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Cloud computing adoption determinants: an analysis of Australian SMEs

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Keywords

australian, smes, computing, cloud, adoption, determinants, analysis

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CLOUD COMPUTING ADOPTION DETERMINANTS: AN ANALYSIS OF AUSTRALIAN SMES

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Abstract

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Keywords: Cloud Computing, Small and Medium-Sized Enterprises (SMEs), Adoption, Australia.

1 INTRODUCTION

Cloud computing technology has been a disruptive technology that promises to provide various benefits to organisations, such as lower initial investment cost, on demand resources, services scalability, and operational cost savings (Avram, 2014). Despite the advantages offered by this technology, the pace towards its adoption is not matching the speed of technology advancement. Various reasons for this are suggested such as: (1) the technology is still in its early advancement stages, with some firms not yet convinced of its benefits and waiting to see actual success to take serious actions; (2) some firms have limited budget allocations for technology; (3) there is limited technical knowledge within the firms; (4) and there is hesitation about migrating to new technologies. On the other hand, some scholars (Carcary et al., 2013, Ross and Blumenstein, 2015, Dillon and Vossen, 2015, Sultan, 2010) have indicated that Small and Medium-sized Enterprises (SMEs) can take advantage of the benefits offered by cloud computing by using its services to be more productive and competitive. However, the decision-making process in adopting these services is not always straightforward, and there are several factors the firms usually take into consideration before they make their decision. Previous studies have discussed some of these determinants (Gajbhiye and Shrivastva, 2014, Goscinski and Brock, 2010, Ercan, 2010). According to (Saedi and Iahad, 2013, El-Gazzar, 2014) investigation of cloud computing must consider context because different contexts might have specific determinants. The present paper reflects this by studying only Australian SMEs.

Prior studies investigated cloud computing adoption in SMEs from perspectives such as benefit-driven perspective (e.g., reduced operation cost) (Saya et al., 2010), risk-driven perspective (e.g., security concern) (Wu et al., 2013a, Daniel et al., 2014) and constraint-driven perspective (e.g., scalability) (Saya et al., 2010). However, the decision process requires consideration of other perspectives (Leimeister et al., 2010). A review of the literature indicates that most of the previous studies used a single approach theoretical perspective in studying cloud computing adoption (Hsu et al., 2014, Borgman et al., 2013, Nkhoma et al., 2013, Kshetri, 2013). However, this single approach is not sufficient to achieve the objective of the present study. It has been found that the lack of integration of adoption and diffusion theories has hindered understanding of innovation characteristics (Saedi and Iahad, 2013). Technological factors are not the only key determinants; there are other factors such as organisational and environmental factors that might have an important impact on the decision process, but they have not been integrated into most of the adoption theories (Low et al., 2011, Feuerlicht, 2010). Therefore, a multi-perspective theoretical framework could be a solution for investigating the cloud computing service adoption by SMEs (Harvie and Lee, 2002).

The SMEs sector in Australia plays a vital role in the country's economy and employs more than 70 percent of the workforce (ABS, 2013). Despite the importance of SMEs, our review of the literature indicates that there are limited studies investigating the cloud computing adoption in this sector. In addition, Australian industry is characterised by a distinctive composition with the manufacturing sector making a lower contribution to GDP than the resources sector, while the services contribution is similar to other developed countries (Minifie, 2014).

The features of cloud computing present an opportunity for firms to achieve competitive advantages in new markets (Prashantham, 2013). This is relevant and critical to Australian SMEs, in particular, due to its relatively small scale of market (Harvie and Lee, 2002). Cloud computing provides new opportunities to SMEs with the development of Australian National Broadband Network (NBNCO, 2015). With access to scalable and affordable computing resources, SMEs can enhance their competitiveness against large enterprises by increasing their efficiency and productivity in delivering products and services. However, despite the promising benefits of cloud computing, Australian SMEs are still relatively lagging behind other countries in Asia (ACCA, 2012). The influential factors in the adoption of cloud computing in the Australian SMEs have not been empirically investigated from the technological, organisational, and environmental perspectives. Thus, this research aims to study the impact of these factors in Australian SMEs.

To address the research gap, the current paper developed a research model based on the integration of innovation characteristics of cloud computing and the Technology-Organisation-Environment framework. The model is also a result of our previous exploratory study on the relevant influential determinants in the adoption process among SMEs. Data collected from 203 firms across Australia are used to evaluate the research model. This paper, therefore, contributes to the scientific knowledge with its holistic presentation of the cloud computing adoption determinants based on the innovation characteristics and the Technology-Organisation-Environment framework (TOE) perspectives. We contribute to the wider knowledge of cloud computing adoption, particularly within the Australian context that has had only limited investigation.

The rest of this paper is organised as follow. Through a literature review, we present the background to cloud computing and related topics. We then provide the theoretical foundations for the research model and propose the hypotheses. The research methodology and the results are presented. After the summary of our contribution and discussion on the limitation of the research, the paper is concluded with the main findings.

2 BACKGROUND

2.1 Cloud Computing

Cloud computing, an emerging concept, has received wide attention in both economic and academic field. The National Institute of Standards and Technology (NIST) define it as *"…a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources, that can be rapidly provisioned and released with minimal management effort or service provider interaction"* (Mell and Grance, 2011). This definition serves and fits the objective of this study and it is found to be more detailed in describing the framework and satisfying the stipulated objectives which also has gained universal acceptance across business, industry, and research.

In our investigation of the relevant literature, we found that the influential factors to the adoption of cloud computing resided mainly into three categories: technological factors, organisational factors, and environment factors. For example, Misra and Mondal (2011) observed the size of IT resource, the capacity of resources usage, data privacy, and the scope of business activity on the adoption of cloud computing in firms. A quantitative research approach used by (Saya et al., 2010) found that organisational perceived benefits such accessibility, scalability, cost effectiveness, and security can increase the adoption decision rate. Other researchers found that SaaS adoption in Taiwanese companies is influenced by social determinants, perceived usefulness, trust, and security issues (Wu et al., 2013a).

Organisational perspectives received limited attention from the cloud computing adoption perspective. For instance, research conducted by Low et al. (2011) used TOE (Technology-Organization-Environment) framework as a theoretical foundation to analyse cloud computing adoption in Taiwanese high-tech industry. This study, however, did not take into account the key factors such as perceived benefits from cost reduction and security issues that are crucial to cloud computing adoption decision. Trigueros-Preciado et al. (2013) followed a mixed research approach to identifying the hindrances to cloud adoption. Awareness of cloud computing and its offering was one of the obstacles to the adoption as it was found by a survey study on SMEs in Spain. Wu et al. (2013b) applied integrated theories (DOI theory and information processing view (IPV)) to study information capacity and the requirement that stimulus firms adoption decision in the context of supply chain management. Nkhoma et al. (2013) obtained data from large service enterprises to investigate the obstacles in the adoption of cloud computing. Kshetri (2013) used institutional theory as his research framework; he implemented a qualitative study to analyse security concerns and the perception of using cloud computing services. With TOE framework, Abdollahzadegan et al. (2013) explored the prevention of cloud computing adoption in the SMEs sector. Their paper did not propose hypotheses or empirical basis. El-Gazzar (2014) ascertained that the evaluation of cloud computing adoption process is not adequately investigated, except for the proof of concept process. El-Gazzar (2014) systematic literature review, calls the need for (1) more empirical studies; (2) cloud computing adoption is multifaceted which requires usage of multi-theoretical perspectives; (3) exploration of theories that explain how organisations react differently to same internal and external factors.

2.2 Australian SMEs Perspective

Cloud computing as claimed to be an affordable IT resource for SMEs (Aljabre, 2012) can play a vital role in the downturn of the current Australian critical economic situation. Cloud technologies can equip firms with the necessary tools for easy deployment of their new and robust business models which can give them the opportunity to access new markets. Furthermore, the technology is offered in affordable investment schemes where there is no requirement big initial investment, but it is in the form of pay-per-use. The technology is also scalable in the sense that its services can be scaled up or down based on use and the technology also offers various flexibility in terms of services offered and types of deployment models requirement by users and so on (ENISA, 2009). It is believed that cloud services can generate innovative prospects for organisations (Babcock, 2010). Australian Bureau of Statistics (ABS) - based on the definition, states that there are three types of SMEs: (1). Micro businesses being those with 0-4 employees; (2). Small businesses with 0-19 employees; and (3). Medium businesses are those with 20-199 employees (ABS, 2001). This definition fits into this paper scope.

SMEs have a significant contribution to the Australian economy. They are considered to be crucial customer base for financial services providers (MacGregor and Kartiwi, 2010). Innovation in processes, services, and products is the key to lifting Australian; this can be achieved through the adoption of new technologies (Daley, 2013). Clear plans from authorities and proper resources allocation for the promotion of taking the advantages of new technological initiatives are crucial in developing Australian SMEs. From the other hand, Pick and Azari (2008) stated that there is a big divergence on the adoption of technology between large corporations and SME. Therefore, this paper remains an important area of research, which helps to understand the socio-technical factors that affect the intention of cloud computing adoption.

3 RESEARCH MODEL & HYPOTHESES

3.1 Research model

The refined research model in this paper was achieved based on the insights of our previous exploratory study that was conducted on 15 Australian SMEs. Initially, the conceptual model was developed based on a multi-perspective theoretical framework and literature review. The adopted theories are diffusion of innovation and technology-organization-environment framework. The theories have been discussed in our previous work. Figure 1 presents the research model of this paper.

3.2 Hypothesis of the Technological Factors

Tornatzky and Klein (1982) identified three characteristics of innovation: relative advantage, compatibility, and complexity. This study will apply Rogers's DOI to investigate the impact of the technological factors. The positive perception of the benefits of cloud computing can provide an incentive for SMEs to adopt the innovation. Furthermore, if cloud computing services are compatible with the existing work practises, SMEs can be more likely to adopt them. On the other hand, the perceived complexity of the cloud computing services is not included in this investigation as it was found to be insignificant in our previous exploratory study.

Security Concerns: The shared multi-tenant environment, which is offered by cloud computing paradigm increases security concerns (Schneiderman, 2011, Shen and Tong, 2010). On the grounds, it leaves organisations vulnerable to potential security threats (Benlian and Hess, 2011). There are several studies that discussed and identified the technical and operational issues that can affect the decision to adopt cloud services and these concerns included security, privacy risks, and information loss (Zissis and Lekkas, 2012, Wang, 2010, Dutta et al., 2013). All these issues can affect the organisation decision in the adoption of cloud solutions.

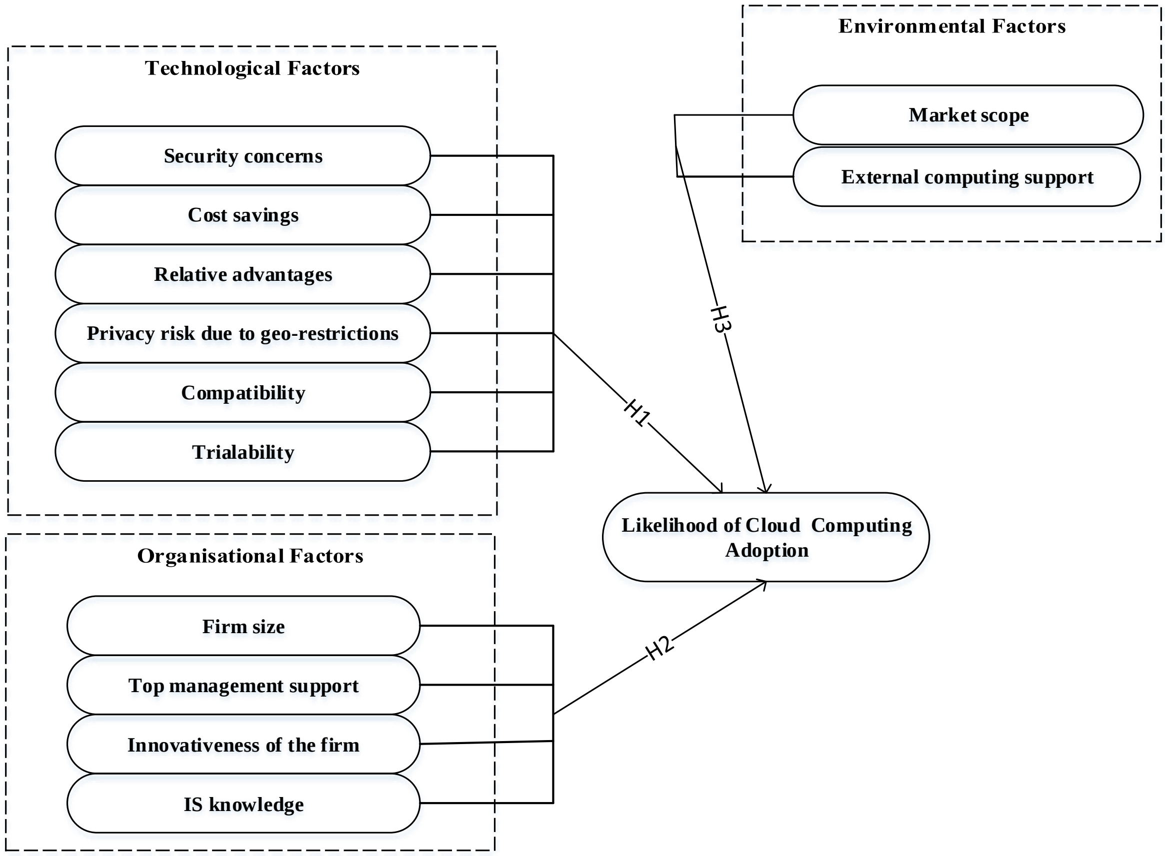

Figure 1. Research model

Cost Savings: Costs play a major role in any economic field. Cloud computing services are not away from this factor consideration. It can be described as the extent of users perceived the total cost of using cloud computing services in comparison with other computing paradigm. Cloud computing provides an opportunity for innovation, reduction in IT investment, and reduction in total cost of computing resources (Cervone, 2010). Cloud computing enables cost savings benefits through lowering energy consumption, decreasing infrastructure costs, and lowering maintenance costs (Marston et al., 2011). Economic of scale concepts enable cloud computing vendors to offer affordable IT solutions (Benlian and Hess, 2011). As a result, these cost-effective methods can help businesses with new opportunities in offering their products and services more innovatively. This can apply to cloud computing services as well.

Relative advantage: as defined by (Rogers, 2003) is "the degree to which an innovation is perceived as being better than the idea it supersedes". In this research, the innovation is referred to cloud computing and the superseded idea is the other computing paradigms. This attributes found to be determinant in investigating technological innovation adoption in various previous studies (Gangwar et al., 2015, Johnson, 2015, Powelson, 2012). Apparently, this factor is important because it is associated with the benefits that the new technology can create in terms of facilitating the processes by making them easier, fast, and more efficient. It further can enhance organisations' productivity and performance and eventually leads to profitability. Cloud computing provides various benefits to firms including efficient business communication, robust coordination features, better customer care, and access to market information mobilisation (Armbrust et al., 2010, Hayes, 2008). Additional reported relative advantages of cloud computing include reduction in capital costs, flexibility in capacity requirement, the agility of implementation, reliability, compatibility, and ease of use (Grossman, 2009, Greer Jr, 2009, Miller, 2008, Leavitt, 2009). Therefore, gains such as cost reduction and technical capabilities from using of cloud services could be useful to SMEs.

Privacy risk due to geo-restrictions: Privacy is considered one of the critical hindrances to the adoption of cloud computing services. Ziyad and Rehman (2014) indicated that data security and privacy are the main hindrances in the acceptance of cloud computing services. They also found that authentication is one of the security measures that users implement to improve their privacy and security. Furthermore, they also claimed that there are several solutions have been proposed all around the world to enhance authentication in the cloud. It is obvious that security and privacy are still the main challenges in cloud computing arena as the same was indicated by Wang before few years back (Wang, 2011). This attribute was identified in our previous exploratory work to be an important determining factor in cloud adoption.

Compatibility: It is one of the element in Roger's theory and it is defined as "The degree to which an innovation is perceived as consistent with the existing values, past experiences, and needs of potential adopters" (Rogers, 2003). Compatibility is a crucial factor in innovation adoption (Cooper and Zmud, 1990, Wang et al., 2010). When compatibility of new technology with a firm systems, then the adoption of the innovation is likely to happen. This can be extended to include cloud computing. In this paper, compatibility will be investigated mainly in the norms and culture of the organisation as well as the compatibility with its technological resources.

Trialability: Roger defined it as "The degree to which an innovation may be experimented with on a limited basis" (Rogers, 2003). Cloud computing also has a reflection in this attribute. This probably can have a significant contribution in the adoption of cloud computing in conjunction with other attributes that believed to be crucial to be investigated such as relative advantages, complexity, and compatibility. These constructs can confirm applicability, usability, and advantages of cloud computing by the organisation through tangible trial of the cloud computing services. Therefore, the hypothesis that this paper is intending to address in the technological context is:

H1: Technological factors will positively relate to the likelihood of cloud computing adoption

3.3 Hypothesis of the Organisational Factors

Organisational context found to be an influential aspect in the adoption of new technologies in various previous studies (e.g.Ramdani, 2008). Four relevant factors were identified to be investigated within this context, and they are firm size, top management support, innovativeness of the enterprise, and IS knowledge experience.

Firm Size: Review from the technological innovation literature has found that larger enterprises have extra resources that motivate innovation adoption (Dewar and Dutton, 1986, Moch and Morse, 1977). Small business usually suffers from low resources. This condition can include financial constraints, operating in a competitive environment, lack of expertise, and influences from external environment forces. Similarly, scholars indicated that financial constraints, lack of professional IS expertise, and short-term management perspective are the unique characteristics of small businesses (Ein-Dor and Segev, 1978). Researchers argued that larger businesses have potential to gain specialised skills and use of IS than smaller businesses because of their bigger scale operations (Baldridge and Burnham, 1975, Lind et al., 1989, Moch and Morse, 1977). It is also can be due to their high flexibility advantages and bigger risk taking scope (Pan and Jang, 2008, Zhu et al., 2004). Consequently, the size of the firm is one of the major factors of IT adoption (Pan and Jang, 2008, Hong and Zhu, 2006).

Top Management Support: is an essential criterion for two main reasons: providing sufficient resources for the adoption of innovation and also to provide necessary support required for the innovation, re-engineering, and change process (Lin and Lee, 2005, Wang et al., 2010). Two previous studies found there is a positive correlation between the adoption of new technology and management support (Pan and Jang, 2008, Zhu et al., 2004).

Innovativeness of The Firm: Innovativeness is the willingness degree of taking a risk and trying new solutions that not been tried or tested before (Thong and Yap, 1995). Many researchers suggested the importance of this attribute in the technological innovation adoption and diffusion (Rogers and Shoemaker, 1971, Leung and Wei, 1998, Lin and Jeffres, 1998). New innovation has always been a promoter for positive innovation decision, and this attribute is highly associated with human as decision makers; in SMEs the company managers or the company owner are the key roles (Marcati et al., 2008). The willingness for exploration of new ways and improving the business processes are characteristics of decision makers that influence the likelihood in embracing new technologies (Marcati et al., 2008). This extent differs from person to person depends on his ability and way of performing tasks. The research believes that people who prefer to improve the way they do their tasks and do them differently are more innovative. This could apply to this study as it is evolving around the two aspects of SME context and cloud computing as an innovation.

IS Knowledge: Attewell (1992) stated that innovation has implications for employees of the small organisations. In general, small businesses are lacking in specialised IS knowledge and technical skills (Plomp et al., 2014, Wymer and Regan, 2005, Al- Qirim, 2005). Businesses with knowledgeable employees in IS are more potential to adopt innovations. An empirical study by Ettlie (1990) confirmed the validity of this statement. Moreover, innovation knowledge is one of the of the DOI theory components. Thong (1999) study found that CEO's technological knowledge have a positive influence in the diffusion of information systems. Thus, in the organisational context, this paper foresees that:

H2: Organisational factors will positively relate to the likelihood of cloud computing adoption

3.4 Hypothesis of the Environmental Factors

The factors within the environmental context are the market scope and external computing support.

Market Scope: It is the range of organisation operations (Zhu et al., 2003). SMEs operations can extend from the local boundaries and reach to a global presence. The largest the business scope demands more information and communication technologies to remain competitive in the biggest markets (Hitt, 1999). Businesses with global operations tend to be more motivated to implement e-business solutions (Zhu et al., 2006). Information systems and technologies providers realised these issue and provided solutions to organisations; these solutions are in continues development. Cloud computing feature of less dependency on location allows SMEs to use the services from anywhere.

External Computing Support: This attribute is defined as " the availability of support for implementing and using an information system" (Premkumar and Roberts, 1999). It discusses how the external support such as training, customer service, and technical support that are offered by cloud providers can influence in increasing the cloud services adoption by SMEs. Hence, in the environmental context, this paper predicts that:

H3: Environmental factors will positively relate to the likelihood of cloud computing adoption

4 RESEARCH METHODOLOGY

4.1 Measurement

To evaluate the research model, a survey was conducted in Australian targeting SMEs from different industries. A questionnaire was developed by an experienced team of researchers in the domain of Information Systems. For the purpose of insuring the validity, this study has operationalised the variables based on the previous relevant literature. This research did not only limited itself in using prior research validated items but also a high consideration was taken into account to provide a more solid balancing with the nature and objective of this study. The constructs were measured using a seven-point Likert scale on an interval level ranging from “strongly disagree” to “strongly agree.” The firm size and market scope used a multiply question style for evaluation. In addition, we applied two control measures (screening questions) in this survey; the first one was about the role of the person who undertakes the survey. This excludes participants who are not involved in the IT decisions in their organisations. The second control question was about the firm size (micro, small, medium, and large) and this excludes all the participants from large organisations (>199 employees). A pilot study was established as a tool to validate the instruments in various aspects such as content validity, the length of the instrument, wording of the scales, and the format of the document in general. In the pilot process, the survey questions were disseminated to academics, business advisors, top managers of twelve firms. These firms were not involved in the main survey. The feedback obtained from this process gave a decent establishment to outlining the review instruments, and various changes were incorporated into the questionnaire. The survey acknowledged academically and practically to be applicable and contain valid content for carrying out the research.

4.2 Data

This research identified 12 independent variables. The firm size was based on the criteria of the number of employees (0-199 employees); region: Australia. The survey was administered using SurveyMonkey Audience to target and recruit SMEs decision makers in Australia. The population is generally representative of the SMEs sector in Australia, which has internet access (SurveyMonkey, 2015). The survey was disseminated online using stratified sampling approach. A donation of $0.50 donation was contributed to charities for each completed survey. The recruitment resulted in 228 replies from potential respondents.

Two controls were applied for screening out the criteria that do not fit in our research target as have been mentioned earlier. Number of excluded surveys because of the individuals were not involved in the decision making in any form was 13. Number of excluded survey with employee size > 199 (large firms) was 5. A total number of rejected surveys with incomplete answers and non-compliance with the screening criteria was 25. All surveys were administered during a two-week period in October 2015, and the final response rate (i.e., completed divided by total received, or 203/228) was 86%.

4.3 Statistical Methodology

This paper developed an empirical statistical model based on the questionnaire response data to address the study research question - What are the determinants that influence the decision of an SME to adopt cloud computing technology? The statistical methodology chosen to address this research question was Partial Least Squares – Structural Equation Modelling (PLS-SEM) or PLS path analysis (Hair Jr et al., 2013).

PLS-SEM is a multivariate method that identifies correlative relationships between multiple variables. Latent variables (i.e., concepts or constructs that are not directly measured by the researchers) are operationalized by compositing multiple indicator variables (specifically the questionnaire item scores collected by the researchers) using factor analysis. The relationships between the latent variables are then explored using path analysis. The four latent variables included in the model were defined as Technological Factors, Organizational Factors, Environmental Factors, and Adoption Stage. The compositions of the indicators used to operationalize each latent variable are available with the authors upon request.

PLS-SEM has the advantage over other multivariate modelling approaches such as covariance-based SEM and multiple linear regressions because it is a non-parametric method (i.e., it does not assume normally distributed variables measured at the scale/interval level). PLS-SEM handles several inadequacies in questionnaire response data (e.g., variables with skewed distributions measured at the ordinal level, and small sample sizes) that may bias the results of parametric methods (Hair Jr et al., 2013). The software used in this study to conduct PLS-SEM was SmartPLS, which operates with a graphic user interface (Wong, 2013). An example of a path diagram drawn using the graphic user interface of SmartPLS for the purpose of this study is illustrated in Figure 2.

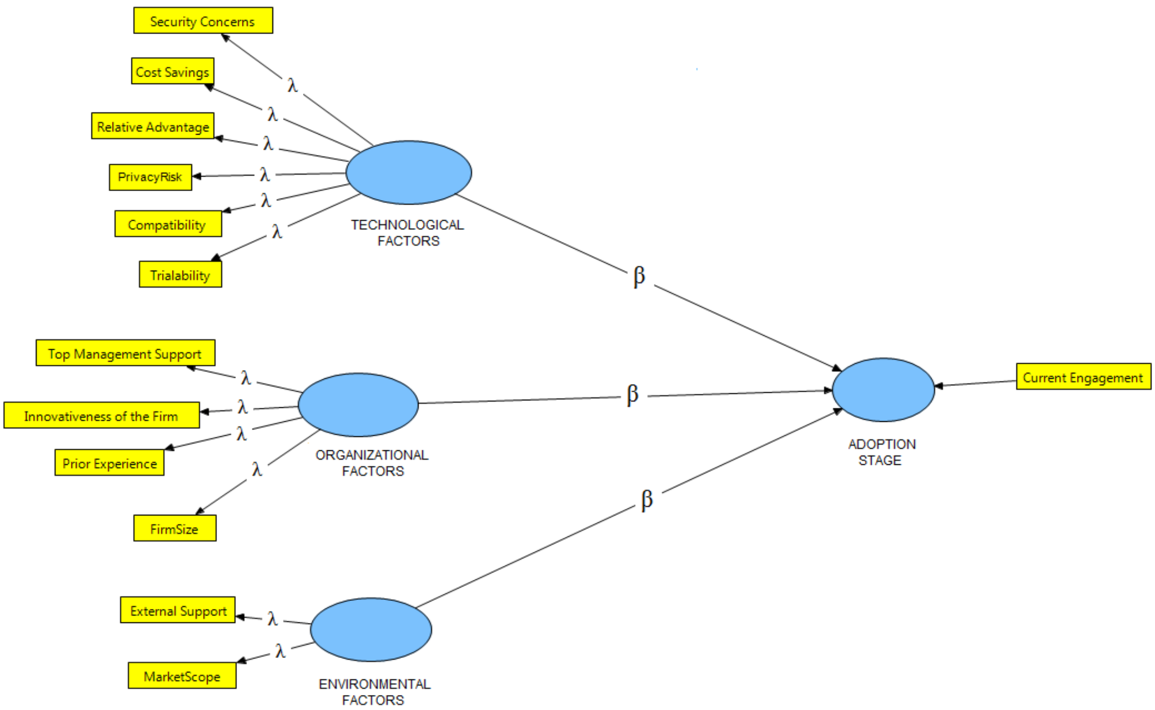

Figure 2. *Path diagram drawn using SmartPLS*

The oval symbols represent the latent variables, and the rectangular symbols represent the indicator variables. The arrows between the symbols represent hypothesised relationships, measured using standardized coefficients, ranging in value from -1.000 to +1.000. The arrows between each latent variable and its corresponding indicators represent the measurement model, measured using factor loading coefficients (λ). A factor loading coefficient measures the strength and direction (positive or negative) of the correlation between an indicator and a latent variable. The arrows between the latent variables represent the structural model, measured with PLS path coefficients (β). Each path coefficient measures the strength and direction (positive or negative) of the correlation between a pair of latent variables. The arrows between the latent variables represent unidirectional paths, leading out of exogenous or predictor variables (i.e., Technological, Organizational, and Environmental Factors) and into the endogenous or dependent variable (i.e. Adoption Stage). Each unidirectional path may reflect a relationship between cause and an effect; however, it is impossible, using a path coefficient alone, to measure a causal relationship. The β coefficients are equivalent to standardised regression coefficients in multiple regression models, and therefore, they can be used to make predictions about the relationships between the variables (Hair Jr et al., 2013).

The second stage of PLS-SEM was to evaluate the quality of the measurement model. The quality criteria used to evaluate the measurement model were (a) the loading coefficients must be strong (≥ 0.5) to indicate the validity of the constructs; (b) the average variance explained (AVE) in each latent variable must be at least 0.5 (50%) to indicate convergent validity (i.e., the indicators shared a high proportion of their variance in common); (c) the composite reliability of each latent variable should be ≥ 0.7 to indicate the internal consistency of the items (Hair Jr et al., 2013); and (d) discriminant validity was indicated if the square roots of AVE (expressed as a decimal) were greater than the values of β (Wong, 2013).

The final stage was to interpret the structural model. The R^2 valued measured the proportion of the variance in a latent variable explained by the variance in the latent variable(s) leading into it. An R^2 of at least 25% was considered to represent a substantial effect size (Hair Jr et al., 2013). The statistical significance of each β coefficient was estimated by bootstrapping. This process involved drawing 5000 random samples repeatedly from the data with 200 cases in each sample. The means and the standard errors of each β coefficient were computed. Two-tailed t-test statistics were used to determine if the mean value of each β coefficient was significantly different from zero at the conventional $\alpha = .05$ levels of statistical significance.

5 RESULTS

Twelve indicator variables were operationalized by averaging the item scores (details of the items composition are available with the authors upon request). The descriptive statistics (sample size, mean, standard deviation, minimum, maximum, and skewness of each indicator variable) are summarized in Table 1. The sample size was N = 203 respondents, with no missing values for all of the indicators.

The 7-point item scores for the indicators of Technological, Organizational and Environment Factors (ranging from 1 = "Strongly disagree" to 7 = "Strongly agree") tended to be negatively skewed (skew = -0.19 to -0.63) with relatively high mean scores (M = 3.66 to 4.90) reflecting the respondents' tendency to consistently endorse the higher ends of the item scales (> 3.5). Firm Size ranged widely, with the ordinal scores ranging from 1 < 4 employees up to 3 > 20 to 199 employees (M = 1.84). The ordinal scores for Market Scope also ranged widely from 1 = "Local" to 4 = "International" (M = 2.26). The indicator measuring adoption of Cloud computing services tended to be positively skewed, reflecting the respondents' tendency to consistently endorse the lower end of the item scales (2.46). The ordinal scores for Current Engagement ranged widely from 1 = "Not considering" to 5 = "Have already adopted services" (M = 2.46, skew = 0.5).

Latent variable	Indicator variable	N	Min	Max	M	SD	Skew
Technological Factors	Security Concerns	203	1	7	4.75	1.18	-0.40
	Cost Savings	203	1	7	4.32	1.19	-0.56
	Relative Advantage	203	1	7	4.41	1.15	-0.63
	Privacy Risk	203	1	7	4.90	1.20	-0.09
	Compatibility	203	1	7	4.37	1.25	-0.58
	Trialability	203	1	7	4.28	1.26	-0.27
Organizational Factors	Top Management Support	203	1	7	3.66	1.34	-0.22
	Innovativeness of the Firm	203	1	7	4.21	1.35	-0.49
	IS knowledge	203	1	7	4.11	1.33	-0.45
	Firm Size	203	1	3	1.84	0.88	0.32
Environmental Factors	External Support	203	1	7	5.10	1.05	-0.19
	Market Scope	203	1	4	2.26	1.14	0.22
Adoption Stage	Current Engagement	203	1	5	2.46	1.55	0.54

Table 1. Descriptive statistics for indicator variables

The PLS path model (called Model I) predicting the relationships between Technological, Organizational and Environmental Factors, and the respondent's perceptions regarding the current Adoption Stage of cloud computing, are presented in Figure 3.

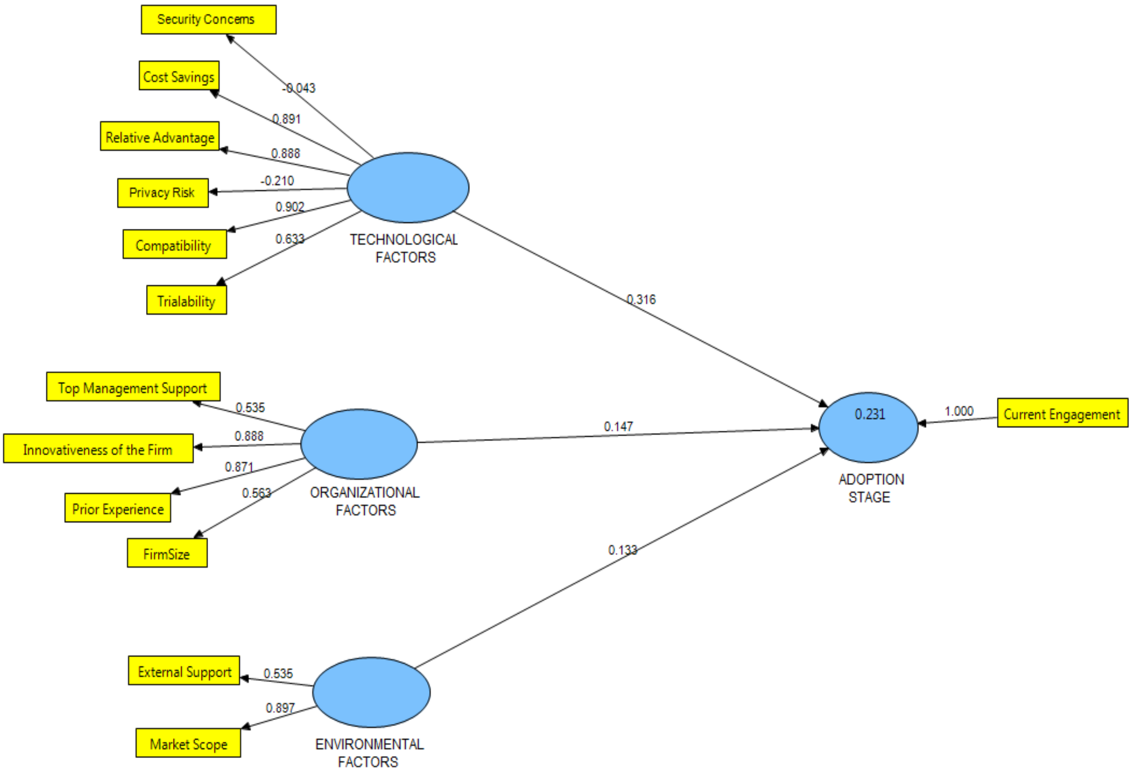

Figure 3. Model I to predict the adoption stage of cloud computing

The effect size ($R^2 = 0.231$) indicated that about 23% of the variance of the current Adoption Stage of cloud computing services was explained by a combination of Technological, Organizational, and Environmental Factors. All but two of the factor loading coefficients for the reflective indicators of the three factors were > 0.5 (λ = .535 to .902) indicating that these indicators contributed significantly the variance in the latent variables. The factor loadings for two of the indicators were, however, very weak (λ = -.043 for security concerns, and λ = -0.210 for privacy risk) implying that these two indicators contributed very little to the variance in Technological Factors. The path coefficient between Current Engagement and Adoption Stage was 1.00 because the latent variable had only one formative indicator. The AVE and reliability statistics are in Table 2.

The average variance explained (AVE = 0.474 to 0.545) in the three latent variables with multiple indicators was about 50%. The AVE was sufficiently large to indicate an acceptable level of convergent validity. The reliability coefficients of the latent variables were about 0.7 or larger (composite reliability = 0.692 to 0.815) reflecting an acceptable level of internal consistency. Furthermore, the square roots of AVE listed in Table 2 were consistently greater than the path coefficients (β) in Table 3. All of the standardized path coefficients (β) were significantly greater than zero ($p < 0.05$), indicated by the results of t-tests following bootstrapping.

	AVE	Square Root AVE	Composite Reliability
Technological Factors	0.474	0.688	0.748
Organizational Factors	0.538	0.733	0.815
Environmental Factors	0.545	0.738	0.692

Table 2. Quality criteria for the model

The strongest positive predictors of the Adoption Stage were Technological Factors (β = 0.316); followed in order of importance by Organizational Factors (β = 0.147); and Environmental Factors (β = 0.119). The positive path coefficients predicted that the participants perceived that a high level of engagement in the adoption of cloud computing services was associated with a high level of belief in the Technological Factors (excluding Security Concerns and Privacy Risk) whilst beliefs in the Organizational and Environmental Factors were perceived to have lesser importance.

Path	β	t	p
Technological Factors → Adoption Stage	0.316	4.048	0.001
Organizational Factors → Adoption Stage	0.147	1.987	0.047
Environmental Factors → Adoption Stage	0.133	3.407	0.001

Table 3. Significance of path coefficients in the model

Figure 4 presents the final model after the exclusion of security concerns and privacy issues factors. The effect size is $R^2 = 0.219$. All the factor loading coefficients for the reflective indicators of the three factors were > 0.5 (λ = .535 to .911) indicating that these indicators contributed significantly to the variance in the latent variables.

The path coefficient of the three latent variables was significant, as per the illustration of the p and t values in Table 4 below.

Path	β	t	p
Technological Factors → Adoption Stage	0.284	2.063	0.039
Organizational Factors → Adoption Stage	0.172	2.181	0.029
Environmental Factors → Adoption Stage	0.121	3.733	0.000

Table 4. Significance of path coefficients in the final model

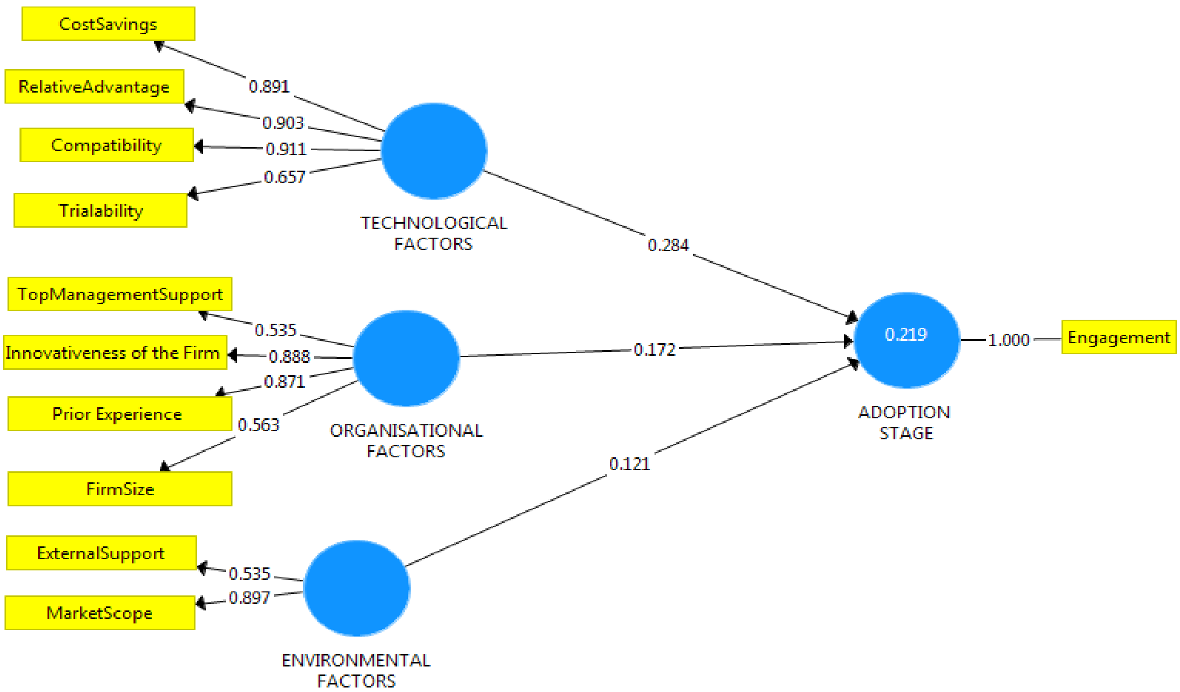

Figure 4. Final model to predict the adoption stage of cloud computing

6 CONTRIBUTION, LIMITATION, & FUTURE RESEARCH

This paper presented a model of the influential factors in Australian SMEs' adoption of cloud computing. The findings presented in this paper provide a guideline for software vendors on the adoption of cloud computing for improving their products and services. It can also be used by policy makers in implementing measures that can support the technology infrastructure and increase awareness among SMEs. The findings could be considered in evaluating the current government incentives and policies to expedite the adoption of cloud computing. In addition, it can be used by SMEs decision makers to understand the different influential factors and take them into their consideration during the adoption process.

On the other hand, this research focuses on to Australian SMEs. As a future direction, the scope of this research can be extended to include other countries with different characteristics. We investigated a number of specific relevant factors in cloud computing adoption. Due to the dynamic nature of cloud computing, new factors will need to be investigated as cloud computing evolves into maturity. Our future study will extend the model developed in this paper with those new factors. In future work, the authors will investigate a prediction method for cloud adoption based on the extent of the adoption.

7 CONCLUSION

This study identified the influential factors in cloud computing adoption by SMEs based on TOE and DOI theories. An integrated research model was developed based on the two theories. The model was empirically examined on a sample of 203 firms from Australia. The results validated the significance of Technological Factors (excluding Security Concerns and Privacy Risk), Organizational Factors, and Environmental Factors in the adoption of cloud computing. The results provide valuable insight to SMEs, cloud services providers, and emerging literature in the context.

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