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Clearing the 'Cloud' Hanging Over the Adoption of Cloud Computing in Australian SMEs

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Completed Research Paper

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Abstract

In Australia, cloud computing is increasingly becoming important especially with the new accessibility provided by the development of the National Broadband Network (NBN). This will give small and medium-sized enterprises (SMEs) opportunities of affordable access to computing resources. Academic studies in investigating the socio-technical issues that might be the reason in influencing the adoption of cloud computing are scant with the consideration of Australian SMEs. To fill the void, a research model was developed based on the diffusion of innovation theory (DOI), the technology-organization-environment (TOE) framework, and unfolding the relevant literature review. Data was collected using mixed methods. The first study was an exploratory study and data was collected from eleven Australian SMEs and four cloud service providers. The second study was a national wide empirical study with 203 Australian SMEs across the country. The findings have two important contributions. First, they extend the existing knowledge of cloud computing adoption by Australian SMEs. Second, they provide SMEs, cloud service providers and policy makers with insights about the determinants of cloud computing adoption useful for planning and making decisions in the adoption of cloud computing. This research followed an exploratory approach in its nature.

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

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Introduction

Cloud computing popularity is growing among enterprises since its inception (El-Gazzar 2014). A strategic decision on adopting the cloud computing is very critical. Decision making in adopting of any technology could be a difficult process even with its promises for various advantages and enhancement of business processes. Cloud computing paradigm can have similar complications. Zhang et al. (2010) found that cloud computing offers outstanding benefits as well as challenges that can hinder adoption. To make an informed decision, prior studies advocated that a decision making of Information and Communications Technology (ICT) adoption usually involve ranges of dimensions including technological factors, organizational factors, and environmental factors (Aboelmaged 2014; Awa et al. 2015; Palacios-Marqués et al. 2015; Soto-Acosta et al. 2015). It is because the most comprehensive understanding of a decision case from different angles the better and more accurate are the final decision and, therefore, more positive benefits, outcomes, and results can be obtained (El-Gazzar 2014). In particular, the unique characteristics Australian Small and Medium-sized Enterprises (SMEs) cloud computing adoption research context make the investigation of the determinants that influence the decision to adopt cloud computing by SMEs in Australia more salient for complementing prior studies on organizational level cloud computing adoption.

In Australian SMEs, the acceptance of cloud computing is slow (Minifie 2014) There are various possible factors that have impact in the adoption of such technology (Doherty et al. 2015; Gangwar et al. 2015). From the technological factor perspective, Australian SMEs have many sensitive data that they need to protect including quotations to their customers, financial details and company databases (Misra and Mondal 2011). Catteddu and Hogben (2009) found that cloud computing adoption is hindered by some technology-driven issues, such as privacy issues, security concerns, and data confidentiality. There are various obstacles for cloud adoption computing in Australian SMEs because of the high sensitivity of data (Jain and Bhardwaj 2010; Misra and Mondal 2011). Koehler et al. (2010) suggested that technology reliability and security are barriers to cloud adoption as well.

From the organizational factor perspective, Australian SMEs are essential to the country economy; they have been defined as companies that have less than 200 employees (ABS 2001). They constitute 99.75% in business economy and recruit 70% of the country employment (ABS 2013). However, Australian SMEs are not eager to equip information technologies for their business. 59% of Australian SMEs are low in adoption and usage of information technologies (Economics 2011). Many Australian SMEs are not aware of what the term cloud computing means and its benefits; the 23% of the cloud services users stated that one of the reasons they use it because it is secure than their servers (MYOB 2012). In an earlier survey in 2011, Optus found that 59% of Australian SMEs are not aware or sure of cloud computing (Optus 2011). According to (Minifie 2014), many Australian SMEs do not have an awareness of the advantages of cloud services or the knowledge to use them.

From the environmental factor perspective, The spread of National Broadband Network (NBN) is valuable for Australia due to the high-speed services provision for the internet and telephone (NBNCO 2015a). It is also could be attractive to Australian SMEs with the new accessibility to ICT resources it provides (NBNCO 2015b). However, In light of cloud computing adoption of SMEs, and despite the promising benefits, the adoption pace is still relatively slow in Australia compared to other nations in Asia (ACCA 2012). Grattan Institute in Australia stated that the adoption rate in SMEs is lower than large firms (Minifie 2014).

Considering the characteristics of Australian SMEs, this paper intends to identify what are the critical factors for making an adoption decision of cloud computing in Australian SMEs. To achieve this objective,

we adopted Technology-Organization-Environment (TOE) framework and Diffusion of Innovations (DOI) theory as the theoretical foundations and applied a mixed-method research approach to investigate the determinants. Two studies were conducted sequentially to refine the research model and validate the hypotheses. The first study was an exploratory research in which the data from in-depth interviews were collected from 15 organisations. The outcomes of exploratory study helped us in refining the research model. Then, the second study was conducted with a national wide survey in Australia. We collected data from 203 Australian SMEs across the country. The survey data analysis validated the hypotheses and identified the critical factors for adopting cloud computing in Australian SMEs. We found that technological factors, risk factors, and environmental factors had influence in the adoption of cloud computing. There was insufficient evidence about the significance of organizational factors. This paper will discuss briefly the exploratory study to provide a short glance about the process followed in the complete study. The survey study is the core of this paper; therefore, it will be discussed in more details.

The rest of this paper is organized as follow: Section two provides the literature review. Then section three present the research model and hypotheses. After that, Section four outlines the qualitative and quantitative methodologies. Section five presents the results and discussion. Finally, research contribution, limitations, a suggestion for further studies, and conclusion are provided.

Background

Cloud Computing Adoption in Australian SMEs

Cloud services providers promote that cloud computing can provide attractive business solutions for SMEs through increasing the efficiency of enterprises IT resources (Mather et al. 2009; Santos et al. 2009). Cloud computing provides companies with more quality times in concentrating on their core businesses and discharging them from planning and management of IT resources; this enables them to increase their productivity (Garrison et al. 2012).

OECD (2006) reported that SMEs constitute the largest percentage of the private sector in the world. Therefore, it is evident that technological innovation can equip SMEs with the necessary capabilities to enhance the global economy. Cloud computing is the technology of the century and it has high expectations to solve the business challenges that are faced by SMEs (Rio-Belver et al. 2012). In Australia, the SMEs are the skeleton of the country economy (ACMA 2014). For facilitating changes in any industry, three crucial components need always to be considered: processes, people, technology (Chen and Popovich 2003). Cloud services could be the solution for enterprises which are lack in financial capabilities for acquiring in-house ICT solutions (Hancock and Hutley 2012). The diffusion of cloud computing created a considerable contribution to the growth estimated at a rate of (between 0.05% to 0.3%) and created around one million new employment opportunities in Europe (Hancock and Hutley 2012). Pike_research (2010) reported that implementing cloud solutions could reduce up to 30% of the associated carbon footprint per user for large organizations and about 90% of smaller businesses.

In Australian SMEs market, the adoption rate found to be slower in SMEs comparing to large firms (Minifie 2014). Academic studies in investigating the socio-technical issues that might be the reason in influencing this drawback are limited especially with SMEs. Mainly the studies addressed the direct influence of technological innovation attributes or other contextual elements (Martins et al. 2014). Therefore, it is obvious that area needs more attention as it has not been adequately researched considering both the direct and indirect influential factors in the adoption of cloud computing.

The unique characteristics of small businesses demand developing different models of investigation than the ones used in large businesses contexts. In most cases, large businesses face many of the same constraints and these effects can be more significant on small businesses. Resources such as skills, time, and employees are not the major issues in large businesses, while they can create significant disadvantages in small businesses (Cohn and Lindberg 1972). Therefore, organizational theories and practices that apply to a large business not necessarily will be suitable for small business context (Cohn and Lindberg 1972; Dandridge 1979; Welsh and White 1981). There is a need to investigate cloud computing adoption in small businesses separately rather than in a generic form as in usual practice.

SMEs have unique characteristics in technology adoption (Chwelos et al. 2001; Stefanou 2014). For instance, SMEs found to be more subjected to risk in technology adoption (Stefanou 2014) and also

having more chances of failure percentage in technology adoption projects (Cochran 1981). Additionally, improper document management systems within SMEs make it more complicated for strategic planning to achieve business objectives (Tetteh and Burn 2001). In the Australian context, a study by MYOB in 2012 found that almost 80% of SMEs are not using cloud services (MYOB 2012). The Department of Broadband, Communication and the Digital Economy in Australian Government stated that the country SMEs are behind their counterparts in other OECD countries in the implementation of online technology (Australian-Government 2013). This leads to the unfavorable competitive position, which could be solved and leveraged through the use of cloud computing services (Fakieh et al. 2014). Furthermore, Australia is behind other OECD countries on domestic broadband speed and prices (OECD 2013).

KPMG in 2012 stated if there are 75% adopters of cloud computing services across Australian economy, then this will mean to have 25% reduction in operation expenses and 50% reduction in capital expenditure (Hancock and Hutley 2012). More clearly, this will lead to significant cost savings that could complement between $2 and $3 billion to nation gross domestic product (GDP), or between 0.15 and 0.2 of a percentage point of GDP. These finidings stated in a study of modeling the Australian economic impact of cloud computing (Hancock and Hutley 2012). There are other non-monetary beneficial values of the cloud that can be higher than cost savings, such as remote access, flexibility, and dismissal of redundant systems. A study in the European Union estimated the value of flexibility and also measured it to be 1 % of the GDP (Hogan et al. 2010).

Analysts estimate that the Australian cloud services market is growing by about 25% per annum, and it is expected by the year 2017 to comprise 15% of IT services market in Australia which will equal to $3 billion growth (IDC 2013a; IDC 2013b). This will change the market and there will be widespread impacts across industries. Industries that already use ICT solutions intensively such as retail banking, manufacturing, logistics and other might find it very useful and beneficial to use cloud services (Hancock and Hutley 2012). Industries with limited ICT use such as trading, construction, agriculture, and fishing might also find the cloud attractive for increasing competitiveness and improve business practices. Cloud services are likely to bring attractiveness to organizations across sectors. For example, some would be more interested in cost reduction while others might think flexibility and mobility are the core benefits they can gain from using the cloud and so on (Repschlaeger et al. 2013).

From the academic perspective, we found only a few studies attempted to this topic from the Australian context. One of the first attempts was our exploratory study to confirm the influential factors from the perspectives of Australian SMEs and cloud services providers (Al-Isma'ili et al. 2016). The other study was conducted by Senarathna et al. (2014) to examine the impact of security and privacy in the adoption of cloud computing among 150 SMEs. Senarathna and colleagues study was limited in addressing the paradigm from a single perspective (i.e., security and privacy concerns) and found that both of the two factors are not significant in the adoption of cloud computing and there is no effect of location (i.e., metropolitan or regional) in the acceptance decision. The main drawback of their study was that it did not consider in exploring the influential factors with the stakeholders (SMEs) before conducting their main empirical study especially with the nature of cloud technology as a technology. This same study also recommended for a further detailed investigation incorporating other relevant aspects. The scarce research on this topic is the motivation of this current research. Our study is endeavoring in filling the gaps found in the previous studies in terms of considering various perspectives especially in the case of SMEs. The study used mixed-method approach starting with exploring the cloud adoption paradigm with the study panel (i.e., SMEs and cloud services providers) and concluding with a larger scale exploratory investigation for the developed cloud adoption model. This was ascertained to be a suitable approach considering the relative newness nature of the cloud computing, limitation in previous studies especially in the Australian context, and the significance of Australian SMEs to the economy of the country.

Research Model & Hypotheses

Research Model

We present a research model (Figure 1) to carry out the study. This model is a result of the exploratory study (Study 1). In this section, we develop the hypotheses for the quantitative study (Study 2).

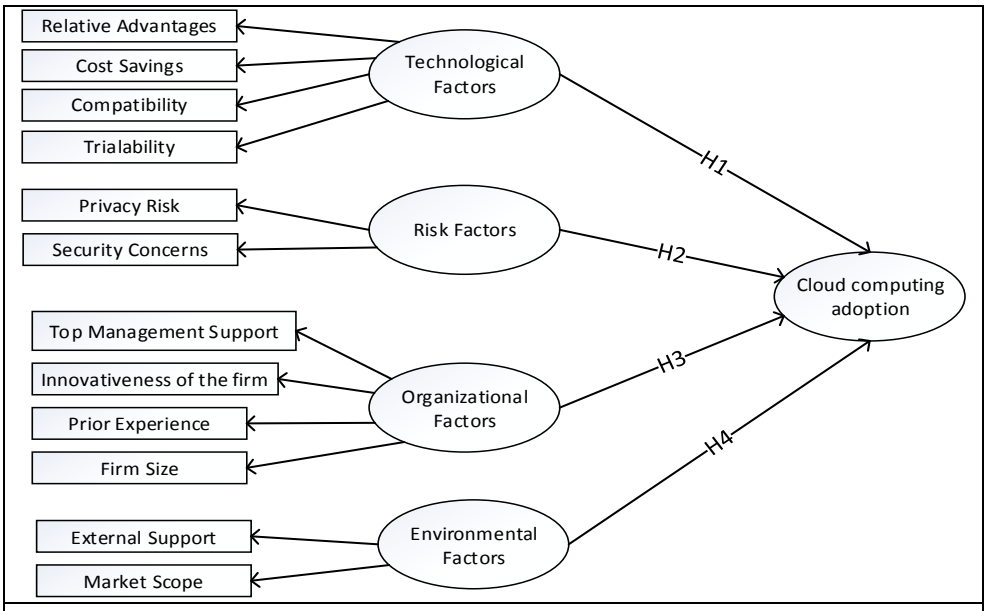

Figure 1. Research model

Technological Factors

Technological factors collectively are predicted to have a positive influence in the adoption of cloud computing. These factors are directly related to the cloud computing technology.

Relative advantages are the perception of the technology advantages in respect to other similar technologies (Rogers 2003). Studies found the advantages that are gained by using ICT technologies to be positive drivers toward the adoption of these technologies (e.g.Armbrust et al. 2010; Marston et al. 2011; Oliveira et al. 2014; Tarofder et al. 2013). Cloud computing is a tool that can help organizations in developing efficient business models (Chang et al. 2010). Cloud computing technology is promising various benefits through providing scalable computing services to its clients (Leimeister et al. 2010).

Marston et al. (2011) suggested that cloud computing can help in reducing infrastructure costs, increasing efficiency in energy consumption, and decreasing maintenance overheads. According to (Australian-Government 2011), cloud computing is expected to provide Australian SMEs with various benefits including easy technical capabilities, easy accessibility of data, and a robust value chain.

Compatibility is one of the factors in the DOI theory, and it was found to be significant in the adoption of IS in SMEs (Thong 1999). Provision of trials period by cloud providers to its clients is crucial and it can influence the likelihood of cloud adoption (Lin and Chen 2012). Hence, the hypothesis of this context is:

H1: *Technological factors are predicted to influence the adoption of cloud computing positively.*

Risk Factors

Like any other innovation, cloud computing still has some concerns and challenges, such as security, privacy, trust, availability, and lock-in (Daniel et al. 2014; Gupta et al. 2013; Habib et al. 2010; Pearson and Benameur 2010). Security issues are one of the key inhibitors in the adoption of this innovation (Kim et al. 2009). Security is a concern for both large organisations and SMEs (Kim et al. 2009). SMEs have many sensitive data that they need to protect including quotations to their customers, financial details, company databases, trade secret, email accounts, research findings, confidential research, and feasibility studies. (Misra and Mondal 2011). SMEs found to be more subjected to risk in technology adoption (Stefanou 2014) and also having more chances of failure percentage in technology adoption projects (Cochran 1981). Whaiduzzaman et al. (2014) discussed security and privacy together as the obstacles for all wireless and wired systems that permit users in sharing resources. Our interview study (study 1)

indicated that privacy risk is a concern for some Australian SMEs. Previous literature and our exploratory study indicated that security and privacy issues are most of the time are linked together and they are associated with risk and uncertainty as it has been discussed earlier. This is why our model considered in linking these two factors under the umbrella of risk. This paper hypothesises that:

H2: *Risk factors are predicted to influence the adoption of cloud computing negatively.*

Organizational Factors

The size of the firm could be one of the factors that impact the likelihood of IT adoption (Hong and Zhu 2006; Pan and Jang 2008). Low et al. (2011) suggested that firm size is an important determinant in the adoption of cloud computing. Top management support for innovation and providing the necessary resources is essential in enhancing the business processes (Wang et al. 2010). Top management support is positively related to the adoption of innovative technologies (Zhu et al. 2004). SMEs with innovative and IS knowledgeable decision makers are more likely to adopt computing technologies (Thong 1999). SMEs characterised with shortage technical capabilities and IS experiences (Plomp et al. 2014). Thus, this paper proposes that:

H3: *Organizational factors are predicted to influence the adoption of cloud computing positively.*

Environmental Factors

The market scope of some SMEs can reach to global. Competitiveness is one of the challenges and firms consider ICT for accomplishing their business activities more efficiently (Hitt 1999). Zhu et al. (2006) found that firms with cross countries operations are more inspired with e-business solutions. Sufficient supplier support for technologies could be the reason for using them by organizations (Premkumar and Roberts 1999). Hence, this predicts that:

H4: *Environmental factors are predicted to influence the adoption of cloud computing positively.*

Methodology

A mixed-method approach was adopted to identify the key determinants of cloud computing adoption in Australian SMEs. Study 1 was designed to explore possible factors that influencing the cloud computing by using interview method. The outcomes of the qualitative study were used for enriching and refining the research model. Study 2 was conducted to get empirical data from a national wide survey from Australian SMEs. Data from the survey was used for verifying the hypotheses of the research model. Due to the scope of this paper the methodology used in the qualitative study will be presented briefly and the main study (quantitative) will be presented in more details as it is the main study which will ultimately confirm the developed research model.

Study 1: Qualitative Study

The study followed a semi-structured interviewing method. Participants were encouraged to identify the influential factors in their opinion besides confirming the predefined factors. The predefined factors were identified from the relevant literature review and the DOI and TOE frameworks. This method helped in reducing the bias for driving participants towards discussing only the pre-identified factors.

Data was collected from 15 organisations within three months period from Jun 2015 to August 2015. The organisations were classified based on the adoption stages as per Rogers' categorization on adoption status (Rogers 2003). The categorisation consisted of four categories: providers (4 firms), adopters (5 firms), prospectors (2 firms), and non-adopters (3 firms). Data then was analysed using Nvivo software.

Study 2: Quantitative Study

The drive of this study was to identify the factors that determined the adoption of cloud computing by SMEs in Australia. The empirical data used to identify the factors were the scores for the measurement items adopted from prior literature (e.g. Moore and Benbasat 1991; Thiesse et al. 2011; Valier et al. 2008). Data was collected from 203 Australian SME decision-makers using a self-report questionnaire. The

constructs were measured using a seven-point Likert scale on an interval level ranging from "strongly disagree" to "strongly agree". A pre-test for the questionnaire was established to validate to check content validity, the length of the instrument, the wording of the scales, and format style of the document. In this process, the survey questions were discussed with academics, business advisors, and top managers of twelve firms. The feedback received for this process helped in improving the questionnaire. SurveyMonkey Audience was used as an online surveying tool to target and recruit SMEs decision makers.

A stratified sampling approach was used. A donation of $0.50 donation was contributed to charities for each completed survey. The recruitment resulted in 228 replies from potential respondents. A total number of rejected surveys with incomplete answers and non-compliance with the screening criteria (i.e., firm size and involvement in the decision-making process) 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%.

Results

This section will discuss briefly the qualitative study (exploratory) and in more details the quantitative study (main-confirmatory of the research model).

Study 1: Qualitative Study

In the exploratory phase, the study confirmed the significance of compatibility, security concerns, trialability, top management support, firm size, prior IT experience, innovativeness, market scope, industry, and external computing support in the decision of cloud computing adoption. Those factors were identified in our prior work in the literature review and the conceptual model development (our reference). In this same study (an exploratory study), two additional factors were identified and they were cost savings and privacy risk due to geo-restrictions. Competitive pressure and complexity were not found to have significance impact in the adoption decision. All the factors from the three dimensions technological, organizational, and environmental were having a positive influence towards the adoption of cloud computing except security concern and privacy risk. The latter two factors have an adverse impact on the adoption of cloud computing (our reference). The outcomes of this study were used as the foundation of the quantitative study.

Study 2: Quantitative Study

Three statistical tools were used to analyse this study. The main tool was Partial Least Squares (Smart PLS 3.0), using the structural equation modelling (SEM) method combined with SPSS. Tableau application (9.3) was used as a third tool to get deeper insights about the interrelationship that occurs within the data.

The findings of this study are presented in four sections (a) Characteristics of Respondents; (b) Descriptive Analysis; (c) The influential drivers in each industry (d) Evaluation of the Measurement Model; (e) Evaluation of the Structural Model.

- Characteristics of Respondents

The personal information provided by N = 203 respondents. Most (74.8%) of the respondents were either Managing Directors/Owner Managers/CEOs (n = 103, 50.7%) or General Managers (n = 49, 24.1%). In response to the question "When it comes to IT decisions for your business, are you…", the majority (86.2%) of the managers replied that they were either the primary decision maker (n = 116, 57.1%) or that they were involved in the decision process (n = 59, 29.1%).

The number of employees in each company ranged from 1 to 199 with 1 to 4 the most frequent (n = 97, 47.8%). The market scopes of the firms ranged from local (n = 76, 37.4%); Regional (n = 36, 17.7%); and National (n = 54, 26.6%), to International (n = 37, 18.2%). The firms operated across a very wide range of industries, classified into 24 groups, of which the most frequent, representing 49.3%, were Services (n = 54, 26.6%) and Technology (n = 46, 22.7%).

The information provided by N = 203 respondents regarding the adoption of cloud computing shows that the most frequent category of Current Engagement was Not considering (n = 84, 41.4%) and relatively few (n = 33, 16.3%) had already adopted services, infrastructure or platforms of cloud computing. A

substantial proportion (n = 67, 33%) whilst the remainder had either already adopted cloud computing, or were expecting to adopt it in the next 1 to 5 years.

- Descriptive Analysis

The sample size was N = 203 respondents, with no missing values for any items. As a separate analysis to PLS-SEM a factor analysis and reliability analysis was conducted using SPSS for all the variables that were incorporated as indicators in the PLS model as first order constructs (factor analysis and reliability analysis of indicators are available with the authors upon request). Factor item loadings and reliability were computed for indicators with two or more items, but could not be computed when there was only one item (denoted N/A = not applicable). All of the indicators for the first order constructs were reliably measured using 2 to 5 items (Cronbach's alpha = 0.814 to 0.928). The high item loadings (λ = 0.813 to 0.960) provided statistical evidence for the validity of the constructs.

The sample size was N = 203 respondents, with no missing values for any items. The descriptive statistics (minimum, maximum, mean, standard deviation and skewness) for each variable) after compositing the constituent item scores by averaging, are summarized in Table 1.

Table 1 Descriptive Statistics (N = 203)

Variables	Min	Max	M	SD	Skew
Compatibility	1	7	4.37	1.25	-0.58
Cost Savings	1	7	4.32	1.19	-0.56
Engagement	1	5	2.46	1.55	0.54
Expectation	1	6	3.14	1.88	0.20
External Support	1	7	5.10	1.05	-0.19
Firm Size	1	3	1.84	0.88	0.32
Innovativeness of the Firm	1	7	4.21	1.35	-0.49
Market Scope	1	4	2.26	1.14	0.22
Prior Experience	1	7	4.11	1.33	-0.45
Privacy Risk	1	7	4.90	1.20	-0.09
Relative Advantage	1	7	4.41	1.15	-0.63
Security Concerns	1	7	4.75	1.18	-0.40
Top Management Support	1	7	3.66	1.34	-0.22
Trialability	1	7	4.28	1.26	-0.27

The 7-point item scores for the four 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). This tendency could possibly be associated with response bias (e.g., acquiescent, extreme, and or social desirability). The possibility of a high level of measurement error, associated with response bias, implied that is was essential to test the reliability and validity of the reflective latent variables when conducting PLS-SEM.

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 two indicators 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 (< 3.5). The ordinal scores for Current Engagement ranged widely from 1 = "Not considering"

to 5 = "Have already adopted services" (M = 2.46, skew = 0.5). The ordinal score for Expected Engagement ranged from 1 = "Not considering" to 6 = "Have already adopted services" (M = 3.14, skew = 0.20). Because PLS-SEM, unlike CB-SEM, makes no assumptions with respect to the distributional and measurement characteristics of the data, PLS-SEM was more applicable than CB-SEM to analyse the skewed and possibly biased distributions of the ordinal level variables collected using the self-report instrument.

- The Influential Drivers in Each Industry

The colour in Figure 2 shows details about cloud adoption variables in SMEs (copy of Tableau output). The figure indicates that the drivers and obstacles are relatively different throughout the various industries. For instance "external support" is the most important factors with technology and service industries. However, it is not the case with manufacturing firms. With manufacturing sector, privacy risks followed by security risk then external support are the three top considerations. Here we only compared the top three industries based on the number of participants in this study. We did a comprehensive evaluation of all industries but it is not possible to present all details in this paper. For instance, in finance sector, it was found that privacy risk is the top issue in the adoption, and the sensitivity of data can explain this concern in this segment. In general, there is a noticeable trend across all sectors as it can be seen from the Figure 2. Firm size, market scope, and top management support appear to be the least important aspects in all industries whereas security, privacy, and external support were the most substantial ones (more details on all industries available with the authors upon request).

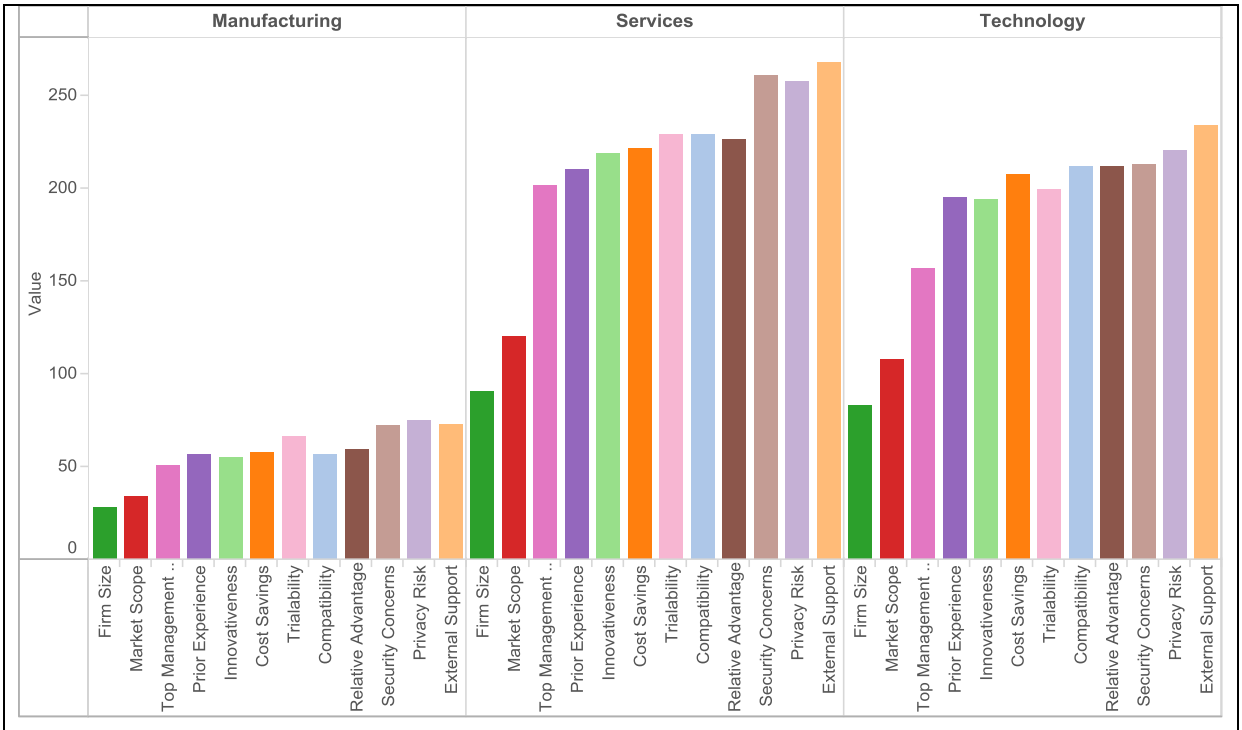

Figure 2. Influential Adoption Factors in Different Industries

- Evaluation of the Measurement Model

The steps taken to evaluate the measurement model were as follows: (1) evaluation of the construct or factorial validity of the latent variables, indicated by consistently strong factor loading coefficients for all of the indicators specified to operationalize each latent variable; (2) evaluation of convergent validity, indicated by the Average Variance Explained (AVE); (3) evaluation of the discriminant validity of the latent variables, indicated the cross loading coefficients; and (4) evaluation of the internal consistency of the latent variables, indicated by composite reliability coefficients.

1. Construct Validity

The five latent variables, or factors representing the second order constructs in the PLS model (Adoption, Environmental, Organizational, Risk, and Technological) were reflective, meaning that they were measured using a battery of positively correlated indicators, where causality was assumed to flow from the latent variables to the indicators (Borsboom et al. 2003; Edwards and Bagozzi 2000). No formative variables were used (i.e., consisting of series of measurements, which indicate different attributes of the latent variable, but the measurements are not correlated with each other). All the factor loading coefficients (λ) for the indicators used to operationalize the reflective latent variables were greater than 0.5 (λ = 0.526 to 0.949). The criterion for keeping the indicators in the model was that they all had factor loadings greater than 0.5. This criterion was based on the recommendation of Hair et al. (2010, p. 117) as follows: "Factor loadings in the range ± 3.0 to ± 4.0 are considered to meet the minimal level for interpretation of structure. Factor loadings ± 0.5 or greater are considered practically significant". The solution to the composite factor analysis indicated, therefore, that all the specified indicators contributed significantly the variance in their corresponding latent variables, and confirmed the construct validity of the factors.

2. Convergent Validity

The output from SmartPLS displaying the Average Variance Explained (AVE) for each reflective variable is reproduced in Table 2. The AVE values ranged from 0.537 for Environmental Factors to 0.901 for Adoption (of Cloud Computing). High convergent validity, indicated by Average Variance Explained (AVE) > 0.5 (Hair et al. 2014). Good convergent validity was confirmed because all the AVE values were greater than 0.5, meaning that, on average, more than 50% of the variance in each latent variable was explained by its respective indicators.

Table 2. Convergent Validity of Reflective Variables

	AVE
Adoption	0.900942
Environmental factors	0.546321
Organizational factors	0.537271
Risk factors	0.784930
Technological factors	0.715465

3. Discriminant Validity

Good discriminant validity was indicated because the cross loading coefficients for the indicators that were not specified to operationalize each latent variable were consistently weaker than the cross loading coefficients for the indicators that were specified to operationalize each latent variable. This meets the quality criteria specified by (Hair et al. 2014) for assessing discriminant validity. There was no threat to discriminant validity (cross loadings results are available with the authors upon request).

4. Internal Consistency Reliability

The output from SmartPLS displaying the Composite Reliability Coefficient for each latent variable is reproduced in Table 3. The reliability coefficients ranged from 0.695 for Environmental Factors to 0.948 for Adoption (of Cloud Computing). Good internal consistency (composite reliability coefficient > 0.7). Lower values would indicate that the validity and reliability of the latent variable is not acceptable, justifying the exclusion of weak reflective indicators (Hair et al. 2014). Good internal consistency reliability was confirmed because all the coefficients were > 0.7. There were no threats to the reliability of the model.

Table 3. Internal Consistency Reliability of Reflective Variables

	Composite Reliability

Adoption	0.947890
Environmental factors	0.695297
Organizational factors	0.814195
Risk factors	0.878833
Technological factors	0.908032

- Evaluation of the Structural Model

The evaluation of the structural model was conducted in three steps (1) test for multicollinearity; (2) significance of path coefficients; and (3) evaluation of effect size. The statistics to test for multicollinearity computed using SPSS for all the indicators are presented in Table 4. All the Tolerance values were > 0.2 and all the VIF values were < 5. Consequently, using the criteria specified by Hair et al. (2014) the model was not compromised by multicollinearity, and there was no need to combine or exclude any of the indicators to eliminate or take account of the correlations between the indicators.

Table 4. Test for Multicollinearity between Indicators

Indicator	Collinearity Statistics	
	Tolerance	VIF
Compatibility	.322	3.109
Cost Savings	.314	3.189
External Support	.656	1.526
Firm Size	.847	1.181
Innovativeness of the Firm	.316	3.161
Market Scope	.881	1.135
Prior Experience	.336	2.979
Privacy Risk	.517	1.936
Relative Advantage	.270	3.708
Security Concerns	.541	1.849
Top Management Support	.751	1.331
Trialability	.570	1.753

The path coefficients (β) computed by SmartPLS measuring the strengths of the predictive relationships between the four factors and Adoption (of Cloud Computing). The results of t-tests after bootstrapping determine the significance of each path coefficient. The results in Table 5 are summarized with respect to testing the four stated hypotheses.

Table 5. Testing of Hypotheses

Hypothesis	β	t
H1: Technological Factors are positive predictors of Adoption of Cloud Computing	0.333	4.513**
H2: Risk Factors are negative predictors of Adoption of Cloud Computing	-0.156	2.482**
H3: Organizational Factors are positive predictors of Adoption of Cloud Computing	0.133	1.773^
H4: Environmental Factors are positive predictors of Adoption of Cloud Computing	0.158	2.613**

Note: **: p<0.01; ^: p<0.1.

The path coefficient is significant if the t-statistic is greater than 1.960 at a conventional 5% level of significance (Hair et al. 2014). The t-test statistics provided the evidence to support three hypotheses at the 0.05 level of significance: H1. Technological Factors are positive predictors of Adoption of Cloud Computing; H2. Risk Factors are negative predictors of Adoption of Cloud Computing; and H4. Environmental Factors are positive predictors of Adoption of Cloud Computing. However, there was insufficient statistical evidence at the 0.05 significance level to support H3: Organizational Factors are positive predictors of Adoption of Cloud Computing. The strongest predictor was Technological Factors ($\beta = 0.333$). Risk Factors ($\beta = -0.156$) and Environmental Factors ($\beta = 0.158$) were relative less strong predictors of Adoption. Organizational Factors ($\beta \approx 0.133$) was not found to be a significant predictor of Adoption of Cloud Computing. The R^2 value was 0.269, implying that 26.9% of the variance in Adoption of Cloud Computing was explained by the model. Using the criteria of Ferguson (2009), this R^2 value implies the results of the statistical analysis have practical significance in the context of social science research, with a "moderate" effect size.

Discussion

Examining the influential factors in the adoption of cloud computing is a vital topic for the organisation due to its implications for leveraging companies competitiveness and performance. This study embraced an integrative theoretical framework merged the TOE framework visioning the organisational perspectives and the DOI theory exploring the features of cloud computing. The findings confirm that technological factors, risk factors, and environmental factors influence the adoption of cloud computing. Surprisingly, organisational factors are not significant causes in the adoption. While this contradicts with the findings of other studies that stated the significance of organisational factors in the adoption of innovation (e.g., Dwivedi et al. 2009; Oliveira et al. 2014). Furthermore, Low et al. (2011) found that two organisational factors (i.e. top management support and firm size) out of three (the third factor was technology readiness) to be influential in the adoption of cloud computing in the high-tech industry in Taiwan. There are two studies in cloud SaaS adoption have similar finding with our study in respect to the insignificant of organisational factors (Erisman 2013; Mangula et al. 2014). Our findings also show that the drivers and obstacles to cloud computing adoption are not always the same in different industries (see Figure 2).

Technological factors (H1)

Both of the two studies confirm the significance of the four technological factors (i.e., relative advantages, cost savings, compatibility) on cloud computing adoption. These finding from the two studies demonstrate a solid conclusion in the importance of these factors in the diffusion of cloud computing. The relative advantages in managing business operations more efficiently, accomplishing tasks more accurately, improving the quality of work, providing new opportunities, and increasing productivity are the identified features of this factor in this study. This finding is consistence with other similar work in the literature (Gangwar et al. 2015; Johnson 2015; Powelson 2012). Our study found relative advantages to be significant across different industries and its rank of importance compared to the other factors varies in the perspective of various industries. For instance, it is the sixth important factors in the service sector and the fourth in the technology sector among the total number of twelve factors of this study (see Figure 2). A similar finding was also confirmed by (Oliveira et al. 2014). However, Lin and Chen (2012) study that investigated the adoption of cloud in high-tech firms found this factor to be a barrier to the cloud adoption.

Cloud cost savings represented by the cost-benefit analysis, lower maintenance cost of the technology, and lower energy and environmental costs are the expenses that have been evaluated in this study. Results show that the reduction in these costs by using cloud computing are beneficial for firms. This factor is useful for all types of industries. The finding is consistence with other similar studies that concluded cost saving is an influential driver in the adoption of cloud technologies. This is in confirmation with other similar studies investigated various industries adopting diverse technologies (Oliveira and Martins 2010; Premkumar and Roberts 1999; Sangle 2011; Thiesse et al. 2011; Thong 1999).

Compatibility with the in-house systems of the firms is an important driver for cloud adoption. The other compatibility dimensions that have been investigated in this study are compatibility with all aspects of work, compatibility with the business operations, and fitness of cloud solutions with the firms working

style. In this view, we addressed both the organisational culture and the technological resources. This is a positive driver for all firms and it is found to be the second highest concern after external support for real estate industry. This finding is consistent with the innovation adoption literature (Cooper and Zmud 1990; Wang et al. 2010). In cloud computing applications, the factor was found to be a major concern in view of nineteen IT professional in Taiwan as reported by (Lin and Chen 2012). It was further investigated in manufacturing and retailing firms (Wu et al. 2013) and with high-tech organisations (Low et al. 2011), and found to be significant. On the other hand, this factor was also found not significant in other studies (e.g. Borgman et al. 2013; Low et al. 2011). Therefore, in a proportional remark, the mixed findings suggest the need for further research to reach to a conclusive result.

Trialability is a positive driver in the adoption of cloud solutions. This factor was measured considering the firm satisfaction of the trial periods and the proper utilisation of the cloud solutions. This factor is useful for all types of SMEs. Our finding is complementing various other contextual ICT adoption studies such as enterprise systems in SMEs (Dwivedi et al. 2009), internet usage in teaching (Martins et al. 2004), online technologies in education (Mohamad Hsbollah et al. 2009)

Risk factors (H2)

In the exploration phase we found that uncertainty factors were constantly linked to security issues and privacy concerns. This is the reason of infusing these two factors together in one dimension named risk factors. Furthermore, previous literature on innovation adoption discussed uncertainty and risk (Erumban and De Jong 2006), uncertainty in respect to security and standardization (Lin and Chen 2012), uncertainty in privacy rights (Pearson and Benameur 2010). There are also various other uncertainties such as technological, market, and regulatory issues found to occur in different innovation process (Jalonen and Lehtonen 2011). However, about cloud computing in the context of Australian SMEs, we found that security and privacy are the issues that are ambiguous and have considerable concern in SMEs views. Cloud providers should plan to implement satisfactory measures in ensuring the provision of secure services for the beneficial of all parties (i.e., cloud providers and its clients). Security concern is the hindrance of cloud computing adoption in all industries. This factor is one of the main obstacles that firms identified in all the surveyed industries. Several scholars arrived at a similar conclusion about the security issues with cloud computing in different perspectives (e.g.Armbrust et al. 2010; Babcock 2010; Catteddu and Hogben 2009; Koehler et al. 2010). We believe that investigating this factor was useful. The reason resides partially in the nature of the technology provision as a multi-tenancy environment. This has the potential in increasing security vulnerability (Schneiderman 2011; Shen and Tong 2010). Identifying the security issues is crucial for cloud computing adoption. This research highlighted the significant impact of this factor.

Privacy risks that are associated with the provision of cloud services from outside the nation border are having great concern for Australian firms. Additionally, the loss control over the data that is hosted in the overseas data centres is also an anxiety with all SMEs. Some industries such as manufacturing, finance, and construction believe that privacy issues are the highest risks in the adoption of cloud-based solutions. Similar results were claimed by (Catteddu and Hogben 2009). Armbrust et al. (2010) and Zhang et al. (2010) also found that privacy and data confidentiality are the main concerns in cloud computing.

Organisational factors (H3)

The four organizational factors identified in this study are top management support, innovativeness of the firm, firm size, and prior IT experience. All of them are not significant. In the exploratory study these factors were identified as important by the participants. However, in the larger scale survey study it was evident that these factors were graded the least important among the other factors. It is obvious that the firms have more concerns about the technology itself, its allied risks, and other external factors such as market scope and the technical support rather than their organizational internal issues.

Top management support is statistically proven to be insignificant. The measurements that have been used to evaluate these factors are top executive involvement in analysing the requirement of cloud computing, and top management reviewing consultant's recommendations on cloud solutions and monitoring the adoption projects. This factor is one of the recognised attributes in the DOI theory. This result is inconsistent with the findings of (Lin and Lee 2005; Wang et al. 2010) about the value of this

factor in providing sufficient resources for the adoption of innovation, re-engineering, and change process. Also, Dwivedi et al. (2009) also stated the importance of top management support element in the adoption of enterprise systems in SMEs in north-west of England. This finding contradicts those previous findings. This can be explained due to the advancement and spread of the cloud solutions as the years proceeding. Companies are becoming more aware of the advantages and the disadvantages of the technology without the need for the support from technological consultants. The decision makers view the weight of this factor in comparison with other technological, risk, and environmental factor as less important.

Innovativeness factor covering experimenting of technological innovation and the firm enthusiasm in trying the technologies is an insignificant driver in acceptance of cloud solutions. This factor is one of the least important factors in all kind of SMEs industries covered in this research. Various studies confirmed contradicting results by the perceived characteristics of innovativeness of SMEs in the adoption of ICT (Agarwal and Prasad 1998; Ritchie and Brindley 2005; Thong 1999).

Firms with its specified three size categories micro, small, and medium-size enterprises have insignificant influence in the adoption of cloud services. Our study also showed that the larger the firm size the more complex information systems it adopts and also advanced cloud computing services it adopts or willing to adopt in the future. This can be explained by the competition demand for an organisation with a larger size to implement latest technologies to remain competitive in the market. The finding of the diversification of cloud services adopted by different firm sizes could be linked with the diversification in the requirements of the businesses in several aspects such as industry, market size, and type of industry. This factor found to be vital in the prior cloud computing adoption studies with different organisation types such as SMEs (Abdollahzadegan et al. 2013; Oliveira et al. 2014) and with different industries such as high-tech industry (Low et al. 2011) and manufacturing & services sectors (Oliveira et al. 2014). As a new insight, this study found that this factor has low influence and it is the least important factor in all SME types (except for mining industry). Even in the mining industry it is the second before last with the relatively small difference in importance with the least important (i.e. market scope) (see Figure 2). This could be due to the reason that other factors have an overwhelming impact on the adoption which reduced the effect of this factor.

Prior IT experience of similar technologies and specific familiarity of cloud computing is statistically insignificant driver toward the embracing of cloud solutions. This finding contradicting with other previous studies in ICT innovation adoption (Al-Qirim 2005; Ettlie 1990; Plomp et al. 2014; Thong 1999; Wymer and Regan 2005). This verdict can be interpreted exactly like the previous factor.

Environmental factors (H4)

Under this dimension there are two factors external support and market scope. External support factor is one of the principal drivers of cloud computing adoption. It receives the highest priority in industries such as services, technology, real estate, and mining. In previous literature, there was mix finding of the significant of this factor. For example, DeLone (1988) and Dwivedi et al. (2009) found that external support is not critical to the success of IS projects. While other studies found that this factor plays an important role in the adoption of innovation (DeLone 1981; Gatignon and Robertson 1989; Kwon and Zmud 1987). Organisations would likely have more confidence and willingness in taking advantage of the innovation when they are backed up with adequate support from its provider.

Market scope found to be an influential factor in the adoption of cloud solutions. The identified scopes were local, regional, national, and international. The impact of this factor is lower if compared with the other 12 factors. In most of the industries it appeared to be the eleventh factor in the rank of importance. It was even the least significant factor in the mining industry (Figure 2). This could be explained by the fact that mining industries usually operate in specific region with limited spreading across different geographical locations. This finding is similar to the findings of other scholars in their examination of ICT innovation adoption (Hitt 1999; Zhu et al. 2006; Zhu et al. 2003). It is also matching the findings of (Hitt 1999) in his study about information technology and firms. This finding in some ways also corresponds to the argument of Hitt (1999). Hitt claimed that high diversified and less vertically integrated firms have a higher requirement for IT investment.

Contributions

This paper presented and validated a model about the cloud computing determinant factors in the acceptance of cloud computing by Australian SMEs. The findings of this study can benefit different stakeholders including cloud computing services providers to improve the deliverable of their services to their customers. For example, providing competitive and within the country border data centres will increase trust and confidence on the service providers and reduces the concerns about privacy and security of the organizations. Also, disseminating awareness of the cloud computing services can increase the rate of adoption. Close communication between the services providers and their clients can help in satisfying the customers' needs and solve their concerns as well as providing better services. Regulators and policy makers can use the insights of this study build supportive infrastructure for this technology and disseminate awareness about the knowledge of cloud computing to Australian SMEs. Most importantly, SMEs' decision-makers can gain the benefit of this study by further understanding the technology and the sector insight regarding the influential factors behind the adoption of cloud computing in Australia and make a knowledgeable decision on their planning about the cloud computing services and technologies.

Limitations & Future Research

The limitation of the interview study was in the sample size. An appropriate sample size can provide a better demonstration of the different industries within the sector and therefore a detailed analysis and comparison between the various sectors in the influential factors and adoption rate. Furthermore, getting insights from other stakeholders such as technical staff, suppliers, and customers would be useful for gaining additional insights from different perspectives. One of the major limitations of the survey study was in only examining Australian SMEs. Future research can consider in extending this research to explore the paradigm in other geographical contexts and make a comparison of the findings. This paper investigated some of the relevant factors of the topic; there is an opportunity to extend the model further by exploring other dimensions. With the rapid change in the technology and the economic market, there is a demand for longitudinal research to measure the influence of the new development of the technology and the change in the market on the adoption. Effective use of the cloud solution is another perspective. Confirmatory research is a future resarch opportunity using the finidings of this exploratory study as a foundation.

Conclusion

This paper explored the determinants that influence the decision of Australian SMEs in adopting cloud computing services. In the qualitative study it was found that security concerns, cost savings, privacy due to geo-restrictions, compatibility, trialability, firm size, top management support, prior IT experience, innovativeness, market scope, industry, and external computing support are influential factors in the adoption of cloud computing. There was not enough evidence for the importance of competitive pressure and complexity of the adoption.

In the nationwide quantitative study, technological factors found to be positive predictors in the adoption of cloud computing. Risk factors were negative predictors, and environmental factors were positive predictors in the adoption of cloud computing. There was insufficient statistical evidence about the significance of organizational factors. The strongest predictor was Technological Factors ($\beta = 0.333$). Risk Factors ($\beta = -0.156$) and Environmental Factors ($\beta = 0.158$) were relative less strong predictors of Adoption. Organizational Factors ($\beta \approx 0$) was not found to be a significant predictor of Adoption of Cloud Computing.

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