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# Use of cloud computing services in micro and small enterprises: a fit perspective

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**Abstract:**
Micro and Small Enterprises (MSEs) require the right Organizational Information and Communication Technology Infrastructure (OICTI) to provide them with the essential functionalities to support their business processes. In order to have the right OICTI, MSEs are expected to make huge investments in financial and human resources, to purchase, deploy and maintain Information and Communications Technologies (ICTs). Cloud Computing Services (CCS) avail OICTI, for a fraction of the resources required to own private ICT infrastructure. The purpose of this study was to assess the fit between the MSEs' OICTI needs and the information processing capabilities of CCS and how this fit influences CCS adoption in the Kenyan MSEs. The research was quantitative in nature, in which, a theory-based model grounded on the task technology fit, organization information processing and technology-organization-environment theories, was developed and validated. Study findings suggest strong correlations between MSEs' tasks and CCS and between MSEs' information processing needs and CCS information processing capabilities. Other factors identified as influencing CCS procurement are affordability and the relationship between the CCS providers and the MSEs. The study contributes to the academic literature on technology adoption in MSEs by showing that there exists a multidimensional fit between CCS and MSEs' OICTI requirements.

**Keywords:**
cloud computing; MSEs; ICT acquisition; organizational information and communication technology infrastructure.

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## 1. Introduction

Micro and Small Enterprises (MSEs) require the right organizational Information and Communication Technology Infrastructure to provide them with the essential functionalities to support their business processes. Organizational ICT infrastructure enables MSEs to process, store, secure and manage information so that it is available for decision making. MSEs that align their organizational ICT infrastructure with their business goals are able to improve their performance in strategic areas such as customer service, productivity and cost reduction. An organizational ICT infrastructure supports these improvements by making it easier for MSEs to communicate, share information, and to streamline business processes. The Kenyan MSEs (sample of this article) are categorized by the number of employees in the firms and their annual turnover. The Kenya's Micro and Small Enterprises Act 2012 [1] defines MSEs as a firm, trade, service, industry or business activity in both formal and informal sectors employing 1-50 workers and whose annual turnover does not exceed Kenya Shillings 5 Million (approx. 43,000€). For Micro-enterprises, these are the firms which employ 10 or less workers and whose annual turnover does not exceed Kenya Shillings five hundred thousand (Approx. 4,300€), while small enterprises are the companies that employ between 11-50 workers and has an annual turnover of between Kenya Shillings 5 hundred thousand (Approx. 4,300€) to 5 Million (approx. 43,000€). Kenya's Vision 2030 [2] recognizes MSEs as an important component of the Kenyan economy. Successful adoption of cloud computing by the Kenyan MSEs could enhance their development and in the achievement of the Vision 2030 project. Kenya Vision 2030 is the Kenya's national long-term development blue-print aiming to transform Kenya into an industrialized, middle-income country that can provide high quality of life to all. Kirori and Achieng [3] indicates that Kenyan MSEs are also considered as a base of entrepreneurial development and the seedbed for inculcating an entrepreneurial culture and supporting rural industrialization and industrial development. The MSEs sector is also considered important to the Kenyan economy by driving industrialization, generating employment and raising household income, hence the need to identify the factors that contribute to successful ICT infrastructure adoption processes in these businesses.

In order to have the right organizational ICT infrastructure, MSEs are expected to make huge investments in financial and human resources, to purchase, deploy and maintain the ICTs. Unlike most MSEs, which have limited financial and human resources, big corporates have the necessary resources to make huge investments in organizational ICT infrastructures. Nevertheless, these organizations tend to explore ways of reducing their organizational computing costs by doing away with the circle of "buy once, fix when required and upgrade where necessary". In today's ICT landscape, organizations can obtain their organizational ICT infrastructure services from a broader range of sources and acquisition models. One such source of organizational ICT infrastructure is the availability of cloud computing services. Cloud computing services avail organizational ICT infrastructure, for a fraction of the resource commitment required if an organization was to acquire its own ICT infrastructure.

Haag and Cummings [4] defines cloud computing as a technology model in which ICT resources including application software, processing power, data storage, backup facilities, and development tools are delivered as a set of services via internet. Cloud computing services provide reliable, customized and Quality of Service (QoS) guaranteed dynamic computing environments for end-users [5]. Hosseini et al. [6] indicates that most organizations are attracted to cloud computing services that are superior to in-house data centres in terms of financial and technological dimensions. By using cloud computing services, MSEs make huge financial savings, and gain access to ICT expertise that may not be readily available internally. The costs for replacement and maintenance of the ICT infrastructure make cloud computing a more appropriate solution to MSEs' ICT needs, as cloud computing services offer affordable ICT resources, creating opportunities for the MSEs to improve on their ICT related capabilities.

The objective of this study was to assess the fit between the MSE's organizational ICT infrastructure needs and the cloud computing services and how this fit influences the adoption of cloud computing services to support the MSEs' business objectives. This study proposed a model to explore the factors influencing acquisition and integration of cloud computing services by MSEs in developing countries. The study posits that there should be a good fit between the MSEs' ICT needs and the cloud computing services for the MSEs to adopt the cloud computing services for their ICT infrastructure. The central research proposition of this paper is as follows: Greater correlation between information processing needs of the MSEs and the information processing capabilities of cloud computing services is associated with the adoption of cloud computing services by the MSEs. Task Technology Fit model (TTF), Organization Information Processing Theory (OIPT) and the Technology, Organization, and Environment (TOE) framework serve as the theoretical basis for this study. An instrument to measure the proposed model and related propositions was developed and validated. The proposed research model was analyzed using the Partial Least Squares (PLS) approach. The next section has the literature review. Section 3 describes the study methodology, section 4 gives the study results, and section 5 discusses the study findings while section 6 reflects on the success of the study, its conclusion and directions for further studies.

## 2. Literature review

### *2.1 The fit perspective*

Literature on technology adoption tends to suggest the existence of a strong correlation between task and technology [7], information processing needs and information processing capabilities [8], source of the technology and recipient of the technology [9] and task type and technology [10]. The study adopts the word fit as defined by Venkatraman [9] to be the match between two related variables.

The main aim of the Task-Technology Fit (TTF) model by Goodhue and Thompson [7] is to match the capabilities of the technology to the demands of a particular task. TTF is defined as the degree to which features of a technology match the requirements of the task and the abilities of the individuals performing the task. TTF suggests that information systems will have a positive impact on individual or organizational performance only when technology functionality is appropriately matched to user task requirements. Information Technology is more likely to have a positive impact on individual performance and be used if the capabilities of the Information Technology match the tasks that the user must perform [7]. Therefore, MSEs use of cloud computing services is dependent on whether the capabilities of the cloud computing services match the information processing tasks' requirements that need to be performed. That is, there must be a fit between the features of cloud computing services and the information processing tasks' requirements within the MSEs. A good task-technology fit will lead to technology usage, while a poor task-technology fit will decrease users' intention to use the technology [12], [13], [14]. MSEs will not use cloud computing services if there is a poor fit between the CCS and their ICT related tasks. For the MSEs to acquire and integrate the cloud computing services, cloud computing characteristics (technology functionalities) should fit the MSEs' task characteristics (task demands, needs or requirements). Hence, the following is proposed:

**Proposition 1:** The greater the fit between the MSEs' information processing tasks' requirements and the cloud computing functionalities, the greater the potential for adoption of the cloud-based services by the MSEs.

Zabukovsek and Bobek [15] posits that organizations will deploy a technology to facilitate organizational work rather than to match user's personal preferences. Zabukovsek and Bobek [15] concludes that the perception of fit between information technology and MSEs' mandatory work will motivate the employees to use the system. This implies that if the cloud computing services fits the MSEs' required tasks, the employees will be motivated to use the technology to perform the required tasks. Zabukovsek and Bobek [13] refers to this fit as work compatibility. Therefore, in the context of cloud computing services, the more compatible with the MSEs' mandatory tasks, the cloud computing services are, the higher the degree of adoption. This leads to the following proposition:

**Proposition 2:** The greater the work compatibility between the cloud-based services and MSEs' mandatory tasks, the greater the potential for adoption of the cloud-based services by the MSEs.

The Organizational Information Processing Theory (OIPT) identifies information processing needs, information processing capability and the fit between the two to obtain optimal performance [8]. From the OIPT point of view, cloud computing services can be conceptualized as a particular type of information processing capability. Information processing is the purposeful generation, aggregation, transformation and dissemination of information associated with accomplishing some organizational task [8]. Cloud computing information processing capability could be defined as

ICT-related capacity to support essential ICT requiring tasks such as computing, storage, data backups and financial management. MSEs' ICT related activities such as data processing, storage, backups and financial management are the organizations' information processing needs. Although it has been argued that there is no relationship between security and cloud adoption [16], data security has been quoted as one of the highest risk elements in the adoption of cloud computing [17], [18], and [19]. Cloud computing services information processing capability should also take into consideration the MSEs' data security management. Therefore, technology must fit the operating practices of an adopting organization [15]. This is defined as the fit between the technology and the organization' business processes. The question is whether the cloud computing information processing capabilities fit the MSEs' business processes. Thus, the following is proposed:

**Proposition 3:** The higher the fit between the MSEs' business processes and the cloud computing services capabilities, the greater the potential for the adoption of the cloud-based services by the MSEs.

The Technology-Organization-Environment (TOE) framework [20] indicates that organizational adoption of technology is influenced by organizational, environmental, and technological contexts. Organizational factors include the enterprise's business scope, the quality of human resource, and the firm size. For the MSEs, the quality of human resource, and the firm size are key characteristics that would influence the desire to acquire and integrate cloud computing services. Environmental factors include vendor support and readiness, government support, and technology support infrastructures. Environment factors such as government support are a significant motivator of Small and Medium Enterprises (SMEs') technology adoption [21]. Technological context defines the availability of internal and external technologies pertinent to the MSE, such as the availability of community and public cloud computing services. Tornatzky and Fleischer [20] indicates that one of the key factor influencing technology adoption at organization level is vendor support and readiness. This implies that the the nature of inter-organizational relationship between the cloud computing vendors and the MSEs should focus on their mutual interests. The vendor should address any issues relating to lack of knowledge on how to acquire and implement cloud computing services in the MSEs and be ready to guide the organization in the process of acquiring and integrating the technology. The desire of any MSEs' management is to have the cloud computing services vendors to tailor their support contracts to fit the organization's ICT infrastructure support needs. Adequate technical and user support by the cloud computing vendors to the MSEs is paramount for the adoption of the cloud computing services. Vendor support is determined by the inter-organizational relationship between the vendor and the consumer of the cloud computing services. Even though it takes just connectivity and payments to use the cloud-based resources, vendor lock-in has been identified as possible barrier to the adoption of cloud computing [22]. Vendor lock-in occurs when an organization gets "trapped" in a public cloud vendor services and is forced to stay with a provider that does not meet its needs, just to avoid the cumbersome and risky process of moving. To avoid the problems associated with vendor lock-in, MSEs should choose vendors who are using the Cloud Data Management Interface (CDMI) standard created by the Storage Networking Industry Association or to run a "multicloud" by using services from two or more public cloud vendors. Trust and long-term partnerships between the vendor and consumer influences cloud computing services adoption. Therefore, the study proposes the following:

**Proposition 4:** The greater the degree of the inter-organizational relationship, the more likely the MSEs will adopt the cloud-based services.

### *2.2 Cloud computing services*

National Institute of Standards and Technology (NIST) defined "cloud computing as a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services), that can be rapidly provisioned and released with minimal management effort or service provider interaction [23]. Cloud computing has five essential characteristics (on demand self-service, broad network access, resource pooling, rapid elasticity and measured service), three service models (software as a service (SaaS), Platform as a Service (PaaS) and Infrastructure as a Service (IaaS), and four deployment models (Public cloud, private cloud, hybrid cloud and community cloud) [24]. Hybrid cloud is a combination of private and public clouds and it is the deployment model of cloud computing which is generally adopted by many organizations [25]. The adoption of cloud computing is essentially driven by trading partners, their requirements and the facilitation of the cloud service providers [26].

### 2.3 *Cloud computing adoption in organizations*

Cloud computing adoption is dependent upon organizational infrastructure and expertise related to the technology within the enterprise [26]. Smaller firms are less likely to have successful system implementations owing to scarcity of financial and human resources, limited information systems knowledge, and a lack of information technology competence [27]. But Carcary et al. [28] suggests that micro firms are adopting cloud computing in order to compete more effectively. Trong [29] also indicates that small businesses could use customizable cloud computing services to enhance their competitive advantage. To gain these benefits, Elson and Howell [30] posits that when adopting cloud computing, organizations and their top management should make an effort to access and analyse possible changes in organizational culture, process and work relationships. Large organizations which have made huge investments in ICT infrastructure experience difficulties related to integrating cloud computing services with the existing on-premise applications [31]. While citing Banerjee [32] and Goscinski and Brock [25], Gangwar et al. [26] concludes that cloud computing adoption rate is not growing as fast as expected even though the technology provides several strategic and operational advantages to organizations. This study is an analysis of how cloud computing fit the MSEs' business processes, employee tasks demands and organizational information processing needs, all which determines the extent of any information technology adoption at the firm level.

Individual consumers have over the years adopted cloud computing services such as the free email services and the data storage facilities available online. The Kenyan consumers of ICT services are also known for their unprecedented uptake of the mobile money and mobile internet. Consequently, examining cloud computing adoption among the Kenyan MSEs would be of interest as any technology adoption is said to be guided by some contextual factors. Kshetri [33] recommended that there is a need to have studies that can elucidate organizations' cloud adoption decisions. One such study done to measure the level of implementation of Cloud Computing in Portuguese companies revealed that the firms were not only using the cloud services to save on costs but also to optimize the resources available in order to improve business processes [34]. Abubakar et al. [35] did a survey on high ranking Information Systems Journals and found minimal serious publishing on cloud computing adoption by Small and Medium Sized Enterprises (SMEs) in Sub-Saharan Africa between 2005 and 2013. This study is an endeavor to reduce the publication gap on cloud computing services in Sub-Saharan Africa as revealed by Abubakar et al. [35] and an attempt to explain the organizations' cloud adoption decisions as recommended by Kshetri [33]. Cloud computing technologies could also be attractive to MSEs as small business have interests in outsourcing their information technology services in order to concentrate more on their core businesses [36], [37].

### 2.4 *Cloud computing affordability*

Cloud computing services involves use of the vendor computing resources over the internet. This lowers the costs of purchasing the required on-premise ICT infrastructure and eliminates the technical complexities required to install, manage and maintain the infrastructure. It has been suggested that cost savings is one of the drivers of cloud computing services adoption. MSEs could benefit from use of cloud based applications as the cost advantages of cloud computing is said to be three to five times for business applications [23] as the organization just pays for use and not for ownership. Cloud computing also reduces organization's cost by reducing the amount of technical support required as opposed to the traditional setup where the ICT team is bogged down with installing, reinstalling, and troubleshooting the ICT infrastructure. Boss et al. [38] concludes that adoption of cloud computing reduce costs through improved utilization, reduced administration and infrastructure cost and faster deployment cycles. Cloud computing vendors use different costing models to bill their customers on pay per use basis [39]. This means that the customers can use the services on a short term basis when required and also release them when no longer required. For instance, Uhasibu [40] is a cloud-based accounting system for SMEs, build specifically for the Kenyan Small and Medium Enterprises. The company offers subscription for the business application as shown on Table 1.

Table 1. Uhasibu accounting package subscription rates for SMEs

| Months / Product | Uhasibu (only) | Uhasibu + Payroll | Payroll (only) |
|---|---|---|---|
| 1 month | 1,000KES + VAT = 1,160KES<br>Approx USD 10/mo | 1,500KES + VAT = 1,740KES | 1,000KES + VAT = 1,160KES |
| 6 months (+ 1 free month) | 6,000KES + VAT = 6,960KES<br>Approx USD 60/mo | 9,000KES + VAT = 10,440KES | 6,000KES + VAT = 6,960KES |
| 10 months (+ 2 free months) | 10,000KES + VAT = 11,600KES<br>Approx USD 100/mo | 15,000KES + VAT = 17,400KES | 10,000KES + VAT = 11,600KES |

**Legend:** 1,000 KES =8.65EUR

The Angani [41] VAULT servers offers redundant datacenters, on subscription bases for fast, reliable and secure backup for business data as shown in Table 2. This kind of pricing allows the MSEs to enjoy scalability and the elasticity to add or remove resources at will, depending of the organizational resource requirement. This allows the MSEs to easily manage peak and off-peak schedules successfully. Armbrust et al. [42] suggests that organizations do not have to handle the peak times computing power demands by purchasing new equipment but instead, the peak computing demands should be handled by cloud servers.

Table 2. Subscription for Virtual Machines Services available from Angani

| Tiny | Small | Medium |
|---|---|---|
| KES 0.69 /Hr. , Approx. USD 0.01 /Hr | KES 2.69 /Hr., Approx. USD 0.03 /Hr. | KES 7.41 /Hr., Approx. USD 0.07 /Hr. |
| KES 512 or USD 5.12 /Mo | KES 1,999 or USD 19.99 /Mo | KES 5,499 or USD 54.99 /Mo |
| RAM: 512 MB<br>vCPUS: 1<br>Disk Space: 10GB<br>1GB/s unlimited traffic within Kenya<br>1TB international transfer | RAM: 1 GB<br>vCPUS: 1<br>Disk Space: 20GB<br>1GB/s unlimited traffic within Kenya<br>1TB international transfer | RAM: 2 GB<br>vCPUS: 2<br>Disk Space: 40GB<br>1GB/s unlimited traffic within Kenya<br>1TB international transfer |

**Legend:** 1,000 KES =8.65EUR

The cost of buying hardware, storing and securing it, licensing and maintaining it is expensive. The cost of in-house data center is beyond the reach of most Kenyan MSEs as the energy costs are also high while administrative costs are prohibitive. Cloud computing pricing could be categorized either as tiered pricing, per-unit pricing and subscription-based pricing [43]. With the subscription model, there is a huge cost savings for small firms [44]. The per use revenue model provides an avenue for the small businesses to manage to pay for enterprise applications like CRM (Customer Relationship Management) or SCM (Supply Chain Management) tools [45], [46]. Use of cloud computing services such as the IaaS reduces the capital expenses and ICT costs [47]. Miller [48] indicates that cloud computing enables organizations to reduce their hardware costs. The cloud-based computing services pricing models allows the MSEs to choose the prices that fit their budget and their ICT infrastructure needs, leading to the following proposition:

**Proposition 5:** The greater the perceived match between the organizational ICT infrastructure budget and the cloud computing service costing models, the more likely the MSEs will adopt the cloud-based services.

### *2.5 Research model*

The study research model presented in Fig. 1 is based on the premise of the fit between the information processing needs of the MSEs and information processing capabilities provided by the cloud computing services and its impact on the acquisition and integration of the cloud computing services. The study identifies the information processing needs of the MSEs and the available cloud computing services offering the requisite information processing capabilities to support these MSEs' information processing requirements. In the conceptual model, the study posits that independent factors like Task Technology Fit, Work Compatibility Fit, Business Process Fit, Inter-organization Fit and Cost Fit will influence the adoption and use of cloud computing.

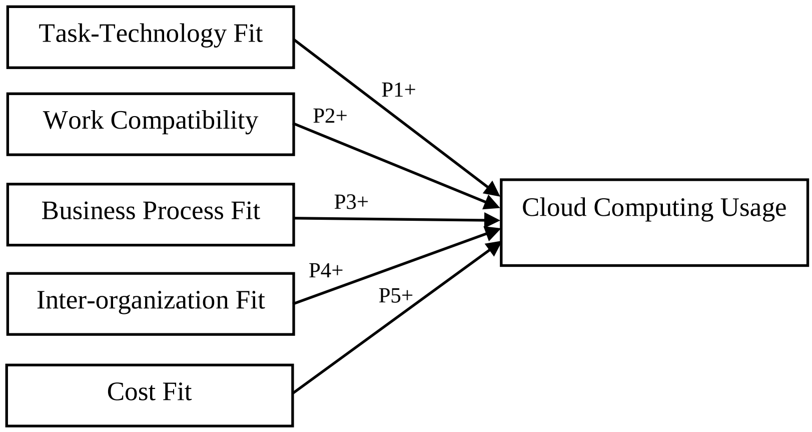


Fig. 1. Theoretical model and propositions

## 3. Research methodology

The study used a combined qualitative and quantitative research approach in two phases. An overview of the overall research design for this study is presented in Fig. 2. The qualitative phase of the study was used to examine the availability of commercial cloud computing services in Nairobi. To identify the commercial cloud computing services offered in Nairobi and especially those targeting MSEs, a review of cloud computing vendors' advertisements in the four Kenyan Daily Newspapers between April 2014 and January 2015 was done. In total, there were thirty-four advertisements placed to sell cloud computing services in the daily newspapers by eight different cloud computing vendors. Five of the advertising companies were randomly selected as study participants.

The study made arrangements to have in-depth semi-structured interviews with the participating cloud computing providers' Chief Operating Officers or any senior personnel who had any role in the management of the distribution of the organization's CCS. Using semi-structured, one-on-one interview, the respondent cloud computing providers' Chief Operating Officers were expected to provide details about their organizations' profiles, types of cloud services offered and their rates, the number of cloud computing customers and any concerns raised by their customers regarding adopting cloud-based services. Each interview lasted 30-60 minutes, and detailed notes were taken and analyzed later. In some instances, two of the five study participating CCS vendors' Chief Operating Officers (COOs) gave the interviewer a tour of their cloud computing facilities. The cloud computing providers' Chief Operating Officers were also requested to make available a list of their customers to be used for the cloud computing service users' survey phase of the study.

In the second phase of the study, a survey with either the MSEs Information Technology managers, managing directors or the owners was accomplished using a hand-delivered questionnaire. To enhance the validity of the questionnaire, a pilot study was conducted. During the pilot study, twenty clients were randomly selected from the customer lists provided by the CCS vendors. To get a representative pilot sample, four customers from each of the list provided by different CCS vendors were selected. A pre-tested survey questionnaire was hand-delivered to the customers' premises for the pilot exercise. The questionnaire was based on the research model, Fig 1. Eighteen questionnaires out of the twenty delivered during the pilot study were filled out properly and were used for the purpose of piloting the questionnaire.

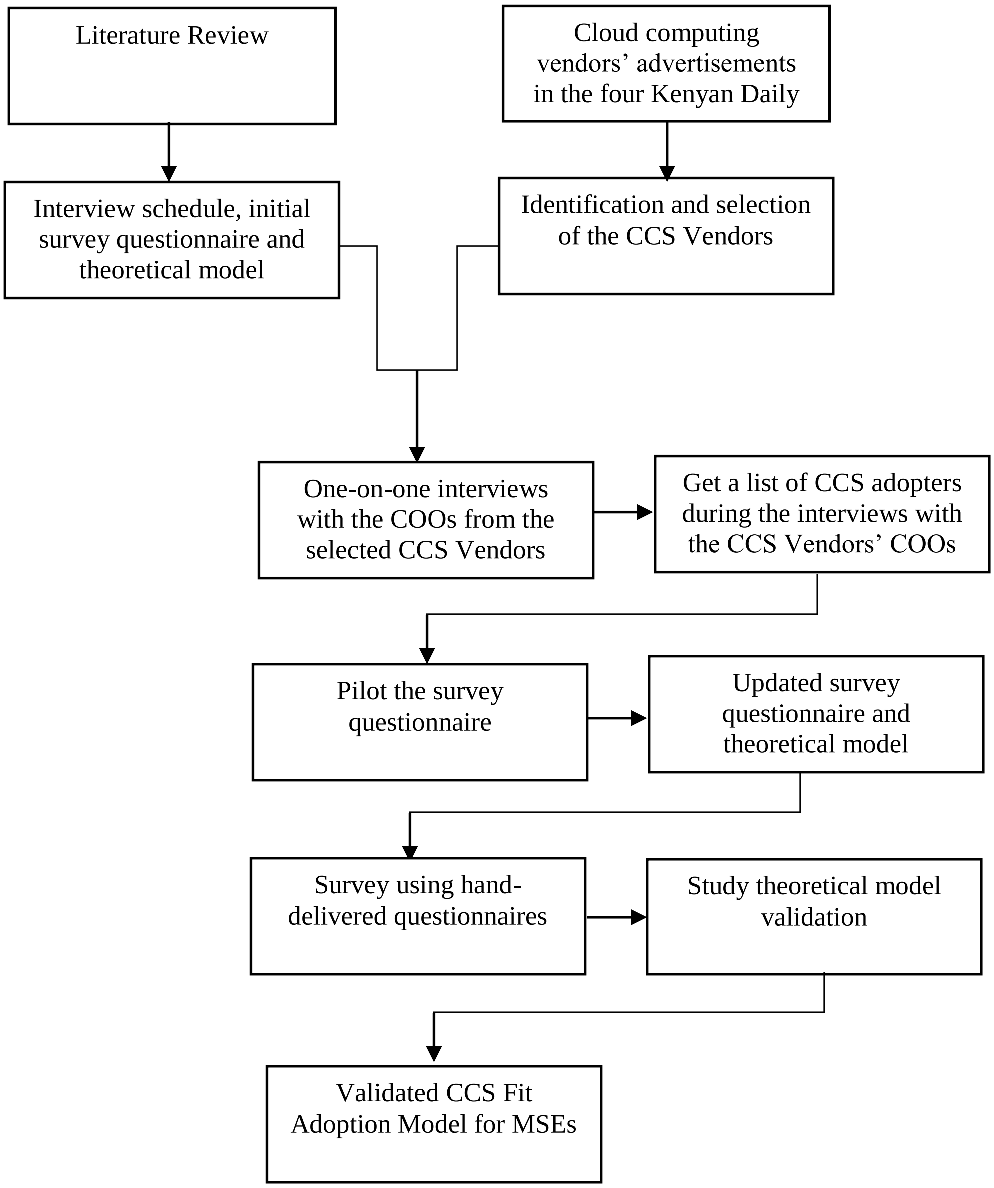


Fig. 2. Overall research design

Table 3 shows data pertaining to some of the commercial cloud computing services offered in Nairobi. This was deemed necessary, given that the services must be made available for the MSEs to procure them. Most of the Chief Operating Officers were happy with the CCS their organizations offered as evidenced by this comment from one of the interviewees, "*I don't know of any other business that offers the most reliable cloud and hosting services like us*".

Table 3: Cloud Computing Services available for the MSEs in Nairobi

| **Type of Cloud Service** | **Available Cloud Computing Service in Nairobi** |
|---|---|
| Software as a service (Saas) | Email, Accounting, Payroll, virtual office, Mobile Sales Force Management and Mobile Fleet Management |
| Infrastructure as a service (Iaas) | Backup, Storage, Compute, Disaster Recovery as a Service, Virtual PABX, Managed Media Platform, Managed Host Services |
| Platform as a service (Paas) | Business process management (BPM PaaS), DBaaS |

The list of the services in Table 3 includes the services provided by either the service providers themselves or the resellers. There are a number of organizations who are resellers of internationally recognized cloud computing services such as the Access Kenya [49] who do resell SEACOM's Cloud Services through their Pamoja Cloud Services. For an organization to qualify to resell a service, they need to meet certain technical and sales skills criteria [49].

The second phase of data collection was a survey using the pre-tested questionnaire. The questionnaire was administered to 250 randomly selected MSEs. The study MSEs were selected from the lists of customers provided by the cloud computing service providers. The characteristics of the selected MSEs are presented in Table 4.

Table 4: Sample Characteristics (the participating MSEs)

| **MSEs Sector** | Number of participating Micro Enterprises | Number of participating Small Enterprises | **Total** (n=250) |
|---|---|---|---|
| Manufacturing | 18 | 22 | 40 |
| Construction | 12 | 26 | 38 |
| Trade (Wholesale and Retail) | 29 | 47 | 76 |
| Services | 41 | 55 | 96 |

To ensure the validity of the study, the questionnaire measures were drawn from prior validated instruments in extant literature. All the items were measured using a five-point Likert scale, ranging from 'strongly disagree' to 'strongly agree'. The adopted constructs are presented in Table 5 and their measures are specified in appendix 1.

## 4. Results

The survey respondents were employees of enterprises that were already using cloud-based solutions. One hundred and eighty (180) questionnaires were properly filled out by the respondents, yielding a 72% response rate, and were used for the data analysis. The data analysis technique used was variance-base Partial Least Squares Structural Equation Modeling (PLS-SEM) using WarpPLS 5.0 software while SPSS AMOS (Analysis of Moment Structures) 23.0 software was used to define additional goodness-of-fit indices for the study model.

The aim of the study was to assess the fit between the MSE's organizational ICT needs and the cloud computing services and how this fit influences the adoption. PLS is considered as a soft modelling approach and a good alternative to covariance based SEM when predictive accuracy is paramount and the number of participants is limited [50]. For studies that seek to predict and explain the target constructs, PLS-SEM is a more appropriate as suggested by Hair et al. [51] and Wong [52]. In addition, PLS-SEM does not impose any normality requirements on the data. PLS-SEM is more suited for theory building (exploratory analysis) and it can also be used for theory confirmation (confirmatory analysis) [50]. Bates et al. [53, p. 200] suggests that CFA "is most appropriate when applied to measures that have been fully developed and with established and validated factor structures" and it is a hypothesis testing approach. The study elected to perform a Confirmatory Factor Analysis (CFA) rather that Exploratory Factor Analysis (EFA) as the study constructs were derived from well-developed and tested theories and the proposed study model was testing propositions.

Table 5. Adopted constructs for the study

| **Constructs** | **Description of Construct** | **Construct category** | **Proposition** | **Literature references** | **Number of Scale Items** |
|---|---|---|---|---|---|
| Task Fit | A user's perception of a match between Task characteristics and Cloud Computing Characteristics | Predictor Variable | P1 | [4], [5], [9], [10], [11], [12] | 4 |
| Work Compatibility Fit | A user's perception of a match between MSEs' mandatory tasks and cloud computing technology | | P2 | [13] | 3 |
| Business Process Fit | A user's perception of a match between MSEs' Information Processing needs and cloud computing information processing capabilities | Predictor Variable | P3 | [4], [5], [13], [15], [16], [17] | 6 |
| Cost Fit | A user's perception of a match between MSEs' ICT infrastructure budget and cloud computing services pricing models | Predictor Variable | P4 | [23], [24] | 3 |
| Inter-organization Fit | A user's perception of a match between the MSEs' ICT support requirement and cloud computing services provider support provision | Predictor Variable | P5 | [12], [14], [18], [19] | 3 |
| Actual Cloud computing Services Use | A user's self-reported use of CCS | Criterion Variable | | [4] | 3 |

### *4.1 Cloud computing services usage among the MSEs*

The study tried to find out the type of cloud computing services adopted by the MSEs. A host of the study MSEs were using multiple cloud-based services. Regarding the level of cloud computing adoption, it is noted that backup and recovery services has the highest level of implementation with 98% of the MSEs participating in the study using the service. Email and messaging services (94%) and office applications (74%) are also popular cloud computing implementations among the study MSEs. Virtual PABX (6%), ERPs (8%) and software development platforms (12%) have low levels of adoption among the study MSEs. Data storage services (44%) and business process management (36%) have moderate levels of adoption among the study MSEs as shown in Fig. 3.

### *4.2 Reliability and validity*

Confirmatory factor analysis was used to test the measurement model for the reliability and the validity. The reliability and validity of the research measurement instrument was assessed using WarpPLS 5.0. Validity is the extent to which an instrument measures what it is supposed to measure and performs as it is designed to perform while reliability is the degree to which the instrument consistently measures what it is intended to measure.

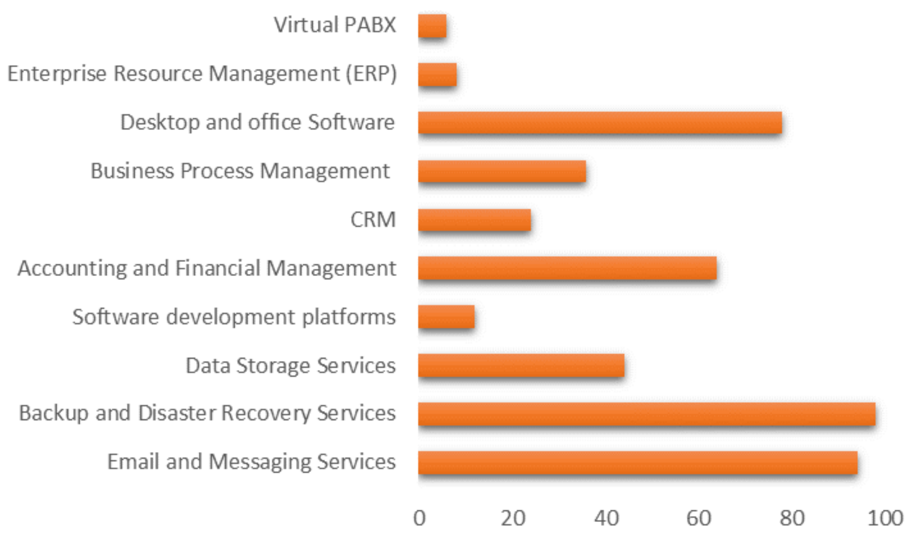


Fig. 3. Use of cloud-based services by the study MSEs

Constructs validity was analyzed using convergent validity and discriminant validity.

Convergent validity is defined as the extent to which a specified set of indicators for a construct converge or share a high proportion of variance in common. Convergent validity of the measures was assessed through calculating composite reliability. The Composite Reliability (CR) for items in each construct was 0.87 or higher, exceeding the 0.70 criterion proposed by Hair et al. [51]. Convergent validity is also assessed using factor loadings. Fornell and Larcker [54] indicates that higher factor loadings show excellent convergent validity. The study factor loadings, Table 7, range from 0.966 to 0.999, which exceeds the required threshold of 0.6 as suggested by Stevens [55], and Goffee, and G. Jones [56]. Fornell and Larcker [37] also recommends a value of 0.5 Average Variance Extracted (AVE) as an acceptable threshold for convergent validity. For this study, the AVEs ranges from 0.665 to 0.892 as indicated in Table 6. Therefore, the study has an acceptable convergent validity.

Discriminant validity is the extent to which the indicators of a construct represent a single construct and the construct's indicators are distinct from other constructs in the model. To measure discriminant validity, the study assessed this through the Average Variance Extracted (AVE). Fornell and Larcker [54] suggests that the square root of AVE should be higher than any correlation of that factor with any other measure. As shown in Table 6, the square root of the AVE (the bolded diagonal values) for each variable in the study is greater than correlations between the variable and all other latent variables which indicates an excellent discriminant validity.

Reliability is an assessment of the internal consistency of a measurement instrument and a measure of the degree of homogeneity among the measurement items in a given construct, an assessment of whether the study instrument would give similar results in different situations or under similar circumstances but at a different time. Composite reliability and Cronbach's alpha coefficients are used to assess a measurement model's acceptable reliability. Gofee and Jones [56] and Nunnally and Bernstein [57] set a more relaxed threshold of acceptable reliability as 0.6 Cronbach's alpha coefficient while Hair et al. [51], and Chin et al. [58] recommends a value of 0.7. From the figures in Table 6, the study Composite reliability and Cronbach's alpha coefficients are all well above the recommend thresholds, hence the study model exhibits adequate reliability and construct validity.

The results of Composite Reliability, Average Variance Extracted (AVEs), square root of AVEs, Chronbach's Alpha, and the correlations of the constructs are summarized in Table 6.

The results of confirmatory factor analysis show a conspicuous factor structure in which all measurement items loaded on the anticipated constructs and were significant at a value of 0.966 or higher. Higher factor loadings are an indication of possible multicollinearity and therefore multicollinearity statistical test was done. Knock [59] defines multicollinearity as a measure of the correlation between the predictors of a variable which falsely inflates the standard errors, and therefore certain model parameters may sometimes become unstable. Multicollinearity is assessed using the Variance Inflation Factors (VIFs). VIFs lower than 5 suggests no multicollinearity [51]. The current study VIFs values indicate nonexistence of multicollinearity as they meet the recommended threshold as shown in Table 7. The result of confirmatory factor analysis confirmed both convergent and discriminant validity.

### *4.3 Study model analysis*

Structural Equation Modeling allows testing of different components of a study model. These are the measurement model and the structural model.

The measurement model tests the goodness-of-fit between the data and the proposed measurement model. WarpPLS provides several measures of model fit. Knock [59] provides the recommended interpretation of each measure. The results of the study measurement model analysis show statistically acceptable goodness of fit according to Knock [59] as shown in Table 8. Therefore, in accordance to Kock [59] the model has a good fit to the data.

SPSS AMOS 23.0 software was also used to determine additional goodness-of-fit indices for the study model as shown in Table 9. These indices include Chi-square (CMIN), Degrees-of-Freedom (df), Chi-square/Degrees-of-freedom (CMIN/DF), and Root mean square error of approximation (RMSEA) as indicated in Table 9. The study model fit indices in Table 9 indicate a good fit. Consequently, in accordance to Kock [59], Hair et al. [51], Bentler and Bonnet [60] and Hu and Bentler [61] the model has a good fit to the data.

The structural model analysis using PLS-SEM was used to examine the predictive capabilities of the model and the relationship between the constructs. The structural model output from WarpPLS is depicted in Fig. 4. Shown on the arrows are the path coefficients values and the path significance.

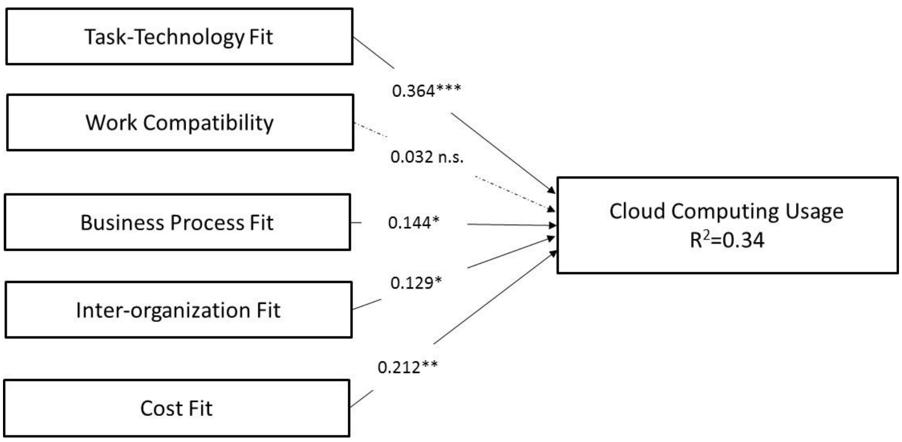


Fig. 4. PLS analysis of the structural model

Path significance: *** p<0.001, ** p<0.01, * p<0.05, n.s. not significant

Table 6. Analysis of reliability and validity

| Constructs | Chronbach's Alpha Coefficient | Composite Reliability | AVE | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|---|---|---|
| Task Fit | 0.832 | 0.888 | 0.665 | **0.816** | | | | | |
| Business Process Fit | 0.940 | 0.952 | 0.769 | 0.434 | **0.877** | | | | |
| Cost Fit | 0.916 | 0.947 | 0.857 | 0.077 | 0.019 | **0.926** | | | |
| Inter-organization Fit | 0.938 | 0.961 | 0.892 | 0.309 | 0.347 | -0.034 | **0.944** | | |
| Work Compatibility Fit | 0.926 | 0.954 | 0.875 | 0.310 | 0.233 | -0.009 | 0.261 | **0.935** | |
| Actual Use | 0.779 | 0.872 | 0.694 | 0.396 | 0.378 | 0.150 | 0.177 | 0.162 | **0.833** |

*Note:* Square roots of the AVE are the bolded diagonal values

Table 7. Confirmatory factor analysis and multicollinearity test

| Scale Item | Task | Process | Cost | InterOr | Work | Usage | VIFs |
|---|---|---|---|---|---|---|---|
| TTF1 | 0.969 | | | | | | |
| TTF2 | 0.981 | | | | | | 1.440 |
| TTF3 | 0.966 | | | | | | |
| TTF4 | 0.983 | | | | | | |
| BP1 | | 0.972 | | | | | |
| BP2 | | 0.989 | | | | | |
| BP3 | | 0.991 | | | | | 1.403 |
| BP4 | | 0.989 | | | | | |
| BP5 | | 0.993 | | | | | |
| BP6 | | 0.924 | | | | | |
| CF1 | | | 0.988 | | | | |
| CF2 | | | 0.999 | | | | 1.031 |
| CF3 | | | 0.983 | | | | |
| IOF1 | | | | 0.997 | | | |
| IOF2 | | | | 0.978 | | | 1.213 |
| IOF3 | | | | 0.997 | | | |
| WC1 | | | | | 0.997 | | |
| WC2 | | | | | 0.997 | | 1.152 |
| WC3 | | | | | 0.98 | | |
| US1 | | | | | | 0.986 | |
| US2 | | | | | | 0.988 | 1.290 |
| US3 | | | | | | 0.972 | |

*Note:* Results are presented as normalized pattern loadings and cross-loadings obtained using oblique rotation and Kaiser Normalization as reported by WarpPLS.

Table 8. Model fit and quality indices using WarpPLS

| Measure | Value (Sig.) | Evaluation Criteria |
|---|---|---|
| Average path coefficient (APC) | 0.176 (P=0.004) | Acceptable if p<0.05 |
| Average R-squared (ARS) | 0.337 (P<0.001) | Acceptable if p<0.05 |
| Average adjusted R-squared (AARS) | 0.318 (P<0.001) | Acceptable if p<0.05 |
| Average block VIF (AVIF) | 1.325 | Acceptable if <= 5, ideally <= 3.3 |
| Average full collinearity VIF (AFVIF) | 1.255 | Acceptable if <= 5, ideally <= 3.3 |
| Tenenhaus GoF (GoF) | 0.516 | Small >= 0.1, Medium >= 0.25, Large >= 0.36 |
| Sympson's paradox ratio (SPR) | 1.000 | Acceptable if >= 0.7, ideally = 1 |
| R-squared contribution ratio (RSCR) | 1.000 | Acceptable if >= 0.9, ideally = 1 |
| Statistical suppression ratio (SSR) | 1.000 | Acceptable if >= 0.7 |
| Nonlinear bivariate causality direction ratio (NLBCDR) | 0.800 | Acceptable if >= 0.7 |

Benchmarks are those cited by Kock [59]

Table 9. Additional Model it indices using SPPS AMOS 23.0

| Goodness of Fit Indices Measure | Recommended Value | The Study Model |
|---|---|---|
| Chi-Square CMIN | N/A | 161.738 |
| Degree of freedom | N/A | 88 |
| X2/d.f - chi-square to the degrees of freedom, Bentler and Bonnet (1980)[60] | <5 is preferred | 1.838 |
| Comparative Fit Index (CFI), Hair et al. (2014)[36] | >0.90 is desirable | 0.952 |
| Standardized Root Mean Square Residual (SRMR), Hu and Bentler, 1999[61] | <0.08 is desirable | 0.044 |
| Root Mean Square Error of Approximation (RMSEA), Hair et al. (2014)[36] | <0.08 is adequate | 0.068 |

Fig. 4 presents the structural relationships between the study variables and the standardized path coefficients with their respective significance levels. The model accounts for 34% of the observed variance in cloud computing services usage. The path coefficients and path significance are also shown in Table 10. With the exception of the path from work compatibility (P2), all the other path coefficients in the model were significant.

Assessing the structural model using PLS-SEM uses four key components namely the significance of the path coefficients, the level of the R-squared (R2) values, the $f^2$ effect size and the predictive relevance Q-squared (Q2).

Table 10: Path estimates for the model relationships

| Propositions | Path | Coefficient | p-value | $f^2$ Effect Size | Decision |
|---|---|---|---|---|---|
| P1 | Task⇨Use | 0.364 | <0.001 | 0.181 | Supported |
| P2 | Work Compatibility⇨Use | 0.032 | 0.334 | 0.006 | Not Supported |
| P3 | Processes⇨Use | 0.144 | 0.024 | 0.056 | Supported |
| P4 | Inter-organization⇨Use | 0.129 | 0.039 | 0.050 | Supported |
| P5 | Cost⇨Use | 0.212 | 0.002 | 0.045 | Supported |

R-Squared value for the Actual Use of cloud computing services is 0.337. R-Squared values are considered substantial for values above 0.67, and moderate for values 0.33-0.67 [62], hence the model has reasonably explained the variance in Actual Use of cloud computing by the study MSEs. For predictive validity of a model, Stone-Geisser Q-Squared is considered an acceptable indicator. A value greater than zero indicates validity, and higher value indicates better predictive power [62], [63]. The current study model Q-Squared value of 0.336 indicates a good predictive validity for the study model.

## 5. Discussion

Cloud computing services are quickly changing the way small businesses use and adopt ICTs. The number of MSEs adopting cloud computing services is increasing every day as cloud-based services helps the MSEs to overcome the constraint of limited ICT infrastructure budget. MSEs have inadequate financial and human resources and their choice of cloud computing adoption could be dependent on a strong need to have a technology that can accomplish a specific business task. This made it necessary for this study not to investigate and test the study model using a single cloud computing service offering, such as IaaS or PaaS, but to assess the fit between the MSE's organizational ICT infrastructure needs and any cloud computing services the MSE have deployed and how this fit influences the adoption of that particular cloud computing service. Consequently, the study results could guide any MSE in making future decision on adoption of cloud computing services. The study findings indicate that cloud computing services fit the MSEs' information processing needs, tasks technology requirements, inter-organizational support requirements and their prices are within the existing MSEs' ICT budgets.

The results of the data analysis show that, Task Fit (Task Technology Fit) has a significant positive effect on utilization which supports prior findings by McCarthy and Claffey [64] where Task Technology Fit is shown to lead to Information Systems utilization. This result provide evidence that the study model proposition 1 holds. That is, if there is a fit between the MSEs' information processing tasks' requirements and the cloud computing functionalities, MSEs will adopt the cloud computing services. Therefore, MSEs use cloud computing because they match their task technology requirements. In contrast to Zabukovsek and Bobek [15], this study did not find any significant relationship between Work Compatibility and usage and hence proposition 2 is not supported by the study data. In this case, using cloud computing services in MSEs is not influenced by the employees' attitude towards the cloud computing services. This is usually noted in studies involving mandatory use of a technology in the work environment such as Chang et al. [65], Wright et al. [66], and Ward et al. [67] where the employee is required to use a specific technology to fulfill their employment obligations rather than to match their personal preferences or habits. The study findings are also consistent with Gribbins et al. [10], Zabukovsek and Bobek [15], Dasa and Narasimhan [68], and Nah et al. [69], by showing that the fit between the MSEs' business processes and the cloud computing functionalities have a notable influence upon cloud computing services usage. This confirms proposition 3, that when the cloud computing services capabilities fit the MSEs' business processes requirements, MSEs will certainly adopt the cloud service.

The study findings also collaborate the importance of inter-organization factors in technology adoption. As with Stock and Tatikonda [7], the findings show that inter-organization fit is very important to any organizational external technology integration success, thus validating proposition 4. That is, the level of inter-organizational relationship (the relationship between the cloud computing vendor and the customer MSE) determines acceptance of the cloud-based services. Based on the analytical results, the study also found that cost fit is an influential factor of cloud computing usage. This is consistent with the results of previous studies on ICTs and cloud computing adoption which show that cost is a factor influencing adoption of ICT services by individuals and organizations [38], [70], [71], [72] and [73]. Use of cloud computing services by the MSEs provides significant financial savings in the MSEs' ICT infrastructure budgets and hence there exists a fit between the financial resources available to procure the required MSEs' ICT infrastructure and the cost of acquiring cloud computing services. This validates proposition 5, that the match between the organizational ICT infrastructure budget and the cloud computing service costing models determines the MSEs choice to adopt the cloud-based services. The results of the study propositions testing provide the evidence that different "Fit" influence the use of cloud computing services in the Kenyan MSEs.

## 6. Conclusion

In this study, the primary focus was to assess the fit between the MSE's organizational ICT infrastructure needs and the cloud computing services and how this fit influences the adoption of cloud computing services to support the MSEs' business processes. This was validated using the study model which identified and tested five propositions on the suitability of cloud computing services in meeting MSEs' ICT needs and hence determining the adoption of cloud computing by MSEs. The propositions one and three indicate that MSEs will adopt a cloud-computing-based service if the provided cloud service has the requisite functionalities to perform the MSEs' information processing task. By matching the cloud computing capabilities to the MSEs' information processing tasks, MSEs can leverage the best of what the CCS providers has to offer to meet their ICT business needs. Cloud computing technical complexities can be very challenging because of the limited ICT skills in most of the MSEs. Therefore, most MSEs require guaranteed support by their CCS providers. Proposition 4 tested and validated the important role of inter-organizational relationship in the adoption of the CCS by the MSEs. Most MSEs have meagre financial resource and the process of budgeting capital expenses for additional hardware and software every eighteen months is not possible. But with cloud computing, the MSEs will only incur recurring and consistent operational expenses. Using proposition 5, the study established that the fit between the MSEs' ICT budget and the cloud computing costing models will lead to CCS adoption.

The study enhances both the practical and theoretical understanding of the fit dimensions between the MSE's organizational ICT infrastructure needs and the cloud computing services and how this fit influences the adoption of cloud computing services to support the MSEs' business objectives. As implied by the study model, the utilization of cloud computing services is related to the good fit between the MSEs' ICT infrastructure needs and how the cloud computing services fulfills this need.  The study model provides good prediction of Actual Use of cloud computing services among the MSEs. The findings provide a foundation for further development and refinement of the model to study the fit between the MSE's organizational ICT needs and the cloud computing services and how this fit influences the adoption of cloud computing services to support the MSEs' business objectives. The study has also presented a picture of the current cloud computing services adopted by the MSEs in Kenya. Therefore, the study is a starting point for investigating fit between the MSE's organizational ICT needs and the cloud computing services.

From a practitioner standpoint, the study model will help the MSEs to leverage cloud computing services by identifying the match between the ICT needs and the cloud computing functionalities on offer. This will help the MSEs to maximise on the benefits of cloud computing services.

From an academic perspective, the study's contribution is in the development and testing of the fit model. This model could be integrated with other models or models' variables to improve on its exploratory power. The study also contributes to the understanding the use of cloud computing in small enterprises in developing countries. Further research is needed to test the presented model in empirical research to prove factors affecting adoption or intention to adopt or continuance intentions of cloud computing services in MSEs.

The study has certain limitations which provide opportunities for further study and research. As the study was a case of Kenya, the proposed model gives the most influential determinants of cloud computing usage by the Kenyan MSE's. Further studies in other developing countries could be used to test the validity of the proposed model and to provide a multi-case comparison of results. Future research should also examine the role of organization size and the years of operations on the adoption of cloud computing services among MSEs as these two variables have been studied in in the past and their impact on organizational ICT adoption documented. The study is also limited in that the study population was the MSEs in Nairobi. Therefore, there is a need to conduct similar study for the MSEs operating in rural areas where other factors such as lack of broadband connectivity could influence cloud computing services adoption. The study also considered cloud computing services as a whole and did not look at a specific service or model. Future studies could be done to validate the study model by testing the adoption of a specific cloud-based service, a service model or even a deployment model by the MSEs.

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**Appendix 1: The Survey questionnaire**

**Section A**

**Firm size**

- Business Sector (Manufacturing, Trade, Service, Construction)
- The number of employees
- Annual business volume

**Cloud Computing Adoption**

- Which organizational cloud computing services have you adopted (Specify the particular services in each of the following categories)
    - Infrastructure (IaaS)
    - Platforms (PaaS)
    - Software (SaaS
    - Others (XaaS)

**Section B (All items are based on 5-point scale)**

**Task-Technology Fit (Direct Measures)**

- TTF1: Cloud computing services are well suited for our MSE's daily routine tasks.
- TTF2: Cloud computing services fit well our MSE's business tasks.
- TTF3: Using cloud computing allows the employees to perform their specific tasks more quickly
- TTF4: Cloud computing services are well suited for the MSEs' ICT needs.

**Work Compatibility (Direct Measures)**

- WC1: The use of cloud computing is compatible with the way I worked before.
- WC2: The use of cloud computing is compatible with my style of work.
- WC3: Using cloud computing is compatible with the MSEs' job culture and value system.

**Business Process Fit (Direct Measures)**

- BPF1: Within the MSE there are the necessary skills to implement cloud computing services.
- BPF2: The use of cloud computing is fully compatible with current MSE's business operations.
- BPF3: Cloud computing technology has improved the efficiency between the MSE's business processes.
- BPF4: Cloud computing technology has improved the MSE's business processes.

- BPF5: The use of cloud computing services has improved the quality of the MSE's business operations.
- BPF6: The use of cloud computing is compatible with existing hardware and software in the MSE.

**Inter-organization Fit (Direct Measures)**

- IOF1: The cloud computing service providers have considerate user support models and pricing, providing an end-to-end continuity plan.
- IOF2: The cloud computing service providers have frequent interactions with the MSEs for the management of the services and its operations.
- IOF3: The cloud service provider is flexible in providing service levels in line with the MSE's requirements.

**Cost Fit (Direct Measures)**

- CF1: The benefits of cloud computing are greater than the costs of adoption.
- CF2: Cloud computing costs Fits the enterprise's annual ICT budget costs.
- CF3: Cloud computing technology has reduced the annual ICT Maintenance costs.

## Biographical notes

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Patrick Kanyi Wamuyu is an Assistant Professor of Information Technology at United States International University-Africa, Nairobi, Kenya. He has a Ph.D. in Information Systems and Technology from the University of KwaZulu-Natal, Durban, South Africa and a Postdoc from Indian Institute of Information Technology, Allahabad. His current research interests include: Information and Communication Technologies for Development (ICT4D), E-business Infrastructures, ICT Innovations and Entrepreneurship, E-Participation, Text and Social Analytics and Databases.

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