

CLLOUD COMPUTING: USE AND IMPACT OF TECHNOLOGY

Haslinda Hassan¹, and Noor Azizi Ismail²

¹Universiti Utara Malaysia, Malaysia, lynn@uum.edu.my

²Universiti Utara Malaysia, Malaysia, azizi833@uum.edu.my

ABSTRACT. The objectives of this study are to identify the current state of cloud computing use and to examine the impact of its use to the small and medium enterprises (SMEs) in Malaysia. The impact of cloud computing use is examined from three dimensions: strategic benefits, informational benefits, and security enhancement. Data are collected through a survey of senior managers of the SMEs. The findings suggest that all of the cloud-based technologies are currently in use. The use of cloud computing in the organization facilitates informational and strategic benefits, but not security enhancement.

Keywords: cloud computing use, impact, SMEs

INTRODUCTION

Cloud computing is an emerging information technology (IT) trend that moves computing and data away from desktop and portable PCs into large data centers (Dikaiakos, Katsaros, Mehra, & Vakali, 2009). Erdogmus (2009) considers cloud computing as a pool of highly scalable, abstracted infrastructure capable of hosting end-customer applications that are billed by consumption. The applications offered via a cloud environment may include e-mail, instant messaging, and web content management (Kalloniatis, Mouratidis, Vassilis, Islam, Gritzalis, & Kavakli, 2014). The benefits of cloud computing include reducing the cost of computing services, increasing the processing throughput, reliability, availability, and flexibility, and decreasing the processing time (Hayes, 2008).

Businesses, including the SMEs, are now increasingly taking advantage of the benefits offered by cloud. To be competitive, SMEs need to sustain itself over the longer term and must be technologically proficient and innovative. Nonetheless, there are challenges for the SMEs to sustain their ITs to stay competitive. The cost of implementing and maintaining the required IT infrastructure to effectively support the business needs has always been a major obstacle (Galligan & Mansor, 2011). In some of the SMEs, IT departments with expertise to operate the IT infrastructure has never exist (Galligan & Mansor, 2011). However, cloud computing is transforming businesses and SMEs cannot afford to be left behind.

The objectives of this study are two-fold: (1) to identify the current state of cloud computing use in the SMEs in Malaysia; and (2) to examine the impact of cloud computing use. It is hoped that the study's findings will assist the Government bodies and policymakers in Malaysia, such as Multimedia Development Corporation (MDeC), National IT Agenda (NITA), and SME Corporation Malaysia (SME Corp), in devising a suitable model or initiative relating to cloud computing use and in deciding on appropriate policy and economic incentives, legislative measures, and awareness-raising initiatives vis-à-vis cloud-computing technologies.

The remainder of this paper is organized as follows. Section two presents the literature review of cloud computing. Section three discusses the research model and hypotheses of the study, followed by the study's findings in section four. The paper concludes with the study's limitations in the final section.

LITERATURE REVIEW

Cloud computing refers to the delivery of computing services over the Internet. Using cloud computing, companies can outsource all their IT department functionalities to a cloud host company and pay for services based on usage or on an on-demand basis. Cloud computing, therefore, offers reduction in infrastructure costs and levels the playing field for SMEs. With cloud computing, SMEs do not have to bother where the servers are based (some of them are in Singapore and some are even in the U.S.A.), but what they care most is it works.

Although the potential for cloud computing is evident, a research conducted by Microsoft in 2011, however, reported that while larger Asian businesses are embracing cloud services, SMEs are still lagging behind (Galligan & Mansor, 2011). In companies with more than 500 PCs, 62% of the companies were either adopted cloud computing or planning to adopt cloud. Nonetheless, in companies with less than 50 PCs, more than half of the companies (68%) had no plans to adopt cloud computing at all (Galligan & Mansor, 2011). This is a missed opportunity that could impact the competitiveness for the country including Malaysia. This study, therefore, aims to examine the current state of cloud computing use in the SMEs in Malaysia and for the adopter companies (i.e., organizations that are using the cloud computing), the impact of use will be investigated.

A number of studies have been conducted on cloud computing (see, for example, Misra & Mondal, 2010). None of these studies, however, examined the impact of the technology especially in the Malaysian SMEs context. Our study addresses this gap.

RESEARCH MODEL AND HYPOTHESES

The research model of this study is shown in Figure 1. Cloud computing use refers to the extent to which the organization uses cloud-based technologies (Choudhary & Vithayathil, 2013). Cloud-based technologies are categorized into three groups: e-mail (e.g., Gmail, Yahoo! Mail, and Hotmail), raw storage (e.g., Carbonite, Dropbox, Google Drive, and VADS cloud server), and raw computing (e.g., Amazon EC2, Smart Cloud, and Rackspace Cloud). A seven-point Likert scale of (1) not used at all to (7) used very extensively, is used for cloud computing use.

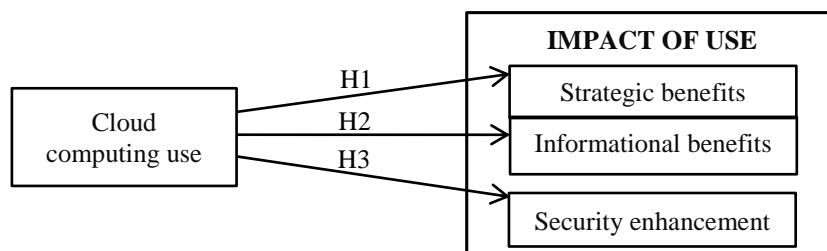


Figure 1. Research Model

Following Iacovou, Benbasat, and Dexter (1995), the impact of use is defined as the actual benefits that adopters receive from using the technology (in this study, cloud). The impact of use is operationalized into three dimensions: strategic benefits, informational benefits, and security enhancement. *Strategic benefits* refer to the positive effects that are realized in the long run, such as ability of the organization to create competitive advantage, align business

strategies to directly support organizational goals, and improve relationship with customers (Gregor, Fernandez, Holtham, Martin, Stern, Vitale, & Pratt, 2005). *Informational benefits* refer to specific transfer of information and subject-matter which benefits a user, including of faster and easier access to internal and external information, and more useful, accurate, and reliable information (Gregor et al., 2005). *Security enhancement* is the ability of the organization to enhance security via cloud's use (Kshetri, 2010). Thus, it is hypothesized that cloud computing use facilitates strategic benefits (H1), cloud computing use facilitates informational benefits (H2), and cloud computing use results in security enhancement (H3). A seven-point Likert scales of (1) strongly disagree to (7) strongly agree, is used for the impact. All constructs are modelled as reflective.

Data collection procedure

The data of the study are collected via a questionnaire approach. The unit of analysis is an organization (i.e., SMEs in Malaysia). SMEs have been highlighted as an important source of economic growth in Malaysia with a contribution of 99% of total business establishment in Malaysia (SME Annual Report 2013/14).

An enterprise is considered an SME based on the annual sales turnover or number of full-time employees. For manufacturing sector, SME refers to a company with sales turnover from RM300,000 to RM50 million or employees from 5 to 200 (SME Corp, 2014). For services and other sectors, on the other hand, SME refers to a company with sales turnover from RM300,000 to RM20 million or employees from 5 to 75. In this study, both manufacturing and services and other sectors are included.

Convenience sampling is used for sample selection. The questionnaires were personally sent to the respondents at four different workshops (i.e., "Seminar Kesedaran dan Latihan GST") in Pahang, Terengganu, and Penang. The workshops, organized by the SME Corp, were held in November and December 2014. The director of the SME Corp of each state was personally contacted to ask permission to distribute the questionnaire during the workshop.

A total of 315 questionnaires were distributed. The questionnaires were completed by the senior managers of the SMEs (such as chief executive officers, owners, or general managers) who participated in the workshops. To and Ngai (2006) suggested that managers have an extensive knowledge of their organization; therefore, their responses are likely to represent well the perspectives of their organizations. Overall, 112 responses were received, with a response rate of 36%. Fourteen responses were, however, excluded as these SMEs are not using any of the cloud-based technologies. Hence, only 98 responses were analyzed (a usable response rate of 31%). Data of this study were analyzed using the Partial Least Square (PLS) technique (i.e., SmartPLS version 3.0 software).

Validity and reliability assessment

The questionnaire was refined via experts' reviews and pre-testing before the actual distribution took place. This was done in two stages involving nine academicians from information systems background (in stage 1) and a deputy director of the International Telecommunication Union-Universiti Utara Malaysia (ITU-UUM) and three SME managers (in stage 2). Each item on the questionnaire was reviewed for its content and scope to ensure that the instrument is well designed and contained items that really measure the constructs. All items were taken from existing literature.

For validation purposes, construct reliability, convergent validity, and discriminant validity were examined for all constructs (see Tables 1 and 2). Construct reliability was assessed by the composite reliabilities (CR). In this study, the composite reliabilities for all measures exceeded the recommended minimum value of 0.70 (Chin, 1998). Convergent validity was ex-

amined by the AVE value where a value of more than 0.50 was evidence for convergent validity (Fornell & Larcker, 1981). For items loadings, all items loaded higher than the threshold value of .70 (Chin, 1998).

Table 1. Measurement model

Construct	Scale	Item	Loadings	AVE	CR
Cloud computing use	Reflective	USE	1.000	1.000	1.000
Impact – Strategic	Reflective	SB1	.890	.843	.970
		SB2	.934		
		SB3	.947		
		SB4	.923		
		SB5	.926		
		SB6	.889		
Impact – Informational	Reflective	IB1	.879	.815	.957
		IB2	.928		
		IB3	.883		
		IB4	.916		
		IB5	.908		
Impact – Security enhancement	Reflective	SE1	.830	.725	.959
		SE2	.831		
		SE3	.848		
		SE4	.717		
		SE5	.920		
		SE6	.786		
		SE7	.892		
		SE8	.900		
		SE9	.918		

Discriminant validity was assessed by examining the square root of average variance extracted (AVE) where all inter-construct correlations were compared. The square roots of AVE were greater than the correlations between them (correlations and square roots of AVE), thereby suggesting discriminant validity.

Table 2. Discriminant validity

	USE	INFOR	SECUR	STRA
Cloud computing use (USE)	1.000			
Informational benefits (INFOR)	-.260	.903		
Security enhancement (SECUR)	-.132	.858	.852	
Strategic benefits (STRA)	-.268	.843	.702	.918

Note: Numbers in bold denote the square root of the AVE.

FINDINGS AND DISCUSSION

More than half of the SMEs (55%) are Sdn. Bhd. companies and most of them (71%) are from services and other sectors. Majority of the SMEs (78%) have less than 30 full-time employees. All of the cloud-based technologies are in use by the SMEs. For e-mail, the highest in use is Gmail (82%), followed by Yahoo! Mail (68%) and Hotmail (25%). In relation to data storage, majority of the SMEs use Google Drive (56%) as compared to Dropbox (44%), VADS cloud server (13%), and Carbonite (12%). However, the use of advanced cloud-based technologies is still low: Smart Cloud (32%), Amazon EC2 (29%), and Rackspace Cloud (28%).

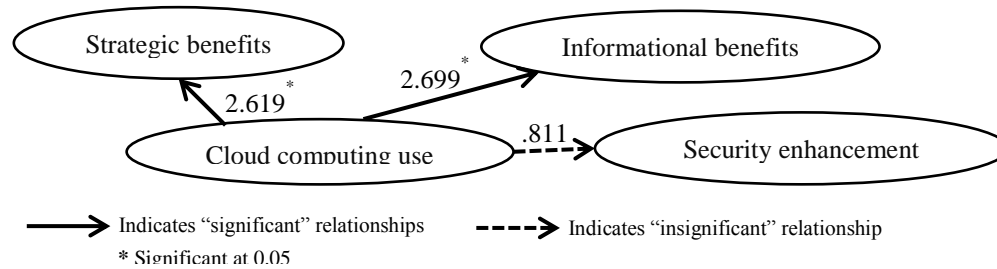


Figure 2. PLS structural model

The results of path loadings revealed that cloud computing use shows significant and positive relationships with both strategic and informational benefits ($p < 0.05$ and above). H1 and H2 are, therefore, supported. The finding that cloud computing use facilitates strategic benefits suggests that cloud-based technologies have been widely accepted as helping organizations in creating competitive advantage, aligning the ICT strategy with business strategy, establishing useful links with other organizations, enabling organizations to respond more quickly to change, improving customer relations, and providing better products or services to customers (Gregor et al., 2005). In relation to the informational benefits, the result suggests that cloud computing enables faster access to information, easier access to information, improve management information for strategic planning, improve information accuracy, and provide information in more useable formats (Gregor et al., 2005). Issues such as security and privacy are among the topmost concerns in organizations' decision to use cloud (Brodin, 2010). One of the largest disadvantages of cloud computing revolves around security and confidentiality (Allen, 2011). Kshetri (2010) argued that the cloud has a possibility to enhance security for the SMEs. In this study, however, the use of cloud computing in the SMEs does not found to significantly lead to security enhancement. H3 is, therefore, not supported ($\beta = .418, p > 0.05$). A possible reason to this finding is that the protection and the security of hardware, software, and data in the cloud lies in the hands of the cloud service provider, and not the organizations (who host the applications or store data on the cloud). Hence, the cloud service provider needs to ensure that their infrastructure is secured and that their clients' data and applications are protected.

CONCLUSION

The findings suggest that all of the cloud-based technologies are used by the SMEs. Nonetheless, the use of advanced cloud-based technologies is rather low. The use of cloud computing facilitates informational and strategic benefits, but not lead to security enhancement.

This study has two limitations. First, the convenience sampling was used for data collection which may lead to biased results. The bias may be compensated for by using a targeted sam-

pling in future research. Second, this study was restricted to SME firms in Malaysia only. Hence, inferences drawn should not be generalized to other populations.

ACKNOWLEDGMENTS

The authors would like to acknowledge Universiti Utara Malaysia and the Ministry of Higher Education Malaysia for funding this research under the (FRGS/1/2014/SS05/UUM/02/29) grant.

REFERENCES

- Allen, J.M. (2011). Cloud computing: Heavenly solution or pie in the sky? *Pennsylvania CPA Journal*, 82(1), 1-4.
- Brodtkin, J. (2010). 5 problems with SaaS security. *Network World*, 27(18), 1-27.
- Chin, W.W. (1998). Issues and opinion on structural equation modelling. *MIS Quarterly*, 22(1), vii-xvi.
- Choudhary, V., & Vithayathil, J. (2013). The impact of cloud computing: Should the IT department be organized as a cost center or a profit center? *Journal of Management Information Systems*, 30(2), 67-100.
- Dikaiakos, M.D., Katsaros, D., Mehra, P., & Vakali, A. (2009). Cloud computing: Distributed internet computing for IT and scientific research. *IEEE Internet Computing*, 10-13.
- Erdogmus, H. (2009). Cloud computing: Does Nirvana hide behind the nebula? *IEEE Software*, 26, 4-6.
- Fornell, C., & Larcker, D.F. (1981). Evaluating equation models with unobservable variables and measurement error. *Journal of Marketing Research*, 18(1), 39-50.
- Galligan, J., & Mansor, D. (2011). Cloud computing for SMEs in Malaysia: Unlocking the potential of cloud computing for a new world of business. *myForesight*. 32-33.
- Gregor, S., Fernandez, W., Holtham, D., Martin, M., Stern, S., Vitale, M., & Pratt, G. (2005). *Achieving value from ICT: Key management strategies*. Department of Communications, Information Technology and the Arts, ICT Research Study, Canberra.
- Hayes, B. (2008). Cloud computing. *Communications of the ACM*, 51, 9-11.
- Iacovou, C.L., Benbasat, I., & Dexter, A.S. (1995). Electronic data interchange and small organizations: Adoption and impact of technology. *MIS Quarterly*, 19(4), 465-485.
- Kalloniatis, C., Mouratidis, H., Vassilis, M., Islam, S., Gritzalis, S., & Kavakli, E. (2014). Towards the design of secure and privacy-oriented information systems in the cloud: Identifying the major concepts. *Computer Standards & Interfaces*, 36, 759-775.
- Kshetri, N. (2010). Cloud computing in developing economies: Drivers, effects and policy measures. *PTC'10 Proceedings*. 7-22. Retrieved from http://www.academia.edu/1161246/Cloud_Computing_in_Developing_Economies_Drivers_Effects_and_Policy_Measures
- Misra, S.C., & Mondal, A. (2010). Identification of a company's suitability for the adoption of cloud computing and modelling its corresponding return on investment. *Mathematical and Computer Modelling*, 53, 504-21. doi:10.1016/j.mcm.2010.03.037
- SME Annual Report 2013/14. Retrieved from <http://www.smecorp.gov.my/vn2/node/1475>
- SME Corp (2014). Retrieved from <http://www.smecorp.gov.my/vn2/node/586>
- To, M.L., & Ngai, E.W.T. (2006). Predicting the organisational adoption of B2C e-commerce: An empirical study. *Industrial Management & Data Systems*, 106(8), 1133-114