The Perceived Business Benefit of Cloud Computing: An Exploratory Study

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ABSTRACT

The objective of the research is to study the benefits of cloud computing perceived by adopters and examine the impact of moderating factors on the relationship between the type of cloud computing and the perceived benefit. The moderating factors include firm size and value-chain activities. A measurement instrument of a 5-point Likert scale was administered on businesses of different sizes in Taiwan. The benefit of cloud computing measured in the study were: cost reduction, improved capability and enhanced scalability. The results show that the perceived benefit of cloud computing varies depending on the type of cloud computing, the value chain activity where cloud computing is deployed, and the business size. Also, businesses benefit more in enhanced scalability than in cost reduction and increased business capability. After adopting cloud computing, businesses gain more capability in support activities than in primary activities. However, there is no significant difference in composite benefit among Software as a Service (SaaS), Platform as a Service (PaaS), and Infrastructure as a Service (IaaS). Furthermore, there is marginally significant interaction effect between the types of cloud computing and the business size.

Keywords: Cloud Computing, SaaS, PaaS, IaaS, Business Benefits

INTRODUCTION

Cloud computing is a newly developed trend of the use of information technology (IT) that simplifies the way computing resources are used and managed through new techniques. It is touted as a big thing of IT industry that will bring plenty of opportunities, induce a revolution in IT applications, and significantly influence the way businesses use IT to create competitive advantage.

Most companies recognize IT as a strategically crucial resource. However, due to the growing amount of investment, management wants to see tangible, quantifiable benefits of an IT investment to justify the investment. Although many research reports and white papers claim that cloud computing can bring substantial benefits, such as reducing costs and flexible deployment, questions regarding how to realize such benefits and what contextual factors may impact the

benefit remain unanswered. The extant academic literature about cloud computing can be classified into four categories of topics: technological issues, business issues, conceptualizing cloud computing, and domains and applications of cloud computing (Yang and Tate, 2012). For example, Srinivasan (2013) and Whitley et al. (2013) investigated security and privacy issues. Furner (2013) and Werfs et al. (2013) studied implementation and adoption issues in cloud computing. There are only few academic studies that put some emphasis on benefits of cloud computing. Ganesan (2013) presented changes in design of an e-learning model and benefits of cloud computing when an e-learning portal was migrated from an on-premise platform to the cloud. Sommer and Subramanian (2013) identified benefits of cloud computing to small biotech and pharmaceutical companies. As shown in these examples, the studies focused on a specific system in a specific type of organizations. Nevertheless, business benefits of cloud computing have been widely stated, but they are seldom supported with empirical evidence.

The purpose of the study is intended to assess the claimed business benefits of cloud computing with an empirical study and to investigate how contextual factors affect the realization of such benefits. Furthermore, according to one survey conducted by the Institute for Information Industry (Lin, 2010), cloud computing was implemented in the support activities of the value chain more often than in the primary activities. This finding is interesting in that, according to the value chain model (Porter 1985), the primary activities are directly related to revenue generation and, thus, in theory, the company should be more likely to apply cloud computing in the primary activities in order to maximize the revenue, assuming that cloud computing is strategically important. This finding inspires us to answer the question: Does the benefit of cloud computing perceived by adopters vary across the value chain areas?

Therefore, the research objectives of this study are to answer the following questions:

- Do different types of cloud computing service generate different amounts of perceived benefit?
- Does the perceived benefit of cloud computing service vary depending on the area of value chain?
- Does the size of business affect the magnitude of perceived benefit of cloud computing?

LITERATURE REVIEW

Evolution of cloud computing

Even though the subject of cloud computing has been widely discussed and received a great deal of attention, there was no one commonly accepted definition (Vaquero et al., 2008; Yang & Tate, 2012). Technically speaking, cloud computing is a shared IT infrastructure where computing resources are scattered but linked together through the Internet into a large pool of computing resources and that could automatically adjust the allocation of computing resources as the need for computing service fluctuates (IBM 2011), resulting in higher utilization and productivity (Rimal et al., 2009). Voas and Zhang (2009) assert that conceptually the "cloud" on the Internet conceals available computing resources and provides a standard interface, through which users would be able to use the entire World Wide Web as a powerful personal computer.

Some believe that the focus of cloud computing should be on the user experience. The essence is to separate the submission of computing needs from the underlying technologies (IBM 2009). For example, Miller (2009) states that cloud computing means the transfer of management of applications and files to the "cloud". Klems (2008) also points out that cloud computing is the provision of personal applications and business applications through the Internet that centralizes servers, which share underlying computing resources. Foster et al. (2008) asserts that cloud computing is a large-scale distributed computing model where virtualized and dynamically extensible computing power, storage, platforms and services are pooled to offer on-demand services. However, Armbrust et al. (2010) claim that cloud computing refers to not only the delivery of applications through the Internet but also the hardware and system software at the data center. Cloud computing is technologically founded on virtualization, distributed computing, utility computing, networks, websites and software services and provide the user with a service-oriented architecture (SOA) and with an opportunity to reduce operating cost (Vouk, 2008).

Voas and Zhang (2009) divide the evolution of computing into six stages: the mainframe, the microcomputer, the LAN, the Internet, the grid computing and the cloud computing. Furht (2010) compares the six periods of computing and claims that while it appears that the cloud computing seems to return to the period of the mainframe, it is quite different: first, the mainframe has limited computing capability, but cloud computing is able to provide almost unlimited computing power; and second, the user interface device of the mainframe is the terminal, which performs simple functions, but the user interface device of the cloud computing is a high-performance personal computer, which owns local computing and storage capability. Foster et al. (2008) compare the difference between the grid computing and cloud computing in several dimensions, including the business models, computing structure, computing resources and computing resource management.

Singer (2010) identifies two parameters as indicators to measure cloudiness: the granularity of the service and the speed of resource scaling. The former means the unit that the computing service could be purchased, ranging from a data center to seconds of computational power. The latter means the time it takes to scale the service up to the amount needed by the user.

Yang and Tate (2012) conducted an extensive literature review of cloud computing and concluded that the definition by the National Institute of Standards and Technology (NIST) has gained recognition and popularity. NIST defines cloud computing as "a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction" (Mell & Grance, 2011, p. 2). NIST asserts that cloud computing has five core competencies offered through three services. The five core competencies are (1) on-demand self-service, (2) broad network access, (3) resource pooling, (4) rapid elasticity, and (5) measured service. The three services are Software as a Service (SaaS), Platform as a Service (PaaS), and Infrastructure as a Service (IaaS) (Mell & Grance, 2011).

SaaS is the one that applications are hosted on a cloud infrastructure (Mell & Grance, 2011), different from applications running on premise (Srinivasa et al, 2009; Vaquero et al 2008). Clients do not need to install software on their machines. Instead, they use the application through a browser and thus SaaS is known as on-demand software (Wang et al., 2008). The user of SaaS

pays for the usage of software applications, reducing the software procurement and maintenance costs (Wang et al., 2008; Tsai et. al., 2010).

PaaS offers a platform on which users acquire an application software development capability and could develop their applications (Mell & Grance 2011). The user can use PaaS for software development, testing, deployment, monitoring, hosting and production environments (Tsai et. al., 2010).

IaaS makes the IT hardware infrastructure, such as servers, storage devices, computing power, available to end users through the Internet. Users of IaaS are charged for the amount of the actual use of the resources. Technically, IaaS systems, via Internet protocol, manage large amount of computing resources and use virtual technology to segment, dynamically reconfigure or change specifications to meet users' needs for custom software in the context of unique computing environment (Vaquero et al., 2008; Mell & Grance, 2011).

Business benefits of cloud computing

Ghalimi (2010) asserts that the benefit of cloud computing can be analyzed in three dimensions:(1) reduce the cost of IT by converting IT investments from the capital expenditure to operational expenses; (2) improve the end-user experience; and (3) cloud computing allows companies to focus on their core competencies. Strategic benefits of cloud computing include IT decapitalization, accessibility, business agility, scalability, cost-effectiveness (Perry et al., 2009; Li et al., 2009; Dijkstra, 2011; Jadhwani, 2009). Li et al. (2009) indicate that agility, integration, flexibility and cost reduction are important benefits of cloud computing. After adopting cloud computing, businesses can improve the utilization of computing resources, reduce capital expenditures, reduce maintenance and operational costs, and improve efficiency through dynamic deployment and recovery capabilities of computing resources.

It is noteworthy that although most experts believe that cloud computing reduces the cost of information technology (Creeger, 2009), an analysis by Armbrust et al. (2009) shows that the amount of Amazon's pay-per-use price is more expensive than the cost of buying similar servers. Therefore, companies that adopt cloud computing should seek benefits beyond cost reduction. Compared to the cost dimension, flexibility and pay on demand offered by cloud computing might be more important. Also, cloud computing can efficiently respond to changes in the demand from the market, improve the utilization of computing resources, and balance the usage of computing resources. Finally, Lyons (2009) proposes six indicators of the IaaS service: scalability, reliability, real-time performance, fault-tolerance, security and cost.

By summarizing the benefits discussed in the extant literature as reviewed above, we consider that cost reduction, enhanced business capability and increased scalability are three important dimensions of cloud computing.

Value chain

Porter (1985) considers an enterprise a set of different activities, each of which adds marginal value to the final product or service, and these activities constitute a value chain. Porter divided

these activities into two categories: (1) primary activity and (2) support activity. Activities of the value chain do not add values to the final product equally. Companies should strategically choose activities they attempt to leverage based on the characteristics of the industry and the company's conditions in order to maximize the value. Since primary activities are related to revenue generation, and support activities are mainly to facilitate the execution of primary activities, the use of cloud computing in the primary activities should create more value for the businesses than in the support activities.
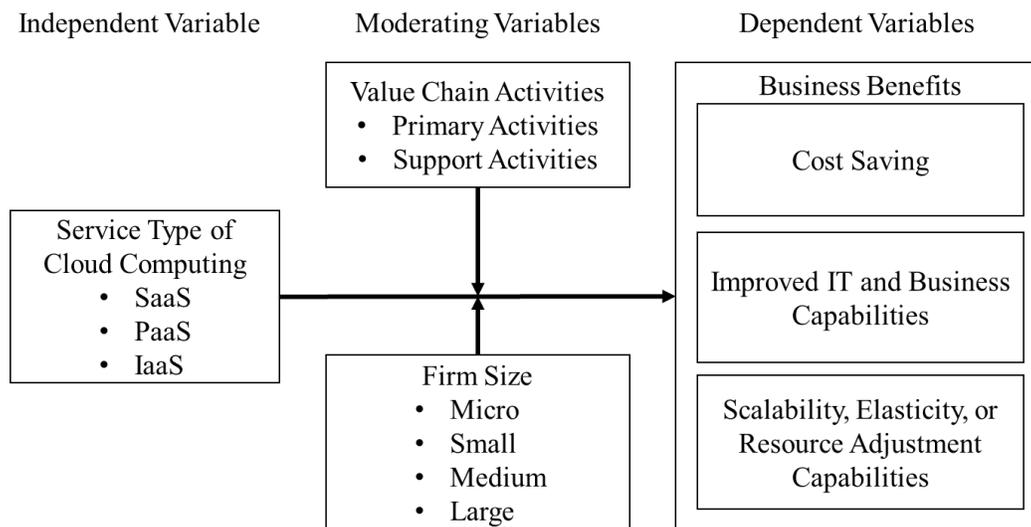
Firm size

Firm size has been identified as an effective factor in predicting the intensity of the IT use and business's ability to use IT (Thong 1999; Thong & Yap 1995; Yao, et al., 2002; Chuang et al, 2007; Chuang et al., 2009). In general, large companies have more resources than small and medium sized enterprises (SMEs) and are more likely to adopt new IT. However, the advent of the Internet provides SMEs with mechanisms and methods to connect information systems across organizations. Furthermore, the advantages of cost and efficiency enable SMEs to adopt innovative technologies and digitize their businesses. As a result, the impact of cloud computing on SMEs is more significant than large companies (Angeles & Nath, 2003). As plenty of literature shows that business size is a significant factor affecting IT adoption, we include the factor in our study.

RESEARCH METHOD

Research model

This study adopts the survey research and uses a 5-point Likert scale questionnaire as a measurement instrument for data collection. The subjects were companies in Taiwan that have adopted cloud computing. Based on our research objectives, a research model is developed as shown in Figure 1. The main proposition of the study is: The benefit of cloud computing, the dependent variable, may vary depending on the independent variable, cloud computing service type, and the relationship between both is affected by two moderating variables, the area where it is adopted in the value chain and the firm size.

Figure 1: Research Model.

Independent Variable   Moderating Variables   Dependent Variables

Value Chain Activities
- Primary Activities
- Support Activities

Business Benefits
- Cost Saving
- Improved IT and Business Capabilities
- Scalability, Elasticity, or Resource Adjustment Capabilities

Service Type of Cloud Computing
- SaaS
- PaaS
- IaaS

Firm Size
- Micro
- Small
- Medium
- Large

Research hypothesis

Cloud computing services can be classified into three types: SaaS, PaaS, and IaaS. In terms of the relationship between the user and cloud computing, these types of cloud computing form a hierarchical structure, which is, from most direct to less direct, SaaS, PaaS, and IaaS, respectively (Tsai, et al., 2010). In general, SaaS is most directly relevant to the user's job. On the contrary, IaaS provides computing infrastructure, which is generally less relevant to the user's job than SaaS. The relevance of PaaS to the user is between SaaS and IaaS. Based on the relationship, it is logical to infer that the use of SaaS might contribute the most and more directly to the user than might IaaS and PaaS is in between. In other words, similar to the relationship hierarchy, the benefits of different types of cloud computing might be presented as a hierarchy from the most beneficial to the least beneficial. This study thus proposes research hypothesis H_1 as follow.

H_1:   Different types of cloud computing produce different levels of business benefits.

Value chain analysis has been used to create competitive advantage based on low cost leadership or differentiation by implementing IT to support the strategy and changing the nature of competition among businesses. Primary activities of value chain are directly related to revenue generation, whereas support activities are to support the implementation of primary activities. Therefore, we expect the application of cloud computing in different value chain activities will have different impact on the bottom line of the business. Therefore, this study proposes hypotheses H_2 and H_3 as follow.

H_2:   Cloud computing produces different levels of business benefits between primary activities and support activities.

H_3:   Different cloud computing types produce different levels of business benefits in different value chain activities.

The firm size may affect the adoption of IT. Large firms are generally resourceful and have the advantage of using new technology and being affordable to greater level of risk. In contrast, due to limited resources, SMEs are generally susceptible to risk and need be cautious in using new technology.

On the other hand, the difference between cloud computing and the traditional IT on premise model lies in that the former provides computing resources when they are actually needed without significant initial investment. Will the new model enable micro- and SMEs that lack resource to obtain the right amount of IT resources to maintain their competitiveness? Based on the reasoning, we expect that the firm size affects the benefit of cloud computing. Thus, the study proposes the following research hypotheses.

> H_4: The benefit of cloud computing varies across different sizes of businesses.
> H_5: Different types of cloud computing produce different levels of business benefit across different sizes of businesses.

Operational definition of research variables

The independent variable of the study is types of cloud computing. We use three types of cloud computing defined by the US NIST, Software as a Service (SaaS), Platform as a Service (PaaS), and Infrastructure as a Service (IaaS). The measurement of value chain activities is based on the sub-categories of Porter's value chain analysis (Porter, 1985): in-bound logistics, production operations, out-bound logistics, marketing and sales, service after the sale, which are primary activities and human resource management, technology development, procurement, and enterprise infrastructure, which are the support activities. The firm size is measured with the number of employees and companies are classified into four categories: micro, small, medium, and large. Micro-businesses have 10 employees or less, small businesses have 11 to 50 employees, medium-sized businesses have 51 to 200 employees, and large businesses have 200 employees or more.

The indicators of the dependent variable, the benefit of cloud computing, are compiled from extant literature: business costs saving, improved business capabilities, and enhanced business scalability. The sources of these indicators are listed in Table 1. Cost saving include saved initial investment, reduced overall operating costs, maintenance costs, and replacement costs. Improved business capabilities include resource deployment capabilities, interoperability, information processing capabilities, business responsiveness, and meeting customer-specific requirements. Enhanced business scalability includes flexible computing resources, operations management flexibility, flexible recovery operation, sharing resources flexibility, and reliability adjustment. These variables are measured with a five-point scale Likert scale, from strongly disagree (1) to strongly agree (5): the higher the score is, the more satisfied the company is.

Table 1: Sources of Business Benefits.

Business Benefit	Sources
Cost Saving	Creeger (2009), Etro (2009), Ghalimi (2010), Kourik (2011), Jadhwani (2009), Kepes (2011)
Improved Business Capabilities	Creeger (2009), Dijkstra (2011), Herbert (2011), Li et al. (2009), Perry et al. (2009), Zhu et al. (2010)
Enhanced Business Scalability	Dijkstra (2011), Jones (2008), Lyons (2009), Mell & Grance (2011), Rimal et al. (2009)

Questionnaire design

The measurement instrument of this study was developed based on extant literature. It was revised through three rounds for the face validity. Five experts (two academics and three practitioners) were invited to review and pre-test for semantic clarity and content validity. The questionnaire consists of 15 items, including background information of the subjects, business industry, the number of employees, the use of cloud computing service types they adopted and areas of value chain they deployed cloud computing (See Appendix).

While the study mainly uses survey as a means to collect data, during the process of developing the measurement instrument, we interviewed three practitioners whose companies had adopted cloud computing. The purpose of the interview was twofold: one was to obtain practitioners' inputs about the feasibility of the study and the other was to validate the instrument.

Sample

The population of subjects was companies with capital of TWD$500,000.00 or more that were registered in Taiwan. The sampling frame consists of four sources: Directory of Hi-Tech Promotion Center (Department of Economic Development, Taipei City Government), The Statistics for Taipei City Firms and Corporations Registration (Taipei City Office of Commerce), Directory of Nankang Software Park Website and Business Registration Directory of Department of Commerce (MOEA). A sample of 7000 companies was randomly chosen from the four directories and invited to participate in the survey via postal mails. After excluding invalid responses, the study obtained 65 effective questionnaires.

DATA ANALYSIS

Descriptive statistics

Statistical software SPSS 20 was used to analyze the data. The descriptive statistics of the data are shown in Table 2 below.

Table 2: Summary of the Descriptive Statistics of the Sample Businesses.

Industry	n	%	Industry	n	%
Financial Bank	1	1.5%	Manufacturing	13	20.0%
Healthcare	2	3.1%	Biochemical Technology	1	1.5%
Information and Communications	14	21.5%	Transportation	6	9.2%
Wholesale	2	3.1%	Real estate	4	6.2%
Insurance	1	1.5%	Business Services	3	4.6%
Utilities	3	4.6%	Warehousing	1	1.5%
Recreation	1	1.5%	Optoelectronics Technology	3	4.6%
Retail	3	4.6%	Other	7	10.8%
Number of employees			**Cloud computing service type**		
10 people or less	8	12.3%	SaaS	22	33.8%
11 to 50 people	19	29.2%	PaaS	15	23.1%
51 to 200 people	16	24.6%	IaaS	28	43.1%
200 people or more	22	33.8%			
Value chain activities					
Primary activities	37	56.9%			
Support activities	28	43.1%		N = 65	

The breakdown of samples by the type of cloud computing and value-chain activity, as shown in Table 3, suggests that businesses use the cloud computing service in the area of primary activity more than in the area of support activity. Nevertheless, it is noteworthy and interesting that the distribution of SaaS between primary and support activities are quite different from those of PaaS and IaaS. It would be interesting to further explore why cloud computing applied in primary activity is mainly in PaaS and IaaS.

Table 3: Breakdown of Samples by Type of Cloud Computing and Value-Chain Activity.

Activity	Type of Cloud Computing			Total
	SaaS	PaaS	IaaS	
Primary	10	10	17	37
Support	12	5	11	28
Total	22	15	28	65

Additionally, the breakdown of samples by the type of cloud computing and the firm size, as shown in Table 4, suggests that more small- and medium-sized enterprises (SEMs) use cloud computing than large companies.

Table 4: Breakdown of Samples by Type of Cloud Computing and Firm Size.

Firm Size	Type of Cloud Computing			Total
	SaaS	PaaS	IaaS	
Large	6	6	10	22
SMEs	16	9	18	43
Total	22	15	28	65

The means of benefits brought about by different types of cloud computing services between firms of different sizes are shown in Table 5. While it appears that large companies gain more in cost reduction than small- and medium-sized enterprises, large companies gain less in the other two dimensions than SMEs.

Table 5: Breakdown of Cloud Computing Values by the Three Dimensions and Firm Size.

Firm Size	Cost	Capability	Scalability
Large	3.52	3.67	3.72
SMEs	3.34	3.70	3.80

Scale reliability and analysis of variance

The internal consistency coefficients of the three dimensions of business benefits of cloud computing are 0.755, 0.659, and 0.722, respectively, and were within the acceptable range. Cronbach alpha of the scale was 0.829 indicating a high reliability. MANOVA (Tabachnik & Fidell, 2001) was adopted to analyze the effect of the independent variables and moderating variables on the dependent variable. Wilks' lambda α value was set at 0.1 for significant test since the nature of the study is explorative and the sample size is less than ideal (Lavrakas, 2008). For post-hoc tests, the Roy-Bargmann Stepdown Analysis method was used to reduce the probability of type one error (Huberty & Morris 1989). The result of multivariate homogeneity of variance test shows that Box's M value is equal to 74.338, F = 2.068, P = 0.001, less than the significant level, indicating that the variances of the four independent variables do not violate the assumption of homogeneity.

The result of MANOVA shows a less than significant level, $F(6, 114) = 0.329$, $P > 0.1$ for the hypothesis test of the impact of cloud computing types on business benefits as the main effect (H_1). However, the result shows that the hypothesis of the impact of cloud computing on business benefits at different value chain activities as the main effect (H_2) is supported at the significant level of 0.1, $F(3, 57) = 2.695$, $P < 0.1$. The interaction of the type of cloud computing and value chain activities (H_3) was a less than significant level, $F(6, 114) = 0.972$, $P > 0.1$. This result indicated that the benefit of cloud computing varies across different areas of value chain.

Additionally, the result of MANOVA shows that the hypothesis that the benefit of cloud computing varies across different sizes of businesses (H_4) is not supported at significance level of 0.1, $F(9, 102) = 0.740$, $P > 0.1$. However, the interaction between the type of cloud computing and the firm size (H_5) is significant at the level of 0.1, $F(18, 144) = 1.592$, $P < 0.1$. The results

suggest that different types of cloud computing produce different levels of business benefit across different sizes of businesses.

Table 6 lists the results of hypothesis tests. Hypothesis H_2 and H_5 were supported, while hypotheses H_1, H_3, and H_4 did not have enough statistical evidence.

Table 6: Study Hypothesis Test Results.

Research Hypothesis		Results
H_1	Different types of cloud computing produce different levels of business benefits.	Not supported
H_2	Cloud computing produces different levels of benefit between primary activities and support activities.	Supported
H_3	Different cloud computing types produce different levels of business benefits in different value chain activities.	Not supported
H_4	The benefit of cloud computing varies across different sizes of businesses.	Not supported
H_5	Different types of cloud computing produce different levels of business benefit across different sizes of businesses.	Supported

DISCUSSIONS

The results of the study support the main thesis that cloud computing can generate benefits to businesses but the level of benefit varies depending on other factors, such as areas where it is adopted in value chain and firm size. One interesting finding is that although most of the literature suggests that one of main benefits of cloud computing is the cost (IT and business operations) reduction, further analysis of this study (one-way ANOVA analysis, p-value <0.001) indicates that the impact of cloud computing on business capability and scalability is greater than on cost saving. The finding seems to concur with what Armbrust et al. (2010) suggested. Armbrust et al. (2010) claims that the cost of cloud computing is not necessarily low and as a result, businesses should consider to adopt cloud computing based on factors beyond cost reduction. An important implication of the finding of the study is that the decision over whether to adopt cloud computing should not be made based on cost only. Instead, business contemplating the decision should make the decision based on values that cloud computing can bring to.

The hypothesis that the type of cloud computing has impact on the amount of benefit is not supported. One possible explanation is that although different types of cloud computing serve different purposes, they may generate the same amount of value. Alternatively, the result could be explained with Perez's Technological Surge Cycle (2002). After studying all of major technological revolutions since the industrial revolution, Perez (2002) found that there were two phases of each technological development: the installation phase and the deployment phase. During the first phase, when the new technology comes to the market, the installation of the technology would destroy the existing structure, establish a new infrastructure and popularize its excellence. During the deployment phase, the technology would be widely accepted and the enterprise's focus with regard to the technology would shift from technical to management to meet the need of new infrastructure. It is in the second phase that the effect of the new technology would

be observed. Cloud computing may be at the first phase right now and thus, effects of the different cloud computing types are not conspicuous. When a business is still in the installation phase, the adoption of cloud computing has not changed its original operation structure, and thus the structure is still evolving to generate new benefit. In other words, the benefits of different types of cloud computing services are still in the fermentation period. In this study, the interview data also supported this interpretation. The interviews with a company in the financial industry revealed that the new operation structure was in the process of the development, the impact of related cloud computing services on their overall operational efficiency were deferred, and thus it would take time to observe the effect of technology adopted and the effect of its adoption has not yet reached to the entire business.

Hypothesis H_2 that cloud computing produces different levels of benefits between primary activity and support activity is supported. Cloud computing generates more benefit in support activities than in primary activities. Further analysis shows that in support activities of the value chain, the benefit of cloud computing is mainly on improved IT and business capabilities. However, there is no significant difference between cost reduction and scalability. The implication of the finding is that businesses that want to enhance its business capability should apply cloud computing in support activities. Also, the result shows that cloud computing applied in support activities enhanced business profit more than the traditional on premise model.

Hypothesis H_3 that different types of cloud computing produce different levels of benefits in different value chain activities is not supported. The result suggests that the relationship between the type of cloud computing and benefits is not moderated by value chain activities.

Hypothesis H_4 that the benefit of cloud computing varies across businesses of different sizes is not supported. One possible explanation is that while large companies are resourceful and can adopt IT to create competitive advantage, when it comes to cloud computing, the affordability and flexibility of cloud computing enables SMEs to obtain similar benefits from cloud computing. Although the benefit of cloud computing does not vary significantly across businesses of different sizes, there exists an interaction between the firm size and the type of cloud computing has generated significant difference, which is hypothesis H_5.

Hypothesis H_5 that different types of cloud computing produce different levels of business benefit across different sizes of businesses is supported. Benefits gained from different types of cloud computing adopted by businesses of different sizes are different. SaaS produces greatest benefit in cost saving. Also, adopting SaaS, large businesses gains more benefit of cost saving than SMEs do. One possible explanation for the result may come from the enterprise resource theory. Because the enterprise applications replaced by SaaS in large businesses are typically expensive, when the use of SaaS become effective, its impact on the cost would be more significant than it is SMEs. Additionally, the result shows that in terms of PaaS, the benefit gained by micro-businesses is the most significant, and is mainly in the dimension of enhanced business scalability. Possible explanation for this is that micro-businesses face competitive business environment, need to use limited resources to maximize benefit through new technology, and thus micro-businesses considers how to use cloud computing as an important strategy. An interesting question is: why is the benefit of cloud computing for micro-businesses, which have very limited resources is mainly in the dimension of enhanced business scalability rather than in that of cost saving? One possible

explanation is that micro-businesses are generally more flexible and agile and can quickly respond to change in the need of the market. And, PaaS enables them to fast develop applications to implement their strategies and operations as the need arises. As a result, they obtain more benefits in the dimension of enhanced business scalability rather than in that of cost saving.

Figure 2: Cloud Computing Benefit Mean in Different Sizes of Business Showing a U-Shaped Curve.
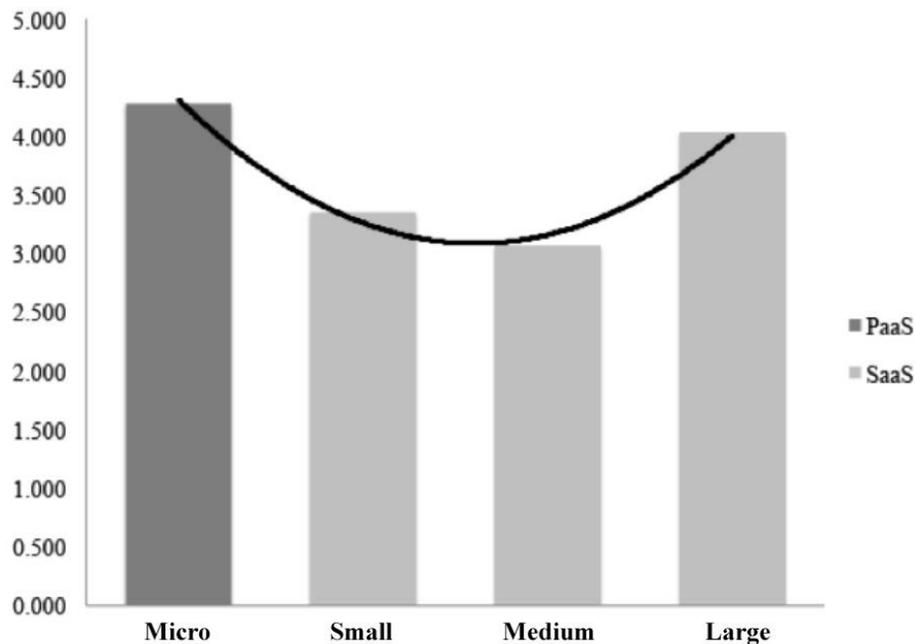
Plotting the most significant benefits of SaaS and PaaS across businesses of different sizes generates a U-shaped curve, as shown in Figure 2. The benefit of SaaS is mainly in cost-saving for large and small businesses, while PaaS produced the most benefit in the enhanced business scalability for micro-businesses. This result means that cloud computing may produce more business benefits for micro and large businesses than the traditional on premise approach do, and provide greater opportunity to them.

CONCLUSION AND LIMITATIONS OF THE STUDY

Conclusion

The study is exploratory in nature. Based on extant literature and our observations, we propose a research model depicting the relationship between the type of cloud computing and the benefit, moderating by the firm size and value chain activity. The main proposition is that different types of cloud computing generate different amounts of benefit. Also, the relationship between types of cloud computing and benefits are the size of adopting company and area where in the value chain cloud computing is adopted. Based on these two propositions, we formulated five hypotheses, and conducted a survey on businesses in Taiwan to investigate. The results of data analysis show that:

1. The benefit of cloud computing is higher in support activities than in primary activities.

2. Large businesses that adopted SaaS gained higher benefits in the dimension of cost saving than micro-, small- and medium-sized companies did.
3. Micro-businesses that adopted PaaS gained higher benefits in the dimension of enhanced business scalability than SMEs and large companies did.

Limitations

While the study reveals several interesting findings, the results should be interpreted with caution. There are several limitations. First of all, the data source is from companies in Taiwan, where businesses are predominantly SEMs, and the unique characteristic of the economy there might affect the deployment of cloud computing. Second, the subjects were randomly selected from four business directories available in Taiwan and the subjects freely chose to answer the questionnaires. Therefore, there are probably sampling problems or self-selection bias. The single source of subjects and self-selection bias might limit the generalizability of the results (Zhou & Lin, 1997). Third, the sample size is not so ideal as expected, which may make the result less representative. Nevertheless, as the study is exploratory in nature, the findings highlight the direction of future research although the potential impact of small sample size should be taken into account when interpreting the result. One possible reason for the small sample size is that since cloud computing is an emerging and evolving technology, the number of businesses that adopted cloud computing is very limited. The possible explanation is corroborated with one similar study conducted by the Institute for Information Industry that was commissioned by the Ministry of Economic Affairs (Lin, 2010). In that study, the sample size was 64, about the same as the study does. We believe that the slow adoption of cloud computing services shows the need for studies such as this one that could further our understanding of the deployment of cloud computing. With the publication of the findings of the study, businesses may gain better understanding and might be more willing to adopt cloud computing services.

Finally, the nature of cross-sectional data set limits the interpretation to that at one point in time. It might not reveal the benefit generated from cloud computing as business go through the two phases of Perez's Technological Surge Cycle (2002). Longitudinal study might be needed to examine such benefits.

REFERENCES

Angeles, R., & Nath, R. (2003). Electronic Supply Chain Partnerships: Reconsidering Customer-Supplier Relationship Attributes In dyads. *Information Resources Management Journal*, 16 (3), 59-84.

Armbrust, M., Fox, A., Griffith, R., Joseph, A. D., Katz, R., Konwinski, A., & Zaharia, M. (2010). A View of Cloud Computing. *Communications of the ACM*, 53 (4), 50-58.

Chuang, T.-T., Nakatani, K., Huang, I. L., & Chen, J. C. H. (2007). Examining the Impact of Organizational Characteristics and Owner's on the Extent of E-Commerce Adoption in SMEs. *International Journal of Business and Systems Research*, 1(1).

Chuang, T.-T., Nakatani, K., & Zhou, D. (2009) An Exploratory Study of the Extent of Information Technology Adoption in SMES: An Application of Upper Echelon Theory. *Journal of Enterprise Information Management*, 22 (1/2), 183--196

Creeger, M. (2009). CTO Roundtable: Cloud Computing. *Communications of the ACM*, 52 (8), 51-56.

Dijkstra, R. (2011). Cloud Computing-A Disruptive New Business Model. Last retrieved on November 30, 2016 from http://cloud-computing-economics.com/business-benefits-applications/cloud-computing-disruptive-business-model/.

Etro, F. (2009). The Economic Impact of Cloud Computing On Business Creation, Employment and Output in Europe. *Review of Business and Economics*, 54 (2), 179-208.

Foster, I., Zhao, Y., Raicu, I., & Lu, S. (2008). Cloud Computing and Grid Computing 360-Degree Compared. In Grid Computing Environments Workshop, GCE'08, 1-10.

Furht, B. (2010). Cloud Computing Fundamentals. *Handbook of Cloud Computing*, 3-19, USA, Springer.

Furner, C. P. (2013). Getting Heads into the Cloud: Pre-Adoption Beliefs and Attitudes Regarding a Cloud-Based Platform Shift at a Public University. *Journal of International Technology and Information Management*, 22 (3), 1 – 18.

Ganesan, N. (2013). Migration of an E-Learning Model to the Cloud. *Journal of International Technology and Information Management*, 22 (3), 19 – 36.

Ghalimi, I. C. (2010). Benefits of Cloud Computing. An Intalio White Paper, Palo Alto, CA, Intalio, Inc. Last retrieved on December 1, 2016 from https://www.scribd.com/document/65379756/Benefits-of-Cloud-Computing

Herbert, L. (2011). The SaaS Market Hits Mainstream: Adoption Highlights 2011, Forester. Last retrieved on November 29, 2016 from https://www.forrester.com/report/The+SaaS+Market+Hits+Mainstream+Adoption+Highlights+2011/-/E-RES59147.

Huberty, C. J., & Morris, J. D. (1989). Multivariate Analysis versus Multiple Univariate Analyses. *Psychological Bulletin,* 105.2: 302.

IBM (2009). The Benefits of Cloud Computing. Last retrieved on November 29, 2016 from http://www.ibm.com/ibm/files/H300444G23392G14/13Benefits_of_Cloud_Computing_634KB.pdf.

IBM (2011). IBM Perspective on Cloud Computing. Last retrieved on November 29, 2016 from ftp://ftp.software.ibm.com/software/tivoli/brochures/IBM_Perspective_on_Cloud_Computing.pdf.

Jadhwani, P., Mackinnon, J., & Elrefal, M. (2009). Cloud Computing - Building a Framework for Successful Transition‖, GTSI, Northern Virginia.

Jones, T. M. (2008). Cloud computing with Linux. Last retrieved on November 29, 2016 from http://www.ibm.com/developerworks/library/l-cloud-computing/.

Kepes, B. (2011) Cloudonomics: The Economics of Cloud Computing, Rackspace Hosting, San Antonio, TX.

Klems, M. (2008). Merrill Lynch Estimates Cloud Computing To Be $ 100 Billion Market, Cloud Expo: Article. Last retrieved on November 29, 2016 from http://web2.sys-con.com/node/604936.

Kourik, J. L. (2011). For Small and Medium Size Enterprises (SME) Deliberating Cloud Computing: A Proposed Approach. *Proceedings of the European Computing Conference*, 28-30.

Lavrakas, P. J. (2008). Encyclopedia of Survey Research Methods. SAGE Publications.

Li, H., Sedayao, J., Hahn-Steichen, J., Jimison, E., Spence, C., & Chahal, S. (2009). Developing an Enterprise Cloud Computing Strategy. Last retrieved on November 30, 2016 from https://www.researchgate.net/publication/263658917_Developing_an_Enterprise_Cloud_ Computing_Strategy.

Lin, Y. (2010). Report of Survey on The Status and Needs of the Information Technology Industry in 2010. Taipei: Ministry of Economic Affairs.

Lyons, C. (2009). The Urban Cloud: The Feasibility of using a Cloud Computing Infrastructure for Urban Traffic Control Systems, Master Dissertation, University of Dublin. Last retrieved on November 30, 2016 from https://www.cs.tcd.ie/publications/tech-reports/reports.09/TCD-CS-2009-50.pdf.

Mell, P., & Grance, T. (2011). The NIST Definition of Cloud Computing, *National Institute of Standards and Technology*. Last retrieved on November 29, 2016 from http://nvlpubs.nist.gov/nistpubs/Legacy/SP/nistspecialpublication800-145.pdf.

Miller, M. (2009). Cloud Computing: Web-based Applications that Change the Way You Work and Collaborate Online. Indianapolis, IN, Que Publisher.

Perez, C. (2002). Technological Revolutions and Financial Capital. Cheltenham, UK, Edward Elgar.

Perry, R., Hatcher, E., Mahowald, R. P., & Hendrick, S. D. (2009). Force.com Cloud Platform Drives Huge Time to Market and Cost Savings. Last retrieved on November 29, 2016 from http://www.salesforce.com/events/docs/IDC_Force_ROI_Study_Sept2009.pdf

Porter, M. E. (1985). *Competitive Advantage: Creating and Sustaining Superior Performance*. New York, NY: The Free Press.

Rimal, B. P., Choi, E., & Lumb, I. (2009). A Taxonomy and Survey of Cloud Computing Systems. In INC, IMS and IDC, 2009. NCM'09. *Fifth International Joint Conference* on (44- 51). IEEE.

Singer, G. (2010). How Cloudy Are You? Last retrieved on November 29, 2016 from http://cloud-computing-economics.com/what-is-definitions/how-cloudy-are-you/

Sommer, T., & Subramanian, R. (2013). Implementing Cloud Computing in Small and Mid-Market Life-Sciences: A Mixed-Method Study. *Journal of International Technology and Information Management*, 22 (3), 55-76.

Srinivasa Rao, V., & Nageswara Rao, N. K. (2009). E Kusuma Kumari, Cloud Computing: An Overview, *Journal of Theoretical and Applied Information Technology*, 9 (1), 71-76.

Srinivasan, S. (2013). Is Security Realistic in Cloud Computing? *Journal of International Technology and Information Management*, 22 (4), 47-76.

Tabachnik, B. G., & Fidell, L. S. (2001). *Using Multivariate Statistics* Boston, MA: Allyn & Bacon, Incorporated

Thong, J. Y. (1999). An Integrated Model of Information Systems Adoption in Small Businesses. *Journal of Management Information Systems*, 15 (4), 187-214.

Thong, J. Y., & Yap, C. S. (1995). CEO Characteristics, Organizational Characteristics and Information Technology Adoption in Small Businesses. *Omega*, 23 (4), 429-442.

Tsai, W. T., Sun, X., & Balasooriya, J. (2010). Service-Oriented Cloud Computing Architecture. *Information Technology: New Generations (ITNG), 2010 Seventh International Conference*, 684-689.

Vaquero, L. M, Rodero-Merino, L., Caceres, J., & Lindner, M. (2008). A Break in the Clouds: Towards a Cloud Definition. *ACM SIGCOMM Computer Communication*, 39 (1), 50-55.

Voas, J., & Zhang, J. (2009). Cloud Computing: New Wine or Just a New Bottle. *IT Professional* 11(2), 15-17.

Vouk, M. A. (2008). Cloud Computing -. Issues, Research and Implementations. *Journal of Computing and Information Technology - CIT*, 16 (4), 235-246.

Wang, L., Tao, J., Kunze, M., Castellans, A. C., Kramer, D., & Karl, W. (2008). Scientific Cloud Computing: Early Definition and Experience. *The 10th IEEE International Conference on High Performance Computing and Communications*, Vol. 8, 825 -830.

Werfs, M., Baxter, G., Allison, I. K., & Sommerville, I. (2013). Migrating Software Products to the Cloud: An Adaptive STS Perspective. *Journal of International Technology and Information Management*, 22 (3), 37-54.

Whitley, E. A., Willcocks, L. P., & Venters, W. (2013). Privacy and Security in the Cloud: A Review of Guidance and Responses. *Journal of International Technology and Information Management*, 22(3), 75-92.

Yang, H., & Tate, M. (2012). A Descriptive Literature Review and Classification of Cloud Computing Research. *The Communication of Association for Information Systems*, 31, Article 2, 35-60.

Yao, J. D., Liu, C., Xu, X., & Lu, J. (2002). Organizational Size: A Significant Predictor of IT - Innovation Adoption. *Journal of Computer Information Systems*, 43(2), 76-82.

Zhou, Q., & Lin, H. (1997). Computer Networks and Communication Survey, China Communication Association 97 Annual Conference and seminar papers, Taipei.

Zhu, et al. (eds.), (2010). The Wisdom of Cloud Computing: The Cornerstone of Future Achievement of Things (first edition), Taipei: Boshuo Culture.

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APPENDIX

The Questionnaire

Part I: THE BASICS

1. What business is your company in?

□ Banking	□ Medical/Cosmetic/Healthcare
□ Construction	□ Information & Communication Technology
□ Wholesaler	□ Education, including regular and continuing
□ Financial Management	□ Insurance
□ Utilities	□ Recreation/entertainment
□ Legal/Intellectual property	□ Retailing
□ Manufacturing	□ Biotechnology
□ Transportation	□ Real Estate
□ Business Services	□ Food warehousing/storage
□ Optoelectronics Technology	□ Others

2. What is the number of employees in your company?
□ 10 people or less   □ 11-50 people   □ 51-200 people   □ 200 or more

3. Which type of cloud computing does your company mainly use? (Choose the most applicable one only)
□ Software as a Service (SaaS): Providing application software or computer programs as services via the Internet. Based on their actual needs, users pay for the service amount and time.
□ Platform as a Service (PaaS): Users can deploy applications and use programming languages. Also, they can configure the application environment.
□ Infrastructure as a Service (IaaS): Standardize the operation, storage and network resources as services so that internal and external users can access.

4. Which category of value-chain activities does your company use cloud computing for? (Choose the most applicable one only)
□ Inbound Logistics: Activities related to receiving and storing of raw materials, parts/components and goods. For example: materials handling, warehousing, inventory control, vehicle scheduling, returns.
□ Outbound Logistics: Activities related to storing, handling, distributing and shipping finished goods. For example: warehousing, materials handling, delivery vehicle scheduling, order fulfillment, and scheduling.
□ Operations: Activities that transform raw materials/parts into finished goods or place products on shelf for sale. For example: processing, packaging, assembly, maintenance, testing, printing, and other factory jobs.
□ Marketing and Sales: Activities related to marketing, sales and promotion of products. For example: advertising, promoting, sales representatives, quoting, placing, and pricing.

- □ Service: Activities related to after-sales service and maintenance or enhancement of product values. For example: call center, product installation, repair, training, spare parts supply and product recall.
- □ Procurement: Activities related to purchases used in all of activities of the value chain, including the purchase of production and procurement of raw materials, research and development and other settings; additionally also contain materials management role.
- □ Human Resource: Activities related to recruitment, hiring, training, professional development and remuneration.
- □ Technological development: Activities related to development of new techniques, new products, quality improvement, simulation, design, patent research, and materials evaluation.
- □ Company infrastructure: Activities related to those supporting the running of the business, such as general management, planning, finance, accounting, legal, government relations, quality management, and information management.

Part II: ASSESSMENT OF BUSINESS BENEFIT OF CLOUD COMPUTING

Please assess changes in performance in the following aspects between after adopting cloud computing and before (i.e. traditional on-premise computing).

	After adopting cloud computing, compared to that of on-premise in the past,	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
		1	2	3	4	5
01	The initial deployment cost of adding new information technology (new facilities or education and training) is lower.	□	□	□	□	□
02	The total operating cost of IT, including time, manpower and facilities, is lower.	□	□	□	□	□
03	The total maintenance cost of IT, including time, manpower and facilities, is lower.	□	□	□	□	□
04	The expenditure of renewing software, hardware, facilities and techniques is lower.	□	□	□	□	□
05	The operating cost of business (marketing, development, manufacturing, sales, and after-sales services) is lower.	□	□	□	□	□
06	The speed of deploying IT resources becomes faster.	□	□	□	□	□
07	Interoperability between different computing resources (Interoperability) is higher.	□	□	□	□	□

08	The information processing operations is more efficient.	☐	☐	☐	☐	☐
09	The response to customer's demand is more efficient.	☐	☐	☐	☐	☐
10	The need for customization of computing resources is lower.	☐	☐	☐	☐	☐
11	The ability to adjust computing resources is higher when facing growth or declining in business.	☐	☐	☐	☐	☐
12	The business gains more efficient ability to adjust its operations and management.	☐	☐	☐	☐	☐
13	When faced with the downtime of computing resources, the time it takes to resume back to normal or acceptable level is shorter.	☐	☐	☐	☐	☐
14	The ability to share computing resources with business partners is higher.	☐	☐	☐	☐	☐
15	The reliability of computing resources is higher.	☐	☐	☐	☐	☐

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