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Cloud computing services adoption in Australian SMEs: a firm-level investigation

Salim Al Isma'ili
University of Wollongong, szaai787@uowmail.edu.au

Mengxiang Li
University of Wollongong, mli@uow.edu.au

Qiang He
Swinburne University of Technology, qhe@swin.edu.au

Jun Shen
University of Wollongong, jshen@uow.edu.au

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Cloud computing services can boost the competitiveness of Small and Medium-sized Enterprises (SMEs) and leverage countries' economies. In the Australian context, there is an emerging trend that SMEs begin to embrace cloud technology in their traditional business activities. However, prior studies did not pay much attention to investigating the factors that influence the cloud computing adoption among Australian SMEs. To fill the research gap, this paper investigates the influential factors that affect the decision on adopting cloud computing services for Australian SMEs. Protocol data collected from fifteen firm-level semi-structured interviews with practitioners are presented and discussed. The protocol analysis indicates that various factors are important to the adoption of cloud computing services for Australian SMEs, such as security concerns, cost savings, and privacy due to geo-restrictions. Furthermore, this study confirms the insignificance of complexity and competitive pressure factors in the adoption of cloud computing among Australian SMEs. These findings have imperative implications to scholars and practitioners alike in the cloud computing research and applications areas.

Keywords

investigation, firm, smes, level, australian, services, adoption, computing, cloud

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CLOUD COMPUTING SERVICES ADOPTION IN AUSTRALIAN SMES: A FIRM-LEVEL INVESTIGATION

Salim Al-Isma'ili, School of Computing and Information Technology, University of Wollongong, Australia, szaai787@uowmail.edu.au

Mengxiang Li, School of Computing and Information Technology, University of Wollongong, Australia, mli@uow.edu.au

Qiang He, School of Software and Electrical Engineering, Faculty of Science, Engineering & Technology, Swinburne University of Technology, qhe@swin.edu.au

Jun Shen, School of Computing and Information Technology, University of Wollongong, Australia, jshen@uow.edu.au

Abstract

Cloud computing services can boost the competitiveness of Small and Medium-sized Enterprises (SMEs) and leverage countries' economies. In the Australian context, there is an emerging trend that SMEs begin to embrace cloud technology in their traditional business activities. However, prior studies did not pay much attention to investigating the factors that influence the cloud computing adoption among Australian SMEs. To fill the research gap, this paper investigates the influential factors that affect the decision on adopting cloud computing services for Australian SMEs. Protocol data collected from fifteen firm-level semi-structured interviews with practitioners are presented and discussed. The protocol analysis indicates that various factors are important to the adoption of cloud computing services for Australian SMEs, such as security concerns, cost savings, and privacy due to geo-restrictions. Furthermore, this study confirms the insignificance of complexity and competitive pressure factors in the adoption of cloud computing among Australian SMEs. These findings have imperative implications to scholars and practitioners alike in the cloud computing research and applications areas.

Keywords: Cloud computing, Small and Medium-sized Enterprises, adoption, Australia.

1 INTRODUCTION

With the rapid growth of cloud technology, the adoption of cloud computing services has become an important topic for both scholars and practitioners (El-Gazzar, 2014). Previous studies (Carcary et al., 2013, Ross and Blumenstein, 2015, Dillon and Vossen, 2015, Sultan, 2010) indicated that Small and Medium-sized Enterprises (SMEs) sector is one of the economic entities that can highly benefit from the adoption of cloud computing services. However, such benefits can be severely impaired if the SMEs cannot identify the key determinants of cloud computing service adoption (Gajbhiye and Shrivastva, 2014, Goscinski and Brock, 2010, Ercan, 2010). More importantly, the investigation on the determinants must consider the contextual background where cloud computing services are adopted, such as in the Australian marketplace (Saedi and Iahad, 2013, El-Gazzar, 2014). To address the need of understanding the cloud computing adoption in SMEs, existing literature has identified several factors that affect the decision on cloud computing adoption from different perspectives, such as benefit-driven perspective (e.g., reduced operational 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, cloud computing services are the backbone of many enterprises' business activities (Chang et al., 2010). It is unrealistic for the practitioners to make an easy decision without a comprehensive evaluation of the possible factors that determine the adoption (Leimeister et al., 2010). Most of the prior literature applied a unitary theoretical view to investigating the antecedents of cloud computing adoption (Hsu et al., 2014, Borgman et al., 2013, Nkhoma et al., 2013, Kshetri, 2013). Consequently, these studies were not able to address the adoption from various perspectives. For example, the adoption and diffusion theories lack integration by researchers in a manner that allows examining other factors besides technological factors (Saedi and Iahad, 2013). Moreover, the literature shows that organisational and environmental factors play important roles in influencing innovation adoption (Abdollahzadegan et al. 2013, Low et al. 2011). However, those factors have not been integrated into most of the adoption/diffusion theories (Low et al., 2011, Feuerlicht, 2010). Thus, a multi-perspective theoretical framework is needed for understanding the cloud computing service adoption among SMEs.

Furthermore, there is a lack of studies on cloud computing service adoption in Australian SMEs. Australian SMEs are the main contributors to the Australian economy (ABS, 2013). The disadvantage of the relatively small market size of Australia (Harvie and Lee, 2002) can be overcome by SMEs through the adoption of the scalability and affordable computing resources that are offered by cloud computing. For SMEs, the technology provides new competitive edges, which were previously only available to large enterprises. This also allows them to access new markets with cloud computing opportunities in the creation of innovative business models (Etro, 2011). The new infrastructure of the Australian National Broadband Network will enhance these opportunities even further (NBNCO, 2015). With all the publicity behind cloud computing, Australian SMEs are still lagging behind other countries in Asia (ACCA, 2012). Also, we have little knowledge of what factors determine cloud computing service adoption among SMEs in the most important economic entity in the southern hemisphere of the world. Thus, the research question of this paper is: *What are the determinants of cloud computing service adoption for Australian SMEs?*. To fill the research gap, we applied a multi-perspective theoretical framework to develop our understanding of cloud computing service adoption among Australian SMEs. Specifically, three theoretical perspectives were assimilated, namely the diffusion of innovation, technology-organization-environment framework and actor network theory, for a comprehensive understanding of the cloud computing adoption. To validate the research model, a qualitative study using semi-structured interviews with 15 SMEs and cloud computing services providers in Australia has been conducted. The findings contribute significantly to the theoretical knowledge of cloud computing adoption and practical implementation in Australia's SMEs sector.

2 RELATED STUDIES

2.1 Cloud Computing Adoption

Cloud computing adoption refers to the way of offering cloud-based services by cloud service providers to its users using a new deployment technology (Marston et al., 2011). Prior literature relevant to this study has investigated a number of influential factors in the adoption of cloud computing that can be categorised into three types, the technological factors, organisational factors, and environment factors. For instance, a survey conducted by (Saya et al., 2010) revealed that organisational perceived benefits such as accessibility, scalability, cost effectiveness, and security can influence the decision on cloud computing adoption. Misra and Mondal (2011) found that the capacity of IT resource, resources usage, data privacy, and the scope of business activity could also affect the adoption of cloud computing in firms. A study of the adoption of SaaS among Taiwanese companies discovered and confirmed social influence, perceived usefulness, trust, and security as three additional factors (Wu et al., 2013a).

There are limited studies in cloud computing adoption from organisational perspectives (El-Gazzar, 2014). Some researchers like Low et al. (2011) used the TOE (Technology-Organization-Environment) framework to analyse the adoption of cloud computing in the Taiwanese high-tech industry. However, they did not consider the key factors such as perceived benefits from cost reduction and security issues that are crucial for cloud computing adoption. A mixed research method was used by (Trigueros-Preciado et al., 2013) to identify the obstacles to cloud adoption. The study surveyed several SMEs in Spain and concluded that limited cloud computing knowledge was the main reason for not adopting cloud computing. A study conducted by Wu et al. (2013b) also used a mixed theory (DOI theory and information processing view (IPV)) to investigate how information capacity and requirements influence organisations' adoption decision within the supply chain field. Other researchers like Nkhoma et al. (2013) obtained data from large services enterprises to investigate the hindrance to cloud computing adoption. Kshetri (2013) employed institutional theory as his conceptual framework and conducted a qualitative study to analyse the security issues and perception of using cloud computing services. With TOE framework, Abdollahzadegan et al. (2013) investigated the hindrance of cloud computing adoption in the SMEs sector. Their study did not propose any hypothesis or empirical foundation. El-Gazzar (2014) stated that the evaluation of cloud computing adoption process and adoption decisions were not adequately investigated, except for the proof of concept process. El-Gazzar (2014) identified the needs of more empirical studies using multi-theoretical perspectives. Researches on the adoption of cloud computing in Australian SMEs become important because there are limited studies having investigated the contextual factors that affect this process, despite all the hype around this technology.

2.2 Australian SMEs Perspective

The decline of today's global economy is calling for affordable IT resources, especially for SMEs. Cloud computing is one of the promising technologies that can achieve this goal (Aljabre, 2012). It is one of the major reasons for SMEs to use the cloud technology which offers low capital investment, flexibility, scalable systems, and new robust business models (ENISA, 2009). In addition, it creates new opportunities for organisations (Babcock, 2010). Australian Bureau of Statistics (ABS) defined three types of SMEs: (1) micro businesses with 0-4 employees; (2) small businesses with 0-19 employees; and (3) medium businesses with 20-199 employees (ABS, 2001). This research adopts this definition. SMEs impact and contribute to the Australian economy significantly. They account for 99.75% in business economy and employ 70% of the country's workforce (ABS, 2013). Innovation in processes, products, and services is the key to lifting Australian. This can be achieved through the adoption of new technologies. In the 1990s, Australia realised a 20% to 35% productivity growth due to the adoption of ICT in non-IT firms (Gretton et al., 2004). However, in regards to cloud computing

adoption in SMEs there are limited studies. The stable and free market, trusted regulation authorities, and skilled people in the Australian economy are attractive measures for the development of a robust cloud infrastructure (McKinnar and Kathage, 2014). These factors can promote rapid the adoption of cloud services and increase the customer base.

KPMG in 2012 stated if there were 75% adopters of cloud computing services across the Australian economy, there would be a 25% reduction in operational expenses and 50% reduction in capital expenditure. More specifically, this will lead to significant cost savings between $2 and $3 billion - between 0.15% and 0.2% of Australian's annual GDP (Hancock and Hutley, 2012). There are other non-monetary benefits of the cloud computing higher than cost savings, such as flexibility, remote access, and elimination of redundant systems. A study in the European Union (EU) estimated the value of flexibility and quantified it to be 1 percent of the EU's GDP (Hogan et al., 2010). Cloud computing provides opportunities for organisations of any size to access new services and resources which were only available to wealthy and large enterprises, and do so at low costs (Michael et al., 2013). This provides Australian SMEs with opportunities to explore new markets and offer efficient business services to their clients. IT investment and its drawbacks, such as high costs of implementation and experimentation, can be reduced through the pay-per-use model for scalable cloud services. Therefore, there is a growing need to conduct research on this topic.

3 RESEARCH MODEL DEVELOPMENT

In this paper, a multi-perspective research model was developed to provide a framework in investigating the adoption of cloud computing adoption in Australian SMEs. As SMEs are the context of this study, organisational-level theories in the adoption of innovation were considered. In particular, three related theories, namely diffusion of innovation, technology-organization-environment framework, actor network theory, were adopted for constructing the multi-perspective research model.

Diffusion of Innovation (DOI) theory: constitutes of five attributes that explain the adoption of innovation in an organisation (Rogers, 2003a). They are: (1) relative advantage, the degree of the current innovation in comparison with the previous versions; (2) compatibility, the extent to which an innovation can be incorporated into the existing business processes, practises, and value chains; (3) complexity, the degree of effort demanding it is to use and understand the innovation; (4) observability, the extent to which the innovation is perceptible to others; and (5) trialability, the ease of testing and being satisfied with the innovation. DOI captures technological dimensions and users' perceptions of the innovation. The theory has been widely applied in studying innovation adoption and diffusion.

Technology–Organisation-Environment (TOE) framework: This theory was originated by (Tornatzky et al., 1990) to analyse the adoption of technological innovations by organisations. The theory consists of three main independent factors- technological context, organisational context, and environmental context that influence the adoption of innovation. The technological context defines both the internal and external technological processes and equipment that have an effect on the organisation. It refers to the characteristics of innovation such as availability, complexity, and compatibility. The organisational context includes the firm characteristics that include its resources, its size, extent of centralisation, structure, managerial formalisation, employees, communication network between employees, available resources and all other descriptive measures of the organisation. The environmental context refers to characteristics of the industry, competition, the macroeconomic, and the regulation context (Tornatzky et al., 1990). This theory has also been widely used in ICT innovation adoption.

Actor Network Theory (ANT): was originated in France in early 1980s by Bruno Latour, Michel Callon and John Law to analyse sociological matters (Callon, 1986, Law and Callon, 1988). The theory explains the network relationship among people, objects and organisations. All these elements of relationships are described as actors or actants. The essential strength of this theory is its ability to

be applied in a heterogeneous network that can contain both social and technical aspects. The objective of this theory resides in its ability to view, describe, and evaluate a specific situation from different angles that can include the socio-technical environment. All actors, whether human (e.g. customers, programmers, and development managers) or non-human (e.g. computer software, hardware, and technical standards), or organisation, are all useful elements of consideration. ANT associated perfectly with the socio-technical environments in which there are no distinctions between human or non-human actors and where both elements have equal weight and importance in understanding a situation (Kennan et al., 2010).

TOE, DOI, and ANT: Based on these theories, 14 factors were selected for examining their impact on the decision of cloud computing service. These constructs were classified into three groups as it is depicted in the research model (see Figure1). The groups are technological factors, organisational factors, and environmental factors which impact the adoption of cloud computing among SMEs. The other two outer groups (human and non-human actors) do not have a causal relationship in other factors. However, they are used to help in better understanding the research situation and appreciate the network of the actor's elements whether human or non-human to the overall cloud adoption situation. Technological factors are mainly originated from Rogers' DOI. Roger listed four attributes of innovation namely: relative advantage, complexity, compatibility, and trialability (Rogers, 2003a). In confirmatory to this, a further study conducted by Tornatzky and Klein (1982) acknowledged that relative advantage, complexity and compatibility are influential elements of innovation. On the other hands, organisational factors are mainly associated with the characteristics of the organisation itself that impact the adoption decision. This includes: company's information resources and employees' knowledge. Environmental factors are the external aspects that have an influence on organisation innovation decision. Human factors are the responsible individuals in making innovation decisions. Thong and Yap (1995) revealed that SMEs decision makers have a remarkable influence in making innovation decision. Non-human are all other influential factors that are not related to human. This study selected constructs from the original theories that apply to the context of this research. For example, innovation decision, communication channels, and nature of social systems constructs from DOI theory were excluded from this study. Innovation decision attribute was not included as the researchers believed it will have low effect on decision making with the no obligation nature of choosing cloud computing services. This paper also presented one additional construct and extended to the theoretical framework and research model; it is the security concerns. It is expected this construct can have a significant impact on cloud computing adoption decision as it has been revealed in the literature and discussed briefly earlier.

Observability attribute from DOI theory has not been included as part of research constructs as it is either not widely used in ICT innovation studies or does not have a significant effect on adoption of technology (Kolodinsky et al., 2004, Chong et al., 2009). Therefore, this attribute has not been considered for this study due to its less significance in technology adoption as it has been indicated by the general themes of ICT innovation studies. All the remaining four attributes from DOI theory are relevant and influence new technologies diffusion. Hence, they have been considered for this research. Literature indicated that relative advantage is a significant factor that influences the adoption of innovation and this research will test this hypothesis. Complexity attribute from DOI will be examined to assess if there is a correlation between the likelihood of cloud adoption and the complexity of the systems. For more clarity, complexity here refers to the difficulty of using cloud computing if compared to other computing technologies. Compatibility is basically the consistency of the past reality with the existing values, experiences, and needs (Rogers, 2003a). In cloud computing context, compatibility is expected to cover all the dimensions that can include compatibility with the existing norms, culture, and technology. An assumption of whether the free trials are beneficial to the adoption of cloud computing or not will be essential for investigation. The security concern is expected to have a significant impact on the adoption decision making and is important research constructs of this study.

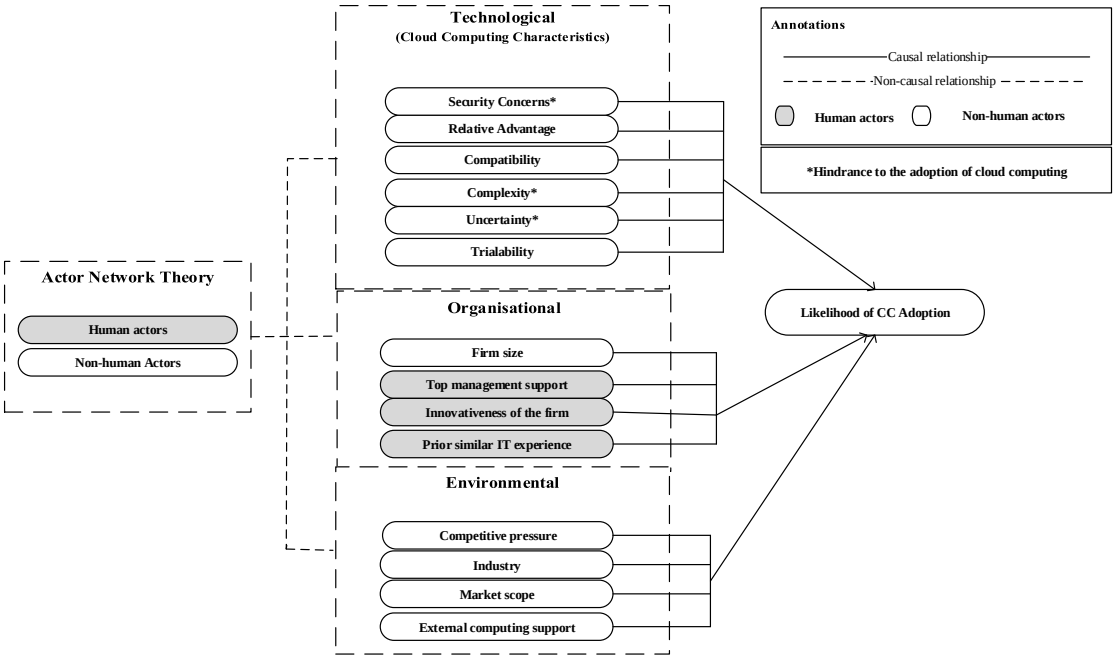

Figure 1. The research model

In TOE framework, the incentives and barriers to cloud computing adoption are classified into three categories technology, organisation, and environment. In the other side, in ANT, the actors undergo the process of revealing and then classifying as human and non-human actors. After that, an integration linkage between all the constructs from the three theories and their relationship in describing either incentives or barriers to adoption can be established. ANT actors claimed to be more flexible in positioning within a specified context and in identifying them to be either as an actor or a property of an actor and therefore no graphical representation of ANT (Tatnall and Burgess, 2002).

4 METHODOLOGY

Research design: To validate the key determinants in the research model, we conducted semi-structured interviews to collect data from practitioners in Australian SMEs. This exploratory study was considered to be relevant in gaining insights of the relevant factors. This method will be the foundation of an explanatory survey study. Using semi-structured interviews can help in exploring the relevant adoption factors in ICT adoption process (Leedy and Ormrod, 2005). The majority of the interview questions were mainly articulated from the three theories relevant to this research. Questions were designed in a way to give first the participants the chance to identify the influential factory. This was then followed with specific questions which were derived from the grounded theories. This helped in avoiding any bias of locking participants on only pre-selected attributes that were derived from those theories.

Data collection and analysis: The interviews were conducted between 01st of June 2015 to 10th of August 2015. The participants were 15 firms. 11 of them were SMEs and 4 of them were cloud services providers. The firms were categorised based on their adoption stage. Rogers' adopter categorization concept was used to formulate the scope and categorisation of this study (Rogers, 2003a). Table1 presents general information about the firms and their adoption stage. In the first category (C1-C4), there were four service providers; some of them had only local presence while the other had both local and global market existence. All the four firms provided various other IT services besides cloud computing services. The second category (C5-C10) included those firms that had already adopted cloud services. The third category (C11-C12) were the prospector firms, which have not yet adopted cloud services at this stage, but are planning and willing to adopt the services in the

coming three years. The last category (C13-C15) were the laggards and they were those firms that have not and do not plan to adopt cloud computing in the future as they do not see any advantage from using it.

Org	Industry	Adoption stage	Interviewee's Occupation	Size
C1	IT	Provider	Systems Analyst & Project Manager	148,000
C2	IT	Provider	Managing Director	16
C3	IT	Provider	Managing Director	2
C4	IT	Provider	Business Development Manager	14
C5	IT	Adopter	Data scientist	30
C6	Business consulting services	Adopter	Director	5
C7	Manufacturer	Adopter	Supply & Procurement Manager	22
C8	Consulting & funding	Adopter	CEO	2
C9	IT	Adopter	IT Manager	9
C10	Design, Marketing, and Printing	Adopter	Owner & Managing Director	9
C11	Manufacturer	Prospector	Director	43
C12	Education	Prospector	VET Director of Studies	80
C13	Pre-school	Non-adopter	Owner & Managing Director	9
C14	Retail	Non-adopter	Company Manager	3
C15	Finance	Non-adopter	Managing Director	12

Table 1. An overview of the interview participants

The interview questions were revised several times in consulting with business people, researchers, and academics (available with the authors upon request, part of the survey obtained from Ramdani (2008)). The average length of the interview was half hour. The questions were divided into three themes: firm's background, ICT adoption, and influential factors in cloud computing adoption. Interviews were reordered following the ethical formalities of requesting permission and ensuring the privacy of individuals and their data. After collecting protocol data, we conducted analysis and coding using Nvivo 10. The process of analysis is involved several stages. First, audio and textual data were imported into Nvivo. Then, we started exploring the interviews. This was followed by coding the themes into nodes to collect all the references. After that, various queries have been run to find the relevant information. Visualisation features were used to display word tree and explore how themes are described by different interviewees.

5 FINDINGS

This study proved that cloud computing adoption is influenced by various factors from different dimensions including technological, organisational, and environmental factors. Among the initial 14 factors proposed in the conceptual model, the research found evidence for the significance of 12 of them. Two of the factors: complexity and competitive pressure were not found to have influential effect in the adoption.

Technological dimensions: From this study two new factors from technological aspects have been identified and they are cost savings and privacy due to geo-restrictions. Cost savings is an important aspect and it is matching with the research of (Marston et al., 2011) that confirmed about cloud computing benefits in reducing infrastructure costs, increasing efficiency in energy consumption, and decreasing maintenance overheads. Privacy due to geo-restriction was found to be a crucial factor and this is due to firm's preferences for their data to be stored locally in Australian boundaries as they trust the regulation of their own country and are not confident with other countries jurisdiction due to the absence of a global governance of cloud computing technologies and services. Complexity was not found to be an influential factor in this study. Uncertainty was mainly linked to the privacy security or privacy issues. Cloud computing adoption pace can be increased if cloud services providers can

improve their position. The improvement can be achieved in these ways: (1) Improving the technology performance in terms of security and privacy measure; (2) Having local data centres in Australia; (3) Improving the compatibility of the offered services with the in-house applications and platforms; (4) A significant marketing effort is required from the cloud services providers to the SMEs sector in order to increase the awareness of cloud services in this sector. Innovativeness of the firms and their expertise in ICT alone is not adequate for them to adopt cloud computing.

Organisational dimensions: As mentioned earlier, the classification of the organisations into four categories is following Rogers' extensive studies on the diffusion of innovation (Rogers, 2003b). It is believed this can provide a better presentation of the cloud adoption in Australian. It was observed that adopters to cloud services were more responsive to our questions and more willing to share with us their experience about the adoption of cloud computing. We think this is due to their excitement about the technology and with the benefits it offered. Even regarding the technology drawback they were even willing to discuss issues and many times recommend solutions for improvements. For example, some of them recommended on having local data centres; others recommended for additional technical support and awareness of cloud services. In this study, all the organisational factors confirmed to be positively related to the likelihood of cloud computing adoption. This, therefore, goes in line with the previous studies of (Pan and Jang, 2008) in firm size, and (Wang et al., 2010) in top management support, and in (Thong and Yap, 1995) innovativeness of the firm, and in (Plomp et al., 2014) IS knowledge.

Environmental dimensions: Industry and market scope are the most two critical factor in the environmental aspects from the perspectives of Australian SMEs and also the perspective of cloud services providers to this business segment. External computing support is also an important factor in the adoption decision. However, it is less important the other two mentioned factors. Remarkably, this study found that competitive pressure was not an important factor for the majority of the organisation. The reason behind this expected to be the low rate of adoption and the awareness of cloud computing services.

SMEs adoption framework: The field of ICT innovation adoption has been widely investigated considering various types of technologies and contexts. The continual emphasis on the context for studying this field is a clear indication of the importance of the context. Previous studies (e.g. Oliveira and Martins, 2010, Pan and Jang, 2008) indicated that this field is complex and there are various interrelated factors that affect organisations decision towards the adoption of innovation. This study proved that cloud computing adoption was also influenced by various factors from different dimensions including technological, organisational, and environmental factors. Among the initial 14 factors proposed in the conceptual model, the research found evidence for the significance of 12 of them. Two of the factors: complexity and competitive pressure were not found to have influential effect in the adoption. The interviews lead to further significant insights that could be a concern to many Australian SMEs and probably to all SMEs around the world. These insights were about two factors: cost savings and privacy due to geo-restrictions.

6 CONCLUSION

This study employed a multi-perspective approach based on three theories, DOI, TOE and ANT, to study the adoption of cloud computing in Australia. The influential factors found are security concerns, cost savings, privacy due to geo-restrictions, compatibility, trialability, firm size, top management support, prior IT experience, innovativeness, industry, market scope, and external computing support. These findings provide insights to decision makers in SMEs and offer an informative framework for their consideration of cloud computing adoption.

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