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Abstract

Software as Service (SaaS) model of cloud computing is currently one of the most advanced technology innovations. Due to its scalability and network-based operation, SaaS offers opportunities for small and medium enterprises (SMEs) to take advantage of the latest technology without costly investment on IT infrastructure and expertise. Despite its benefits, SMEs' adoption of SaaS is not prevalent. In this paper, by synthesizing Diffusion of Innovation theory, Technology-Organization-Environment theory and Protection Motivation theory, we propose a conceptual model which explains adoption factors of SaaS in SMEs. Our proposed model extends focus on protection motivation of SMEs in assessing SaaS adoption risks in addition to technology, organisation, and environment factors.

Keywords: Software as a service (SaaS), Adoption theory, Small and medium size enterprises (SMEs), Cloud computing, Risk

1 INTRODUCTION

Cloud computing has attracted attention from both practitioners and academics as one of the latest information technology trends (Lin & Chen 2012; Brender & Markow 2013). In cloud computing, cloud users rent applications and infrastructure from cloud providers on a pay-as-you-need basis. Cloud users only pay to cloud providers for the services used in specific time via Internet (Christauskas & Miseviciene 2012). Cloud providers deliver computing services to cloud users through three main forms: Infrastructure as a Service (IaaS), Platform as a Service (PaaS) and Software as a Service (SaaS) (Brender & Markov 2013). In IaaS, cloud providers offer fundamental computing resources such as storage, networks and processing powers on which cloud users can run operating systems and applications (Brender & Markov 2013). At one level higher, PaaS denotes operating platforms on which cloud users can deploy their own applications (Brender & Markov 2013). On top of IaaS and PaaS is SaaS in which IT applications are hosted by the cloud provider and made available to cloud users over the Internet (Brender & Markov 2013). The focus of this study is to explore adoption factors of SaaS where the pay-as-you-need model is utilised at the full scale.

SaaS offers adopting companies potential benefits including computing cost reduction, better system scalability, and mobility which are especially relevant to small and medium enterprises (SMEs) (Seethamraju 2014). It is estimated that by 2013, fifty percentages of US SMEs would spend at least one third of their IT budget on cloud solutions (CISCO IBSSG 2011). Among US SMEs, the compound annual growth rate of SaaS specifically was expecting to considerably grow about 22-27 percentages during 2011-2013 (CISCO IBSSG 2011). Despite the potential benefits and expected growth of SaaS adoption in some markets, growth of cloud computing adoption is not consistent across different countries (ACCA, 2014). The readiness of cloud adoption in emerging markets (e.g. Thailand, Indonesia, Vietnam, Brazil) is still low in comparison with that of developed countries (e.g. Japan, Australia, US, Germany, Singapore) (BSA Global Cloud Computing Scorecard 2013). Thus, we see the need for an investigation on determinants that could facilitate or inhibit SaaS adoption in SMEs in developing countries like Vietnam.

Adoption of cloud computing has been investigated in companies generally (Hsu et al. 2014; Lin & Chen 2012; Venters & Whitley 2012) or in SMEs particularly (Alshamaila et al. 2013; Gupta et al. 2013; Christauskas et al. 2012). However, most of these studies have not focused on SaaS particularly. In the SaaS model, most if not all the system ownerships and controls of the IT systems are transferred to the cloud provider. This lack in control and ownership lead to higher concern of security risks with SaaS adopters than with IaaS or PaaS adopters (Hwang & Li 2010). Security risk concerns in SaaS model can negatively affect SaaS adoption (Brender & Markov 2013; Venters & Whitley 2012). In this study, we propose SaaS adoption model for SMEs in which issues around security risks are taken into account.

2 LITERATURE REVIEW

As an IT innovation, the adoption of SaaS could follow the IT innovation adoption models. The following section provides a summary of common technology adoption theories.

2.1 Technology Adoption Theories

Most adoption models (see Table 1) focus on individual aspects; Innovation Diffusion Theory (DOI) and the Technology-Organization-Environment (TOE) are the only two models which focus on IT adoption at the organizational level. In DOI, five determinants of an innovation adoption include observability-how visible the effectiveness of an innovation is to potential adopters, relative advantage-how superior an innovation is in comparison with the others, compatibility-how well the

innovation fits to the organizations, trialability-at which degree the potential adopters can experience the innovation on a limited basis and complexity-how simple is the innovation (Rogers 1995).

Source	Theory	Determinants of IT adoption	I	O
Davis et al. (1989)	Technology Acceptance Model	Perceived usefulness and perceived ease of use	X	
Fishbein & Ajzen (2011)	Theory of Reasoned Action	Actual usage is a direct function of behavioural intention which is rooted in attitude and subjective norm.	X	
Emerson (1976)	Social Exchange Theory	Reciprocity, interdependence and negotiated rules	X	
Ajzen (1991)	Theory of Planned Behaviour	Attitudinal belief, normative belief and control belief	X	
Rogers (1995)	Innovation Diffusion Theory	Innovation observability, relative advantage, compatibility, trialability, complexity		X
Venkatesh et al. (2003)	The Unified Theory of Acceptance and Use of Technology	Performance expectancy, effort expectancy, and social influence	X	
Tornatzky et al. (1990)	Technology-Organization-Environment	Technology, organization and environment context		X

I: Individual level; O: Organizational level

Table 1. Theories in IT adoption

While DOI's five-factor model focuses mainly on the characteristics of the new innovation itself, TOE takes into account contextual factors. Beside technology factors, TOE includes internal organization factors and external environment factors as main determinants of a new technology adoption (Tornatzky et al. 1990). Internal factors include, for example, a company's characteristics and resources which facilitate the technology implementation. External factors can include competitive pressure, available infrastructure, and governmental regulation (Lippert & Govindarajulu 2006). Hence, a combination between TOE and DOI provides a more inclusive list of determinants to IT adoption. Moreover, combination of more than one theoretical model is important to achieve a better understanding of the IT adoption for more complex new technologies (Oliveira & Martin 2011). However, few studies have employed this approach (see Table 2).

Table 2 illustrates the findings of current research on cloud computing adoption. Technology factors including compatibility, relative advantage, trialability and complexity contribute to the companies' cloud computing adoption. Top management support, technology readiness, and organizational innovativeness are main organization factors that can affect SaaS adoption. Firm size is also a critical factor; however, as the current research only focuses on SMEs, this factor is excluded. For environment factors, cloud provider support, competition intensity and regulatory issues are commonly included in existing studies. Finally, security risk concern is another determinant influencing cloud computing adoption; however, the findings are inconclusive. For instance, Hsu et al. (2014) postulate companies' concerns on cloud security risks negatively affect cloud adoption. On the other hand, (Oliveira et al. (2014) found that security risk does not necessarily inhibit the adoption of cloud computing.

Studies	Model	Technology				Organization				Environment			Security concerns
		Compatibility	Relative advantage	Trialability	Complexibility	Technology readiness	Top management support	Innovativeness	Firm size	Cloud provider support	Competition intensity	Regulatory issues	
Seethamraju (2014)	TOE	X	X				X			X		X	
Oliveira et al. (2014)	DOI TOE		X		X	X	X		X				
Alshamaila et al. (2013)	TOE	X	X	X			X	X	X	X	X		X
Lin & Chen (2012)	DOI	X	X										X
Morgan & Conboy (2013)	DOI TOE	X	X	X	X								X
Borgan et al. (2013)	TOE		X				X				X		
Lian et al. (2014)	TOE		X	X	X		X					X	X
Hsu et al. (2014)	TOE		X			X						X	X
Low et al. (2011)	DOI TOE		X				X		X		X		
Wu et al. (2013)	DOI	X						X					

Table 2: Recent research outcomes on cloud computing adoption

As a result, based on the initial review in Table 2 together with our upcoming arguments, this research will include compatibility, relative advantage, trialability, complexity as technology factors.Top management support, IT readiness and organizational innovativeness are constructs for organization context while cloud provider competency, competitive intensity and regulatory framework are included in envirronmental context in our proposed model. Besides, security risk protection motivation is also integrated in our proposed model as a SaaS adoption determinant. In the next section, we will exhaustively discuss on why and how security risk protection motivation can be integrated into our model.

2.2 Protection Motivation Theory (PMT) and IT adoption

Both practitioners and academics found that cloud security concerns are the most cited reason why organizations are reluctant in adopting SaaS (Herbert & Erikson 2009; Castellina 2011; Lin & Chen 2012; Lian et al. 2014). Compared to IaaS and PaaS cloud models, SaaS raises even more security concerns since organizations would be heavily dependent on cloud providers in protecting their business data (Heart 2010). Using SaaS, organizations are required to transmit critical business data via the Internet which are subject to network intrusions or leaking of confidential business information. Besides, since data center and other IT infrastructure are located and managed by the cloud provider, the cloud provider's capability in protecting digital resources becomes an important determinant to the SaaS adoption. Security concerns of SaaS adoption are even more critical to SMEs which often have insufficient experience, skills, and financial resources in conducting effective risk management (Brender & Markov 2013).

Protection motivation theory (PMT) explains how individuals are motivated to take protective responses based on risk appraisal and coping appraisal (Rogers 1975). PMT shows that the level of evoked fear and the perceived effectiveness of the advised behaviour have an independent influence on the adoption of the advised behaviour. Organizations may not adopt SaaS if the risks associated with the new technology are considered as severe and the adopting measures are not capable of responding to the risks. It is essential to understand what risks are most severe and/or relevant to SMEs given their high reliance on the cloud providers. Similarly, what measures of the cloud providers could ensure the SMEs of the coping efficacy towards those risks. Thus, risk appraisal and coping appraisal of SaaS-related risks should be included to explain SaaS adoption model.

3 SAAS ADOPTION MODEL IN SMES

To explain the factors that affect the SMEs' SaaS adoption , we develop an integrated framework from the three theories of DOI, TOE and PMT (Figure 1). Based on TOE and DOI theories, the current research hypothesizes that technology, organization and environment are the three factors that impact on SaaS adoption. Additionally, drawing from PMT, the research proposes that SaaS security risks and SaaS security risk coping appraisal are the determinant factors of SaaS adoption.

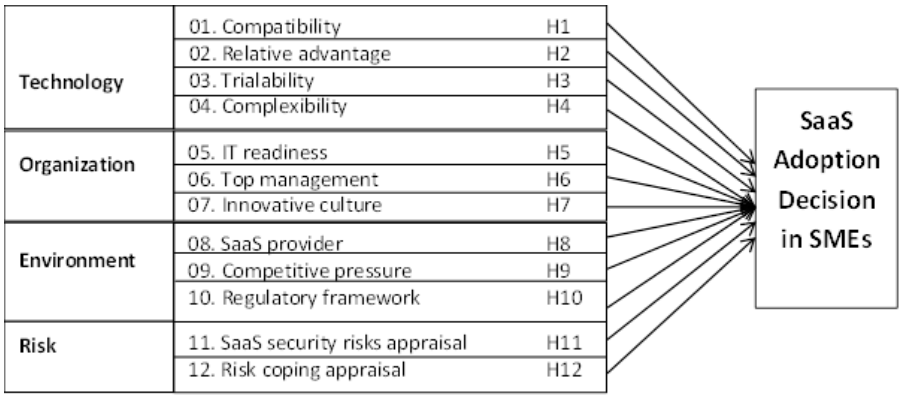

Figure 1. SaaS Adoption Model in SMEs

3.1 Technology Factors

Compatibility refers to how SaaS fits to companies' business operation, corporate culture, IT infrastructure and so on (Lin & Chen 2012; Morgan & Conboy 2013). Compatability can be measured by the fit of SaaS to existing technological background (Wu et al. 2013; Alshamaila et al. 2013), to business model and to organization values (Lin & Chen 2012; Morgan & Conboy 2013; Wu et al. 2013; Alshamaila et al. 2013). The higher the compatibility is, the more likely those companies will adopt SaaS (Rogers 1995). Hence, this study hypothesizes that: **Compatibility of SaaS will positively affect SaaS adoption in SMEs. (H1)**

Relative advantage refers to the advantages that SaaS can offer in comparison with previous technologies. SaaS offers several key technological advances to SMEs: virtualisation, backup efficiency, and mobility and so on (Morgan & Conboy 2013; Oliveira et al. 2014; Hsu et al. 2014). Virtualisation enables better use of hardware by sharing hardware and software resources among the users thus reducing maintenance and management costs (Morgan & Conboy 2013; Oliveira et al. 2014). Most data backup is offered by cloud providers to release business users from managing this complex and costly operation. Finally, as data and applications are stored on networked servers, cloudusers can have access to data and a virtual workstation from anywhere any time (Oliveira et al. 2014; Hsu et al. 2014). This results in greater mobility and hence enhances the flexibility of SMEs in allocating its limited resources (Garengo et al. 2005). Hence, this study hypothesizes that: **Relative advantage of SaaS will positively affect SaaS adoption in SMEs. (H2)**

Trialability describes the opportunities that a company can expriment the new technology before the actual adoption (Rogers 1995). Especially in a new market where previous SaaS experience is not yet concrete like in Vietnam, it would be very helpful for early adopters to try out the service before the adoption (Alshamaila et al. 2013; Morgan & Conboy 2013). Hence, this study hypothesizes that: **Trialability will positively affect SaaS adoption in SMEs. (H3)**

Complexity refers to the ease of use of the adopted technology. Despites its obvious benefits, SaaS usage may require certain level of technical skills that SMEs may not have (Garengo et al. 2005). Complexity can be experienced by both IT personnel (Oliveira et al. 2014; Lian et al. 2014) and end-users (Morgan & Conboy 2013; Seethamraju 2014). The more complex a technology, the less likely a company will adopt the technology (Rogers 1995). Hence, this study hypothesizes that: **Complexity will negatively affect SaaS adoption in SMEs (H4)**

3.2 Organization factors

Technology readiness refers to a company's internal IT capacity to handle the new technology. The readier the IT capacity of a company is, the higher likelihood that it will adopt SaaS (Hsu et al. 2014, Oliveira et al. 2014). IT capacity can include IT infrastructure, IT budgets, IT experts, or experience that a company has obtained through various IT projects (Hsu et al. 2014). Technology readiness is a particularly critical issue for SMEs as most of them have low IT expertise or financial resources to adopt new technologies (Kurnia et al., 2015). Hence, this study hypothesizes that**: Technology readiness will positively affect SaaS adoption in SMEs. (H5)**

Top management support refers to the degree in which senior managers support the SaaS adoption intrinsically and extrinsically. Migrating to SaaS can involve many restructuring or reengineering in companies' business processes (Low et al. 2011; Seethamraju 2014). Thus, SaaS adoption requires top management commitment. Intrinsically, it is critical that top managers show the enthusiasm towards the adoption and development of SaaS which can then affect the motivation of IT/IS team as well as other staffs in implementing SaaS (Oliveira et al. 2014; Lian et al. 2014). Extrinsically, top management supports can be in form of resources (e.g. budget, time, human resource) (Lian et al. 2014). In SMEs, since decision making is particularly centralized in comparison to larger corporates (Mintzberg 1979), the enthusiams of decison maker as well as his/her provison on resources are critical for SaaS adoption. Hence, this study hypothesizes that**: Top management support will positively affect SaaS adoption in SMEs. (H6)**

Innovativeness describes how pioneered a company is in adopting an innovation. Innovativeness can be interpreted in two levels: organization and individual. At organizational level, the level of openness or being entrepreneurial in the company's culture has positive impact on its adoption behavior (Wu et al. 2013; Alshamaila et al. 2013). Entrepreneurial companies tend to be innovative as they want to become the pioneer in a particular field (Wu et al. 2013) and hence be more open to new solution such as SaaS for their business. At individual level, innovativeness is usually defined as an owner's or a decision maker's openness to try out new technology (Alshamaila et al. 2013). While organizational innovativeness can be critical for SaaS adoption in companies in general, individual innovativeness contributes particualarly to SMEs cases. As discuss above that SMEs can have greater centralized decison making structure than big corporates (Mintzberg 1979), whether a company's leader is open minded and want to try out new technologies can be critical for SaaS adoption in SMEs. Hence, this study hypothesizes that**: Innovativeness will positively affect SaaS adoption in SMEs (H7)**

3.3 Environment factors

Due to its limited resources, SMEs are usually companies which take advantage of outsourcing its IT activities to outsourcing cloud providers (Malhotra & Temponi, 2010). However, this outsourcing relationship leads to greater dependence on cloud provider's competencies (e.g. technical skills, supportiveness) (Alshamaila et al. 2013). Innitial evaluation of SMEs on cloud providers' competencies influences adotpion decision (Alshamaila et al. 2013). This study hypothesizes that**: Cloud providers' competencies will positively affect SaaS adoption in SMEs. (H8)**

Competitive intensity is the competitiveness pressure in an industry. The higher the competitiveness that a company faces, the higher likelihood that company will adopt new technology (Low et al. 2011; Borgman et al. 2013). In competitive industries, companies are usually under the pressure to keep up with innovation that other competitors are adopting. Moreover, new technology innovation like SaaS will help company be more proactive and effective in obtaining and analyzing market data to become more agile and competitive (Low et al. 2011). We argue that SMEs facing compeitive intensity will be more likely to adopt SaaS than the others. Hence, this study hypothesizes that**: Competitive intensity will positively affect SaaS adoption in SMEs. (H9)**

Another environment impact on SaaS adoption is government regulatory policies for cloud computing (Oliveira et al. 2014; Hsu et al. 2014). Different governments have different data regulatory policies which can either facilitate or inhibit SaaS adoption. For example, European Union (EU) prohibits some types of personal data to be transmitted outside of EU territory (Sultan 2010). Thus, concerns on government policy might restrict EU companies from adopting SaaS provided by international cloud providers as well as restrict international cloud providers (e.g. Amazon) in penetrating EU since cloud providers have to build up data center within EU to comply with EU law (Sultan 2010). More importantly, the readiness of government regulationary framework for cloud computing is considerably low in developing countries like Vietnam (Kurnia et al., 2015; BSA Global Cloud Computing Scorecard 2013). Facing with uncertain government regulatory framework can lead to low SaaS adoption. cloud provider. Hence, this study hypothesizes that**: The maturity of regulatory framework will positively affect SaaS adoption in SMEs. (H10)**

3.4 Risk-based protection motivation

As dicussed before, concerns over cloud security issues may discourage companies in adopting externally managed system like SaaS (Alshamaila et al. 2013; Lin & Chen 2012; Lian et al. 2014; Hsu et al. 2014). Limited resources (Garengo et al. 2005) and low IT readiness in SMEs (Kurnia et al., 2015) can make cloud security risks a core constraint for SaaS adoption. Hence, this study argues that: **Perceived SaaS security concern will negatively affect SaaS adoption in SMEs. (H11)**

Though SaaS can contain security risks, there is no guaranty that an in-house system will be a safer solution. Most networked systems are subject to online security risks regardless the systems are managed internally or externally. Thus, it is also important to examine how the effectiveness of managing cloud security risks can affect SaaS adoption. According to PMT coping appraisal or effectiveness of coping measures will be measured by response efficacy and self efficacy. In this study, response efficacy indicates the capability of cloud providers in handling security risks while self efficacy reflects the capability of the adopting company on handling security risks. Companies which believe that security risks can be managed will not hinder their cloud adoption (Brender et al. 2013). Some companies believe that SaaS is a safer solution in comparison with storing data internally as data are managed by cloud providers given their IT core competencies (Seethamraju 2014). This study hypothesizes that: **Coping appraisal will positively affect SaaS adoption in SMEs. (H12)**

4 CONCLUSION

Among the three business models of cloud computing (i.e. IaaS, PaaS, and SaaS), SaaS presents the last frontier of companies in governing their IT resources. SaaS has the potentials for SMEs to use external IT capabilities to suit their changing business needs. The purpose of this study is to identify factors that affect the SaaS adoption in SMEs. We develop an integrated model from three technology adoption theories including TOE, DOI and PMT. In addition to the three core factors of technology, organization and environment, security risk factor is included to address how cloud security risks, cloud provider' risk response measures and self-efficacy of adopting companies affect SaaS adoption. Practitioners, especially cloud providers can benefit from the research by understanding the concerns of SMEs when adopting cloud applications so that they can support SMEs better. For the future research, the proposed SaaS adoption model will be tested quantitatively to examine the significance of the identified factors in the model and enhance the generalisation of the findings. Data will be collected through survey from Vietnam SMEs.

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