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Examining cloud computing adoption intention, pricing mechanism, and deployment model

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ABSTRACT

Cloud computing is a new information technology (IT) paradigm that promises to revolutionize traditional IT delivery through reduced costs, greater elasticity, and ubiquitous access. On the surface, adopting cloud computing requires a firm to address many of the same concerns they face in adopting any enterprise IT. However, cloud technologies also offer new pricing and deployment strategies that are unavailable in traditional enterprise solutions. It is unclear how previous research frameworks of enterprise IT adoption relate to these new adoption strategies. To bridge this gap in the literature, our study uses the technology–organization–environment (TOE) framework of innovation diffusion theory to develop a cloud service adoption model that deals with not only adoption intention, but also pricing mechanisms and deployment models. Our research model has been empirically tested using 200 Taiwanese firms. We found that: (1) Cloud adoption is still at its initial stage, since the adoption rates are very low; (2) the perceived benefits, business concerns, and IT capability within the TOE framework are significant determinants of cloud computing adoption, while external pressure is not; (3) firms with greater IT capability tend to choose the pay-as-you-go pricing mechanism; (4) business concern is the most important factor influencing the choice of deployment model, with higher concerns leading to private deployment options.

1. Introduction

With the advance of computer science and the introduction of the Internet, cloud computing has developed from abstract laboratory sketches into a concrete business paradigm (Armbrust et al., 2010). According to the National Institute of Standards and Technology (NIST), Cloud Computing is defined 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, 2009). Cloud computing enables customers to rent IT infrastructure, platform, and software services in the cloud when needed (Buyya, Yeo, Venugopal, Broberg, & Brandic, 2009; Dikaiakos, Katsaros, Mehra, Pallis, & Vakali, 2009). Thus, cloud clients can deploy their business applications, store data, and run analyses via the Internet on a pay-per-use basis (Sultan, 2011).

With the special and unique characteristics listed above, cloud computing revolutionizes traditional IT adoption. In the past, expensive IT innovations were usually adopted first by large firms since only they could afford them. Now, it is believed that cloud computing will benefit small and medium-sized enterprises (SMEs), as well as startups, by "eliminating the up-front commitment," and allowing companies to "pay for use of computing resources on a short-term basis (i.e. pay-as-you-go)" (Armbrust et al., 2010; Hofmann & Woods, 2010; Sultan, 2011). Despite the attractive benefits presented above, misgivings about cloud computing remain. A variety of issues, such as "security," "confidentiality," "performance instability," "latency," and "network bottleneck," need to be considered when choosing a cloud computing solution (Hofmann & Woods, 2010; Sultan, 2011; Chang, 2013). With the pros and cons listed above, cloud computing is a somewhat double-edged sword – it is never easy for corporate executives to decide whether they should move their original IT systems onto the cloud. Thus, a thorough investigation on the issue of cloud adoption has been called for by many scholars and practitioners (Armbrust et al., 2010; Marston, Li, Bandyopadhyay, Zhang, & Ghalsasi, 2011).

Our study investigating cloud adoption not only responds to this call but also has its uniqueness since cloud computing is

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not merely another enterprise IT adoption issue. Cloud computing has some characteristics that are very different from traditional IT innovations, such as its customer targets (small and medium firms), its pricing mechanism (pay-as-you-go), and its deployment models (public/private), which have seldom been analyzed in previous adoption studies (Böhm, Leimeister, Riedl, & Krcmar, 2011; Kakumanu & Portanova, 2006; Qu, Pinsoneault, & Oh, 2011). When considering enterprise adoption, the most important distinction of cloud technology is that it offers a larger array of adoption strategies than many previous enterprise solutions (such as ERP, SCM, and CRM). Firms can fully or partially host cloud technologies and can distribute costs via different pricing mechanisms. Put another way, cloud technologies offer more than a binary adoption proposition: Firms can adopt cloud at different levels of commitment by choosing different adoption modalities (pricing and deployment). This is very different from previous enterprise IT adoption.

Consequently, our paper's objective is to advance the enterprise IT adoption literature by exploring this multi-modal approach to viewing adoption. We will empirically examine the determinants of cloud adoption through the lens of Technology–Organization–Environment (TOE) framework, which has been extensively used to explain enterprise IT adoption, and ask whether it can appropriately explain not only adoption decisions but also the modalities of adoption (pricing and deployment) offered by cloud platforms. Thus, we could understand what factors can influence companies' preferred pricing mechanism when choosing/considering cloud services from adopters' point of view and what factors will influence companies choice of cloud deployment models (public/private).

2. Theoretical foundation

2.1. Previous studies on cloud adoption

Since cloud computing is a new business model and a trend that involves next-generation application architecture, most existing cloud studies are exploratory, descriptive, or case-based research. For example, studies from Buyya et al. (2009), Sultan (2011), and Marston et al. (2011) focus on the general concepualization and definition of cloud computing, and further discuss some practical issues such as resource management strategy of cloud computing. Furthermore, many previous studies on cloud adoption rely on case study method to qualitatively investigate cloud's benefits and concerns (e.g. Alshamaila, Papagiannidis, & Li, 2013; Brender & Markov, 2013; Lin & Chen, 2012; Wang & He, 2014), hypothetically calculate cloud's benefits based on cloud vendors' price-lists (e.g. Buyya et al., 2009; Khajeh-Hosseine et al.), or propose frameworks to help firms achieve cloud design, deployment and services (e.g. Chang, Walters, & Wills, 2013). While the extant literature provides a fundamental understanding of cloud computing, empirical studies that rigorously examine the proposed factors that might affect the adoption of cloud computing is needed (Lin & Chen, 2012; Low, Chen, & Wu, 2011). Though some previous studies have used survey data to quantitatively exam cloud adoption issue (e.g. Garrison, Kim, & Wakefield, 2012; Gupta, Seetharaman, & Raj, 2013; Lee, Chae, & Cho, 2013; Lian, Yen, & Wang, 2014; Wu, Cegielski, Hazen, & Hall, 2013), they mostly focus on a binary cloud adoption proposition. Our study, instead, intends to explain not only the adoption decisions but also the modalities of adoption (pricing and deployment) offered by cloud platforms. Moreover, we found that many of the previous cloud adoption studies do not have a grounded theory to guide their research, and our study will empirically examine the determinants of cloud adoption based on Technology–Organization–Environment (TOE) framework, a rigorous foundation applied by many innovation adoption studies. In Appendix A, we summarize these representative prior cloud adoption studies.

2.2. Technology–organization–environment framework

Diffusion of Innovation theory (DOI) (Rogers, 1995) is a fundamental approach to investigating how a new technology diffuses. DOI theory is concerned with the way that a new technological innovation, progresses from creation to use. It describes the patterns of adoption, explains the mechanism of diffusion, and assists in predicting whether and how a new invention will be successful. Rogers' diffusion of innovation theory posits two categories of factors that influence a firm's adoption of innovations: Innovation Characteristics and Organizational Characteristics. Factors within the Innovation Characteristics category are the "perceived attributes of the innovation" that either encourage or inhibit innovation use. Rogers indicated that five attributes of an innovation (i.e. relative advantage, compatibility, complexity, trialability, and observability) can explain 49–87% of the variance in rate of adoption. While the "Innovation Characteristics" explain a portion of the innovation diffusion, these results are primarily based on studies at the individual decision-making level (Chwelos, Benbasat, & Dexter, 2001). When considering the diffusion of an innovation used at the organizational level, Rogers reported that several Organizational characteristics influence the adoption of innovations, such as centralization, size, slack, formalization and interconnectedness.

Although Rogers' diffusion of innovation theory appears to be most applicable to investigate innovation use, researchers still keep searching other contexts influencing organizational innovativeness and combine them with Rogers' diffusion of innovation theory to provide richer and potentially more explanatory models (Prescott, 1995). Similar to Rogers' framework, Tornatzky and Fleischer (1990) build a framework including three categories – Technology, Organization and Environment (TOE) – to explain a firm's technological innovation decision making behavior. The technological context describes the characteristics of the technologies that will influence decisions about IT adoption, such as technology readiness, perceived benefits, and concerns about the technology. Organizational context addresses the traits and characteristics of the organization that will also influence IT adoption decisions, such as human resources, financial slack and organization size.

While the Technology and Organization categories are parallel to the two categories in Rogers' model, Tornatazky and Fleisher added a new and important component – Environmental context. The Environment context is the arena in which a firm conducts its business – its industry, competitors, and dealings with government. The environment presents both constraints and opportunities for technological innovation. The TOE framework makes Rogers' innovation diffusion theory more complete in explaining innovation diffusion at the firm level. Furthermore, the TOE framework has been used to examine various technology adoption issues, in order to distinguish adopters from non-adopters. Zhu, Kraemer, and Xu (2006) empirically examined seven TOE factors (i.e. technology readiness, technology integration, firm size, global scope, managerial obstacles, competition intensity, and regulatory environment) that have strong influence on three different stages of e-Business assimilation at the firm level. Kuan and Chau (2001) reported that perceived direct benefits in a technology context; perceived financial cost and perceived technical competence in an organizational context; and perceived industry and governmental pressure in an environmental context have significant influence on EDI adoption in small businesses. Pan and Jang (2008) applied the TOE framework to examine the relationship and influence of ERP adoption in Taiwan's communications firms with the results indicating that technology readiness, size, perceived barriers, and production and