CLOUD COMPUTING DEPLOYMENT AS A DUAL DECISION OF DISCONTINUANCE AND ADOPTION

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Abstract

In recent years, many organizations have been confronted with cloud computing deployment decisions. One critical decision is to balance between discontinuation of in-house systems and adoption of cloud computing systems. Previous researchers usually investigated the determinants that influence cloud adoption only from a new IT adoption perspective. However, when a firm makes its decision to replace or upgrade the existing IS structure, it needs to consider two things at the same time: whether the existing system may fit future development and whether the new system could meet the organization's requirements. This research seeks to alleviate this research gap by investigating cloud deployment behaviour within an organization from the perspectives of both existing structure discontinuance and new technology adoption intentions. To provide new insights into the cloud computing decisions and the existing adoption theory, a number of hypotheses are developed based on the TOE framework, Upper Echelon Theory, and the IS discontinuance literature. A survey will be conducted to collect data and test the proposed hypotheses. The findings of this research are expected to offer a deeper understanding of transformation from in-house systems to cloud computing systems.

Keywords: Cloud structure, TOE framework, Upper Echelon Theory, Organizational ambidexterity, Deployment decision making

1 INTRODUCTION

Cloud computing refers to a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources that can be provisioned and released with minimal management effort or service provider interaction (Mell et al. 2009). Cloud computing, a successful paradigm of service-oriented computing, has revolutionized the way that computing infrastructure is abstracted and used. Fifty years ago, we had to adopt time-sharing servers because of limited computing resources (Wang et al. 2010a). Nowadays, cloud computing is popular due to the need to build complex IT infrastructures. The emergence of large data centres and cluster computers has created a new business model, where users can rent storage and computing capacity instead of making the large capital investments to construct and provision large-scale computer installations (Bryant et al. 2008).

There's no doubt that cloud computing has numerous benefits, which have won high praise in the past few years. Many companies start or expand their businesses smoothly through the cloud, but some companies are still reluctant to adopt cloud service. Some companies have changed from cloud-based back to in-house business services. (e.g., MemSQL Inc.). Cloud computing is not simply about a technological improvement of data centres; it is a fundamental change in how IT is provisioned and used (Creeger 2009). When a firm makes its decision to replace parts of their existing IT structure, it usually considers two things: whether the existing system may fit future development and whether the new system could meet their requirements.

This research seeks to investigate the cloud structure replacement decision behaviour within an organization from the perspectives of both existing structure discontinuance and new technology adoption intentions. In particular, this research expands the concept of organizational ambidexterity in information technology adoption.

2 RESEARCH BACKGROUND

The new opportunities associated with the emergence of cloud computing services, as well as the challenges and risks (Benlian et al. 2010), are receiving widespread attention among information systems (IS) scholars. Cloud computing is seen as a shift in emphasis to service (Iyer et al. 2010). From this perspective, the cloud enables creative use of technology for business purposes in a simple and efficient manner. Misra and Mondal (2011) tried to broaden this outlook with a model that helps identify the suitability of a company for cloud computing and seeks to give a certain profitability valuation of the benefits associated with cloud computing. Literature has revealed that various factors affect cloud adoption. In particular, the work of Haag and Eckhardt (2014) shows empirical studies on organizational cloud service adoption have explored factors that directly or indirectly drive organizations to adopt or inhibit them from adopting cloud services from different perspectives and dimensions. These factors can be classified into technological, organizational, or environmental contexts. Thus, it is feasible to apply the technology-organization-environment (TOE) framework to explore the cloud computing adoption issue (Low et al. 2011). The model links these three contexts to an organization's strategic choice of cloud computing services (Li et al. 2012).

The TOE framework (Tornatzky and Fleischer 1990) helps explain the innovation adoption. It has been extensively used in the information systems (IS) field, for example, to examine the adoption of open systems (Chau et al. 1997) and e-business (Zhu et al. 2005). The cloud deployment characteristics in each context could be measured. However, the challenge occurs when making a decision about whether cloud computing would be appropriate for an organization with an existing functional system structure. The organization has to choose to either invest in its own resources or to make changes based on the consideration of its environmental situation (Low et al. 2011).

IT adoption has been a traditional research stream in IS. Most research focuses on examining the effect of contextual factors on the adoption of information technologies (Dwivedi et al. 2010). The findings of extant research show that the characteristics of senior managers have significant impact on

the decision to employ IT (Caldeira et al. 2002; Harrison et al. 1997). The Upper Echelon Theory (Hambrick et al. 1984) suggests that organizational strategic outcomes and processes are a function of managerial characteristics of top managers. Moreover, studies have shown that the characteristics of a top management team (TMT) can affect the adoption of cloud technologies. For example, Chuang et al. (2009) found that that the compositions of age and education have a positive influence on the extent of IT adoption in SMEs, while the group heterogeneity, specifically ethnicity diversity and gender diversity, of TMTs seems to have a negative relationship with the extent of IT adoption in SMEs.

An organization usually decides to adopt a new technology because the perceived benefits of the new technology are very high and the existing IS discontinuance intention is high. The expectation disconfirmation theory (Oliver 1980) contends that discrepancies between what a user expects from IS and what it delivers in practice determine future use (Bhattacherjee et al. 2004). If the existing information structure cannot support the computing requirements but the cloud can, then organizations may transfer their business into the cloud. Discontinuance decisions can have significant implications for organizational effectiveness and the allocation of resources. Furneaux and his colleagues (2011) have shown that system capability shortcomings, support availability, and technical integration are the three most essential factors that impact discontinuance intentions.

Organizational ambidexterity, as a research paradigm in organization research, refers to the ability of an organization to both explore and exploit to compete technologically. Tushman et al. (1996) proposed that organizational ambidexterity, defined as "the ability to simultaneously pursue both incremental and discontinuous innovation from hosting multiple contradictory structures, processes, and cultures within the same firm," was required for long-term firm survival. One fundamental insight from organization research is that different organizational forms are associated with different strategies and environmental conditions (Lawrence et al. 1967).

In this study, we regard cloud computing as a new emerging technology and consider a new cloud structure as an exploration activity. Using the existing IT system belonging to exploitation, Lubatkin and colleagues (2006) found that the behavioural integration of top management teams facilitates the processing of disparate demands essential to attaining ambidexterity. For companies, the main reason for the top managers' decision to adopt a cloud structure or maintain an existing system is whether the whole IT system could meet their needs. If each of the two systems has its own features, strengths, and specialties, the deployment decision could be made in a combined perspective—by allowing existing techniques and resources to be more fully employed to acquire new capabilities, and also by permitting new computing capabilities and resources to be more fully integrated into the existing pool of competencies.

3 RESEARCH MODEL AND HYPOTHESES

In this research, we articulate that discontinuance and adoption are two qualitatively different phenomena and contend that technology adoption theories provide a valuable, but incomplete, understanding of organizational deployment behaviour. Based on the TOE framework, Upper Echelon Theory, and the work done by Furneaux et al. (2011) and Cao et al. (2009), we develop a research model as shown in Figure 1. In this model, the right side illustrates the perceived adoption motivations for cloud computing structure and the left side details investigating the discontinuance intention of the existing system within an organization using a TOE framework. We plan to measure the deployment decision using three approaches: intention of cloud-computing structure adoption, intention of existing structure discontinuance, and combination of the structural ambidexterity.

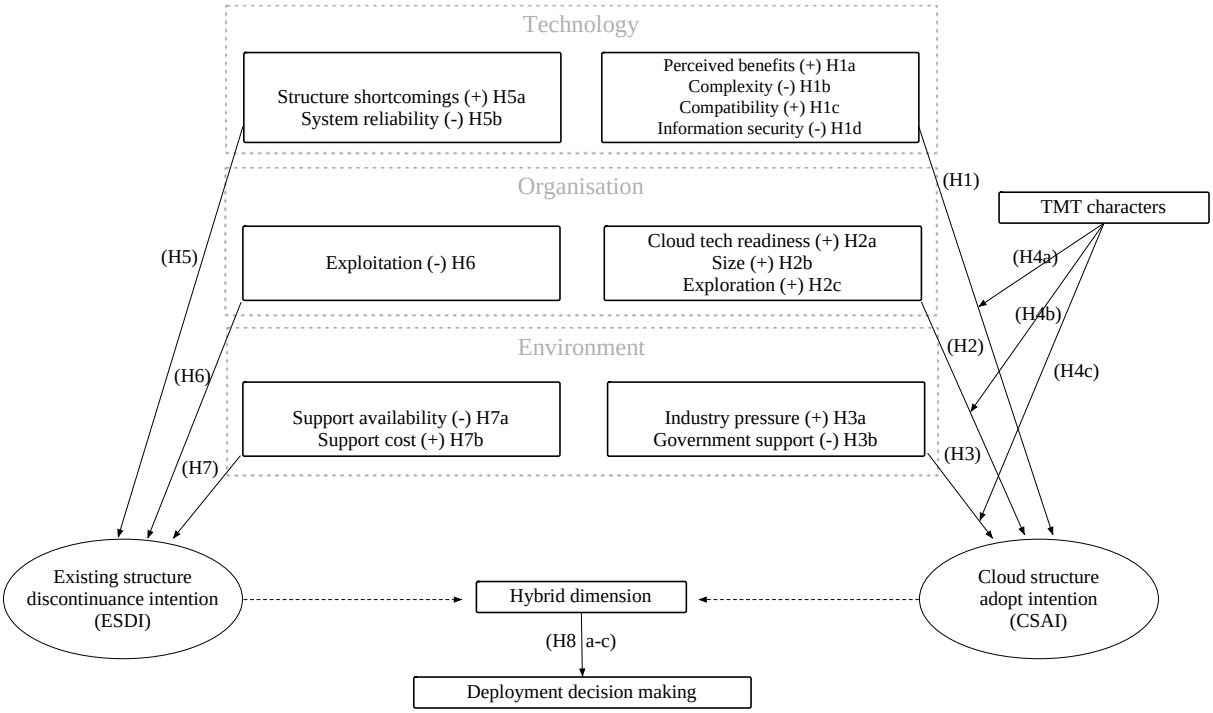

Figure 1. Research model

3.1 Cloud Structure Adoption Intention

3.1.1 Technology Context

Adoption of IT innovations is related to the attributes of the innovations as perceived by potential adopters. Literature has shown that perceived direct benefits were significant in IT adoption (Iacovou et al. 1995). Indirect benefits become insignificant when cloud providers offer positive indirect benefits to IT firms. Therefore, we propose that:

H1a. Perceived benefits will be positively associated with cloud structure adoption intention.

Complexity describes the degree to which an innovation technology is perceived to be difficult to understand and use (Rogers 2010). Higher complexity will lead to higher uncertainty related to a successful implementation (Grover 1993). The integration of cloud computing with a firm's existing IT landscape triggers new enterprise architecture challenges (Borgman et al. 2013). We postulate that:

H1b. Complexity will be negatively correlated with cloud structure adoption intention.

Another essential technology property of cloud computing is compatibility. Compatibility is the degree to which innovation fits with the potential adopter's existing values and needs (Rogers 2010). Compatibility is essential for innovation and technology adoption (Cooper et al. 1990; Wang et al. 2010b). When technology is viewed as significantly incompatible, major adjustments in processes that involve considerable learning are required. Thus, the following hypothesis is proposed:

H1c. Compatibility will be positively correlated with cloud structure adopt intention.

Security issues are a major concern of senior IT managers. The cloud information security touches confidentiality, integrity, and availability (the CIA triad) as Agarwal et al. (2011) and Wooley (2011) mentioned. Potential security risks of cloud computing are unpredictable (Benlian et al. 2011). The lack of mature security protocols and identity management standards implies that organizations will be unwilling to adopt a cloud solution (Oliveira et al. 2014). Thus, we propose that:

H1d. Information security will negatively influence cloud structure adoption intention.

3.1.2 Organizational Context

Organizational size is essential for technology adoption (Kimberly et al. 1981). Some cases showed that larger firms generally possess slack resources which facilitate the implementation and usage of technology (Tornatzky et al. 1990). It is often reported that larger organizations tend to adopt more innovations largely due to their greater flexibility and ability to absorb more risk (Pan et al. 2008).

H2a. Organization size will be positively associated with cloud structure adoption intention.

The technological readiness of organizations influences the adoption of a new technology (Tornatzky et al. 1990). As Low et al. (2011) mentioned, cloud computing services can become part of value chain activities only if firms have the required infrastructure and technical competence. Therefore, firms that have technological readiness are more prepared to adopt cloud services. Thus:

H2b. Technology readiness will be positively correlated with cloud structure adoption intention.

3.1.3 Environmental Context

In many cases, an organization may adopt a new technology due to the influences exerted by its business partners and/or its competitors. Teo et al. (2003) found that pressure from business partners or competitors is an important factor in adoption intention. Borgman et al. (2013) and Low et al. (2011) mentioned that competitive pressure could be essential for cloud adoption. Partner pressure and government support are included in environmental context (Oliveira et al. 2014; Kuan et al. 2001). Thus, industry pressure is used to capture both competitive pressure and partner pressure.

H3a. Industry pressure will be positively associated with cloud structure adoption intention.

Another practical reason for organizations to adopt IT comes from government policies. The ACCA's report (2013) and other's work (e.g., Borgman et al. 2013) show that it is essential that cloud providers and adopters collaborate with regulators and receive government support. We hypothesize that:

H3b. Government support will be positively correlated with cloud structure adoption intention.

3.1.4 Perceived TMT Characteristics

Adoption intention is relevant for top managers, who face great complexity and ambiguity in their tasks. Managers are typically confronted with numerous bits of information that demand attention (Mintzberg 1973). Hambrick and Mason (1984) suggested an unexhausted list of observable managerial characteristics, including age, functional tracks, experience, education, socioeconomic roots, financial position, and group characteristics. Chuang et al. (2009) believed a focus on secondary characteristics would facilitate a more general understanding of IT adoption. Many organizational characteristics turn out to be secondary as well (Downs Jr et al. 1976). We propose that:

H4a-c. In the TOE framework, TMT characteristics will moderate the relationship between the technology/organization/environment and cloud structure adoption intention.

3.2 Existing Structure Discontinuance Intention

Since the adoption of a new system is frequently associated with the discontinuance of an existing system, there would appear to be some basis for expecting models of IS adoption to offer an adequate account of IS discontinuance. As and Wade (2011) determined that continuance can be seen as an extension of acceptance behaviour (Kim et al. 2005) and the discrepancies between user expectations and practice deliverables (Bhattacherjee et al. 2004). Discontinuance decisions can have significant implications for organizational effectiveness and the allocation of resources. We follow the ideas of factors in Furneaux's paper (2011) and add some new organizational contexts.

3.2.1 Structure Shortcomings

Existing structure shortcomings are a limitation in the functionality of an existing information system

structure that undermines its ability to meet organizational needs. It was frequently framed in reference to organizational needs or requirements.

H5a. Existing structure shortcomings are positively associated with existing structure discontinuance intention.

3.2.2 System Reliability

System reliability is defined as the degree to which the existing system can be counted on to perform its intended tasks. A system can be extended for a long time provided that it continues to be reliable. But, if a system is viewed as providing a potential risk, it would become unreliable. Thus:

H5b. System reliability will be negatively correlated with existing structure discontinuance intention.

3.2.3 System Support Availability

System support availability is the availability of the vendor and other supporters that are considered important to the continued use of an existing IS system structure. Continuing to operate an IS structure under conditions of limited support availability is believed to increase potential risk for the organization. Support availability has an impact on the intention to replace a system. Hence:

H7a. Reduced system support availability is associated with increased existing structure discontinuance intention.

3.2.4 System Support Cost

Statistical data and many cases indicate that excessive support costs can lead to an increased interest in replacing an existing system. System support costs are defined as the costs of supporting ongoing operation of an existing information structure within an organization. Our proposed hypothesis is:

H7b. Higher system support costs are associated with increased existing structure discontinuance intention.

3.3 Organizational Ambidexterity in IS-based Organizations

We take exploitation and exploration as two different factors of an organizational context, which could impact incremental and discontinuous IS adoption intention. Some researchers characterized exploration and exploitation as independent activities, such that firms can choose to engage in high levels of both activities at the same time (Gupta et al. 2006). Exploitation activity is more concentrated on improving the organization performance by maximizing the value of the existing system. Exploration activity focuses on discovering a new IS system, such as cloud computing structure. We hypothesize that:

H6. Higher levels of exploitation activity in an organization are associated with reduced existing structure discontinuance intention.
H2c. Higher levels of exploration activity are associated with increased cloud structure adoption intention.

3.4 Deployment Decision-making

According to the National Institute of Standards and Technology, there are four deployment models of cloud computing: public cloud, private cloud, hybrid cloud, and community cloud (Mell et al. 2009). This research focuses on the deployment decision-making within the organization. So we exclude the community cloud. Moreover, in the cases of public and private cloud, an organization may operate all or most of its business in the cloud. Thus, we combine these two deployment models into a cloud-based structure. Therefore, this research studies three deployment structures: cloud-based structure, non-cloud structure, and hybrid structure. Figure 2 illustrates that when both cloud adoption and existing structure discontinuance intention are high, the organization may switch its IT system to the cloud structure. When an organization perceives a high intention of existing structure discontinuance

but a low intention of cloud adoption, it may operate the business based on the existing system. However, when an organization wants to maintain the internal computing resources to meet its basic needs and also wants to utilize public cloud services for external computing capabilities (namely, a low-level intention of existing structure discontinuance and a high-level intention of cloud adoption), it might redeploy the structure into a hybrid approach. Therefore, we hypothesize that:

H8a. When ESDI and CSAI are both high, the organization is more willing to choose cloud-based structure as its deployment decision.
H8b. When ESDI and CSAI are both low, the organization is more willing to choose non-cloud structure as its deployment decision.
H8c. When ESDI is low and CSAI is high, the organization is more willing to choose hybrid structure as its deployment decision.

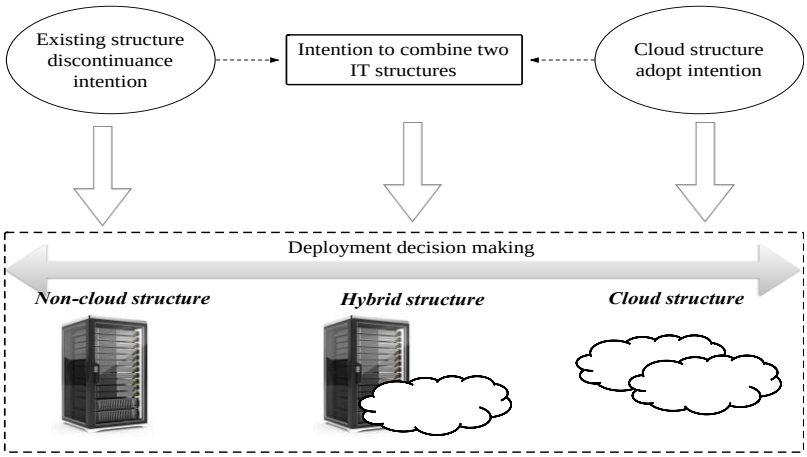

Figure 2. Cloud deployment decision-making

4 RESEARCH METHODOLOGY

A two-stage method paradigm will be undertaken to collect the data and test the proposed hypotheses. First, a semi-structured interview will be conducted with both experienced and inexperienced top managers of IT companies. We will also observe their decision process by making a field visit whenever it is possible. We plan to interview 20 managers, 10 from cloud structure and 10 from non-cloud structure IT companies. Second, surveys will be conducted with senior IT decision- makers in organizations to test our proposed hypotheses. The measurement items for all constructs in our research are presented in appendix 1. These items are adapted from existing studies.

5 CONCLUSION

This research investigates organisation's cloud structure replacement decision-making behaviour from the perspectives of both existing structure discontinuance and new technology adoption intentions. The findings of this research are expected to (1) provide completely new insights into cloud computing deployment decisions and IT transformation; (2) add new insights to the understanding and application of the TOE framework; (3) help highlight the role of leadership styles and characteristics in the adoption process of cloud computing services; and (4) expand the understanding of organizational ambidexterity by incorporating the information technology adoption mechanism.

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Appendix 1. *Measurements of Constructs*

Construct	Items	Source
Direct benefits	Improve data accuracy/ Improve operation efficiency/ Speed up application process/ Reduce clerical errors	Kuan et al. 2001
Indirect benefits	Improve organization image/ Improve competitive advantage/ Benefit other business practices/Improve customer service/ Improve relationship with business partners	
Complexity	My company believes cloud structure is complex to use/ My company believes cloud development is a complex process	Wang et al. 2010b
Information security	Degree of company's/customer's concern with information security on cloud computing/ Degree of concern about privacy in cloud	Zhu et al. 2006
Industry pressure	Requested by important business partner/ by majority business partners/ Recommended by important business/ Recommended by majority of business partners/ Important competitors using/will be using cloud structure/ Majority of competitors using/will be using cloud structure	Lin et al. 2008; Wang et al. 2010b
Government pressure	Progressive mandatory measures introduced by the government/ Stringent government regulations on recycling, environmental protection and consumer rights protection force our company to implement cloud structure/ The preferential subsidy and tax policy on reverse logistics implementation has increased our company's willingness to implement cloud structure	Kuan et al. 2001; Ye et al. 2013
Cloud tech readiness	The cloud technology is a new, non-obvious invention/ The patent and literature search are complete and clear/ The cloud technology is state-of-the-art or major breakthrough/ The cloud structure is a core or platform technology	Heslop et al. 2001; Lin et al. 2007
Firm size	The capital of my company is high compared to the industry/ The revenue of my company is high compared to the industry/ The number of employees at my company is high compared to the industry	Dholakia et al. 2004; Wang et al. 2010b
System support cost	Supporting the ongoing use of this system is costly/ The operational costs of this system are high/ Support costs for this system are excessive	Furneaux et al. 2011; Gill 1995
Support availability	Support for existing system is readily available/ We do not encounter difficulties in obtaining needed system support services/ We can easily obtain the support resources necessary to continue operating this system	
System reliability	People consider this system to be reliable/ This system has proven itself to be dependable/ This system can be counted on to perform as needed	
Structure shortcomings	The performance and functionality of this system is highly inadequate/ There are notable limitations in the ability of this system to meet our needs/ We would like to have many capabilities that are not supported by this system	
IT capability	Changes introduced by cloud services are consistent with my firm's existing values/ Cloud structure is compatible with existing information infrastructure/ The changes introduced by cloud services are consistent with existing practices/ Cloud is compatible with my existing experiences with similar systems	Low et al. 2011; Wang et al. 2010b
TMT characters	TMT Educational level/ TMT Organizational tenure/ TMT International experience/ TMT Functional background/ TMT average age	Herrmann et al. 2005
Exploitation	Commits to improve quality and lower cost/ Continuously improves the reliability of its products and services/ Increases the levels of automation in its operations/ Constantly surveys existing customers' satisfaction/ Fine-tunes what it offers to keep its current customers satisfied/ Penetrates more deeply into its existing customer base	Patel et al. 2012; Cao et al. 2009
Exploration	Looks for novel technological idea by thinking "outside the box"/ Bases on its ability to explore new technologies/ Creates products or services that are innovative to the firm/ Looks for creative ways to satisfy needs/ Aggressively ventures into new market segments/ Actively targets new customers groups	
CSAI	Be contemplating to adopt cloud structure in one year/ Be likely to adopt cloud service in one year/ Be expecting to adopt cloud in one year	Liu et al. 2010;
ESDI	We plan to replace this system with a competing system/ Our intention is to replace this system with an entirely different system/ We will be implementing a replacement to this system	Furneaux et al. 2011
DDM	At what stage of cloud deployment is your organization currently engaged? Not considering; Currently evaluating (e.g., in a pilot study); Have evaluated, but do not plan to adopt this structure; Have evaluated and plan to adopt […] structure; Have already adopted the […] structure/ If you are expecting that your company will adopt […] structure in the future, how soon do you think it will happen? Not considering; More than 5 years; Between 2 and 5 years; Between 1 and 2 years; Less that 1year; Have already adopted	Oliveira et al. 2014

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