Cloud computing adoption in the context of small and medium enterprises

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CLOUD COMPUTING ADOPTION IN THE CONTEXT OF SMALL AND MEDIUM ENTERPRISES

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Abstract

The value of cloud computing to reduce operational costs and enhance organizational competitiveness has drawn attention to both scholars and practitioners. We argue that this form of technological innovation is particularly helpful to small and medium-sized enterprises (SMEs) to reduce their IT investment while obtaining and maintaining their competitive edges in the business environment. In this study, we examine the factors that might influence the adoption of cloud computing for SMEs in Taiwan. We developed a research model and conducted an empirical test by using the data from 100 SMEs in Taiwan. Results indicate that for SMEs, both perceived direct technological benefits and perceived technical competence are relevant to adoption decision. Nonetheless, we find no significant support for vendor performance in influencing SMEs’ adoption decision. We conclude with the discussion of analysis and future research.

Keywords: SMEs, cloud computing, technology adoption
1. INTRODUCTION

Cloud computing is an evolution of computer technology and business model that is expected to reshape the IT industry (Armbrust 2009). From a technical perspective, cloud computing can be seen as a new name for a combination of many existing technologies such as grid computing, utility computing, services computing and distributed computing. (Foster et al. 2008). Over the past few years, together with development of Web 2.0 and large-scale computing requirements from business side turned cloud computing into a commercial reality. For cloud computing providers, the time has finally come that they can make this technology innovation from science mainframe to commodity clusters (Armbrust 2009).

In the literature, a number of studies have focused on adoption and implementation of cloud computing in two major perspectives: technology and business (Armbrust 2009; Marston 2010; Iyer & Henderson 2010). However, we find that there is a limited number of studies focusing on small and medium-sized enterprises (SMEs). According to the Organization for Economic Co-operation and Development (OECD), in most countries SMEs account for 60%-80% of employment and over 95% of established businesses. Furthermore, taking the context of empirical setting in this study, Taiwan, as an example, not only that SMEs contribute a significant portion of employment and business establishments, but also their successful strategies—deployments of flexibility, innovativeness, pioneering spirit and problem-solving actions—provide economic growth momentum and create “Taiwan miracle.”
Given the importance of SEMs in economic development, it is important to study how SMEs evaluate the potential opportunities and the adoption decision of cloud computing. Besides, as Kuan and Chau (2001) point out, given the different business characteristics between large and small enterprises, there is a need to analyze whether a typical adoption model for technological innovation is also applicable in the context of SMEs.

Thus, the research objective of this study is to propose a research model that might influence the adoption decision of cloud computing for SMEs. In our proposal model, we draw on innovation literature to develop hypotheses that are important to adoption decision for SMEs. Furthermore, we articulate that cloud computing is a form of sourcing solution that SMEs can outsource their operational activities to cloud service providers. Therefore, we further hypothesize the role of perceived vendor performance in affecting adoption decision. These hypotheses are later empirically tested by using the sample of SMEs in Taiwan.

The reminder of this paper is organized as follows. The next section will describe the research background associated with cloud computing and its relevance in the context of SMEs. This is followed by the discussion of the hypothesis development. In Section 4, we present our research methodology. In Section 5, we discuss our results. We conclude with the implication and limitation of this research in Section 6.

2. RESEARCH BACKGROUND
The National Institute for Standards and Technology (NIST) defines cloud into three generalized categories by the service it delivers: Infrastructure-as-a-Service (IaaS), Platform-as-a-Service (PaaS) and Software-as-a-Service (SaaS). IaaS is the most basic service which provides storage capacity, computing power and bandwidth to users. SaaS refers to an application or suite of applications that reside in the cloud instead of on a user’s hard drive (McAfee 2011). PaaS is a core architecture layer of the stack structure. It provides pre-tested and integrated infrastructure software stack which allows users to create a cloud-agnostic private platform on public cloud. There are five essential characteristics of cloud computing scoped by NIST: on-demand self-service, broad network access, resource pooling, rapid elasticity, measured service. To SMEs, the characteristics of cloud such as on-demand self service, resource pooling, and rapid elasticity not only overcome barriers of IT implementation caused by the inherent shortage of organizational resources in terms of human resource, finance and knowledge, but also complement the competitive advantages of SMEs in terms of flexibility and innovativeness.

Concerning the business perspective of cloud computing adoption, Iyer and Henderson (2010) construct a massive cloud vendor ecosystem and identified seven capabilities of cloud computing. They suggested that companies should understand these seven capabilities when they begin to formulate their cloud strategies. Marston (2010) developed a similar stakeholder map of cloud computing, but made recommendations to different group of audience: business
professionals who prepare to migrate to cloud, and IS researchers who expect to provide
guidance to business implementation. In addition, McAfee (2011) elaborates benefits and
concerns of cloud computing adoption in simple and straightforward guidelines. Putting
himself in CIOs’ shoes, McAfee considered that major benefits of cloud computing is to
enhance individual productivity and leverage IT intelligence for better business
decision-making. Nevertheless, none of these studies above distinguished the differences
between large and small organizations. Therefore, it would be interesting to study whether the
adoption of cloud computing in small-and-medium sized enterprises (SMEs) would be any
different.

From our perspective, small-and-medium-sized enterprises (SMEs) have a strong influence
over economies all over the world and have been the major source of employment. In view of
the significant contribution of employment creation, many economies started to pay more
attentions on studies on SMEs. Most studies have highlighted advantages of information
system (IS) implementation for big firms, but SMEs have much to gain from them too.

Compared to big firms, SMEs are often weak in terms of financing, planning, control, training
and information systems owing to a chronic lack of resources (White 1981). On the other
hand, SMEs have their particular advantages such as rapid implementation and execution of
decisions, market proximity and capacity for adaption and short-term reorientation (Julien
1977). To understand threats and opportunities of IT implementation for SMEs, Bilili and
Raymond (1993) propose a characteristic summary of five specificities of SMEs with respect to strategic implementation of information systems: environmental, organizational, decisional, psycho-sociological, and information systems. In the environmental specificity, they argued that SMEs are characterized by a high level of environmental uncertainty due to its lack of resources. If the use of information technology imposed on SMEs is by major customers or suppliers, this would in turn increase their independence to each other. The focus of the network has shifted from labor, capital, market information and technological knowledge (Ernst 2001). The peer learning effect and pressure play important roles in terms of technology implementation.

Besides, to address the adoption of cloud computing in SMEs, several studies have focused on SMEs as the research object. Sultan (2011) demonstrates the economic viability and efficiency of cloud computing which would particularly benefit SMEs. He suggested that cloud computing is an attractive option to SMES, but it is unlikely to be suitable for every organization for different organizational and strategic reasons. In addition, Kourik (2011) agrees that cloud computing would be particularly beneficial to SMEs in terms of reduced IT investment since SMEs often have fewer IT related resources. Nonetheless, he also points out that cloud computing does come with many serious security and assurance challenges which SMEs currently have no compelling capabilities to deal with, such as identity, authentication, data assurance and compliance. With regard to these challenges, Kourik (2011) propose an
risk assessment (RA) approach as a viable tool when SMEs plan to deploy cloud computing.

Similarly, Khalid (2010) proposes mitigating steps against some of the most critical downsides of cloud computing. The mitigating steps resembled Kourik’s (2011) conclusion that the foremost tasks SMEs need to tackle when adopting cloud computing are security, privacy and control of data.

Although these studies discussed benefits and downsides of cloud computing adoption in SMEs, there is no comprehensive model and empirical analysis on the potential factors that might affect their adoption decision. In the following section, we develop our hypothesis of cloud computing adoption for SMEs.

3. HYPOTHESIS DEVELOPMENT

For our theoretical development, we adopt the model initially developed by Kuan and Chau (2001), that has been applied to analyze the adoption of EDI for small businesses in Hong Kong. They proposed a technology-organization-environment framework. For our study, we consider that both technological and organizational dimensions are also important for cloud computing adoption. These dimensions are developed on the basis of innovation theory. This theoretical approach argues that adopters make voluntary decisions to accept or reject an innovation based on the benefits they expect to accrue from their use of a particular technology. Variables such as organizational readiness, technology compatibility and relative
advantages have been analyzed to show their impact on the adoption and diffusion of various technological innovation. Expanding from the individual firm’s perspective, other studies have considered the implications of network externalities on organizational adoption decisions. With respect to environment dimension in Kuan and Chua’s (2001) work, we argue that cloud computing is different from EDI. EDI is considering as part of interorganizational systems in which the influences from peer organizations and other external parties can be important. In contrast, cloud computing can be understanding as a form of sourcing strategies or solutions for SMEs. Thus, in this study, we believe the vendor performance will be more important than environmental factors in their adoption decision. In the followings, we detail our hypothesis development.

First, for perceived technological benefits, scholarly studies have shown that perceived benefits in the context of technology advantage can have a positive impact on organizational adoption decision (Tornatzky & Klein 1982; Moore & Benbasat 1991; Iacovou et al. 1995). Cragg and King (1993) further argue that to small businesses, relative advantage is the only variable that has been consistently identified as a critical adoption factor and as the most important factor for IT growth. Technological benefits can be further divided into two groups: direct and indirect benefits. Direct benefits are associated with the perceived value in improving customer service and enhancing organizational strategies, while indirect benefits are related to the quality improvement and efficiency of organizational daily operation. In the
context of cloud computing, we argue that SMEs to utilize a variety of cloud services, such as different SaaS, for strategic and competitive purpose. For example, SMEs can use cloud-based customer-relation-management (CRM) solution to effectively analyze customer data and develop appropriate marketing strategies. In addition, we consider that the provision of cloud-based storage service can help SMEs reduce operational and maintain cost. In doing so, SMEs can achieve indirect technological benefits. Thus, we develop the following hypotheses.

**Hypothesis 1a:** Higher level of perceive technological direct benefits will lead to greater intent to adopt cloud computing.

**Hypothesis 1b:** Higher level of perceive technological indirect benefits will lead to greater intent to adopt cloud computing.

Second, organization dimension for adoption considers the issues of financial resources and technical competence in organizations. Kuan and Chau (2001) contend that without appropriate resources, it is difficult to achieve a successful adoption and implementation. Iacovou et al. (1995) identified financial and technological resources as “organizational readiness” for innovation adoption. Comparing with EDI adoption, we believe that the usage-based cost structure of cloud computing service will attract SMEs, especially those with financial constrains. Besides, Kourik (2011) also support the argument that the
on-demand service model was particularly valuable to SMEs in terms of reduced IT investment whereas SMEs often have fewer IT related resources. As for the level of technological competence, it is relevant to the level of IT compatibility and dimensions of IS sophistication in organizations (Raymond & Pare 1992). From the adoption of cloud computing perspective, as Kourik (2011) argued, although cloud computing can bring the potential benefits to help SMEs to reduce IT investment cost. There is still a need for SMEs to understand the possible security risk associated with the use of cloud-based services. That is, it requires managers from SMEs to have certain technical know-how to understand and evaluate the potential risks associated with the cloud-based services. Thus, we develop the following hypotheses.

**Hypothesis 2a:** Lower levels of perceived financial resources will lead to greater intent to adopt cloud computing.

**Hypothesis 2b:** Higher levels of perceived technical competence will lead to greater intent to adopt cloud computing.

Third, the framework developed by Kuan and Chua (2001) included the industry pressure and government policy as the influential factors for the adoption of EDI. In the context of cloud computing for SMEs, we contend that these two factors are less significant in comparison with the dimension of vendor performance. To evaluate the effect of cloud computing vendor
on SME adoption, we drawn on the work on outsourcing since we see the parallel idea between cloud computing services and outsourcing. There are two different sources to maximize the value of outsourcing and increase its success: tightening control and developing mutual trust to improve the quality of the relationship between client and vendors (Sabherwal, 1999). Mao et al. (2008) show that trust and control are important factors in the evaluation of vendor performance. Vendor’s trust in the client can be built through information sharing and enhanced communication quality between vendors and clients. Furthermore, effective control over the vendor in sourcing relationship should help ensure more desirable outcomes, because organizations are likely to have more confidence in their partners’ cooperation when they feel they have sufficient control over their partners (Mao 2008). We believe that trust and control can equally be applied in the context of cloud computing. As we point out earlier, given the uncertainty and risks associated with the adoption of cloud services, SMEs are more like to adopt if they are confident in the services offered by cloud providers. Thus, we develop the following hypotheses,

**Hypothesis 3a:** Higher levels of trust on vendor will lead to greater intent to adopt cloud computing.

**Hypothesis 3b:** Higher levels of perceived control over vendor will lead to greater intent to adopt cloud computing.
4. RESEARCH METHOD

4.1 Instrument Development and Pilot Test

We developed an initial questionnaire with 30 five-point Likert-style questions. These 30 questions were about perceived benefits, perceived financial cost, perceived technical competence, and cost control. By using this initial questionnaire, a pilot test was performed by randomly approaching 25 subjects in Taiwan SMEs. Based on the responses and feedbacks, we check for reliability, internal consistency, and discriminant validity to refine the questionnaire. We also interviewed experts and colleagues in the IT industry to further improve the questionnaire by adding new items to each construct. The resulting questionnaire has 44 five-point Likert-style questions.

4.2 Sample and Data Collection

An initial sample was built from two mailing list: SMEs awarded with the “SME Innovation Research Award” by Taiwan Small and Medium Enterprise Administration, and “2010 Standard Chartered Bank Elite Award Top 500.” From the list, we made sure that the respondents for this study were the owners or managers who have influential power over IT purchasing decision within organizations. The respondents were also surveyed beforehand to conform to the criteria of SME set by Taiwan Ministry of Economic Affairs. The subjects were first probed by telephone invitation to ensure that potential participants were qualified for this study and understood the objective of this survey. Then the web-based questionnaire
was delivered. Based on our sample selection criteria, a total of 840 respondents were included in our sample. The response rate is 12%, yielding 100 usable questionnaires: 50% of them were completed by MIS manager, 19% by owner managers, 12% by sales manager, 10% from product manager, and 4% from finance manager. Among the 100 usable questionnaires, 56 came from adopters of cloud computing while 44 were non-adopters. Demographic information on respondents reveals that the adoption rate has no strong correlation with the number of offices a company has. That is, more offices do not necessary increase the intent to adopt cloud computing. However, industries, such as IT and service, have relatively higher intention to adopt cloud computing. The responses also showed that SaaS is the service with the highest adoption rate among adopters (69.2%), followed by IaaS (65.4%) and PaaS (40.4%).

5. RESULTS

We use the partial least squares (PLS) to perform our analysis. The results show that all items in the questionnaire have met the minimum suggested loadings 0.5 on their associated factors. The Cronbach’s alpha range from 0.739 to 0.925 which are acceptable. Construct reliabilities are therefore deemed to be sufficient for all factors. All constructs meet the assessing requirement and display adequate internal consistency and discriminant validity.

We explore how perceived direct technological benefits, perceived indirect technological
benefits, perceived financial resources, perceived technical competence, trust and cost control would affect intent to adopt cloud computing. The results are given in Figure 1. The significant path coefficient between perceived direct benefits and the intent to adopt (0.459, \( p < 0.01 \)) shows that the higher the perceived direct benefits, the greater the intent is to adopt cloud computing. The perceived indirect benefits are insignificant to adoption decisions (0.001, \( p > 0.10 \)). The above results support H1a but inconsistent with H1b. It is consistent with findings of prior EDI researches of small firms that perceived technological benefits were significant in EDI adoption (Chwelos 2001). Furthermore, the different results of perceived direct technological benefits and perceived indirect technological benefits are also consistent with findings by Iacovou et al. (1995) and Kuan and Chaun (2001). Their works indicate that in their research, most small firms seem to recognize the importance of direct benefits of EDI but not indirect benefits. They articulate that although small firms might be aware of the potential indirect benefits, such advantages were not perceived particularly important for adoption decision. Kuan and Chau (2001) further argue the insignificance of indirect benefits to EDI adoption might be due to the short of small firms’ expectations on EDI, and therefore positive perceived indirect benefits did not result in positive adoption decisions. We argue that similar expectation can be applied in the situation for cloud computing adoption. Because of the competitive business environment, SMEs are more anxious and willing to consider the adoption of innovation technological solution if they
perceive cloud service can offer strategic and competitive advantages for their business operations.

Second, our findings indicate that the path coefficient of perceived financial cost is insignificant (0.137, $p > 0.10$) suggesting that the intention to adopt cloud computing is not affected due to the availability of financial resources which is different from our expectation in H2a. Differently, the perceived technical competence positively and significantly affects the intent to adopt cloud computing (0.334, $p < 0.01$) which supports H2b. We were surprised to find that the consideration of financial constraints did not appear to be a significant factor for the adoption of cloud computing. This was not consistent with the previous findings that

Figure 1. PLS Results
the availability of financial resources is one of the important factors for technological adoption (Chwelos et al. 2001; Kuan & Chau 2001). We speculate that the insignificance of financial resources might be explained by different pricing mechanism of cloud computing. Cloud services are not purchased in the form of paid-in capital such as EDI systems; rather, it is on a contract-base and proceeded with operational expenses. Managers of SMEs would not feel the pain of giving away a great amount of down payment to cloud providers. Similarly, because cloud services are based on outsourcing contracts, SMEs do not necessarily perceived the importance of internal resources such as professionals or labor force used to maintain and operate IS. Put differently, we consider that the immediate cost-saving or cost incentive for cloud computing might not as apparent as other technological implementations in SMEs.

As for technical competence, our finding demonstrates that there is a significant relationship between the level of technical competence and the adoption decision. We believe that this empirical result reflects the concern about the security and privacy aspects of cloud services. As we discussed earlier, while SMEs are positive about the potential technological benefits brought by the adoption of cloud computing, not all SMEs are fully confident about the stability and security of cloud computing. This might explain that SMEs are more likely to adopt cloud computing services when they perceived higher level of internal technical competence. Internal IT professionals equipped with a better technical knowledge can help managers in SMEs to evaluate and assess the potential risks associated with the use of cloud
Finally, since cloud services can be understood as a form of outsourcing solution, we further evaluate the impact of trust and cost control on adoption decision. Our findings demonstrate that the path coefficients between trust as well as cost control and the intent to adopt cloud computing are insignificant (0.110, and 0.123 respectively, $p > 0.10$) which are not consistent with our expectation in H3a and H3b. In other words, SMEs do not perceive vendor performance as an important factor to influence on their adoption decisions. This is an interesting finding since in most outsourcing literature, vendor performance has been an important criteria for adoption decision. We speculate that this might be related to types of cloud services adopted. In our survey, 65% of firms have adopted IaaS as their cloud solution. We consider that the static performance of IaaS is difficult to evaluate. Furthermore, most of IaaS providers in Taiwan are major companies with a well-established reputation. Therefore, SMEs in Taiwan did not take into account of vendor performance when they consider the decision for cloud computing adoption. We consider that further research can be carried in other countries to validate the relationship between vendor performance and adoption decision for SMEs.

6. CONCLUSION

With the maturity of mobile technologies, cloud computing nowadays is a feasible and helpful
IT solution to business practices. In this study, we analyze the factors that might influence the decision-making of SMEs for cloud computing adoption. Our empirical findings indicate that for SMEs, the factor of perceived direct technological benefits and internal technical competence are significantly important to the consideration for adoption of cloud computing.

We believe that

We also see some limitations of this study and offer suggestions for further research. Due to limited sample size, the attempt to test correlations by separating adopters and non-adopters was unsuccessful. A larger sample size extracted from a more comprehensive survey might help to identify factors which would influence adopters and non-adopters differently by conducting separate statistic analyses. Moreover, with a large sample size, a further research can be conducted to empirically test the correlations among proposed constructs and types of cloud service (IaaS, PaaS, SaaS). This might offer more valuable insights into how SMEs weigh different factors when considering different types of cloud services. In addition, we believe that a qualitative research based on findings of this research can also be beneficial to further elaborate understandings of each specific dimension or discover other dimensions that might also be important for SMEs’ adoption decision on cloud computing.

REFERENCES


