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Modelling the Drivers of Cloud Computing Use for SME Businesses

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Abstract: *This study proposes a model of the drivers of cloud computing use for small and medium enterprises (SMEs) in Malaysia. The research model is developed based on technology-organization-environment (TOE) framework and diffusion of innovation (DOI) theory. It is proposed that the use of cloud computing is being influenced by relative advantage, compatibility, and complexity (from the technological context), CEO's innovativeness, top management support, and technology readiness (from the organizational context), and competitive pressure (from the environmental context). A sequential explanatory mixed methods is used for data collection. The findings will contribute to knowledge in cloud computing, especially in regards to cloud-based technologies used by the SMEs and the drivers of use. The findings will also assist the government agencies in accelerating the use of cloud computing among the SMEs and extending the full benefits of cloud computing to sustain the competitiveness of the SMEs.*

Keywords: Cloud computing, TOE framework, DOI theory, SMEs.

1. INTRODUCTION

The term "cloud" is derived from the idea of businesses being able to access applications over the Internet with no geographical boundaries (Behrend, Wiebe, London, & Johnson, 2010). Instead of installing the software applications on user's local computer, users can now access these applications from any computer without having the connection to the hardware that holds the source software (Behrend et al., 2010). Erdogmus (2009) considered cloud computing as a pool of abstracted, scalable, and managed computer infrastructure capable of hosting end-customer applications and billed by consumption. With cloud computing, users are able to access applications like e-mail and office software that are shared over the Internet. They also can communicate with many servers at the same time (Hayes, 2008).

Small and medium enterprises (SMEs) have always been characterized as firms with low capital outlays, low levels of information technology (IT) sophistication, and lack of IT integration. Using cloud computing, SMEs are able to reduce total cost of ownership of information systems and, thus, lowering the barrier to acquisition of IT systems for the organizations. As the users of cloud computing have no connection with the servers, the user's hardware requirements are much lower than they would be otherwise, hence, reducing both cost and maintenance requirements (Erenben, 2009). The maintenance of applications is cheaper as they can be offered through cloud solutions as centralized services.

The Government of Malaysia sees cloud computing as a catalyst for SMEs to be more competitive (The Star, 2011). To accelerate the use of ITs by the companies in Malaysia, especially the SMEs, the Government of Malaysia through its agencies, such as Multimedia Development Corporation (MDeC), has taken the cloud computing use in these companies very seriously. For instance, the SME Cloud Computing Adoption Programme was carried out to accelerate the use of cloud computing among Malaysian SMEs and elevate the competitiveness and efficiency of SMEs in doing business.

The objectives of this study are two-fold: (1) to determine the extent of cloud computing use in Malaysian SMEs; and (2) to examine factors driving

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the cloud computing use. A research model, developed based on technology-organization-environment (TOE) framework and diffusion of innovation (DOI) theory, is proposed.

The findings of this study will contribute to knowledge in cloud computing, especially in regards to cloud computing technologies used by the SMEs and the factors driving the use. The findings would also benefit the government agencies, such as MDeC and SME Corporation Malaysia (SME Corp), in accelerating the cloud computing use and extending the full benefits of cloud computing to sustain the competitiveness of the SMEs.

This paper is structured as follows. Section 1 introduces cloud computing. Section 2 presents the literature review of the study. This is followed by a discussion of research model and hypothesis in the third section. Research design is explained in section 4. Data analysis and progress of study are presented in section 5 and 6, respectively. The final section concludes the study with the limitation.

2. LITERATURE REVIEW

Malaysia aspires to become a fully developed country and economy by the year 2020. In line with this aspiration, Tun Dr. Mahathir Mohamad, the former Prime Minister of Malaysia, unveiled a vision, known as Vision 2020, in 28 February 1991. The gist of the Vision is:

> *"By the year 2020, Malaysia is to be a united nation, with a confident Malaysian society, infused by strong moral and ethical values, living in a society that is democratic, liberal, caring, economically just and equitable, progressive and prosperous, and in full possession of an economy that is competitive, dynamic, robust, and resilient."*

Malaysia has already made a significant progress in realizing this Vision. In 25 September 2010, for instance, the Economic Transformation Programme (ETP) was launched. ETP is a roadmap to take Malaysia into the next level of growth and new level of innovation. ETP is centred on raising Malaysia's competitiveness via the implementation of six Strategic Reform Initiatives (SRIs) to strengthen the country's commercial environment. The aim of ETP is to ensure that Malaysian companies are globally competitive. This includes SMEs, which represent 99% of businesses in Malaysia.

For the SMEs to be competitive, they must be dynamic, robust, resilient, and able to sustain itself over the longer term. This can be achieved if they are technologically proficient, fully able to adapt, innovative, increasingly technology-intensive, and moving in the direction of higher levels of technology.

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 most SMEs, the budgets allocated to IT are usually small or not exist at all (Kotelnikov, 2007). Some of the SMEs do not even have IT departments with specialists who know how to operate the IT infrastructure (Galligan & Mansor, 2011).

A technology, known as "cloud computing" can be seen as a potential solution to this problem. The term cloud computing is used to describe the services offered for multiple users to use the software applications or other resources via the Internet (Mell & Grance, 2011). Cloud computing enables companies to 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 (Christauskas & Miseviciene, 2012) and levels the playing field for SMEs (Irani, 2008). 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, Microsoft reported in 2011 that while large Asian businesses are increasingly embracing cloud services, SMEs are, however, still lagging behind (Galligan & Mansor, 2011). In particular, 62% of the companies with more than 500 PCs were either used cloud computing or planning to use cloud. Nonetheless, more than half of the companies with less than 50 PCs had no plans to use cloud computing at all (Galligan & Mansor, 2011). This missed opportunity could affect the competitiveness for the country including Malaysia. The International Data Corporation (IDC) study reported that there would be 107% cloud-related job growth in Malaysia from 2012-2015 (Asprey, 2012).

Much of the prior researches on cloud computing use in the Malaysian SME context involved case studies, hence qualitative in nature (see, for

example, Saedi & Iahad, 2013; Wu, Lan, & Lee, 2011) and focused on a particular type or service model of cloud such as software as a service (SaaS) (see, for example, Wu et al., 2011). For instance, Saedi and Iahad (2013), in their case study of cloud computing adoption in three Malaysian SMEs, involved data collection from interviews, document analysis, and other methods used in ethnography. Comparatively, our study covers both quantitative (i.e., survey questionnaire) and qualitative (i.e., interview) data. The qualitative data, however, provides a supplementary role to the quantitative findings. According to Bryman (2006), mixed-methods design improves the validity or usefulness of the research findings.

Our study does not limit to a particular cloud service model only, such as SaaS, platform as a service (PaaS), and infrastructure as a service (IaaS). A number of cloud-based technologies, such as e-mail and raw storage, will be used for cloud computing use (see section 4.1 for details).

3. RESEARCH MODEL AND HYPOTHESES

The research model of this study (see Figure 1) is developed based on TOE framework, DOI theory, and on the existing empirical studies of cloud computing use. TOE framework (Tornatzky & Fleischer, 1990) suggests that the use of a technological innovation is driven by factors from three contexts: technology (T), organization (O), and environment (E). DOI theory (Rogers, 2003) describes the process of innovation adoption in a social system. Zhu, Dong, Xu, and Kraemer (2006) suggest that a combination of TOE framework and DOI theory is a good starting point for formulating models of technology use.

In this study, it is proposed that cloud computing use is affected by factors from the technological context (i.e., relative advantage, compatibility, and complexity), organizational context (i.e., CEO's innovativeness, top management support, and technology readiness), and environmental context (i.e., competitive pressure).

3.1. Technological context

Technological context refers to technologies that are relevant to organizations (Tornatzky & Fleischer, 1990; Zhu et al., 2006). The factors covered from the technological context are relative advantage, compatibility, and complexity. These factors are derived from the DOI theory. Based on a meta-analysis on innovation characteristics and innovation adoption-implementation conducted by Tornatzky and Klein (1982), relative advantage, compatibility, and complexity were consistently found to explain innovation adoption and use and, therefore, used in this study.

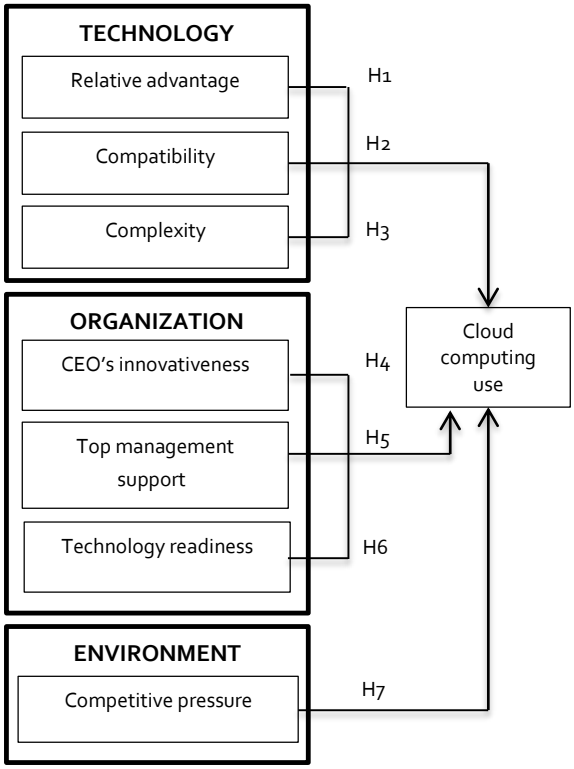

Fig. 1. Research model

Relative advantage refers to the degree to which a new technology is perceived as better than the existing technology in use (Rogers, 2003). The relative advantage of cloud computing includes increased competitive advantage, improved customer relations, and enhanced goods and services delivered to customers. Rogers (2003) suggests that when user perceives relative advantage of the technology, they will tend to adopt it. Hence, it is argued that an organization will use cloud computing when they perceive the potential benefits of using it. The following hypothesis is, therefore, proposed:

H1 : There is a positive relationship between relative advantage and cloud computing use.

Compatibility refers to the degree to which an IT innovation is perceived as consistent with existing values, needs, and prior experience of potential adopter (Rogers, 2003). Several studies (see, for example, Al-Jabri & Sohail, 2012; Tan, Chong, Lin, & Eze, 2009; Yang, Lu, Gupta, Rao, & Zhang, 2012)

have shown the impact of compatibility on IT innovation. For instance, Al-Jabri and Sohail (2012), in a survey of companies in banking industry in Saudi Arabia, found a positive impact of compatibility on mobile banking adoption. Tan et al. (2009), in a survey of companies in the manufacturing and services industries in Malaysia, found that compatibility affected the Internet-based ICT adoption. Hence, it is hypothesized that organizations are more likely to use cloud computing when it is compatible with their existing practices and values. The following hypothesis is, therefore, proposed:

H2 : There is a positive relationship between compatibility and cloud computing use.

Complexity refers to the degree to which an IT innovation is perceived as easy to understand, learn, or operate (Rogers, 2003). Teo, Lim, and Fedric (2007) argued that difficulty in understanding and applying a new technology increases the risk associated with its use. This may result to slower recognition of the technology's value, fear of failure, and resistance (Cho & Kim, 2002). Hence, an innovation that is perceived as easy to use and to understand is more likely to be used by an organization. The following hypothesis is, therefore, proposed:

H3 : There is a negative relationship between complexity and cloud computing use.

3.2. Organizational context

Organizational context refers to organization's size, scope, and the amount of slack resources available internally, or other internal aspects of the organization (Tornatzky & Fleischer, 1990; Zhu & Kraemer, 2005). The factors from the organizational context included in the model are CEO's innovativeness, top management support, and technology readiness.

Kirton (1976) categorised CEOs into two: adaptor and innovator. The adaptor CEO would seek solutions that have already been tried and understood. The innovator CEO, on the other hand, would prefer solutions that have never been tried out and are, therefore, risky. Existing literature presented evidence that CEO's innovativeness is a crucial factor in explaining high levels of IT use. For instance, Al-Qirim (2007), in a survey of e-commerce communications and applications adoption in small businesses in New Zealand, found that CEO's innovativeness is a strong factor in determining the external e-mail adoption. Hence, it is argued that the role adopted by the CEO determines the innovativeness of the business. In addition, Ramayah, Niu, Taghizadeh, and Rahman (2015), who studied the factors influencing SMEs website continuance intention in Malaysia, revealed that apart from CEO attitude towards IT adoption, CEO innovativeness also played its role. The following hypothesis is, therefore, proposed:

H4 : There is a positive relationship between CEO's innovativeness and cloud computing use.

Top management support refers to the extent of commitment and support that top management gives to the use of cloud computing. Support from top management, as organizational decision makers, is vital to ensure that resources needed to adopt a technology or to expand its use are available (Grover, 1993). With lack of top management support, it would be difficult to secure necessary resources (Enns, Huff, & Golden, 2001) and would result in failure of implementation (Grandon & Pearson, 2004). Top management support is vital as sufficient financial investment and technological competencies could not be provided unless there is a strong willingness of top management in understanding business-related benefits of cloud computing, hence, supporting its implementation (Gangwar, Date, & Ramaswamy, 2015). The importance role of top management support in IT use has long been recognized (see, for example, Chong, Ooi, Lin, & Raman, 2009; Cohen, Mou, & Trope, 2014). For instance, Cohen et al. (2014), in a study of cloud computing adoption by firms in South Africa, found top management support as the most important factor in influencing the adoption. The following hypothesis is, therefore, proposed:

H5 : There is a positive relationship between top management support and cloud computing use.

Technological readiness refers to the extent to which the organization has established technological infrastructure and IT human resources necessary for cloud implementation. Low, Chen, and Wu (2011) and Oliveira, Thomas, and Espadanal (2014) suggested that technological readiness of the organizations, covering both technological infrastructure and IT human resources, has an influence on the adoption of new technology like cloud computing. Technological infrastructure refers to network technologies and enterprise systems required for cloud computing use (Low et al., 2011).

IT human resource refers to knowledge and skills required to implement cloud computing (Wang, Wang, & Yang, 2010). Oliveira et al. (2014) argued that both technological infrastructure and IT human resources enhance the technological readiness of an organization. Hence, it is hypothesized that organizations that have technological readiness are more prepared to use cloud computing:

H6 : There is a positive relationship between technology readiness and cloud computing use.

3.3. Environmental context

Environmental context refers to the external environment in which an organization conducts its business, including other organizations it interacts with and the relevant standards and regulations (Teo, Lin, & Lai, 2009; Tornatzky & Fleischer, 1990). The only factor from the environmental context included in the model is competitive pressure.

Competitive pressure refers to the pressure felt by the firm from competitors within the industry (Oliveira et al., 2014). Due to the rapid changes of the technology, organizations face pressure and will commonly follow their competitors' adoption of new technologies (Low et al., 2011). Prior studies (see, for example, Lin & Lin, 2008) have found the importance of competitive pressure as an IT use driver. Hence, it is hypothesized that:

H7 : There is a positive relationship between competitive pressure and cloud computing use.

4. RESEARCH DESIGN

This study uses a sequential explanatory mixed methods research design (Creswell, Clark, Gutmann, & Hanson, 2003), with qualitative data playing a supplementary role. Quantitative data, obtained via a cross-sectional survey, will be used to test the hypotheses. The qualitative data from interview will be used to interpret the results of the hypotheses testing. Bryman (2006) suggested that mixed-methods design improves the validity or usefulness of the research findings.

The questionnaires will be mailed to the respondents using a self-addressed stamped envelope. At the end of the questionnaire, a question asking the respondent to participate in the interview is included. Interviews will be carried out with the respondents who agreed to participate.

4.1. Measurement of variables

All measures of this study are taken from the existing literature (see Table 1 for details).

Table 1. Measurement of variables

Construct	Source	Scale
Cloud computing use	Choudhary and Vithayathil (2013)	Reflective
TECHNOLOGICAL CONTEXT		
Relative advantage	Teo et al. (2009)	Reflective
Compatibility	Teo et al. (2009)	Reflective
Complexity	Teo et al. (2009)	Reflective
ORGANIZATIONAL CONTEXT		
CEO's innovativeness	Thong (1999)	Reflective
Top management support	Low et al. (2011); Oliveira et al. (2014)	Reflective
Technology readiness	Low et al. (2011); Oliveira et al. (2014)	Reflective
ENVIRONMENTAL CONTEXT		
Competitive pressure	Oliveira et al. (2014)	Reflective

Cloud computing use is measured by the range of cloud-based technologies currently in use in an organization. Following Choudhary and Vithayathil (2013), cloud-based technologies are classified into three categories: e-mail (e.g., Gmail), raw storage (e.g., Dropbox), and raw computing (e.g., SmartCloud). A seven-point Likert scale of (1) not used at all to (7) used very extensively, is used for each of the items within this construct. On the other hand, a seven-point Likert scales of (1) strongly disagree to (7) strongly agree, is used for all independent variables. All constructs are modelled as reflective.

4.2. Sample of study

The unit of analysis of this study is an organization (i.e., SMEs in Malaysia). An enterprise is considered as an SME based on annual sales turnover or number of full-time employees (see Table 2).

SMEs have been highlighted as the backbone of economic development in Malaysia with a contribution of 99% of total business establishment in Malaysia (SME Annual Report 2013/14). Both manufacturing and services and other sectors are covered.

Table 2. Definition of SME

Category	Small	Medium
Manufacturing	Sales turnover from RM300,000 - to RM14,999,999 OR employees from 5 - 75	Sales turnover from RM15 mil – RM50 mil OR employees from 75 - 200
Services and other sectors	Sales turnover from RM300,000 – RM2,999,999 OR employees from 5 - 29	Sales turnover from RM3 mil to not exceeding RM20 mil OR employees from 30 - 75

Source: SME Annual Report 2013/14 (http://www.smecorp.gov.my/vn2/node/586)

Senior managers in the organizations, such as director and IT manager, will be our key informant. They are considered as the most appropriate key informants in this study as they are well positioned in the organizations and know well about their organization's IT resources and technological environment (Cohen et al., 2014).

Table 3. Number of SMEs

State	Frequency
Selangor	1,724
Kuala Lumpur	724
Pulau Pinang	655
Johor	482
Perak	316
Kedah	237
Terengganu	174
Melaka	169
Negeri Sembilan	134
Sarawak	109
Sabah	91
Pahang	80
Kelantan	66
Perlis	11
Putrajaya	7
Labuan	1
TOTAL	4,980

The list of the SMEs is obtained from the SME Business Directory (see http://www.smeinfo.com.my). The website was browsed from August 25 to November 9, 2014. As of that date, there are 4,980 SMEs listed on the website (see Table 3 for details).

A simple random sampling is used for sample selection. This sampling method enables the company in both sectors an equal chance of being selected.

5. DATA ANALYSIS

The data of this study will be analysed using the Partial Least Squares (PLS) technique (i.e., SmartPLS version 3.0 software). Chin, Marcolin, and Newsted (2003) suggested that this technique is particularly useful because of its ability to model latent constructs under conditions of nonnormality and with small and medium sample sizes.

6. PROGRESS OF STUDY

This study is currently at the data collection stage. As at April 15, 2015, 600 questionnaires have already been distributed to the SMEs.

7. CONCLUSION

This study proposes a model of the drivers or factors affecting cloud computing use in the SMEs in Malaysia. In particular, the objectives of this study are to determine the extent of cloud computing use in the SMEs and to examine the factors affecting the cloud computing use. The research model is developed based on TOE framework and DOI theory. The factors covered include relative advantage, compatibility, and complexity (from the technological context), CEO's innovativeness, top management support, and technology readiness (from the organizational context), and competitive pressure (from the environmental context). Data collection comes from both quantitative (via survey questionnaire) and qualitative (via interview) approaches. Better understanding of the factors affecting cloud computing use is relevance to SME managers in considering their IT investments when implementing cloud computing. Nonetheless, as the study focuses on the SMEs in Malaysia only, the study's findings cannot be generalized to other populations.

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