An Empirical Study of Cloud Maturity Across Industries

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Abstract
The cloud adoption can be regarded as a paragon shift of business transaction, which will accompany with business process reengineering. How do cloud systems be implemented to enhance the business processes across industries? By conducting a empirical survey, this study focuses on the comparison of the cloud adoption across industries in Taiwan. This research project was conducted by two research institutes (i.e. IDC and III). A cloud maturity matrix is composed of four dimensions (i.e., familiarity, process, change management, and performance). Through investigating the cloud maturity of seven industries, including finance, public/education, retail, manufacturing, ICT, healthcare, and transportation, the contributions of this work are: (1) to compare the status quo of cloud adoption across industries, (2) to understand the possible factors of difference toward industrial cloud adoption, and (3) to discuss the strategy foci for industries. A cluster-random sampling method was utilized to chosen 724 qualified firms from the IDC survey database. One hundred and seventy one valid response were received. The findings reveal that the significant different across industries in cloud maturity. Both public/education and healthcare reveal highest cloud maturity. The public/education industry is more mature in familiarity, process, and change management. The ICT industry performs better in change management, while the healthcare industry shows higher performance. The findings provide valuable insights for managers and policy makers to develop effective cloud development policies and procedures.

Keywords: Cloud Computing, System Adoption, Cloud Maturity, Industrial Survey.

Introduction

With the evolution of information and communication technologies, cloud computing has been regarded as a new paradigm for hosting IT infrastructure (Zhang et al., 2010). Cloud computing is a virtualized resource pooling technology which can be accessed through network and has several conspicuous characteristics for managers, such as on-demand delivery, elasticity, and measured service (Vaquero et al, 2009). According to IDC's forecast, with 27% growth rate, the worldwide public cloud services spending will over $55 billion in 2014 (IDC, 2010). The concept of network-based, on-demand software delivery model was introduced since late 1990s, which was named as Application Service Provider (ASP) (Smith and Kumar, 2004). However, cloud computing provides a more mature environment for Software-as-a-Service (SaaS) which offers web-based applications as well as supports service-oriented multi-tenancy under a shared IT infrastructure (Benlian et al., 2009; Weiss, 2007).

Companies need to adjust business processes, organizational procedures, and even organizational structure to leverage their ICT investments. Cloud-based systems adoption infers organizations should partially or fully replace their incumbent system landscapes toward cloud environment. Moving legacy systems into a public cloud implies that firms may take the risk of running critical business transactions under the control of external providers. To construct a private or hybrid cloud also has a myriad of technical and organizational difficulties. Although could-based systems demonstrate several charming change forces, organizations may be shackled to existing systems by the inertia, such as the investment and embeddedness of existing systems (Furneaux and Wade, 2011). The research purpose of this study is to find the status quo of cloud adoption across industries.

The cloud adoption can be regarded as a paragon shift of business transaction, which will accompany with business process reengineering. How do cloud systems be implemented to enhance the transaction processes across industries? By conducting a empirical survey, this study focuses on the comparison of the cloud adoption across industries in Taiwan. This research project was conducted by two research institutes (i.e. IDC and III). Through investigating the cloud maturity of seven industries, the contributions of this work are: (1) to compare the status quo of cloud adoption across industries, (2) to understand the possible factors of difference in cloud adoption, and (3) to discuss the strategy foci for industries.
This paper is organized as follows. In the next section, we present the theoretical background and review the theory of system adoption. The research procedure of this work is described in the third section. Then, the progress of e-invoice policies, the evolution of e-invoice platform, and the strategic shift are presented in the fourth section. In the discussion and conclusions section, the implications for academy and management will be discussed.

Research Background

The development of cloud computing

Building on the existing techniques including virtualization, distributed computing, utility computing, and networking techniques, individual and organizational users can lease computing resources through network with the pay-as-you-go pricing model (Weinhardt et al., 2009). According to the definition of National Institute of Standards and Technology (NIST),

cloud computing refers to a network-accessed computing resources pooling, including network, storage, application, and other computing service (Mell & Grance, 2011). The service models of cloud computing can be distinguished into Software as a Service (SaaS), Platform as a Service (PaaS), and Infrastructure as a Service (IaaS), which have five essential characteristics, including on-demand self-service, broad network access, resource pooling, rapid elasticity, and measured service.

The governments around the world have regarded cloud computing as an important IT infrastructure for the development of a country (Chandrasekaran & Kapoor, 2010). The US proposed the Federal Cloud Computing Initiative (FCCI) in 2009 and also initiated several projects for enhancing the cloud implementation of federal institutions. The standards proposed by NIST also become the foundation for cloud computing development. The UK government initiated the Digital Britain Project in 2009 and constructed a platform (i.e., CloudStore) of cloud service procurement for the public sectors, which now has 257 providers and more than 1,700 services. About 50% of the ICT expenditure of UK government in 2011, about 0.9 billion in GBP, was enabled by CloudStore. As to asia counties, Singapore announced the iN2015 (Intelligent Nation 2015) in 2006. Chia's 12th Five-Year Plan had listed cloud computing as one of the seven strategic emerging industries. Japan approved the Digital Japan Creation Project in 2009 to establish cloud-based ICT infrastructure for sharing resources and increasing efficiency. To improve the service quality of public sectors, South Korea implemented cloud-based IT environment and deployed a government cloud computing platform in 2011. Table 1 presents the strategic foci of worldwide governments.

Table 1. Summary of the cloud computing strategies of worldwide government

Strategic Foci	Country (Time-Initiated)						
	US (2009)	UK (2009)	AU (2011)	CN (2010)	SIN (2006)	JA (2009)	SK (2009)
Standard Development	✓	✓	✓	✓		✓	
Industrial Development		✓	✓			✓	✓
Techniques Development	✓					✓	✓
Setting Regulations				✓			
Common Procurement	✓	✓	✓				
Open Data	✓			✓	✓	✓	
Big Data	✓		✓		✓		
Proof of Concepts				✓	✓		✓

Note: US = United Stated; UK = United Kingdom; AU = Australia; CN = China; SIN = Singapore; JA = Japan; SK = South Korea

The Taiwan government had listed cloud computing as the important developing industry and initiated the Cloud Computing Development Project in early 2009. Through 15 cloud-related application projects, cloud computing provides transformation opportunities for ICT firms in Taiwan. Furthermore, an evaluation policy for the government cloud computing project is provided, for "Value to citizens" and "Economy to the industry" as the planning and implementation target guidelines. After three years of effort, by the end of 2012, the Cloud Computing Development Project has been revised to become the Cloud Computing Application and Development Project. The main purposes are to accommodate the diversity of domestic demand and technological competition from international industries. The cloud applications by the government shall be transparent to the general public and shall lead the way for the cloud computing industry's development in Taiwan.

The Cloud Open Platform is offered as a supply-demand channel in between governmental agencies and the hardware/software vendors in cloud computing applications.

With the cloud computing development in Taiwan, it provides opportunities of exploring new markets for vendors including cloud server, storage, terminal device, and other cloud solutions. The experience of ICT manufacturing also provides foundations for becoming cloud service providers (Fan et al., 2013). The government and firms continuously infuse resources for developing cloud-based techniques and solutions. The increasing cooperation among firms and research institutions had released some fruitful cloud platforms. The development of cloud industry, environment construction, and the positioning in the international cloud market will increase the needs for cloud-related human resources.

Theoretical foundations for system adoption

Firms are inclined to adopt a innovation which can enable them to address the encountering organizational or technological challenges (Kraatz & Zajac, 1996). There are various theoretical perspectives have been proposed to provide complementary viewpoints on the IT innovation adoption (Lee & Xia, 2006). The common theoretical perspectives are diffusion of innovation theory (DOI), technology-organization-environment (TOE) framework, institutional theory, resource-based view (RBV), and transaction cost economics (TCE). In the following section, we briefly introduce the essence and arguments of each theoretical foundation as well as provide the findings on system adoption.

The diffusion of innovation (DOI) theory is introduced to explain the process of a new idea or technology spread out in a social system. An innovation is communicated, over time, among the members of a social system through particular channels (Rogers, 2003). Tornatzky and Fleischer (1990) argue that the contextual factors of adopting an IT innovation are threefold, including technological context, organizational context, and external environment context. Institutional theory examines why firms tend to react to comply with institutional legitimacy (Liang et al., 2007). The basic argument of resource-based view (RBV) is that the heterogeneous resources of firms enable them to compete against with others (Barney, 1991; Wernerfelt, 1984). That is, in RBV, an organization is viewed as a bundle of resources and capabilities. The adoption of IT can help to reduce the transaction costs. For example, with SCM system or EDI, the coordination between business partners can be enhanced as well as enable the business integration (Subramani, 2004). The following section will further develop the theoretical concepts of the status quo bias theory.

Research Method

The research was conducted through two research institutes, including IDC and III. Following the worldwide methodology, this study adopted the instrument of cloud maturity form IDC. Cloud maturity is composed by four main sub-concepts, including familiarity, process, change management, and performance. The survey was conduct during October 2014. The IDC survey database was chosen as our sample frame. In order to compare the difference across industries, a cluster-random sampling method was conducted. 724 qualified firms from seven industries were chosen as target respondents. Informants should know about the organizational IT utilization and deployment. One hundred and seventy one valid responses were received within a month, with a response rate of 23.6%. The respondents reveal a wide spectrum of industry types (see Table 2).

Data Analysis

By conducting several ANOVA tests, the results suggest that the significant difference across industries in cloud maturity, especially in familiarity and performance. The findings also suggest that different IT resources can influence the familiarity and performance of cloud adoption. Large companies have better change management of cloud adoption. Public sector and Healthcare reveal the highest maturity of cloud adoption. However, ICT industry reveals well change management during adopting cloud computing. The findings also suggest that Healthcare provide better performance after adopting cloud systems. The findings are shown in Table 2.

Table 2. Summary of the cloud computing strategies of worldwide government

Industry		Familiarity		Process		Change Management.		Performance		Cloud Maturity	
	N	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Finance	20	2.84	0.54	2.78	0.75	2.63	0.63	2.07	0.60	2.58	0.32
Public	20	3.19	0.50	2.87	0.68	2.85	0.60	2.39	0.52	2.82	0.39
Retail	55	2.90	0.63	2.72	0.72	2.77	0.65	2.31	0.59	2.67	0.36
Manufacturing	41	2.77	0.48	2.74	0.73	2.74	0.62	2.00	0.51	2.56	0.39
ICT	11	2.86	0.65	2.79	0.62	2.85	0.40	2.31	0.62	2.70	0.28
Healthcare	12	3.16	0.72	2.72	0.68	2.83	0.75	2.57	0.50	2.82	0.45
Transportation	12	2.64	0.58	2.75	0.71	2.50	0.56	2.12	0.47	2.50	0.36
Total	171	2.89	0.59	2.75	0.70	2.75	0.62	2.22	0.57	2.65	0.38
$F_{industry}$		2.07		0.13		0.62		2.82		2.06	
		0.06		0.99		0.72		0.01		0.06	
$F_{IT\ Employee}$		3.29		0.43		1.79		2.25		1.51	
		0.01		0.83		0.12		0.05		0.19	
$F_{Organizational\ Size}$		1.49		0.21		2.07		1.03		1.23	
		0.19		0.97		0.06		0.41		0.30	

Discussion and Conclusions

System adoption often accompanies with the adjustment organizational processes and structures. Cloud computing adoption refers to partially or fully replace current system with a cloud-based landscape. Our survey revealed the current status quo of cloud adoption across industries. The findings provide a foundation to understand the difference of cloud adoption among different industries. The status quo bias will exert its effects through commitment to environmental pressures and cost-benefit assessment by using incumbent systems as the anchor. Institutional pressures have profound effects on an organization's reaction to external competition without mindfulness thinking. Institutional forces enable to reinforce the legitimacy of norms and practices toward adopting cloud ERP as new IT hosting paradigm. As to evaluate possible risk of cloud adoption, rational decision making is remarkable aspect of three status quo bias sources. In comparison with in-house, on-promise system, cloud computing provides benefits like scalability, pay-per-use, and no up-front investments. However, it also accompanies transition and uncertainty costs, such as data security and service reliability. According to our findings, switching benefits can diminish the perceived risk while switching costs lead organization to remain current situation by enlarging risk perception.

Future research directions

Our finding can provide some implications for IT and business managers. First, the findings reveal the importance of considering possible status quo bias in cloud adoption decision making. As to vendors, in order to provide suitable cloud-based solution, they should take the firms' incumbent situation into consideration. Second, organizational managers can use cost-benefit analysis and emphasize possible gains of adoption, in contrast with existing system, to decrease possible resistance reaction. Third, cloud computing vendors can promote their application by cooperate with some leading firms. By construct breakthrough success stories, both vender and adopters can reap what they have sowed.

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