Contents lists available at Science-Gate

International Journal of Advanced and Applied Sciences

Journal homepage: http://www.science-gate.com/IJAAS.html

Analyzing the factors influencing the adoption of cloud computing by SMEs using the SEM approach

Abdifatah Farah Ali [1, *], Abdikarim Abi Hassan [2], Husein Osman Abdullahi [1], Rusli Haji Abdulah [3]

[1]*Faculty of Computing, SIMAD University, Mogadishu, Somalia*
[2]*Faculty of Engineering, SIMAD University, Mogadishu, Somalia*
[3]*Department of Software Engineering and Information System, University Putra Malaysia, Selangor, Malaysia*

A R T I C L E I N F O

Article history:
Received 3 December 2022
Received in revised form
1 May 2023
Accepted 16 May 2023

Keywords:
Cloud computing
Technology adoption
TOE framework
SMEs

A B S T R A C T

Cloud computing (CC) represents a third-generation computing platform that offers numerous benefits, including faster data transactions, cost advantages, elasticity, flexibility, and pay-per-use models, among others. However, CC adoption in developing nations, such as Somalia, is impeded by various challenges. This study aims to investigate the factors influencing CC adoption in small to medium-sized enterprises (SMEs) in Somalia. Data was collected from 195 ICT officials and experts in the SME domain in Mogadishu, Somalia, and analyzed using structural equation modeling (SEM). The results revealed that cost savings, firm size, top management support, and regulatory support significantly influence CC adoption in SMEs. Conversely, security concerns and competitive pressure showed no significant relationship with CC adoption. This study contributes to the literature by examining the technology, organization, and environment (TOE) framework in the context of CC adoption and provides valuable insights to inform policymaking and promote CC adoption in developing nations. Nonetheless, the study's limitation lies in its narrow focus on Somalia, and the generalizability of the results to other developing nations may be limited.

1. Introduction

As a result of rapid economic growth, organizations are compelled to respond promptly to market changes in order to effectively explore new IT opportunities and innovations. This necessitates an agile approach to adapt swiftly to evolving market conditions and embrace technological advancements that can provide competitive advantages in the dynamic business landscape (Lee et al., 2015; Liu et al., 2018; Willcocks and Lacity, 2018). However, traditional information technology (IT) architecture may delay a business because of its high cost in terms of technological infrastructure (Chae et al., 2018; Lowry et al., 2016; Lu and Ramamurthy, 2011). Therefore, in order to maintain competitiveness in today's rapidly changing settings, small businesses must reduce the complexity of their business and IT operations. This constraint has been brought about by the rise of cloud computing (CC) in small businesses (Battleson et al., 2016; Kranz et al., 2016; Luo et al., 2018; Marston et al., 2011; Petter et al., 2012; Zissis and Lekkas, 2012). Note that CC is among the intense topic or innovations in the information system (IS) field in the modern year. It defines an IT service in which software, hardware, shared resources, information, and other devices are delivered on demand to customers than a product (Ali et al., 2017; Wang et al., 2016; Armbrust et al., 2010). Accordingly, CC lowers maintenance costs and investment costs associated with IT infrastructure (Khorshed et al., 2012), allowing businesses to maintain and innovate their place in the global market (Mourtzis and Vlachou, 2016). In comparison to traditional IT, CC has five key features that make it possible to create cost-efficient and flexible IT solutions: Broad network access, on-demand self-service, rapid elasticity, resource pooling, as well as measured services (Buyya et al., 2010; Chen and Wu, 2013; Liu et al., 2016; Son et al., 2014). These solutions will permit businesses to minimize the cost of maintaining and managing IT systems as well as improve operational along with communications more quickly than the traditional methods (Attaran and Woods, 2019; Iyer and Henderson, 2010; Sultan, 2011; Marston et al.,

* Corresponding Author.
Email Address: fitaaxfarah@simad.edu.so (A. F. Ali)
https://doi.org/10.21833/ijaas.2023.07.009
Corresponding author's ORCID profile:
https://orcid.org/0000-0003-4388-606X

2011). Nevertheless, despite the predicted advantages, the rate of CC adoption and utilization inside small and medium enterprises (SMEs) remains significantly high (Kasemsap, 2015, Lin and Chen, 2012). According to a report by EIU (2015), the highest adoption rate of CC is in the retail industry at 57%, while the healthcare sector has been recorded with a 31% adoption rate, as shown in Fig. 1. Nearly 96% over 997 respondents now use CC, while public cloud adoption enhanced to 92% from 89% in 2017 while private cloud adoption enhanced to 75% from 72% in 2017 (Gans et al., 2023).

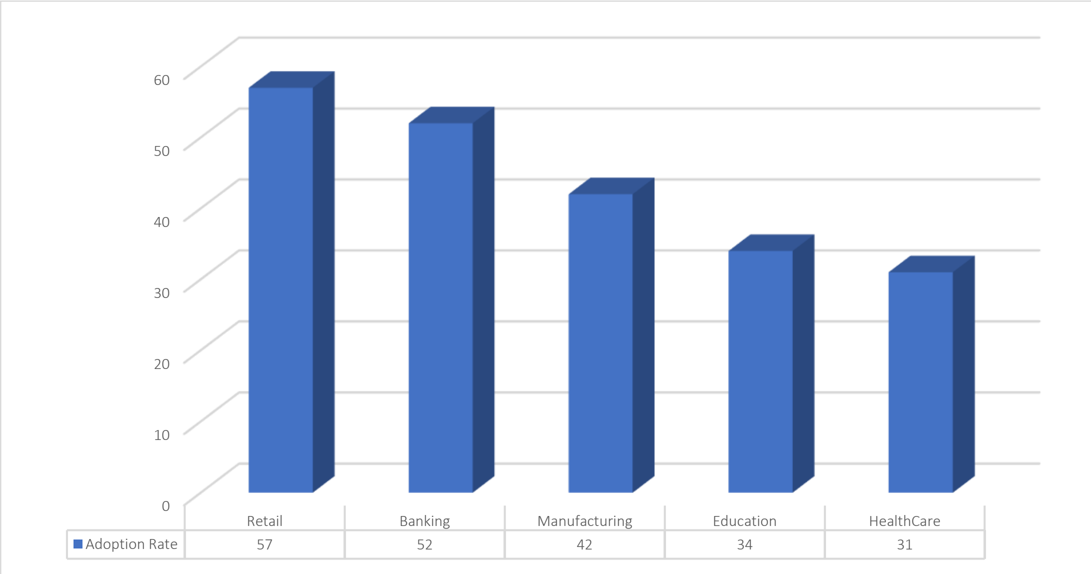

Fig. 1: The current adoption of cloud computing in different five sectors (EIU, 2015)

Research about CC in SMEs is still at an early stage of progress, even though there have been several investigations regarding CC adoption in SMEs, for example, Gangwar et al. (2015), Gupta et al. (2013), and Vidhyalakshmi and Kumar (2016). Regrettably, they frequently overlook explaining the CC adoption in SMEs with pertinent statistical backing or simply offer qualitative descriptions and explanations. In particular, current research cannot answer the questions, "How can SMEs be adopted on CC?" and "Can small businesses actually use CC?" Investigating the variables influencing CC adoption in SMEs is the goal of this investigation, which will also present the literature on organizational CC adoption. In order to incorporate other viewpoints into this analysis, the present research also makes use of a TOE (technology, organization, and environment) framework (Tornatzky et al., 1990). The remaining sections of this article examine each component of this investigation in turn: The theoretical foundations, the research model, the research methodology applied to assess this model, the findings of the hypothesis testing, the implications, the contributions, and the limits.

2. Literature review

2.1. Cloud computing definitions

Cloud computing (CC) is not a brand-new concept. John McCarthy reportedly had the idea that computing resources would be made available to the public community as a utility in the 1960s (Parkhill, 1966). In the 1990s, the keyword cloud was utilized in numerous contexts, including large ATM networks. A study on global management consulting firms by McKinsey discovered that there are 22 viable CC definitions. In reality, it appears that CC has no essence (Grossman, 2009; Voas and Zhang, 2009). Nevertheless, the most frequent definition depicts it as a distributed computer cluster (most often big data centers as well as server farms) that offer services and resources on request via a networked medium (usually the internet). Illustrations in IT textbooks that referred to remote settings like the internet as "cloud images" served as the basis for the word "cloud" (Sultan, 2011; Zhang et al., 2010). The National Institute of Standards and Technology (NIST) has worked to standardize the CC definition, which is described as "a system for providing quick, on-demand network access to a pool of shared, programmable computing resources" (Mell and Grance, 2011). These resources include servers, networks, applications, storage, as well as services, all of which may be immediately provisioned and released with basic service provider interaction or management work. It is a concept that gives users on-demand access with respect to a shared pool of computing resources, including both hardware and software, across a network (Lu et al., 2014). Researchers have paid a lot of attention to CC since it has been shown to (I) foster relationships between organizations (Demirkan and Delen, 2013), (II) promote customer collaboration (Sultan, 2011), (III) develop the capacity to react to environmental changes (Iyer and Henderson, 2010), as well as (IV) generate value for businesses (Liu et al., 2016). The cloud service provider (CSP), as well as the cloud service consumer (CSC), are the primary players in the CC context, as per the NIST definition, even though service brokers may also be engaged (Hogan et al., 2011).

Broad network access, resource pooling, on-demand self-service, rapid elasticity, as well as measurable service are the five fundamental aspects of CC that set it apart from other traditional computing systems (Petter et al., 2012). Infrastructure as a service (IaaS), platform as a service (PaaS), as well as software as a service (SaaS), is three separate service model types that may be differentiated in CC (Ryan and Loeffler, 2010). PaaS entails offering the necessary platform-layer resources, for instance, operating system support, hardware, databases, software development, web servers, middleware, as well as other software for application development and deployment. The most well-known vendors are Microsoft Azure, Amazon Web services, Force.com, as well as Google's App Engine. IaaS pertains to on-demand infrastructural resource provisioning, typically in regard to VMs. It is capable of sharing a full IT infrastructure, including virtual computers, servers, storage devices, etc., via remote delivery or the internet and data that can be used as a service. The most known vendors are Amazon EC2, Windows Azure SQL, Joyent, and GoGrid's Cloud servers. SaaS provides a complete application functionality from productivity applications such as on-demand software over the internet, for instance, word processing, spreadsheet, and others, to programs like Enterprise Resource Management (ERM) or customer relationship management (CRM). The most known vendors are Yahoo Mail, Google Apps, Microsoft Office Live, and WebEx (O'Driscoll et al., 2013). The following four deployment models can be utilized to implement these types of service models: (1) Private cloud, in which infrastructure is only available to be utilized by a single organization and ought to be owned, managed, as well as operated by the organization; (2) Community cloud, in which infrastructure is only available to be utilized by a particular community to exchange key resources, and may be owned, managed, as well as operated by one or more organizations in the community; (3) Public cloud, in which infrastructure is available to all organizations, and ought to be owned, managed, and operated by all organizations; as well as (4) Hybrid cloud, in which it integrates two or more different types of cloud infrastructure (Petter et al., 2012; Ryan and Loeffler, 2010).

2.2. Related literature on cloud computing adoption

Cloud computing (CC) adoptions have been investigated from two different perspectives, which are developing and developed countries. Several investigations have been published examining CC adoption from the developed country's point of view (Gupta et al., 2013; Sultan, 2014). Similar research has been carried out on CC adoption among SMEs in North-East England using the TOE theory by Alshamaila et al. (2013). The result indicated the determinant of CC adoption like geo-restriction, firm size, uncertainty, compatibility, relative advantage, trialability, innovativeness, market scope, supplier effort, top management support, industry, external computing support, competitive pressure, and prior experience to be an irrelevant determinant of CC. These results are instructive. Nevertheless, SMEs may pursue distinct adoption decisions than big organizations. Furthermore, the adoption of CC may vary from that of developing nations from the viewpoint of wealthy ones. Consequently, it is necessary to assess the determinants that impact CC adoption by various organizations from the viewpoint of developing nations. Although some progress has been made, further research is needed on the adoption of CC in developing nations.

Recent investigations have demonstrated the adoption of CC with respect to the point of view of developing countries (Low et al., 2011, Makena, 2013; Senyo et al., 2016; Sharma et al., 2016). For example, Sharma et al. (2016) investigated the CC adoption service by information technology professionals. They propose an innovative model by broadening the Technology Acceptance Model (TAM), having three external constructs: Job trust, opportunity, as well as self-efficacy. The result indicated that job opportunity, trust, self-efficacy, perceived ease of use (PEU), and perceived usefulness (PU) are the top indicators of CC adoption. By integrating TOE theory with HOT-fit frameworks, Lian et al. (2014) delved into the determinants that impact the choice to deploy CC in Taiwanese hospitals. The findings indicated that significant adoption factors included cost, data security, complexity, top management support, as well as perceived technical competence. Numerous research and reviews have been performed to investigate the variables that affect CC adoption from an organizational, individual, or even national viewpoint, but their conclusions are only applicable to industrialized nations (Cegielski et al., 2012; Park and Ryoo, 2013; Wu et al., 2011). These constraints in the literature highlight more studies in the CC adoption context in developing nations. Specifically looking at Africa, several investigations have been conducted on CC adoptions. For example, Sabi et al. (2018) studied the variables that affect CC adoption at universities located in sub-Saharan Africa. The outcomes indicated that factors such as result demonstrability, socio-cultural, usefulness, as well as data security substantially affect CC adoption in the universities. In this subject, significant studies are needed to acknowledge readiness determinants rather than emphasizing the factors of CC adoption. Utilizing the TOE theory, Makena (2013) investigated the variables influencing SMEs' adoption of CC in Kenya. The findings showed that cloud technology adoption had been impacted by environmental, organizational, and technological variables as shown in Table 1.

Table 1: Adoption of cloud computing studies published in journals

Cloud adoption (Depend variable)	Adoption theory	Factors or constructs (Independent variable)	Method	Data and context	Reference
Cloud computing	TOE	-Technology (Relative advantage, complexity, compatibility) -Organization (Top Management support, Firm size, technology readiness) -Environment (competitive pressure, trading partner pressure)	Conceptual paper	Conceptual paper	(Abdollahzadegan et al., 2013)
Cloud computing	TOE	-Technology (Relative advantage, Uncertainty, complexity, compatibility, Trialability) -Organization (Size, Top Management support, Innovativeness, Prior IT experience) -Environment (competitive pressure, Industry, Market Scope, supplier efforts, and external computing support)	Semi-structured interviews	15 different SMEs and service providers in northeast England.	(Alshamaila et al., 2013)
Cloud computing	TOE	-Technology (technology readiness) -Organization (Top Management support, Firm size) -Environment (competitive pressure, regularity support), -Innovation characteristic (Relative advantage, complexity, compatibility, Security concern, and cost-saving).	Structural Equation Model using SmarPLS	Online Questionnaire of 369 responses in Portugal.	(Oliveira et al., 2014)
Cloud computing	DOI and TOE	Relative advantage, cost, complexity, compatibility, security and privacy, Trialability, competitive pressure, external support, decision maker's innovativeness, decision maker's cloud knowledge, Employee's cloud knowledge, and information intensity.	Factor Analysis (FA), Logistic regression.	Survey of 101 SMEs'	(Tehrani and Shirazi, 2014)
Cloud computing	DOI	Relative advantage, complexity, compatibility, trialability, observability	Semi-structured interviews	Survey of 19 IT professionals in Taiwan	(Lin and Chen, 2012)
Cloud computing	DOI and TOE	-Technology (Availability, reliability, Security, privacy, trust) - organizational (top management support, organization size, technology readiness) -environment (compliance with regulation, competitive pressure, trading partner pressure, physical location)	Semi-structured interviews	20 IT experts at different organizations in Saudi Arabia.	(Alkhater et al., 2014)
Cloud computing	TAM and TOE	-DOI theory (Relative advantage, complexity, compatibility) Relative advantage, complexity, compatibility, Organizational competency, top management support, training and education, competitive pressure, trading partner support, perceived ease of use, and perceived usefulness.	Exploratory factor analysis, confirmatory factor analysis, and structural equation model using AMOS	A questionnaire of 280 companies in IT, Finance, and manufacturing sectors in India	(Gangwar et al., 2015)
Cloud computing	DOI and IPV	Business process complexity, compatibility, entrepreneurial culture, application functionality	Confirmatory factor analysis and multiple regression	Email survey of 289 firms in retail and manufacturing.	(Wu et al., 2013)

2.3. Benefits and challenges of cloud computing for SMEs

ICT adoption among SMEs might be accelerated by CC, which makes ICT available to small firms without significant effort and cost. The biggest barrier to SMS adoption of ICT is the expense of the ICT infrastructure. By leveraging CC, SMEs may have access to a variety of software applications which include Supply Chain Management, Enterprise Resource Planning (ERP), as well as Customer Relationship Management (CRM), with the least amount of work and expense (Bajenaru, 2010). Pay-per-use models for CC payment choices are appealing to SMEs since they let them access modern ICT without requiring them to invest in infrastructure, installation, or ongoing maintenance costs (Truong, 2010). Several studies have explored the CC advantages for SMEs, for instance, cost advantages, elasticity, faster data transactions, flexibility, pay-per-use, easily accessible software solution, ease of configuration, easy deployment process, better collaboration and remote work, better security and automatic updates, scalability, low IT deployment cost, increased IT performance, back up capabilities and disaster recovery process (Assante et al., 2016; Bajenaru, 2010; Bruque Camara et al., 2015; Gupta et al., 2013; Jede and Teuteberg, 2015; Liu et al., 2016; Marston et al., 2011; Saedi and Iahad, 2013; Sultan, 2011; Tehrani and Shirazi, 2014; Truong, 2010; Vasiljeva et al., 2017; Wu et al., 2013; Yeboah-Boateng and Essandoh, 2014). There are several concerns with organizations adopting CC. It includes losing control of their data as well as IT infrastructure, availability, and cloud services, dread of getting cornered with only one provider, and high risk regarding security factors that prevent various businesses from utilizing CC (Sultan, 2011). Furthermore, customers are given internet access with respect to a shared pool of resources in CC, raising additional questions about cloud service availability and how it will affect their business (El-Gazzar et al., 2016; Rittinghouse and Ransome, 2017; Sultan, 2011; Yeboah-Boateng and Essandoh, 2014). A primary concern of CC for SMEs is vendor lock-in, which is the difficulty or incapability to transition to other cloud service providers. Inadequate accessibility and poor consistency of cloud services might also interfere with CC adoption (Armbrust et al., 2010). Additionally, data security and privacy, internet connectivity, including weak regulatory framework, and limited compatibility with existing applications and systems, service availability, also impact CC adoption by SMEs (Doherty et al., 2015; Oliveira et al., 2014; Vemula and Zsifkovits, 2016).

3. Hypotheses and research model

This investigation is considered among the well-known technology adoption models (TAM) for studies in the organizational context, which is the TOE framework. Besides that, Tornatzky et al. (1990) suggested the TOE framework clarifies the innovation process in an enterprise setting that influences the adoption and describes the procedure by which an organization adopts as well as implements technological innovations is affected by the technology context. It considers three features, instance, environment, organization, as well as technology setting. These three contexts impact the method a business adopts new technology. The proposed research model is shown in Fig. 2. The technology context explains the external and internal technology factors appropriate to the organization. Furthermore, the organization context explains the resources and characteristics of the organization, for instance, firm size, organizational structure, human resources, managerial structure, as well as the communication process among workers. The environmental context explains the organization's structure and size, and it comprises the market elements, the firm's competitors, including the regulatory environment (Oliveira and Martins, 2010; Oliveira et al., 2014; Tornatzky et al., 1990; Zhu and Kraemer, 2005).

3.1. Technological context

A security breach is when a government or company agency loses personal records, information, or other sensitive data (Bishop, 2003; Fatima and Ahmad, 2019). CC is a computing resource and storage in which hardware, information, software, as well, as other devices are shared by multi-user surroundings which heightens security concerns (Alsmadi and Prybutok, 2018; Schneiderman, 2010; Shen and Tong, 2010; Yadav and Sharma, 2018) and companies leave uncertain and unaware of possible danger (Benlian and Hess, 2011). The absence of security standards and protocols suggests that businesses will be hesitant to use cloud technology. However, the choice of a company to implement the innovation would be impacted by the addition of new layers of complexity for protecting data in the cloud. Hence, we have:

H1: Security concerns will negatively influence CC adoption in SMEs.

CC provides a chance for innovations, reduces the cost of computing, lowers IT expenditure (Aldossary et al., 2019; Cervone, 2010), and permits organizations to concentrate on their fundamental business activities. A business can minimize the time allocated to infrastructure cost and system maintenance, lower maintenance expenditure and decrease energy consumption by adopting CC (Marston et al., 2011; Peng et al., 2019; Zhou et al., 2019). CC provides an affordable way to shift businesses by re-inventing how goods and services are consumed and sold. Hence, we have:

H2: Cost saving will positively influence CC adoption in SMEs.

3.2. Organizational context

The organizational context describes the firm characteristics and the resources accessible to limit or support the implementation and adoption with respect to innovation (Lippert and Govindarajulu, 2006). Moreover, the correlation between organizational structure and new technology adoption is affected by multiple factors, including the firm size, level of top management support, information link, and resources availability (Tornatzky et al., 1990; Xu and Quaddus, 2012; Low et al., 2011). Therefore, the above-mentioned firm size, along with top management support, were key determinants in assessing CC adoption (Low et al., 2011; Alkhater et al., 2014).

Top management support serves a major function in CC adoption. It provides guidance on system integration, re-engineering process, and allocation of resources (Low et al., 2011). Besides that, top management, which understands the CC advantages, is allocating the resources needed and the organization members that impact the adoption or implementation changes. If they are unsuccessful in acknowledging the CC benefits, its adoption will be opposed by management. Hence, we have:

H3: Top Management support will positively influence CC adoption in SMEs.

Firm size also plays a major role that can impact CC adoption. For instance, huge firms possess a greater benefit in terms of resources that they have and are ready to face risks correlated with the innovation of new technology adoption over small firms (Thiesse et al., 2011; Zhu et al., 2006). This investigation has found that tiny firms are not easily adopting new technologies but are more versatile (Lippert and Govindarajulu, 2006). Firm size is, therefore, a factor in CC adoption (Low et al., 2011). Hence, we have:

H4: Firm size support will positively influence CC adoption in SMEs.

3.3. Environmental context

The environment context pertains to the business environment where the firm operates, affected by the competitors of the firm, the nature of the industry, government interactions as well as access to resources provided by others (Lippert and Govindarajulu, 2006). Therefore, the regulatory environment and firm competition are determinants that influence CC adoption in SMEs (Zhu et al., 2006). Competitive pressure was considered a significant driver of innovation diffusion literature on diffusion of technology. This expresses the strain from the industry rivals experienced by the firm (Low et al., 2011; Oliveira and Martins, 2010; Zhu et al., 2003), and adopting new innovative technology is often need a strategic imperative for market competition (Oliveira et al., 2014). Through adopting CC, businesses could gain an advantage from stronger visibility of the market, better operational efficiency as well as highly precise access to real-time data (Misra and Mondal, 2011). Hence, we have:

H5: Competitive pressure will positively influence CC adoption in SMEs.

Regulatory support expresses the government's support to promote firms to incorporate IT innovation (Zhu et al., 2006). When adopting new technologies, the effect of current laws and regulations may be important. Government regulations may be promoted or discourage businesses from adopting new technology. Organizational data protection, for instance, is specifically required by law in the European Union and the USA. Corporations will be increasingly inclined to utilize CC if the government mandates compliance with cloud-specific protocols and standards. Hence, we have:

H6: Regulatory support will positively influence CC adoption in SMEs.

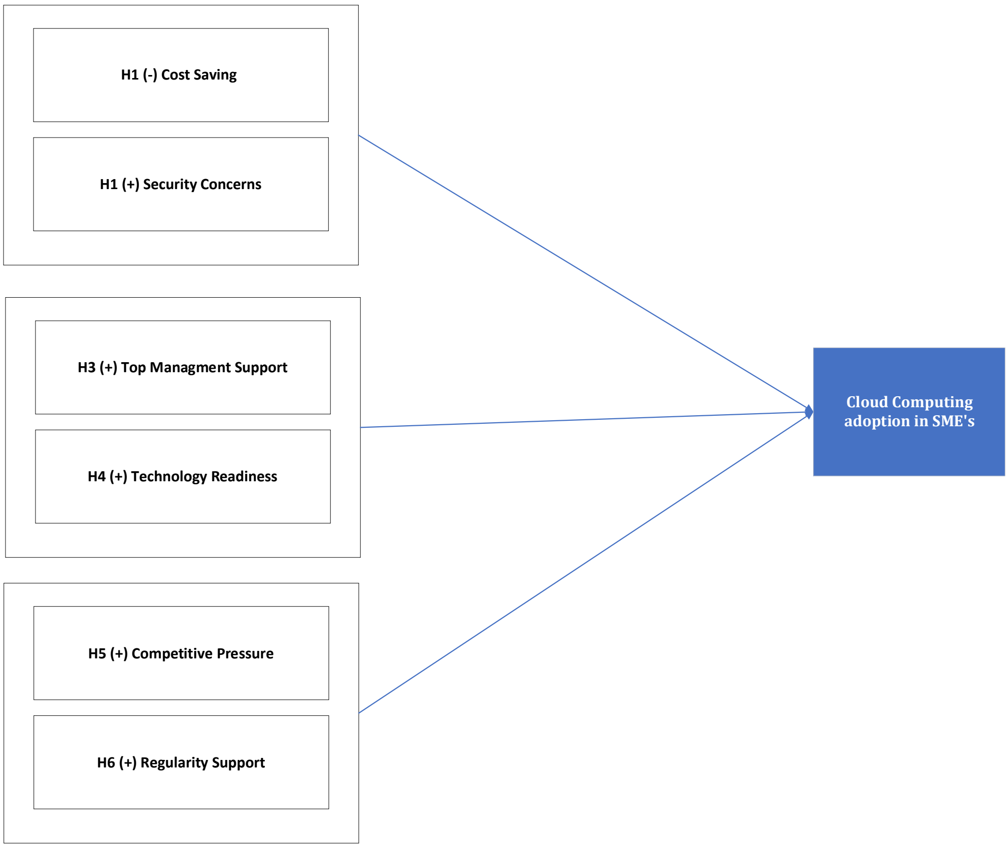

Fig. 2: The research model

4. Methods and materials

This study has been undertaken in Somalia to examine the variables of CC adoption in the SME sector. While employing a quantitative research method, this study used a structured questionnaire as the primary research instrument. Furthermore, the questionnaire was assimilated to the SMEs in Mogadishu-Somalia. This study has utilized a 5-point Likert scale instrument, from 1 (strongly disagree) to 5 (strongly agree).

5. Results and findings

In the preliminary analysis stage, SPSS is utilized to identify errors and missing values, as proposed by Hair Jr et al. (2016). Then, SPSS's Replace Missing Values (with Linear Interpolation) is used to solve the missing values, which were very small. As per Podsakoff et al. (2003), it is essential to assess common method variance since this data was accumulated from a single source. After conducting Harman's single-factor test, the results depict that the first factor discusses 39.7% of the variance, which signifies that it is fewer than 50%, as suggested by Podsakoff et al. (2003). Hence, this indicates that a common method bias is an easy-to-tackle problem in this investigation.

According to the demographic profile, 80% of participants were male, while 20% were female. In regard to staff count, 55% have fewer than 20 workers, whereas 12% have more than 100 employees. In terms of the number of IT staff, 75% have 3 to 5 IT staff, whereas 15% have more than six (6) IT staff. The majority of respondents (88%) have a Broadband (Internet) connection, while 11% don't have a Broadband (Internet) connection. Almost 47.69% of the respondents use SaaS as a CC service model, while 30.25 % of the respondents use PaaS. The payment mode indicates that 39.5% of the respondents can pay per user license, whereas 23.6% can pay an established amount by subscription (yearly or monthly). The demographic profile details are provided in Table 2. In analyzing this data, the study employed the partial least square method using the SmartPLS3.0 software (Ringle et al., 2015). Moreover, both the structural model (testing the relationship among variables) as well as measurement model (validity and reliability) have been evaluated to complete the study's outcome.

Table 2: Demographic data

Distribution		Frequency	Percentage (%)
Gender	Male	155	79.48
	Female	40	20.51
No. of employees	5 or less	2	1.02
	6 to 10	23	11.79
	11 to 20	108	55.38
	21 to 99	50	25.64
	100 to 200	12	6.15
No. of IT staff	No IT staff	0	0
	1 to 2	18	9.23
	3 to 5	147	75.38
	6 and more	30	15.38
Broadband (Internet) connection	Yes	173	88.71
	No	22	11.28
Cloud computing layer usage	IaaS	43	22.05
	PaaS	59	30.25
	SaaS	93	47.69
Payment mode	Do not know	0	0
	Pay for each transaction	4	2.05
	Pay for the time duration for which I am using the cloud solution	27	13.84
	Pay per-user license	77	39.48
	Pay a fixed amount by subscription (monthly, yearly, etc.)	46	23.58
	Single, one-time payment for unlimited users	41	21.02
	Others (not applicable)	0	0

5.1. Measurement model

Discriminant and convergent validities were investigated to assess the measurement model.

5.1.1. Convergent validity

As per Hair Jr et al. (2016), convergent validity pertains to an internal consistency measure used to evaluate how well items within a scale are correlated in measuring similar constructs (Hair et al., 2011). It is determined via factor loading, average variance extracted (AVE), Cronbach's alpha, as well as composite reliability (CR) measures of Jöreskog's rho (ρc) and Dijkstra-Henseler's rho (ρA). This research discovered that the items loading was greater than 0.7, the AVE was higher than 0.5, while the value of Jöreskog's rho (ρc) and Dijkstra-Henseler's rho (ρA) were greater than 0.7, as illustrated in Table 3. Given that all three criteria reached the suggested threshold values, these findings demonstrate that all requirements were satisfied. Nevertheless, one item (RS3) was eliminated because of insufficient factor loading.

5.1.2. Discriminant validity

Henseler et al. (2015) criticized the Fornell and Larcker (1981) criterion for failing to reliably identify the absence of discriminant validity in common research situations. As a result, this research utilized the heterotrait-monotrait ratio of correlations (HTMT), relying on the multitrait-multimethod matrix (Henseler et al., 2015). We assess first whether the HTMT value is bigger than the HTMT.85 value of 0.85 (Kline, 2015) or HTMT.90 value of 0.90 (Gold et al., 2001) provided that HTMT is bigger than the former values, then discriminant validity is uncertain. As demonstrated in Table 4 and Table 5, all HTMT values above the HTMT.90 and HTMT.85 threshold values demonstrate the establishment of discriminant validity.

Table 3: Convergent validity

Construct	Item	Loading	Dijkstra-Henseler's rho (ρA)	Jöreskog's rho (ρc)	Cronbach's alpha(α)	Average variance extracted (AVE)
Security concern	SC1	0.757	0.846	0.796	0.740	0.647
	SC2	0.849				
	SC4	0.803				
Cost saving	CS1	0.926	0.925	0.885	0.879	0.805
	CS2	0.864				
	CS3	0.900				
Top management support	TMS1	0.834	0.891	0.819	0.816	0.732
	TMS2	0.850				
	TMS3	0.881				
Technology readiness	TR1	0.893	0.942	0.914	0.907	0.844
	TR2	0.931				
	TR3	0.932				
Competitive pressure	CP1	0.850	0.861	0.765	0.759	0.674
	CP2	0.822				
	CP3	0.790				
Regularity support	RS1	0.906	0.919	0.869	0.868	0.792
	RS2	0.859				
	RS4	0.903				
Cloud computing adoption	CCA1	0.869	0.898	0.834	0.829	0.745
	CCA2	0.826				
	CCA3	0.894				

Table 4: Discriminant validity- heterotrait-monotrait (HTMT) criterion

	CCA	*CP*	*CS*	*RS*	*SC*	*TMS*
CCA						
CP	0.560					
CS	0.712	0.514				
RS	0.653	0.557	0.565			
SC	0.581	0.409	0.700	0.585		
TMS	0.702	0.544	0.531	0.523	0.530	
TR	0.660	0.557	0.606	0.455	0.397	0.672

Table 5: Discriminant validity-cross loading

	CCA	CP	CS	RS	SC	TMS	TR
CCA1	**0.869**	0.401	0.578	0.464	0.430	0.512	0.558
CCA2	**0.826**	0.341	0.439	0.479	0.414	0.470	0.445
CCA3	**0.894**	0.411	0.562	0.493	0.408	0.516	0.485
CP1	0.401	**0.850**	0.313	0.283	0.130	0.334	0.445
CP2	0.355	**0.822**	0.382	0.404	0.345	0.383	0.357
CP3	0.340	**0.790**	0.345	0.423	0.304	0.337	0.338
CS1	0.577	0.396	**0.926**	0.428	0.519	0.415	0.540
CS2	0.495	0.315	**0.864**	0.449	0.513	0.424	0.463
CS3	0.572	0.411	**0.900**	0.453	0.510	0.371	0.453
RS1	0.469	0.441	0.436	**0.906**	0.451	0.383	0.378
RS2	0.505	0.268	0.486	**0.859**	0.370	0.431	0.389
RS4	0.501	0.481	0.392	**0.903**	0.454	0.359	0.321
SC1	0.307	0.187	0.377	0.290	**0.757**	0.245	0.164
SC2	0.498	0.285	0.499	0.422	**0.849**	0.430	0.346
SC4	0.302	0.256	0.494	0.428	**0.803**	0.330	0.281
TMS1	0.465	0.382	0.399	0.420	0.356	**0.834**	0.524
TMS2	0.503	0.328	0.278	0.298	0.273	**0.850**	0.489
TMS3	0.516	0.385	0.473	0.414	0.479	**0.881**	0.479
TR1	0.486	0.441	0.496	0.277	0.308	0.454	**0.893**
TR2	0.525	0.374	0.494	0.419	0.313	0.558	**0.931**
TR3	0.573	0.468	0.503	0.417	0.322	0.578	**0.932**

5.2. Structural model

A variation of the conventional multiple linear regression model employed in this research is the partial least square (PLS) regression. As per Hair Jr et al. (2016), standard beta, R-squared, and t-values via a bootstrapping procedure with a resample of 5000, the predictive relevance (Q2), as well as the effect size (f2), need to be investigated to evaluate the structural model. All of these parameters and matrices have been evaluated in this research, as indicated in Table 6. After investigation, it was discovered that cloud computing (CC) adoption and cost savings had a significant relationship (β=0.258, p<0.000, f2=0.076). Therefore, H1 is supported. Also, top management support possesses a significant relationship with CC adoption (β=0.219, p<0.001, f2=0.062). Therefore, H3 is supported. Similarly, the findings reveal the occurrence of a significant relationship between technology readiness as well as CC adoption (β=0.182, p<0.003, f2=0.040). Thus, H4 is also delivered. Likewise, the outcomes disclose that Regularity Support has a significant relationship with CC adoption (β=0.202, p<0.003, f2=0.057); thus, H6 is also sustained. To compare, the findings indicated that security concerns (β=0.050, p>0.310, f2=0.004) and Competitive Pressure (β=0.066, p>0.382, f2=0.006) had zero influence on adoption. H2 and H5 were hence not recognized. As indicated in Table 6, the R-squared value is 0.556, signifying that all six predictors taken together can account for 55.6% of the variation in CC adoption. As per Hair Jr et al. (2016), the change in R-squared has to be examined to check the effect size, f2. As illustrated in Table 6, the findings of f2 reveal adequate effect size for the supported hypotheses, as per Cohen's (1988) guideline, which is 0.35 (large), 0.15 (moderate) as well as 0.02 (weak). Moreover, multicollinearity among the model's variables was checked to employ the variance inflation factor (VIF) criteria. As depicted in Table 6 and Fig. 3, every variable has VIF values smaller than the suggested value of 5.00 (Hair et al., 2013; Sarstedt et al., 2014). As advised by Hair Jr et al. (2016), the blindfolding process was utilized to gauge the model's predictive relevance. The findings, as shown in Table 6, reveal that the model possesses sufficient predictive relevance as the Q2 value with respect to CC adoption (Q2=0.384) is greater than zero (Q2>0).

Table 6: Structural model-hypothesis testing

Hs	Path relationship	Std. Beta	SE	t-value	f^2	R^2	VIF	Q^2	p-Values	Decision
H5	CP -> CCA	0.050	0.057	0.874	0.004	0.556	1.467	0.384	0.382	Not supported
H1	CS -> CCA	0.258	0.069	3.745	0.076		1.964		0.000***	Supported
H6	RS -> CCA	0.202	0.068	2.994	0.057		1.603		0.003***	Supported
H2	SC -> CCA	0.066	0.065	1.016	0.006		1.673		0.310	Not supported
H3	TMS -> CCA	0.219	0.063	3.499	0.062		1.747		0.001***	Supported
H4	TR -> CCA	0.182	0.062	2.935	0.040		1.871		0.003***	Supported

***: p<0.001; CCA: Cloud computing adoption; SC: Security concern; CS: Cost saving; TR: Technology readiness; CP: Competitive pressure; TMS: Top management support; RS: Regularity support

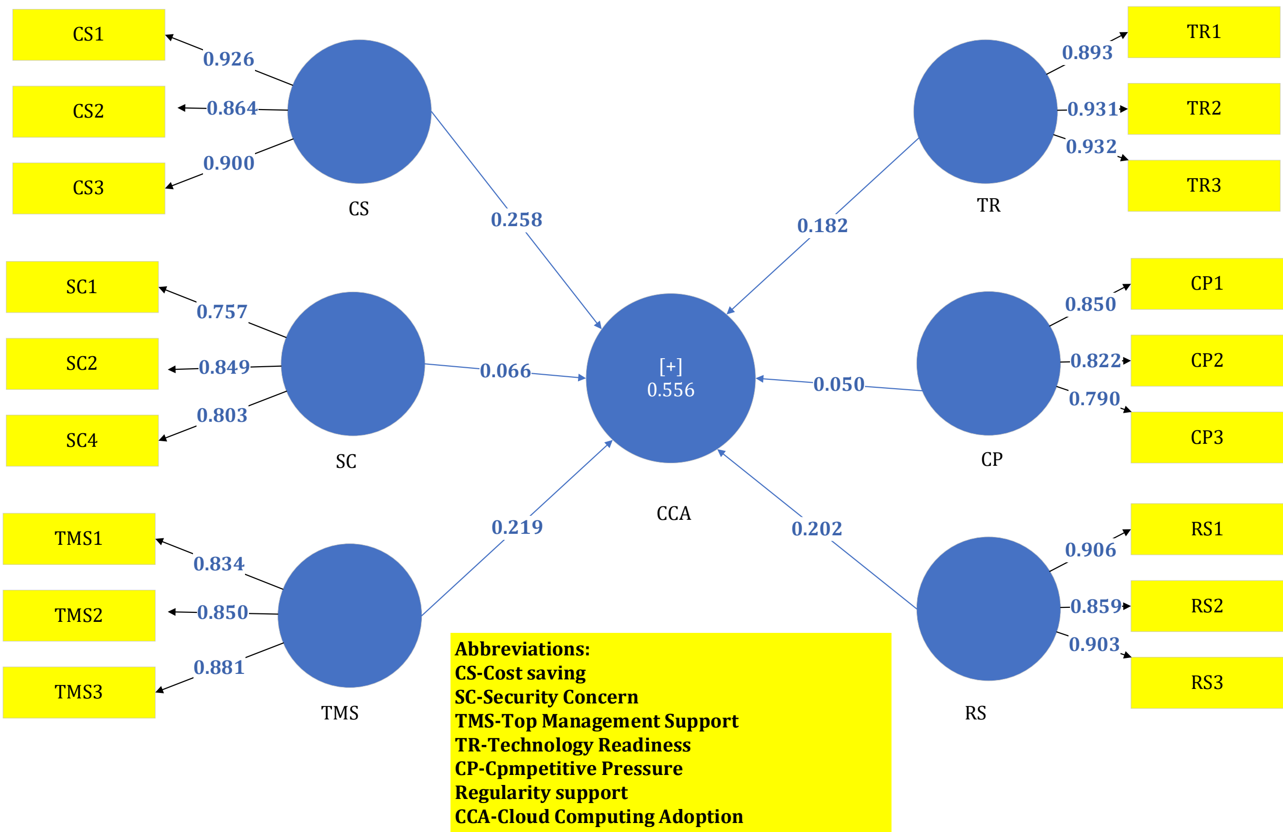

Fig. 3: Structural model

6. Discussion

Understanding the CC determinants is key when organizations consider adopting cloud computing (CC) for collaboration, flexibility, accessibility, transparency, content management, and transformation of business processes. To advance the literature on organizational CC adoption, the purpose of the investigation is to explore the variables that influence CC adoption in SMEs. The result indicates that four factors influence CC adoption. These are top management support, cost-saving, regulatory support as well as technology readiness (Table 6).

From the two technology contexts, cost saving (H1) has a positive influence on CC adoption. Moreover, this outcome aligns with similar research in the literature that has discovered cost saving to be a huge driver for CC adoption in SMEs (Garrison et al., 2012; Benlian and Hess, 2011; Lin et al., 2009). Contrarily, security concerns (H2) are not identified to be a CC adoption inhibitor in SMEs. Security concerns with respect to the CC environment include enhancing privacy techniques, level of encryption schemes, monitoring mechanisms, and ensuring integrity and confidentiality (Wang, 2010; Muñoz et al., 2012; Sonehara et al., 2011; Saha et al., 2019; Asvija et al., 2019). Furthermore, FedRamp is a recently established standard and federal regulation (Chong et al., 2009). The Act of Federal Information Security Management seeks to create data protection as well as organizational trust in the implementation of cloud-based solutions. This can explain the scarcity of security and privacy concerns when accounting for the CC approach.

Organizational context: Of the two organizational perspectives, our research offers empirical evidence that in explaining the CC adoption of CC, which is top management support (H3) is significant. The result signifies that top management support can affect CC adoption by committing organizational and financial resources as well as engaging the business process. This outcome aligns with corresponding investigations in the literature as well as the use of innovative technologies that have found top management support to be a strong driver with respect to CC adoption in SMEs (Ramdani et al., 2009; Luo et al., 2010; Al-Sharafi et al., 2019; Singh and Mansotra, 2019; Ifinedo, 2011).

Firm size (H4) possesses a positive effect on CC adoption in SMEs. Moreover, this outcome aligns with the literature proposing that bigger organizations have the resources to bear new technology's cost as well as investment risk (Wang et al., 2010; Chong and Chan, 2012; Crook and Kumar, 1998). On the contrary, smaller firms typically lack resources available in terms of knowledge mining, testing, and implementation CC environment (Thiesse et al., 2011). In addition, firm size is a predictor of CC (Low et al., 2011), whereas Borgman et al. (2013) stated that firm size is determined to be inconclusive.

Environmental context: Of the two environmental contexts, our study provides empirical evidence that in explaining the CC adoption, which is competitive pressure (H5) is significant. These results align with corresponding investigations in the literature that have discovered competitive pressure to be a strong driver for CC adoption in SMEs and pushed firms more quickly in the high-tech industry (Low et al., 2011). According to Ifinedo's (2011) survey of 214 SMEs, the technology adoption that aligns with online commerce is positively influenced by competitive pressure. The survey also identified factors that did not play a significant role, for instance, business partners, pressure from customers, as well as government support.

Our study indicates that regulatory support (H6) is not a determinant of CC adoption. The advantages of CC are probably known by businesses, but the organizational environment prevents these advantages from being turned into a competitive advantage. Therefore, it was also determined that regulatory support had little impact on the adoption of CC. This does not imply that businesses violate established standards and regulations, but organizational decision-makers have not given current legislation protecting or regulating CC any consideration (Oliveira et al., 2014). Furthermore, these results align with similar research in the literature that has found regulatory support is not determinant with respect to CC adoption (Oliveira et al., 2014). Regulatory support is necessary to disseminate the sense of trust that businesses need to turn technology into business opportunities. Technological advancements, increasing CC standards, including governmental restrictions could not be enough to remove obstacles to CC adoption in the absence of economic incentives that create great business sense (Oliveira et al., 2014). The following is a summary of the investigation's practical and theoretical consequences.

6.1. Limitations and future directions

This investigation, despite its contributions, has certain limitations that should be acknowledged. Firstly, the data collection was restricted to Mogadishu, the capital city with the largest number of SMEs in the country. While this sample may be representative of the entire country, future researchers should consider expanding the coverage to include other cities like Hargeisa and Bosaso to ensure a more comprehensive representation.

Another aspect that future research should address is the continuity of CC adoption. It remains uncertain whether organizations are inclined to sustain the use of CC over time. Therefore, researchers are encouraged to consider the concept of "continuance intention" to gain insights into the long-term adoption trends of this technology. Expanding the research model to incorporate supplementary factors, such as information processing capacity and requirements, can provide a more comprehensive understanding of the factors influencing CC adoption among SMEs.

Moreover, this study sheds light on the technological development of SMEs in Somalia. A similar research approach could be applied in other least-developed countries (LDCs) to inspire technological advancements in their respective business markets. By conducting similar investigations in LDCs, valuable insights can be gained to address technological disparities and foster growth in these regions.

7. Conclusion

The widespread availability of Information and Communication Technology (ICT) through CC has the potential to accelerate the adoption of ICT among SMEs without imposing significant financial burdens or extensive efforts. CC offers a plethora of benefits to its adopters, including cost advantages, scalability, faster data transactions, flexibility, pay-per-use models, easy accessibility to software solutions, simplified configuration, streamlined deployment processes, enhanced collaboration and remote work capabilities, improved security with automatic updates, low IT deployment costs, increased IT performance, data backup facilities, and effective disaster recovery processes.

This research aims to investigate the factors influencing the adoption of CC among SMEs in Somalia. The study employs the SEM method for data analysis. The findings highlight that factors such as cost savings, firm size, top management support, and regulatory backing are significantly associated with CC adoption in SMEs. However, the study reveals that security concerns and competitive pressure do not exhibit a significant relationship with CC adoption among SMEs. Moreover, this investigation lays the groundwork for future research on the adoption of new theories. Additionally, it provides valuable insights for practitioners considering the adoption of CC solutions to enhance their business operations.

Acknowledgment

The work was funded by a research grant from the SIMAD University Centre for Research and Development, which the writers gratefully appreciate. The writers would also like to thank all of the research participants.

Compliance with ethical standards

Conflict of interest

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

References

Abdollahzadegan A, Che Hussin AR, Moshfegh Gohary M, and Amini M (2013). The organizational critical success factors for adopting cloud computing in SMEs. Journal of Information Systems Research and Innovation, 4(1): 67-74.

Aldossary M, Djemame K, Alzamil I, Kostopoulos A, Dimakis A, and Agiatzidou E (2019). Energy-aware cost prediction and pricing of virtual machines in cloud computing environments. Future Generation Computer Systems, 93: 442-459. https://doi.org/10.1016/j.future.2018.10.027

Ali A, Warren D, and Mathiassen L (2017). Cloud-based business services innovation: A risk management model. International Journal of Information Management, 37(6): 639-649. https://doi.org/10.1016/j.ijinfomgt.2017.05.008

Alkhater N, Wills G, and Walters R (2014). Factors influencing an organisation's intention to adopt cloud computing in Saudi Arabia. In the IEEE 6th International Conference on Cloud Computing Technology and Science, IEEE, Singapore, Singapore: 1040-1044. https://doi.org/10.1109/CloudCom.2014.95

Alshamaila Y, Papagiannidis S, and Li F (2013). Cloud computing adoption by SMEs in the north east of England: A multi-perspective framework. Journal of Enterprise Information Management, 26(3): 250-275. https://doi.org/10.1108/17410391311325225

Al-Sharafi MA, Arshah RA, and Abu-Shanab EA (2019). Questionnaire development process to measure the SMEs' continuous use behavior towards cloud computing services. In the 8th International Conference on Software and Computer Applications, Association for Computing Machinery, Penang, Malaysia: 50-55. https://doi.org/10.1145/3316615.3316723

Alsmadi D and Prybutok V (2018). Sharing and storage behavior via cloud computing: Security and privacy in research and practice. Computers in Human Behavior, 85: 218-226. https://doi.org/10.1016/j.chb.2018.04.003

Armbrust M, Fox A, Griffith R, Joseph AD, Katz R, Konwinski A, and Zaharia M (2010). A view of cloud computing. Communications of the ACM, 53(4): 50-58. https://doi.org/10.1145/1721654.1721672

Assante D, Castro M, Hamburg I, and Martin S (2016). The use of cloud computing in SMEs. Procedia Computer Science, 83: 1207-1212. https://doi.org/10.1016/j.procs.2016.04.250

Asvija B, Eswari R, and Bijoy MB (2019). Security in hardware assisted virtualization for cloud computing: State of the art issues and challenges. Computer Networks, 151: 68-92. https://doi.org/10.1016/j.comnet.2019.01.013

Attaran M and Woods J (2019). Cloud computing technology: Improving small business performance using the Internet. Journal of Small Business and Entrepreneurship, 31(6): 495-519. https://doi.org/10.1080/08276331.2018.1466850

Bajenaru A (2010). Software-as-a-service and cloud computing, a solution for small and medium-sized companies: Bulletin of the Transilvania University of Brasov. Economic Sciences: Series V, 3(52): 173-184.

Battleson DA, West BC, Kim J, Ramesh B, and Robinson PS (2016). Achieving dynamic capabilities with cloud computing: An empirical investigation. European Journal of Information Systems, 25: 209-230. https://doi.org/10.1057/ejis.2015.12

Benlian A and Hess T (2011). Opportunities and risks of software-as-a-service: Findings from a survey of IT executives. Decision Support Systems, 52(1): 232-246. https://doi.org/10.1016/j.dss.2011.07.007

Bishop M (2003). Computer security: Art and science. Addison Wesley Professional, Boston, USA.

Borgman HP, Bahli B, Heier H, and Schewski F (2013). Cloudrise: exploring cloud computing adoption and governance with the TOE framework. In the 46th Hawaii International Conference on System Sciences, IEEE, Wailea, USA: 4425-4435. https://doi.org/10.1109/HICSS.2013.132

Bruque Camara S, Moyano Fuentes J, and Maqueira Marín JM (2015). Cloud computing, Web 2.0, and operational performance: The mediating role of supply chain integration. The International Journal of Logistics Management, 26(3): 426-458. https://doi.org/10.1108/IJLM-07-2013-0085

Buyya R, Broberg J, and Goscinski AM (2010). Cloud computing: Principles and paradigms. John Wiley and Sons, Hoboken, USA. https://doi.org/10.1002/9780470940105

Cegielski CG, Jones-Farmer LA, Wu Y, and Hazen BT (2012). Adoption of cloud computing technologies in supply chains: An organizational information processing theory approach. The International Journal of Logistics Management, 23(2): 184-211. https://doi.org/10.1108/09574091211265350

Cervone HF (2010). An overview of virtual and cloud computing. OCLC Systems and Services: International Digital Library Perspectives, 26(3): 162-165. https://doi.org/10.1108/10650751011073607

Chae HC, Koh CE, and Park KO (2018). Information technology capability and firm performance: Role of industry. Information and Management, 55(5): 525-546. https://doi.org/10.1016/j.im.2017.10.001

Chen PY and Wu SY (2013). The impact and implications of on-demand services on market structure. Information Systems Research, 24(3): 750-767. https://doi.org/10.1287/isre.1120.0451

Chong AYL and Chan FT (2012). Structural equation modeling for multi-stage analysis on radio frequency identification (RFID) diffusion in the health care industry. Expert Systems with Applications, 39(10): 8645-8654. https://doi.org/10.1016/j.eswa.2012.01.201

Chong AYL, Lin B, Ooi KB, and Raman M (2009). Factors affecting the adoption level of c-commerce: An empirical study. Journal of Computer Information Systems, 50(2): 13-22.

Cohen J (1988). Statistical power analysis for the behavioral sciences. 2nd Edition, Lawrence Erlbaum Associates, Hillsdale, USA.

Crook CW and Kumar RL (1998). Electronic data interchange: A multi-industry investigation using grounded theory. Information and Management, 34(2): 75-89. https://doi.org/10.1016/S0378-7206(98)00040-8

Demirkan H and Delen D (2013). Leveraging the capabilities of service-oriented decision support systems: Putting analytics and big data in cloud. Decision Support Systems, 55(1): 412-421. https://doi.org/10.1016/j.dss.2012.05.048

Doherty E, Carcary M, and Conway G (2015). Migrating to the cloud: Examining the drivers and barriers to adoption of cloud computing by SMEs in Ireland: An exploratory study. Journal of Small Business and Enterprise Development, 22(3): 512-527. https://doi.org/10.1108/JSBED-05-2013-0069

EIU (2015). Ascending cloud: The adoption of cloud computing in five industries. The Economist Intelligence Unit, London, UK.

El-Gazzar R, Hustad E, and Olsen DH (2016). Understanding cloud computing adoption issues: A Delphi study approach. Journal of Systems and Software, 118: 64-84. https://doi.org/10.1016/j.jss.2016.04.061

Fatima S and Ahmad S (2019). An exhaustive review on security issues in cloud computing. KSII Transactions on Internet and Information Systems, 13(6): 3219-3237. https://doi.org/10.3837/tiis.2019.06.025

Fornell C and Larcker DF (1981). Structural equation models with unobservable variables and measurement error: Algebra and statistics. Journal of Marketing Research, 18(3): 382–388. https://doi.org/10.1177/002224378101800313

Gangwar H, Date H, and Ramaswamy R (2015). Understanding determinants of cloud computing adoption using an integrated TAM-TOE model. Journal of Enterprise Information Management, 28(1): 107-130. https://doi.org/10.1108/JEIM-08-2013-0065

Gans J, Hervé M, and Masri M (2023). Economic analysis of proposed regulations of cloud services in Europe. European Competition Journal. https://doi.org/10.1080/17441056.2023.2228668

Garrison G, Kim S, and Wakefield RL (2012). Success factors for deploying cloud computing. Communications of the ACM, 55(9): 62-68. https://doi.org/10.1145/2330667.2330685

Gold AH, Malhotra A, and Segars AH (2001). Knowledge management: An organizational capabilities perspective. Journal of Management Information Systems, 18(1): 185-214. https://doi.org/10.1080/07421222.2001.11045669

Grossman RL (2009). The case for cloud computing. IT Professional, 11(2): 23-27. https://doi.org/10.1109/MITP.2009.40

Gupta P, Seetharaman A, and Raj JR (2013). The usage and adoption of cloud computing by small and medium businesses. International Journal of Information Management, 33(5): 861-874. https://doi.org/10.1016/j.ijinfomgt.2013.07.001

Hair JF, Ringle CM, and Sarstedt M (2011). PLS-SEM: Indeed a silver bullet. Journal of Marketing Theory and Practice, 19(2): 139-152. https://doi.org/10.2753/MTP1069-6679190202

Hair JF, Ringle CM, and Sarstedt M (2013). Partial least squares structural equation modeling: Rigorous applications, better results and higher acceptance. Long Range Planning, 46(1-2): 1-12. https://doi.org/10.1016/j.lrp.2013.01.001

Hair Jr JF, Hult GTM, Ringle C, and Sarstedt M (2016). A primer on partial least squares structural equation modeling (PLS-SEM). Sage Publications, Thousand Oaks, USA.

Henseler J, Ringle CM, and Sarstedt M (2015). A new criterion for assessing discriminant validity in variance-based structural equation modeling. Journal of the Academy of Marketing Science, 43: 115-135. https://doi.org/10.1007/s11747-014-0403-8

Hogan M, Liu F, Sokol A, and Tong J (2011). NIST cloud computing standards roadmap. NIST Special Publication, 35: 6-11. https://doi.org/10.6028/NIST.SP.500-291v1

Ifinedo P (2011). Internet/e-business technologies acceptance in Canada's SMEs: An exploratory investigation. Internet Research, 21(3): 255-281. https://doi.org/10.1108/10662241111139309

Iyer B and Henderson JC (2010). Preparing for the future: Understanding the seven capabilities cloud computing. MIS Quarterly Executive, 9(2): 117-131.

Jede A and Teuteberg F (2015). Integrating cloud computing in supply chain processes. Journal of Enterprise Information Management, 28(6): 872-904. https://doi.org/10.1108/JEIM-08-2014-0085

Kasemsap K (2015). The role of cloud computing adoption in global business. In: Chang V, Walters RJ, and Wills G (Eds.), Delivery and adoption of cloud computing services in contemporary organizations: 26-55. IGI Global, Pennsylvania, USA. https://doi.org/10.4018/978-1-4666-8210-8.ch002

Khorshed MT, Ali AS, and Wasimi SA (2012). A survey on gaps, threat remediation challenges and some thoughts for proactive attack detection in cloud computing. Future Generation Computer Systems, 28(6): 833-851. https://doi.org/10.1016/j.future.2012.01.006

Kline RB (2015). Principles and practice of structural equation modeling. Guilford Publications, New York, USA.

Kranz JJ, Hanelt A, and Kolbe LM (2016). Understanding the influence of absorptive capacity and ambidexterity on the process of business model change–The case of on-premise and cloud-computing software. Information Systems Journal, 26(5): 477-517. https://doi.org/10.1111/isj.12102

Lee OK, Sambamurthy V, Lim KH, and Wei KK (2015). How does IT ambidexterity impact organizational agility? Information Systems Research, 26(2): 398-417. https://doi.org/10.1287/isre.2015.0577

Lian JW, Yen DC, and Wang YT (2014). An exploratory study to understand the critical factors affecting the decision to adopt cloud computing in Taiwan hospital. International Journal of Information Management, 34(1): 28-36. https://doi.org/10.1016/j.ijinfomgt.2013.09.004

Lin A and Chen NC (2012). Cloud computing as an innovation: Percepetion, attitude, and adoption. International Journal of Information Management, 32(6): 533-540. https://doi.org/10.1016/j.ijinfomgt.2012.04.001

Lin G, Fu D, Zhu J, and Dasmalchi G (2009). Cloud computing: IT as a service. IT Professional, 11(2): 10-13. https://doi.org/10.1109/MITP.2009.22

Lippert SK and Govindarajulu C (2006). Technological, organizational, and environmental antecedents to web services adoption. Communications of the IIMA, 6(1): 147-160. https://doi.org/10.58729/1941-6687.1303

Liu S, Chan FT, Yang J, and Niu B (2018). Understanding the effect of cloud computing on organizational agility: An empirical examination. International Journal of Information Management, 43: 98-111. https://doi.org/10.1016/j.ijinfomgt.2018.07.010

Liu S, Yang Y, Qu WG, and Liu Y (2016). The business value of cloud computing: The partnering agility perspective. Industrial Management and Data Systems, 116(6): 1160-1177. https://doi.org/10.1108/IMDS-09-2015-0376

Low C, Chen Y, and Wu M (2011). Understanding the determinants of cloud computing adoption. Industrial Management and Data Systems, 111(7): 1006-1023. https://doi.org/10.1108/02635571111161262

Lowry PB, D'Arcy J, Hammer B, and Moody GD (2016). "Cargo Cult" science in traditional organization and information systems survey research: A case for using nontraditional methods of data collection, including Mechanical Turk and online panels. The Journal of Strategic Information Systems, 25(3): 232-240. https://doi.org/10.1016/j.jsis.2016.06.002

Lu Y and Ramamurthy K (2011). Understanding the link between information technology capability and organizational agility: An empirical examination. MIS Quarterly, 35(4): 931-954. https://doi.org/10.2307/41409967

Lu Y, Xu X, and Xu J (2014). Development of a hybrid manufacturing cloud. Journal of Manufacturing Systems, 33(4): 551-566. https://doi.org/10.1016/j.jmsy.2014.05.003

Luo X, Gurung A, and Shim JP (2010). Understanding the determinants of user acceptance of enterprise instant messaging: An empirical study. Journal of Organizational Computing and Electronic Commerce, 20(2): 155-181. https://doi.org/10.1080/10919391003709179

Luo X, Zhang W, Li H, Bose R, and Chung QB (2018). Cloud computing capability: Its technological root and business impact. Journal of Organizational Computing and Electronic Commerce, 28(3): 193-213. https://doi.org/10.1080/10919392.2018.1480926

Makena JN (2013). Factors that affect cloud computing adoption by small and medium enterprises in Kenya. International Journal of Computer Applications Technology and Research, 2(5): 517-521. https://doi.org/10.7753/IJCATR0205.1003

Marston S, Li Z, Bandyopadhyay S, Zhang J, and Ghalsasi A (2011). Cloud computing: The business perspective. Decision Support Systems, 51(1): 176-189. https://doi.org/10.1016/j.dss.2010.12.006

Mell P and Grance T (2011). The NIST definition of cloud computing. NIST Special Publication 800-145, National Institute of Standards and Technology, Gaithersburg, USA. https://doi.org/10.6028/NIST.SP.800-145

Misra SC and Mondal A (2011). Identification of a company's suitability for the adoption of cloud computing and modelling its corresponding return on investment. Mathematical and Computer Modelling, 53(3-4): 504-521. https://doi.org/10.1016/j.mcm.2010.03.037

Mourtzis D and Vlachou E (2016). Cloud-based cyber-physical systems and quality of services. The TQM Journal, 28(5): 704-733. https://doi.org/10.1108/TQM-10-2015-0133

Muñoz A, Gonzalez J, and Maña A (2012). A performance-oriented monitoring system for security properties in cloud computing applications. The Computer Journal, 55(8): 979-994. https://doi.org/10.1093/comjnl/bxs042

O'Driscoll A, Daugelaite J, and Sleator RD (2013). 'Big data', Hadoop and cloud computing in genomics. Journal of Biomedical Informatics, 46(5): 774-781. https://doi.org/10.1016/j.jbi.2013.07.001 **PMid:23872175**

Oliveira T and Martins MF (2010). Understanding e-business adoption across industries in European countries. Industrial Management and Data Systems, 110(9): 1337-1354. https://doi.org/10.1108/02635571011087428

Oliveira T, Thomas M, and Espadanal M (2014). Assessing the determinants of cloud computing adoption: An analysis of the manufacturing and services sectors. Information and Management, 51(5): 497-510. https://doi.org/10.1016/j.im.2014.03.006

Park SC and Ryoo SY (2013). An empirical investigation of end-users' switching toward cloud computing: A two factor theory perspective. Computers in Human Behavior, 29(1): 160-170. https://doi.org/10.1016/j.chb.2012.07.032

Parkhill DF (1966). Challenge of the computer utility. Addison-Wesley Publisher, Boston, USA.

Peng H, Wen WS, Tseng ML, and Li LL (2019). Joint optimization method for task scheduling time and energy consumption in mobile cloud computing environment. Applied Soft Computing, 80: 534-545. https://doi.org/10.1016/j.asoc.2019.04.027

Petter S, DeLone W, and McLean ER (2012). The past, present, and future of "IS success." Journal of the Association for Information Systems, 13(5): 341-362. https://doi.org/10.17705/1jais.00296

Podsakoff PM, MacKenzie SB, Lee JY, and Podsakoff NP (2003). Common method biases in behavioral research: A critical review of the literature and recommended remedies. Journal of Applied Psychology, 88(5): 879-903. https://doi.org/10.1037/0021-9010.88.5.879 **PMid:14516251**

Ramdani B, Kawalek P, and Lorenzo O (2009). Predicting SMEs' adoption of enterprise systems. Journal of Enterprise Information Management, 22(1-2): 10-24. https://doi.org/10.1108/17410390910922796

Ringle CM, Wende S, and Becker JM (2015). SmartPLS 3. SmartPLS GmbH, Bönningstedt, Germany.

Rittinghouse JW and Ransome JF (2017). Cloud computing: implementation, management, and security. CRC Press, Boca Raton, USA. https://doi.org/10.1201/9781439806814

Ryan WM and Loeffler CM (2010). Insights into cloud computing. Intellectual Property and Technology Law Journal, 22(11): 22-28.

Sabi HM, Uzoka FME, Langmia K, Njeh FN, and Tsuma CK (2018). A cross-country model of contextual factors impacting cloud computing adoption at universities in sub-Saharan Africa. Information Systems Frontiers, 20: 1381-1404. https://doi.org/10.1007/s10796-017-9739-1

Saedi A and Iahad NA (2013). An integrated theoretical framework for cloud computing adoption by small and medium-sized enterprises. In the Pacific Asia Conference on Information Systems, Jeju Island, Korea: 1-12. https://doi.org/10.1109/ICRIIS.2013.6716757

Saha M, Panda SK, and Panigrahi S (2019). Distributed computing security: Issues and challenges. In: Le DN, Kumar R, Mishra BK, Chatterjee JM, and Khari M (Eds.), Cyber security in parallel and distributed computing: Concepts, techniques, applications and case studies: 129-138. John Wiley and Sons, Hoboken, USA. https://doi.org/10.1002/9781119488330.ch8 **PMid:30269299**

Sarstedt M, Ringle CM, Smith D, Reams R, and Hair Jr JF (2014). Partial least squares structural equation modeling (PLS-SEM): A useful tool for family business researchers. Journal of Family Business Strategy, 5(1): 105-115. https://doi.org/10.1016/j.jfbs.2014.01.002

Schneiderman R (2010). For cloud computing, the sky is the limit [special reports]. IEEE Signal Processing Magazine, 28(1): 15-144. https://doi.org/10.1109/MSP.2010.938751

Senyo PK, Effah J, and Addae E (2016). Preliminary insight into cloud computing adoption in a developing country. Journal of Enterprise Information Management, 29(4): 505-524. https://doi.org/10.1108/JEIM-09-2014-0094

Sharma SK, Al-Badi AH, Govindaluri SM, and Al-Kharusi MH (2016). Predicting motivators of cloud computing adoption: A developing country perspective. Computers in Human Behavior, 62: 61-69. https://doi.org/10.1016/j.chb.2016.03.073

Shen Z and Tong Q (2010). The security of cloud computing system enabled by trusted computing technology. In the 2nd International Conference on Signal Processing Systems, IEEE, Dalian, China, 2: V2-11-V2-15. https://doi.org/10.1109/ICSPS.2010.5555234

Singh J and Mansotra V (2019). Factors affecting cloud computing adoption in the Indian school education system. Education and Information Technologies, 24(4): 2453-2475. https://doi.org/10.1007/s10639-019-09878-3

Son I, Lee D, Lee JN, and Chang YB (2014). Market perception on cloud computing initiatives in organizations: An extended resource-based view. Information and Management, 51(6): 653-669. https://doi.org/10.1016/j.im.2014.05.006

Sonehara N, Echizen I, and Wohlgemuth S (2011). Isolation in cloud computing and privacy-enhancing technologies: Suitability of privacy-enhancing technologies for separating data usage in business processes. Business and Information Systems Engineering, 3: 155-162. https://doi.org/10.1007/s12599-011-0160-x

Sultan N (2014). Making use of cloud computing for healthcare provision: Opportunities and challenges. International Journal of Information Management, 34(2): 177-184. https://doi.org/10.1016/j.ijinfomgt.2013.12.011

Sultan NA (2011). Reaching for the "cloud": How SMEs can manage. International Journal of Information Management, 31(3): 272-278. https://doi.org/10.1016/j.ijinfomgt.2010.08.001

Tehrani SR and Shirazi F (2014). Factors influencing the adoption of cloud computing by small and medium size enterprises (SMEs). In: Yamamoto S (Ed.), Human interface and the management of information: Information and knowledge in applications and services: 631-642. Volume 8522, Springer, Cham, Switzerland. https://doi.org/10.1007/978-3-319-07863-2_60

Thiesse F, Staake T, Schmitt P, and Fleisch E (2011). The rise of the "next-generation bar code": An international RFID adoption study. Supply Chain Management: An International Journal, 16(5): 328-345. https://doi.org/10.1108/13598541111155848

Tornatzky LG, Fleischer M, and Chakrabarti AK (1990). Processes of technological innovation. Lexington Books, Lanham, USA.

Truong D (2010). How cloud computing enhances competitive advantages: A research model for small businesses. The Business Review, Cambridge, 15(1): 59-65.

Vasiljeva T, Shaikhulina S, and Kreslins K (2017). Cloud computing: Business perspectives, benefits and challenges for small and medium enterprises (case of Latvia). Procedia Engineering, 178: 443-451. https://doi.org/10.1016/j.proeng.2017.01.087

Vemula R and Zsifkovits H (2016). Cloud computing for supply chain management. BHM Berg-und Hüttenmännische Monatshefte, 161: 229-232. https://doi.org/10.1007/s00501-016-0485-3

Vidhyalakshmi R and Kumar V (2016). Determinants of cloud computing adoption by SMEs. International Journal of Business Information Systems, 22(3): 375-395.

Voas J and Zhang J (2009). Cloud computing: New wine or just a new bottle? IT Professional, 11(2): 15-17. https://doi.org/10.1109/MITP.2009.23

Wang H (2010). Privacy-preserving data sharing in cloud computing. Journal of Computer Science and Technology, 25: 401-414. https://doi.org/10.1007/978-3-031-01834-3

Wang N, Liang H, Jia Y, Ge S, Xue Y, and Wang Z (2016). Cloud computing research in the IS discipline: A citation/co-citation analysis. Decision Support Systems, 86: 35-47. https://doi.org/10.1016/j.dss.2016.03.006

Wang YM, Wang YS, and Yang YF (2010). Understanding the determinants of RFID adoption in the manufacturing industry. Technological Forecasting and Social Change, 77(5): 803-815. https://doi.org/10.1016/j.techfore.2010.03.006

Willcocks LP and Lacity M (2018). Cloud computing as innovation: Cases and practices. In: Willcocks L, Oshri I, and Kotlarsky J (Eds.), Dynamic innovation in outsourcing: Technology, work and globalization: 197-237. Palgrave Macmillan, Cham, Switzerland. https://doi.org/10.1007/978-3-319-75352-2_7

Wu D, Greer MJ, Rosen DW, and Schaefer D (2013). Cloud manufacturing: Strategic vision and state-of-the-art. Journal of Manufacturing Systems, 32(4): 564-579. https://doi.org/10.1016/j.jmsy.2013.04.008

Wu WW, Lan LW, and Lee YT (2011). Exploring decisive factors affecting an organization's SaaS adoption: A case study. International Journal of Information Management, 31(6): 556-563. https://doi.org/10.1016/j.ijinfomgt.2011.02.007

Xu J and Quaddus M (2012). Examining a model of knowledge management systems adoption and diffusion: A partial least square approach. Knowledge-Based Systems, 27: 18-28. https://doi.org/10.1016/j.knosys.2011.10.003

Yadav R and Sharma A (2018). A critical review of data security in cloud computing infrastructure. International Journal of Advanced Studies of Scientific Research, 3(9): 112-117.

Yeboah-Boateng EO and Essandoh KA (2014). Factors influencing the adoption of cloud computing by small and medium enterprises in developing economies. International Journal of Emerging Science and Engineering, 2(4): 13-20.

Zhang Q, Cheng L, and Boutaba R (2010). Cloud computing: State-of-the-art and research challenges. Journal of Internet Services and Applications, 1: 7-18. https://doi.org/10.1007/s13174-010-0007-6

Zhou Z, Abawajy JH, and Li F (2019). Analysis of energy consumption model in cloud computing environments. In: Herawan T, Chiroma H, and Abawajy J (Eds.), Advances on computational intelligence in energy: The applications of nature-inspired metaheuristic algorithms in energy: 195-215. Springer, Cham, Switzerland. https://doi.org/10.1007/978-3-319-69889-2_10

Zhu K and Kraemer KL (2005). Post-adoption variations in usage and value of e-business by organizations: Cross-country evidence from the retail industry. Information Systems Research, 16(1): 61-84. https://doi.org/10.1287/isre.1050.0045

Zhu K, Kraemer K, and Xu S (2003). Electronic business adoption by European firms: A cross-country assessment of the facilitators and inhibitors. European Journal of Information Systems, 12: 251-268. https://doi.org/10.1057/palgrave.ejis.3000475

Zhu K, Kraemer KL, and Xu S (2006). The process of innovation assimilation by firms in different countries: A technology diffusion perspective on e-business. Management Science, 52(10): 1557-1576. https://doi.org/10.1287/mnsc.1050.0487

Zissis D and Lekkas D (2012). Addressing cloud computing security issues. Future Generation Computer Systems, 28(3): 583-592. https://doi.org/10.1016/j.future.2010.12.006