



## DETERMINANTS OF CLOUD COMPUTING ADOPTION AMONG SMES IN SRI LANKA: A META THEORETICAL FRAMEWORK



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### ABSTRACT

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Cloud Computing has recently emerged as a noteworthy milestone in the area of information and communications technology (ICT) systems development. In particular, Cloud Computing improves reliability and scalability of ICT systems, which allows small and medium-sized enterprises (SMEs) to scale down its ICT infrastructure while improving performance. Yet, there remains a dearth of literature that explicitly addresses the determinants of Cloud Computing adoption by SMEs. This paper aims to address voids in extant literature by developing a meta theoretical framework by assimilating two dominant theories in technology adoption literature. Following the pragmatism research paradigm and mixed methods research design, a face-to-face questionnaire survey was conducted as the main research strategy. Data stemmed from 142 SMEs in Sri Lanka were used to test the proposed framework using PLS-SEM. Twenty semi-structured interviews were initially used to validate the measurement scales before the main survey was undertaken. At the end, a supplementary qualitative phase was included with eight follow-up interviews to further discuss the findings of PLS-SEM analysis. Relative advantage, complexity, training and education, top management support, competitive pressure and trading partner support were identified as significant determinants.

**Contribution/ Originality:** This study is one of very few studies which have investigated the determinants of Cloud Computing adoption by developing a Meta theoretical framework. The Meta theoretical framework was developed by integrating TAM with TOE framework using variables of TOE framework as external variables of TAM.

## 1. INTRODUCTION

Small and medium-sized enterprises (SMEs) are perceived as a crucial element in socio-economic development of any country (Scupola, 2009). SMEs are the fastest growing sector in most economies around the world and play a pivotal role in creating job opportunities that large organizations fail to produce in sufficient quantities (Yeboah-Boateng and Essandoh, 2014). Similarly, SMEs have been recognized as an incubation ground for generating high economic growth, reducing unemployment, inequality and poverty in Sri Lanka (Weerasiri and Zhengang, 2012). In

recent years, SMEs are noted to experience a gradual reception towards adoption and diffusion of information and communications technology (ICT) innovations (Scupola, 2009; Yeboah-Boateng and Essandoh, 2014). Yet, a significant proportion of SMEs find it extremely challenging to invest in planning, designing, implementing and managing increasingly complex software, hardware and networking for in-house ICT requirements compared to their larger counterparts (Carroll *et al.*, 2014; Yeboah-Boateng and Essandoh, 2014). Instead, many SMEs are seeking alternative solutions that can reduce total costs of ownership of their ICT systems to focus their limited time and resources on core business and strategy.

This has led to increased interest in Cloud Computing, which provides scalable ICT capabilities as a service through the Internet to meet SMEs' business needs and scale down the operational costs of their ICT systems (Alshamaila *et al.*, 2013). Cloud Computing is a novel business model which is particularly valuable for SMEs, as Cloud Computing adoption can be undertaken with limited capital investment (Sahandi *et al.*, 2013). Moreover, Cloud Computing is commercially viable for many SMEs due to its reliability, scalability and flexibility as well as pay-as-you-go cost structure. Thus, SMEs have been identified among the primary beneficiaries of Cloud Computing (Alshamaila *et al.*, 2013). However, the early adopters of technology in the SME sector are minute in number and converting them to a larger "technology acceptor" market is challenging (Alshamaila *et al.*, 2013). Moreover, despite the noteworthy benefits, the uptake of Cloud Computing among SMEs is slow and discouraging and many of them seem to be still conservative when it comes to migration to Cloud Computing (Gupta *et al.*, 2013).

According to many scholars the decision-making process in Cloud Computing adoption is not always straightforward, and there are several factors that organizations take into consideration before they embark such decisions (Yeboah-Boateng and Essandoh, 2014; Gangwar *et al.*, 2015; Ross and Blumenstein, 2015). Some of these factors include low awareness of the benefits of technology, limited budget allocation and technical know-how, poor infrastructure and hesitation about migrating to new technologies. Recently, El-Gazzar (2014) and Adam and Musah (2015) highlighted the importance of investigating the determinants of Cloud Computing adoption in different research settings due to the presence of context-specific factors in most research settings.

Mostly, emerging literature on Cloud Computing has utilized a unitary theoretical perspective in investigating the determinants of Cloud Computing adoption (Low *et al.*, 2011; Abdollahzadegan *et al.*, 2013; El-Gazzar, 2014). Yet, Cloud Computing adoption is not a simple linear process. Technological factors are not the only significant determinant in this regard. There are other determinants such as organizational, environmental and economic factors that might have a significant impact on the decision-making process, but they have not been properly captured in most of the prior studies. In addition, a review of Cloud Computing adoption studies shows that a large portion of the extant literature was conducted in developed and industrialized economies (El-Gazzar, 2014; Adam and Musah, 2015). In contrast, scant scholarly attention has been paid in developing economies particularly when noteworthy benefits of Cloud Computing have been trumpeted continuously (Yeboah-Boateng and Essandoh, 2014). This gap is particularly apparent in the Asia-Pacific region and most SAARC countries including Sri Lanka. Although a significant number of studies aimed at SMEs have been conducted in Sri Lanka, much of these studies are being focused on economic, marketing, legal and employment aspects (Weerasiri and Zhengang, 2012). SMEs and Cloud Computing adoption have not been sufficiently investigated. As such, this paper attempts to fill this deficit in extant literature by investigating the determinants of Cloud Computing adoption by SMEs in Sri Lanka.

## 2. THEORETICAL FRAMEWORK AND HYPOTHESES DEVELOPMENT

### 2.1. Cloud Computing

Not surprisingly, Cloud Computing has been defined in many different ways, typically focusing on technical and service characteristics. For instance, Buyya *et al.* (2008) defined Cloud Computing as "a type of parallel and distributed system consisting of a collection of interconnected and virtualized computers that are dynamically provisioned and present as one or more unified computing resources based on service-level agreements established through negotiation between

service provider and customer”(p.2), while Plummer *et al.* (2008) defined it as “a style of computing where massively scalable IT-related capabilities are provided as a service using Internet technologies to multiple external customers” (p.3). In a broader context, Armbrust *et al.* (2009) defined cloud as “data center hardware and software that provide services” (p.5). It is decided to adopt the definition of Plummer *et al.* (2008) in this paper as it concisely captures the five essential characteristics (i.e. on demand self-service, broad network access, resource pooling, rapid elasticity and measured service) of Cloud Computing.

Cloud computing technology offers three different service models namely, Infrastructure-as-a-Service (IaaS), Platform-as-a-Service (PaaS) and Software-as-a-Service (SaaS) (Lal and Bharadwaj, 2016). IaaS is known as the basic level of Cloud Computing services that abstracts the user from the details of infrastructure such as physical computing resources, location, networking, data partitioning, scaling, security and backup. It delivers infrastructure services to customers over a network (e.g. the Internet). The objective of IaaS is to provide a virtual operating environment as a foundation for PaaS and SaaS, which is available on usage-based costing. PaaS is known as the second level of Cloud Computing services which offers online access to all the resources that are required to build an application. PaaS vendors offer a development environment (e.g. including operating system, programming-language execution environment, database, Web servers and hosting tools) that helps organizations in developing and deploying their applications by using infrastructure platforms available on the Internet. And, SaaS is known to deliver users a piece of software over a network such as the Internet. Unlike conventional IT solutions, in SaaS, there is no need to download and install any software applications (Jain and Bhardwaj, 2010). Instead, cloud service providers deliver their software applications to users over the Internet on a subscription basis (Goscinski and Brock, 2010; Low *et al.*, 2011). Thus, individuals and organizations pay for their services on-demand, or more simply, with a flat monthly charge. This eliminates the need to install and run the application on cloud user's own computers, which simplifies maintenance and support. Prolific literature witnessed that majority of the studies on Cloud Computing has considered Cloud Computing services in any form (e.g. SaaS, PaaS or IaaS) (Lal and Bharadwaj, 2015). To this end, this paper also focuses on all three different service models.

Cloud deployment models are categorized according to the type of exclusive and non-exclusive methods of providing cloud services (e.g. public clouds, private clouds, community clouds and hybrid clouds) to customers (Mell and Grance, 2011). Private clouds are on-premises clouds which are built inside an organization's own firewall. Individual business units will pay the IT department for these remote computing services (Low *et al.*, 2011). In comparison, public clouds are referred to as the off-premises clouds where their IT infrastructures are built outside of the organizations' own firewall (Marston *et al.*, 2011). Community clouds are used and controlled by a group of enterprises which have shared interests (Gupta *et al.*, 2013). Hybrid clouds are a combination of public and private clouds whereby “typically, non-critical information is outsourced to the public cloud, while business-critical services and data are kept within the control of the organization” (Marston *et al.*, 2011). To incorporate the benefits of public clouds with the privacy and security of private clouds, most of the organizations are expected to deploy hybrid clouds which will enable them to transfer part of their ICT services to the public cloud, while the rest are maintained internally (Goscinski and Brock, 2010; Low *et al.*, 2011).

## 2.2. Challenges of Cloud Computing Adoption

In spite of striking benefits, Cloud Computing has also faced outright rejection too (Yeboah-Boateng and Essandoh, 2014). Contemporary literature witnessed vehement criticisms and concerns against Cloud Computing adoption (Feuerlicht *et al.*, 2011; Géczy *et al.*, 2012). First criticism is related to technological aspects of Cloud Computing adoption. Understanding benefits of Cloud Computing over other contemporary technologies determines the extent of its adoption. Although Cloud Computing allows organizations to identify specific functions where it is applicable to improve predetermined performances, it is known for its issues related to structural aspects such as complex structure and compatibility (Hasan and Bassam, 2007; Géczy *et al.*, 2012).

Second criticism is related to organizational aspects of Cloud Computing adoption. Lack of top management support emerged as the principal obstacle influencing effective deployment and provision of Cloud Computing services in an organization (Gangwar *et al.*, 2015). Further, it involves the specialized human resources with the knowledge and skills to implement Cloud Computing services (Gangwar *et al.*, 2015). Also, IT managers need to train their employees as trained employees supported by organizational resources, understand the usefulness of Cloud Computing deployment and find easiness in performing their duties utilizing Cloud Computing services.

Third criticism is related to cloud service providers. Trust between a cloud service provider and an organization is vital in cloud deployments. Since Cloud Computing adoption is facilitated by cloud service providers, their availability and support are needed as users of Cloud Computing services do not fully control the infrastructure provided which may raise some concerns, such as security breaches and violations or attacks from hackers (Subashini and Kavitha, 2011; Yeboah-Boateng and Essandoh, 2014).

Given the discussed barriers of Cloud Computing adoption clearly evident that technological and organizational variables influence perceived ease of use and perceived usefulness of Cloud Computing services which further affect Cloud Computing adoption. Environmental variables such as reliability, availability and security related concerns also, directly influence Cloud Computing adoption. Technological, organizational and environmental variables belong to Technology-Organizational-Environmental (TOE) framework whereas perceived ease of use and perceived usefulness are the two main constructs of Technology Acceptance Model (TAM).

### 2.3. Technology Acceptance Model (TAM)

Technology Acceptance Model (TAM), developed by Davis (1986) is one of the most influential research models for understanding technology adoption process of an organization. It provides basis for unveiling the impacts of external variables on adoption decisions with its basic postulates resting firmly on economic, utilitarian, and attitudinal grounds. TAM proposes perceived usefulness (PU) and perceived ease of use (PEOU) as the fundamental determinants of technology adoption.

PEOU refers to the degree to which a user believes that using a particular technology will be free of effort (Davis, 1989). It is possible that while users may believe that computers are useful, they may be, at the same time, feel that it is too hard to use and that the performance benefits of usage are outweighed by the effort of using the application (Davis, 1989). PU is defined as the degree to which a user believes that using a particular technology will enhance his or her job performance (Davis, 1989). Users tend to use a system if they believe it will enhance their job performance (Davis, 1989). This includes decreasing time for doing the job and achieving more efficiency and accuracy. PEOU and PU positively affect individuals' intentions to use and the acceptance of information systems. In addition, PEOU positively affects PU, and both PEOU and PU are influenced by external variables (Davis, 1989).

While theory of reasoned action and theory of planned behavior have the capability to explore the system usage by incorporating subjective norms and perceived behavioral controls with attitudes towards technology adoption, TAM is more appropriate to be applied in Cloud Computing adoption for several reasons. First, TAM is specific on information system acceptance and adoption. Besides, TAM is more parsimonious. Furthermore, TAM is more robust in various information system applications and has received considerable attention in technology adoption literature over the past two decades.

### 2.4. TOE Framework

Realizing the vital importance of technology adoption for business success, Tornatzky and Fleischer (1990) developed Technological, Organizational and Environmental (TOE) framework to evaluate technology adoption process of an organization. TOE framework is consistent with the theory of innovation diffusion in organizations

by Rogers (2003). TOE framework is an organization-level theory. It represents one segment of the innovation process, that is, how organizational context influences the adoption and implementation of innovations (Baker, 2011). Based on this framework, the technology innovation adoption process is influenced by three aspects of an organization's context namely, technological, organizational and environmental contexts.

Technological context describes both internal and external technologies related to the organization; technologies that are existing in the organization, as well as those that are available in the marketplace but not currently in use (Baker, 2011). These technologies may include either equipment or practice. The organizational context outlines the various constructs of an organization including firm size, degree of centralization, managerial structure, quality of staff and the amount of slack resources available internally. The environmental context concerns the external factors that influence to the arena in which an organization conducts its business such as the structure of the industry, competition, government incentives and regulations and external suppliers. These three contexts present both constraints and opportunities for technological innovations.

### *2.5. Development of a Meta Theoretical Framework*

Formulated in late 1980s and discussed extensively in early 2000s, TAM and TOE framework were and remain as revolutionary ideas in technology adoption literature. Though, numerous empirical and conceptual studies have successfully utilized and replicated TAM and TOE framework in explaining technology adoption at their individual levels, the models has individual limitations. The two constructs of TAM (PU and PEOU) explain about 40% of the system's use (Legris *et al.*, 2003) and the external variables in the extended models of TAM are not clearly defined yet. On the other hand, TOE framework has unclear major constructs (Wang *et al.*, 2010) and is too generic (Oliveira and Martins, 2011). So, TOE framework is needed to be strengthened by integrating it with the models having clear constructs. The application of TOE framework would add more meaningful findings if it is used in conjunction with other theories or models. Therefore, scholars have advocated the need of integrating TAM and TOE framework so that predictive power of the resulting model can be improved and some of their individual limitations can be overcome.

However, integrating the two models is not simple as variables of TAM and TOE framework vary across different research contexts (e.g. type of technology, country of study, and size of organization) and their significance as well (Oliveira and Martins, 2011; El-Gazzar, 2014). Thus, there is a lack of common set of variables which can be generalized to explain technology adoption and is applicable to any context and technology. However, prior literature emphasized that technological and organizational variables influence PEOU and PU of Cloud Computing services which further affect Cloud Computing adoption (Abdollahzadegan *et al.*, 2013). And environmental variables directly influence Cloud Computing adoption (Behrend *et al.*, 2011). PU is an important indicator of Cloud Computing adoption as users are willing to adopt Cloud Computing when they are aware about its use can improve efficiency, performance and productivity of their businesses (Low *et al.*, 2011; Alshamaila *et al.*, 2013). PEOU of Cloud Computing services is also an effective motivator as users tend to use Cloud Computing services more when they know that they don't need to have deep knowledge to operate it (Alshamaila *et al.*, 2013). Building on this background, this paper utilizes TAM as the main theoretical underpinning. To develop a meta theoretical framework which is more relevant to Cloud Computing adoption process, this paper attempts to integrate TAM with TOE framework using variables of TOE framework as external variables of TAM as shown in Figure 1. The conceptual framework of this paper provides the foundation to generate seventeen hypotheses emphasizing the hypothesized relationships among the main constructs.



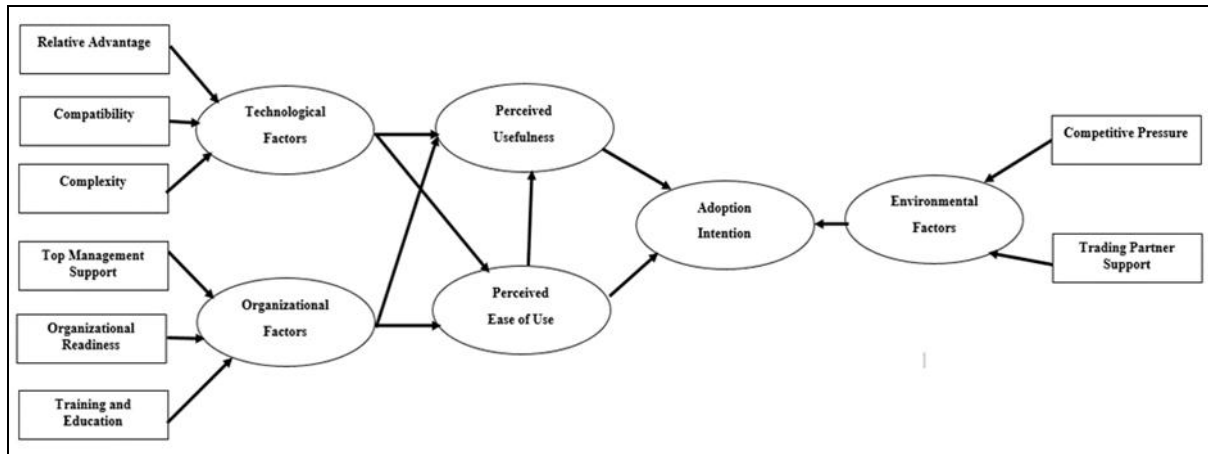


Figure-1. The Meta Theoretical Framework

Source: Adopted from Davis (1989); Tornatzky and Fleischer (1990)

### 2.5.1. Relative Advantage

Additional benefits of an innovation over its alternatives are considered as a central indicator in its adoption. Prior literature witnessed numerous advantages of Cloud Computing over contemporary technologies such as reduced cost, scalability, flexibility, mobility and shared resources. Organizations spend a big percentage of their finances on IT infrastructure while less than 10% of their servers are actually utilized which results in expenses that can be avoided adopting Cloud Computing (Marston *et al.*, 2011). Also, Cloud Computing frees organizations from administering and maintaining ICT infrastructure, thus, reduces operational cost radically. Cloud computing offers rented services on usage-based costing which leads to adjust the level of usage according to the current needs of the organization (Feuerlicht *et al.*, 2011). Mobility offers users the facility of accessing and working on their documents from anywhere in the world; provided they have a computer access and an Internet connection (Jain and Bhardwaj, 2010). Shared resources are another advantage offered by Cloud Computing to organizations which enables their employees to access resources placed on cloud from any location, and thus it saves organizations' time and money (Jain and Bhardwaj, 2010). Accordingly, following hypotheses are proposed:

H1a: Relative advantage has a positive effect on PU.

H1b: Relative advantage has a positive effect on PEOU.

### 2.5.2. Compatibility

Compatibility takes into account whether existing values, behavioral patterns and experiences of an organization and its employees are in the reconcilability of a new technology and/ or innovation (Rogers, 2003). A number of studies in technology adoption literature have witnessed the valid role of compatibility in PEOU as well as PU (Oliveira and Martins, 2011). It is perceived that when the Cloud Computing platforms are in line with the Internet platform, an organization tends to utilize the benefits of Cloud Computing and there is a high possibility of reducing the degree of uncertainty among the users of technology. Géczy *et al.* (2012) have also explained that Cloud Computing services should be compatible with the existing formats, interfaces, and other structured data in an organization, or else integration and customization services should be provided by the cloud service providers. Thus, following hypotheses are proposed:

H2a: Compatibility has a positive effect on PU.

H2b: Compatibility has a positive effect on PEOU.

### 2.5.3. Complexity

Complexity is defined as the perceived degree of difficulty of understanding and using a system (Rogers, 2003). In case of Cloud Computing adoption, it is measured as time taken to perform tasks, integration of applications with

the specialized cloud infrastructure, efficiency of data transfer, system functionality and interface design (Gangwar *et al.*, 2015). Rogers (2003) generalizes that the complexity of an innovation is negatively related to its rate of adoption as when employees perceive it as complicated, they are highly unlikely to adopt it thus, may pose problems to organizations. In amalgamation, many scholars highlight that ease of use, which is perceived to be quite close to complexity, is a key criterion when making an adoption decision (O'Connor and Frew, 2004). Thus, it can be inferred that complexity is inversely proportional to PEOU and PU. Accordingly, following hypotheses are proposed:

H3a: Complexity has a negative effect on PU.

H3b: Complexity has a negative effect on PEOU.

#### 2.5.4. Top Management Support

Similar to other disciplines of management, technology adoption literature has also recognized the vital role of top management support in initiation, implementation and adoption of new technologies in an organization. Top management support ensures long-term vision, reinforcement of values, optimal management of resources, cultivation of favorable organizational climate, higher assessments of individual self-efficacy, support in overcoming barriers and resistance to change (Wang *et al.*, 2010; Shaar *et al.*, 2015). Without a clear vision from top management regarding the usefulness of technological innovations in creating values for customers, an organization is not likely to be technology-oriented. Extant literature emphasized that top management support positively affects PU and PEOU in technology adoption. Thus, following hypotheses are proposed:

H4a: Top management support has a positive effect on PU.

H4b: Top management support has a positive effect on PEOU.

#### 2.5.5. Organizational Readiness

Tan *et al.* (2007) described organizational readiness as managers' perception and evaluation of the degree to which they believe that their organization has the awareness, resources, commitment and governance to adopt IT. Organizational readiness can be viewed from two lenses namely financial readiness and technological readiness (Oliveira and Martins, 2010). It is clear that organizations equipped with effective ICT infrastructure, technically competent employees, and financial support increases the usefulness of the technologies. Thus, following hypotheses are proposed:

H5a: Organizational readiness has a positive effect on PU.

H5b: Organizational readiness has a positive effect on PEOU.

#### 2.5.6. Training and Education

Training is described as the degree to which an organization instructs its employees in using a tool in terms of quality and quantity (Schillewaert *et al.*, 2005). Since Cloud Computing is a complex ICT system, an organization needs to train and educate its employees before implementing it. It reduces employees' anxiety and stress about the use of Cloud Computing, and provides motivation and better understanding about its benefits for their tasks. Moreover, it reduces ambiguity and help employees in developing knowledge for effective Cloud Computing service usage. Accordingly, following hypotheses are proposed:

H6a: Training and education has a positive effect on PU.

H6b: Training and education has a positive effect on PEOU.

#### 2.5.7. Competitive Pressure

Many scholars recognized Competitive pressure as an effective motivator in IT adoption (Lippert and Govindarajulu, 2006; Lin and Lin, 2008). Competition in the industry is generally perceived to positively influence

IT adoption specially when technology directly affects the competition and it is a strategic necessity to adopt new technologies to compete in the market. This fact is applicable in the context of Cloud Computing. Adopting ICT systems is useful for an organization to alter the competitive environment in terms of rules of competition, industry structure and outperforming their competitors (Porter and Millar, 1985). Thus, first-movers in implementing Cloud Computing tend to derive considerable competitive advantages and smooth survival. Accordingly, following hypothesis is proposed:

H7: Competitive pressure has a positive effect on Cloud Computing adoption intention.

#### 2.5.8. Trading Partner Support

Trading partners in Cloud Computing are related to the cloud service providers. The service providers are required to ensure data availability all the time or rather, at the time when they need to use it. This raises the concerns over the effectiveness of cloud service providers. Kim (2009) argues that adoption of high availability architecture, and tested platform and applications provide 100% availability of the data. Also, service level agreements and a combination of precautionary measures (e.g. backup on on-premises storage, backup cloud) are the main driving factors to ensure desired levels of availability (Kim, 2009). Security is another trading partner-related concern. Security in Cloud Computing is not just about authenticity, authorization and accountability but is more concerned with data protection, disaster recovery and business continuity (Yeboah-Boateng and Essandoh, 2014). Further, many enterprises are found reluctant to host their internal data on computers which are external to them and which might be co-hosted with other enterprises' applications. Accordingly, following hypothesis is proposed:

H8: Trading partner support has a positive effect on Cloud Computing adoption intention.

#### 2.5.9. Perceived Usefulness

PU is defined as the prospective user's subjective probability that using a specific application system will increase his or her job performance within an organizational context (Davis, 1989). Thus, following hypothesis is proposed:

H9: PU has a positive effect on Cloud Computing adoption intention.

#### 2.5.10. Perceived Ease of Use

PEOU refers to the degree to which the prospective user expects the target system to be free of effort (Davis, 1989). TAM model suggests that PEOU influences PU, as technologies that are easy to use can be more useful (Schillewaert *et al.*, 2005). Thus, following hypotheses are proposed:

H10a: PEOU has a positive effect on Cloud Computing adoption intention.

H10b: PEOU has a positive effect on PU.

### 3. METHODOLOGY

Conceptually, the whole research process of this paper, although being substantially grounded in two technology adoption models, is also open to the development of a meta theoretical framework. Hence, following the pragmatism research paradigm, sequential research design was adopted. Since some of the vital information on Cloud Computing adoption was not apparently available in existing literature, twenty semi-structured interviews (with entrepreneurs of selected SMEs) were initially conducted to form the conceptual framework. The second phase involved a quantitative approach, in particular, a face-to-face questionnaire survey was conducted to empirically test the proposed hypotheses in SMEs in Sri Lanka.



### 3.1. Measures

The questionnaire was designed to capture SMEs' profiles and determinants of Cloud Computing adoption. Determinants of Cloud Computing adoption were operationalized based on prior literature as follows. In amalgamation with TOE framework, technological, organizational and environmental factors were defined as formative second-order constructs and measured using 43 items. Consistent with TAM, PU, PEOU and adoption intention were defined as first-order reflective constructs and measured using 14 items. All the items were framed on a 5-point Likert scale ranging from 1= "strongly disagree" to 5= "strongly agree". Majority of questionnaire items were worded positively, with some items negatively worded and subsequently recoded to reduce response bias. Two consecutive rounds of pre-testing were conducted to ensure the intelligibility of questions from the perspective of potential respondents as well as evaluate items' representativeness of the specified construct domain: first, the questionnaire was reviewed by three academic experts in Cloud Computing and then was piloted with twenty entrepreneurs of selected SMEs who are in the process of Cloud Computing adoption. Their comments were used to make necessary modifications to the scale.

### 3.2. Sample and Data Collection Method

SMEs are described differently and face the dilemma of a globally accepted uniform definition. Different definitions are used across countries, regions, economic groups and international organizations using various criteria. Department of Census and Statistics in Sri Lanka defines SMEs as establishment with 5-199 persons engaged and the same definition is adopted in this paper to select the sample. In Sri Lanka, SMEs consist of both manufacturing and service sector enterprises in a wide spectrum of industry disciplines. Only medium-sized (with 25-199 employees) manufacturing enterprises were used in this study since more than 50% of SMEs belong to manufacturing sector. According to the Economic Census published in 2016, there were 10,400 organizations belonging to the category of medium-sized manufacturing enterprises which can be considered as the sampling frame. Based on the sampling frame, 245 medium-sized manufacturing enterprises were selected employing the sample size determination formula developed by [Krejcie and Morgan \(1970\)](#) with 95% confidence interval and 5% degree of accuracy. A stratified random sampling technique was used in selecting 245 medium-sized manufacturing enterprises according to provinces and districts covering entire Sri Lanka. Identifying people from the top-level management (e.g. owner, CEO) or decision makers of ICT practices of SMEs (e.g. IT manager/ executive) as key informants is due to several reasons as follows. They are the people who deemed to have authority and responsibility of business decisions related to ICT innovations (e.g. procurement, and funding of IT projects). Furthermore, they reflect characteristics of the theoretical constructs that this paper seeks to investigate (i.e. top management support, training and education, organizational readiness).

The survey generated 159 responses, out of which 17 were unusable as the respondents were really interested in discussing Cloud Computing adoption in general, but was not able to answer the questions presented in the questionnaire. The final sample analyzed consisted of 142 responses yielding an effective response rate of 57.95%. Majority of the respondents were owners of SMEs (72.8% of the sample) followed by IT managers (15.4%), CEOs (8.7%) and IT executives (3.1%). Majority of SMEs had been operating for more than five years (73.8%), while 22.8% had been operating for one to five years and only a few (3.4%) had been operating for less than a year. The highest percentage of SMEs (23.1%) was manufacturing food products, followed by wearing apparels (18.6%) and textiles (7.6%). The rest of the SMEs were into printing and reproduction of recorded media, chemicals and chemical products and rubber and plastic products manufacturing etc. Majority of SMEs were located in Western province (54.5%) followed by Southern (10.2%) and Central Provinces (9.7%). More than two-thirds (83.6%) of responding SMEs were identified as current users of some form of Cloud Computing services. 16.4% of SMEs were identified as non-users of Cloud Computing and were still using traditional computing methods.

#### 4. RESULTS AND DISCUSSION

Mean, standard deviation and standard error mean for all the constructs were calculated using SPSS 22.0. Mean values of all the constructs were relatively high (ranging from 4.18 to 4.53) reflecting the respondents' tendency to consistently endorse the higher ends of the item. All standard deviation values were below one indicating a less cluttered dataset.

Partial least squares – structural equation modelling (PLS-SEM) has been used to assess the proposed framework using SmartPLS 2.0 (Ringle *et al.*, 2005). PLS technique employs a component-based approach for model estimation and is best suited for testing complex structural models. PLS was selected as it does not impose any normality requirements on the data. A two-step approach has been used to first assess the quality of measures using the measurement model, and then to test the hypotheses using the structural model. Bootstrapping procedure with 1000 resamples was applied to calculate the standard error and the t-statistics of the path coefficients. The critical t-statistic for a two-tailed test is 1.96 at 0.05 significance level.

##### 4.1. Evaluation of the Measurement Model

First, the measurement model is evaluated for reliability and validity before the structural model is estimated. The evaluation of measurement model includes the estimation of indicator and internal consistency reliability and the convergent and discriminant validity of the measurement items, as given below.

Indicator reliability of individual items was evaluated by examining the loadings of each item. A commonly accepted threshold is to accept items with loadings of 0.707 or higher, which implies that there is more shared variance among the construct and its items than error variance (Hulland, 1999). Consequently, an item trimming process was undertaken during which items with significant low loadings were removed one at a time, until most items achieved reasonable loadings and a significant t-value at 0.05 significance level. Three items with factor loadings less than the threshold value was removed from technological and organizational factors to maintain parsimony. After removing that, all measurement items exceeded the threshold and loaded significantly and highly (between 0.704 and 0.976) on their intended constructs achieving unidimensionality.

To assess the internal consistency reliability, composite reliability (CR) of the measurement scales was used. CR is considered as a more rigorous estimate for reliability compared to Cronbach's Alpha. An internal consistency reliability is considered satisfactory when CR value is higher than 0.7 (Hair *et al.*, 2011). As depicted in Table 1, all the constructs demonstrated CR between 0.8937 and 0.9773 which is well above the threshold value of 0.7.

**Table-1.** Reliability and validity assessment for latent constructs

Constructs	Composite Reliability	Cronobach's Alpha	AVE
Relative advantage (RA)	0.9773	0.9349	0.9650
Compatibility (C)	0.9245	0.8039	0.8869
Complexity (CO)	0.9718	0.8121	0.9670
Top management support (TMS)	0.9317	0.8721	0.8534
Organizational readiness (OR)	0.8937	0.7377	0.8207
Training and education (TAE)	0.9540	0.9121	0.9057
Competitive pressure (CP)	0.9691	0.9126	0.9521
Trading partner support (TPS)	0.9758	0.9306	0.9627
Perceived usefulness (PU)	0.9587	0.8230	0.9466
Perceived ease of use (PEOU)	0.9737	0.9249	0.9593
Adoption intention (AI)	0.9453	0.8525	0.9116

Source: Survey Data, 2017

Convergent validity is adequate when constructs have an average variance extracted (AVE) of at least 0.5 (Fornell and Larcker, 1981). For discriminant validity, the square root of AVE for each construct should be greater than the correlation coefficients among the particular constructs and any other constructs (Chin, 1998). As observed

in Table 1, AVE values of all the constructs were above 0.8207., indicating sufficient convergent validity of the constructs. Table 2 lists the correlations of the latent variables and the square root of AVE on the diagonal. As shown in Table 2, in all cases, the square root of AVE of each construct is larger than all the cross-correlations among the construct and other constructs (Fornell and Larcker, 1981) suggesting that discriminant validity is satisfactory for the measurement model.

**Table-2.** Correlations of latent variables and square root of AVE

	RA	C	CO	TMS	OR	TAE	CP	TPS	PU	PEOU	AI
RA	0.9823										
C	0.5807	0.9417									
CO	0.6236	0.2893	0.9833								
TMS	0.0783	0.0112	0.0868	0.9237							
OR	0.3101	0.4291	0.513	0.0382	0.9059						
TAE	0.5425	0.2829	0.4312	0.0851	0.3715	0.9516					
CP	0.4100	0.4290	0.5128	0.0383	0.4087	0.3832	0.9757				
TPS	0.7775	0.3471	0.4626	0.1905	0.3726	0.3668	0.4006	0.9811			
PU	0.5435	0.3866	0.4263	0.0173	0.2951	0.3679	0.3832	0.3870	0.9729		
PEOU	0.5268	0.2643	0.3378	0.0234	0.4089	0.3584	0.3936	0.3456	0.3588	0.9794	
AI	0.7718	0.3475	0.3104	0.1675	0.2891	0.4236	0.3885	0.3011	0.4236	0.2742	0.9544

Source: Survey Data, 2017

#### 4.2. Assessment of the Structural Model

The results of the structural model assessment are summarized in Table 3. Findings revealed that relative advantage, complexity, top management support and training and education as significant determinants of Cloud Computing adoption using PEOU and PU as mediating variables. In consistent with prior literature, relative advantage, top management support and training and education were found to demonstrate positive, statistically significant impacts on PEOU and PU whereas complexity had a negative, statistically significant impact. Unexpectedly, compatibility and organizational readiness were not emerged as significant determinants of Cloud Computing adoption. This finding is inconsistent with prior studies of Oliveira and Martins (2011) and Wang *et al.* (2010). Nevertheless, this inconsistency does not mean that SMEs think Cloud Computing adoption does not require technological compatibility or organizational readiness. One possible explanation for this being insignificant is that the immaturity of Cloud Computing technology in Sri Lanka. If SMEs' prior experiences with information systems are compatible and match existing information infrastructure, then the changes introduced by Cloud Computing services will be consistent with existing practices. Moreover, insignificant impact of organizational readiness on Cloud Computing adoption may stem from the fact that majority of SMEs were current users of any kind of Cloud Computing services, and thus, there is likely to be less variance in the existing business processes. That is, SMEs adopting Cloud Computing may have already made requisite organizational changes, reducing the influence of organizational readiness in distinguishing different levels of Cloud Computing diffusion. Also, competitive pressure and trading partner support were found directly affecting Cloud Computing adoption intention. This finding is consistent with prior studies from Oliveira and Martins (2011) and Gangwar *et al.* (2015) and implies that, when SMEs face strong competition, they tend to implement changes more aggressively.

The effect size ( $R^2 = 0.741$ ) indicated that about 74% of the variance of PU was explained by a combination of technological factors, organizational factors and PEOU whereas 67.3% of the variance of PEOU was explained by a combination of technological and organizational factors. The structural model explains a robust model with 61% ( $R^2 = 0.611$ ) of the variance in Cloud Computing adoption intention explained by a combination of PEOU, PU and environmental factors.

**Table-3.** Results of bootstrapping for structural model evaluation and summary of hypothesis testing

Hypothesis	Exogenous Construct	Endogenous Construct	Path-coefficient	t-value	Result
H1a	Relative advantage	PU	0.688	10.463	Accepted
H1b	Relative advantage	PEOU	0.638	9.681	Accepted
H2a	Compatibility	PU	0.047	1.404	Rejected
H2b	Compatibility	PEOU	0.054	1.581	Rejected
H3a	Complexity	PU	-0.106	2.427	Accepted
H3b	Complexity	PEOU	-0.212	3.011	Accepted
H4a	Top management support	PU	0.353	4.229	Accepted
H4b	Top management support	PEOU	0.326	3.663	Accepted
H5a	Organizational readiness	PU	0.014	0.428	Rejected
H5b	Organizational readiness	PEOU	0.017	0.081	Rejected
H6a	Training and education	PU	0.205	4.401	Accepted
H6b	Training and education	PEOU	0.106	3.373	Accepted
H7	Competitive pressure	Adoption intention	0.560	7.139	Accepted
H8	Trading partner support	Adoption intention	0.443	5.427	Accepted
H9	PU	Adoption intention	0.744	16.528	Accepted
H10a	PEOU	Adoption intention	0.757	19.740	Accepted
H10b	PEOU	PU	0.560	8.229	Accepted

Source: Survey Data, 2017

As a whole, the results are consistent with those of [Gangwar et al. \(2015\)](#) who witnessed that the internal integration and external diffusion of ICT create capabilities that enhance a SME's ability to diffuse Cloud Computing. Thus, SMEs with a stronger TOE conceptual orientation coupled with increasing user awareness of the benefits of Cloud Computing are in a better position to facilitate efficient use and rapid diffusion of Cloud Computing services.

## 5. CONCLUSION

Cloud Computing is definitely making waves with SMEs and will soon be considered as an integrated aspect in their business strategy formulation. Although SMEs have been identified among the primary beneficiaries of Cloud Computing, Cloud Computing is still not a panacea for most of them. This paper attempts to examine the determinants of Cloud Computing adoption by developing a meta theoretical lens incorporating variables of TOE framework as external variables of TAM. The findings reveal that relative advantage, complexity, training and education, top management support, competitive pressure and trading partner support significantly influencing SMEs' adoption of Cloud Computing services. However, contrary to prior studies, this paper did not find enough evidence to claim compatibility and organizational readiness as determinants of Cloud Computing adoption.

These findings have important implications and great value to SMEs and Cloud Computing service providers. The findings of this paper provide valuable insights for decision makers to make informed Cloud Computing adoption decisions. More specifically, this paper highlights significant contributions of the technological, organizational, and environmental contexts of the organization on decision makers' perceptions in evaluating Cloud Computing adoption process. For service providers, this paper can assist in increasing their understanding of why some SMEs choose to adopt Cloud Computing services, while seemingly similar ones facing similar market conditions do not. On the other hand, however, Cloud Computing service providers may need to improve their interaction with SMEs who are involved in the Cloud Computing experience, in an effort to create a healthy environment for Cloud Computing adoption, and to remove any vagueness surrounding this type of technology.

This paper makes important contributions to the technology adoption literature as well. In recent years, scholars have highlighted the pressing need for more holistic approaches that combine unitary theoretical

perspectives to understand the complexity of ICT adoption phenomenon involving innovative technologies. This paper integrates two theoretical perspectives (TAM and TOE framework) to develop a meta theoretical framework to investigate the determinants of Cloud Computing adoption by SMEs in Sri Lanka. Thus, this is different from most prior studies on Cloud Computing that fall short of holistically capturing the wide spectrum of adoption determinants.

There are a number of limitations to this paper. One limitation is that the sample is limited to Sri Lanka, which implies that the findings reflects only the situation in one country. This paper is limited in terms of TAM and the TOE framework in examining determinants of Cloud Computing adoption. There may be other relevant theories and models (e.g. actor network theory, diffusion of innovation theory, information processing view) which can be used to construct a comprehensive, multi-perspective theoretical framework. Future research could build on this paper by validating findings of this paper in different settings, industries and countries utilizing both qualitative and quantitative research approaches. Moreover, future researchers need to consider the possibility of the inclusion of additional variables to account for factors such as an organization's information processing requirements and information processing capacity. This paper thus opens possibilities for additional research and a refinement of the constructs to further elucidate determinants of Cloud Computing adoption.

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