analysis can be performed with the data.

Bartlett's test of sphericity tests the null hypothesis that the correlation matrix is an identity matrix, indicating that variables are unrelated and therefore unsuitable for factor analysis (Ul Hadia et al., 2016). Small *p*-values, less than the chosen significance level (α) rejects the null hypothesis, hence indicating that factor analysis may be useful with the data (Hair et.al, 2014). This study assumed a 95% confidence level, thus $\alpha = 0.05$. The results of Bartlett's test of sphericity yielded $p = .000$ which is less than α (0.05). Therefore, it was reasonable to perform factor analysis.

Factor Analysis

Factor analysis is a statistical method for investigating whether observed variables are linearly related to the latent variables called factors (Didas, 2019). In factor analysis, factor loadings are computed which measure correlation of the variables with a factor (Kline, 1994). According to Hair et al. (2014) an estimated factor loading of 0.50 or greater indicates a variable is practically significant. The study employed exploratory factor analysis using the principal component analysis (PCA) extraction method with varimax rotation, in order to gain insights of the relationships between latent variables and measured variables. The variables produced loadings between 0.374 and 0.954, as shown in Table 2. However, out of 47 variables from the questionnaire, three variables (SP4, TB1 and PC3) had factor loadings of less than 0.50. These were considered insignificant and hence were not used in further analysis.

Table 2

Factor Loadings

VR	RA	CP	CX	AW	CT	SP	AR	TR	TM	TB	IF	PC	TP	SA
RA1	0.615													
RA2	0.584													
RA3	0.522													
RA4	0.577													
CP1		0.563												
CP2		0.592												
CP3		0.585												
CP4		0.552												
CX1			0.586											
CX2			0.623											
CX3			0.517											
AW1				0.673										
AW2				0.708										

VR	RA	CP	CX	AW	CT	SP	AR	TR	TM	TB	IF	PC	TP	SA
AW3				0.954										
CT1					0.781									
CT2					0.559									
CT3					0.676									
SP1						0.594								
SP2						0.511								
SP3						0.507								
SP4						0.430								
AR1							0.630							
AR2							0.598							
AR3							0.501							
TR1								0.601						
TR2								0.613						
TR3								0.511						
TM1									0.571					
TM2									0.586					
TM3									0.573					
TB1										0.374				
TB2										0.518				
TB3										0.593				
TB4										0.685				
IF1											0.578			
IF2											0.587			
IF3											0.565			
PC1												0.667		
PC2												0.547		
PC3												0.405		
PC4												0.507		
TP1													0.521	
TP2													0.693	
TP3													0.687	
SA1														0.632
SA2														0.755
SA3														0.505

Note. Factor variance and eigenvalues have not been presented in the table. VR = variable; RA = relative advantage; CP = compatibility; CX = complexity; AW = awareness; CT = cost; SP = security and privacy risk; AR = availability and reliability; TR = technological readiness; TM = top management support; TB = industry type; IF = internet infrastructure; PC = competitive pressure; TP = trading partners pressure; SA = software-as-a-service adoption

Regression Analysis

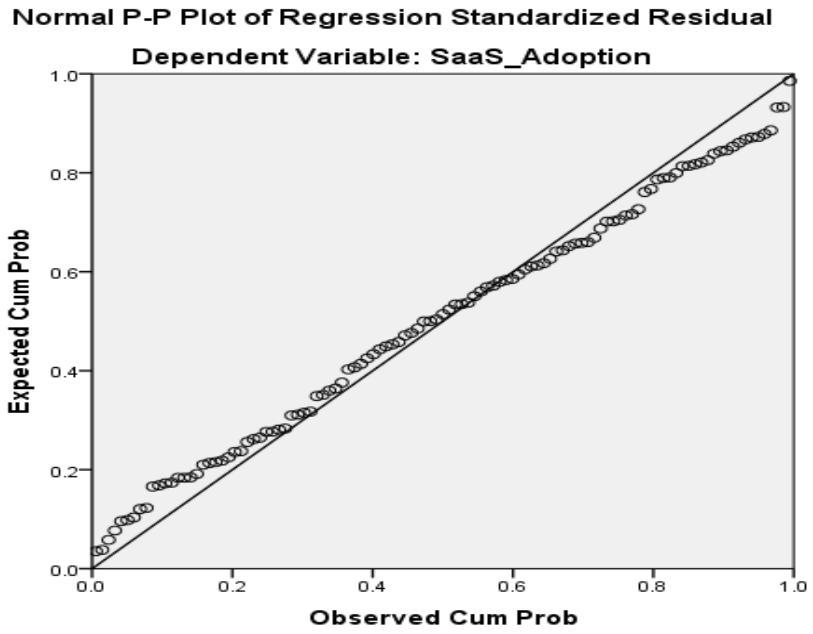
Regression analysis is a statistical technique for modeling the relationship between a dependent variable and one or more independent variables (Yan & Su, 2009). This study used multiple linear regression analysis to evaluate factors in the proposed conceptual framework for SaaS adoption by SMEs in Tanzania. Multiple linear regression model is a regression model with one dependent variable and more than one independent variables (Uyanık & Güler, 2013). The regression analysis process involved a series of tests as described hereunder.

Testing Normality of Data

Prior to regression analysis computations, it is conventional to test for the normality of the data since the entire regression analysis is based on a normality assumption (Schmidt & Finan, 2018). This study used a *p-p* plot (probability-probability plot) to check for normality of the data because, in *p-p* plot outliers are easily visible (Rani & Imon, 2016). The *p-p* plot is a graphical illustration of the distribution of the observed data compared to cumulative percentiles expected from a normal distribution. The plots follow a diagonal line if the data distribution is close to normal (Hélio, 2017). The *p-p* plots for the data was trailing the diagonal line as shown in Figure 3, indicating that the observed data were normally distributed and hence eligible for regression analysis.

Figure 3

Normality Diagnostic (P-P Plot)



Note. SaaS = software-as-a-service

Checking for Collinearity

Collinearity refers to linear relationships between two or more independent variables in a multiple regression model. The presence of collinearities is the most confusing aspect of linear regression

especially when predictors are highly correlated, because collinearity masks the true relationship of the predictor variables with the dependent variable (Lavery et al., 2019; Salmerón Gómez et al., 2016). This study used variance inflation factors (VIFs) to detect the presence of collinearities. VIF associated with a predictor variable is the variance of the estimated coefficient for that predictor divided by the variance if the predictors were orthogonal (Akinwande et al., 2015). According to Marcoulides and Raykov (2019) common rule-of-thumb suggests that a predictor, Xj with VIFj > 10 indicates the presence of serious collinearity whereas VIFj > 5 indicates the presence of considerable collinearity. The VIFs for the independent variables were between 1.18 and 3.66 as shown in Table 3, indicating no collinearities among predictors and hence no correlation among independent variables.

Table 3

Collinearity Diagnosis

VR	VIF	Tolerance
RA	2.13	0.4695
CP	1.61	0.6211
CX	1.48	0.6757
AW	1.58	0.6329
CT	1.18	0.8475
SP	1.42	0.7042
AR	1.92	0.5208
TR	1.44	0.6944
TM	3.66	0.2732
TB	1.75	0.5714
IF	1.31	0.7634
PC	1.79	0.5587
TP	3.54	0.2825

Note. RA = relative advantage ; CP = compatibility; VIF = variance inflation factor; CX = complexity; AW = awareness; CT = cost; SP = security and privacy risk; AR = availability and reliability; TR = technological readiness; TM = top management support; TB = industry type; IF = internet infrastructure; PC = competitive pressure; TP = trading partners pressure

Determining the Adjusted R-Squared Value

Miles (2014) described R^2 and adjusted R^2 in linear models as representing the proportion of variance in the outcome variable which is explained by the predictor variables in the sample (R^2) and an estimate in the population (adjusted R^2). The R^2 value is measured from 0 to 1 and is commonly presented as percentages from 0 percent to 100 percent. There is no specific value considered as a minimum acceptable R^2 value as it depends on the application of the results. However, higher values are better (Ricci, 2010). The regression model had R^2 value of 0.4099 and adjusted R^2 value of 0.3485, indicating that the proposed conceptual framework can explain adoption of SaaS by SMEs in Tanzania by 34.85%.

Hypotheses Testing

The summary of the coefficients and *p*-values in the regression model are presented in Table 4. Coefficients describe the mathematical relationship between each independent variable and the dependent variable, while *p*-values for the coefficients indicate whether these relationships are statistically significant or not. It further indicates something about "how significant" the result is. The smaller the *p*-value, the stronger the evidence against the null hypothesis (Wright, 1992). The general rule of thumb is if the adjusted *p*-value for an individual hypothesis is less than the chosen significance level (α), then the hypothesis is rejected (Hair et al., 2014). This study assumed a 95% confidence level, thus α = 0.05. This implies that factors with hypotheses having *p*-values of less than 0.05 are considered significant.

Table 4

Research Model Summary

				95% CI	
Variable (VR)	Coeff	*SE*	*p*	*LL*	*UL*
Relative Advantage	0.360	0.801	0.000	-0.518	-0.201
Compatibility	-0.504	0.081	0.000	-0.664	-0.343
Complexity	0.010	0.082	0.907	-0.153	0.172
Awareness	0.182	0.087	0.039	0.009	0.354
Cost	0.375	0.820	0.000	0.213	0.537
Perceived Security and Privacy Risk	-0.183	0.079	0.023	-0.340	-0.026
Reliability and Availability	0.251	0.721	0.042	-0.049	0.294
Technological Readiness	-0.075	0.085	0.378	-0.242	0.092
Top Management Support	0.240	0.075	0.002	0.091	0.389
Industry Type	0.015	0.800	0.852	-0.143	0.173
Internet Infrastructure	0.177	0.085	0.139	-0.008	0.345
Competitive Pressure	-0.106	0.083	0.202	-0.270	0.058
Trade Partners' Pressure	0.263	0.774	0.001	0.110	0.416
Constant	3.160	0.744	0.000	1.682	4.638

Note. CI = confidence interval; *LL* = lower limit; *UL* = upper limit

DISCUSSION

This study aimed to propose a conceptual framework for SaaS adoption by SMEs in Tanzania and recommend strategies for enhancing its adoption among Tanzanian SMEs. In achieving that objective, the study investigated determinants of SaaS adoption by SMEs. The identified determinants were used as constructs in the proposed conceptual framework.

Upon rigorous statistical analysis, the study revealed that out of thirteen determinants in adoption of SaaS by SMEs identified from literature, eight determinants are practically significant in the decision to adopt a SaaS model by SMEs in Tanzania; Cost reduction (β = 0.375, *p* = .000), Top Management Support (β = 0.240, *p* = .002), Awareness in SaaS model (β = 0.182, *p* = .039), Relative Advantage attained with SaaS solutions (β = 0.360, *p* = .000), Perceived Security and Privacy Risk of the SaaS model (β = -0.183, *p* = .023), Reliability and Availability of SaaS tools (β = 0.251, p = .042),

Compatibility challenges of the SaaS model (β = -0.504, *p* = .000) and Trade Partners' Pressure from the firm's trading partners (β = 0.263, *p* = .001).

The study has revealed that cost reduction is the most significant determinant for adoption of SaaS by SMEs in Tanzania which is similar to the study of Mokwena and Hlebela (2018). SMEs in Tanzania are characterized by low capital investment and are thus conscious of heavy spending in IT resources such as development and maintenance of on-premises software. The SaaS model offers a relatively low-cost solution as it shifts the development, maintenance, and infrastructure costs from users to the CSP. Reduction in the CAPEX and OPEX for IT infrastructure is the highest driver for cloud adoption. This finding correlates with interview comments as given by executive managers of some firms:

> We are saving significant amount of money by using cloud-based software, imagine for a tiny software like Human Resource Management System, without SaaS products we had to pay an IT firm to develop the HR application for us again to pay for update or maintenance costs.
>
> We are using cloud-based sales application from a certain local firm to manage sales and stock. We are really paying very small amount to use the software.

Therefore, it is recommended that CSPs should offer low-cost solutions in order to improve adoption of SaaS by SMEs in Tanzania.

On the other hand, compatibility issues, and perceived security and privacy risk have been identified as significantly affecting adoption of the SaaS model by SMEs in a negative manner. Compatibility is caused by difficulty in integrating the SaaS products to existing systems or norms of a firm since the SaaS tools are built to suit general public or industry demands. The study of (Usman et al., 2019) has also found compatibility issues significantly affect the adoption of cloud computing services.

Perceived security and privacy risk prevails when SMEs' fear that their sensitive data such as customers' information may be accessed by the CSP or any third party. Security and privacy is a major concern for many firms in their decision to adopt cloud computing (Alismaili et al., 2020; Narwane et al., 2019). Thus, the study recommends that CSPs consider software compatibility and security issues in order to enhance the adoption of SaaS model by Tanzanian SMEs.

In this study, top management support has been identified as a significant determinant for adoption of a SaaS model, which is similar to other studies in developing economies such as Al-Shboul (2018) and Kumar et al. (2017). Unlike large firms which are composed of several departments, some of which can be autonomous, SMEs in Tanzania have a simple management structure. Thus, top management primarily provides the firm's strategic decisions, such as adoption of any technological innovation. Therefore, SMEs' top management should actively participate in the adoption of the SaaS model in order to enhance adoption in their firms.

In general, the study acknowledges that determinants for cloud computing adoption vary in different developing economies; determinants are influenced by geographical and industrial factors (Maqueira-Marín et al., 2017).

LIMITATIONS OF THE STUDY

Despite the contribution of this research, the study had some limitations as described hereunder.

Internal validity; this study assumed a 95% confidence level, thus a significance level, α = 0.05. This means only factors having hypotheses with *p*-values less than 0.05 are considered significant in the adoption of SaaS by SMEs in Tanzania.

External validity; the study used a non-probability sampling technique (judgmental sampling) which does not follow the theory of probability in the choice of respondents from the sampling population, but rather relied on the researchers' knowledge as to who could provide accurate information to fulfill the objectives of the study. The non-probability sampling techniques may be biased if consideration of selecting elements from the sampling population has not been done carefully.

Construct validity; this study used two theoretical frameworks (DOI and TOE) in determining factors affecting adoption of SaaS by SMEs, which means factors from other theoretical frameworks have not been explored.

Conclusion validity; the study characterized SMEs as defined in the current SMEs policy of Tanzania. If this policy changes significantly the applicability of the results may not be generalized.

FUTURE WORKS

We suggest the following areas for future works:

- consider the use of a probability (random) sampling design where all SMEs in Tanzania will have an equal and independent chance of being selected in the sample,
- consider the use of other theoretical frameworks of technology adoption apart from DOI theory and TOE framework to enrich the body of knowledge about adoption of SaaS in Tanzania,
- consider narrowing the scope by investigating either small enterprises or medium enterprises independently in order to have more compact results, since these two categories may differ slightly in business operations, and
- a cross-sectional study is suggested as determinants of technology adoption may change over time. Therefore, this study should be repeated within a reasonable future timeframe.

CONCLUSION

This work investigated determinants of SaaS adoption by SMEs in Tanzania and provided recommendations that would enhance its adoption among SMEs in the country. Adoption of cloud-based software can improve business performance, productivity, and efficiency at a relatively low operational cost. The study provides insights about factors affecting adoption of SaaS by SMEs and proposes a conceptual framework for SaaS adoption by SMEs in Tanzania based on DOI Theory and TOE framework. Therefore, SMEs and ASPs can utilize this work as a guide in the adoption of SaaS products by the firms. Furthermore, this study will help ASPs to develop SaaS products more relevant to Tanzanian SMEs.

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