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Understanding the effect of cloud computing on organizational agility: An empirical examination

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ABSTRACT

The emergence of cloud computing has significantly changed the model used for existing information technology and enhanced agility of a firm through its pay per use mode. However, few studies have focused on this phenomenon, and prior studies are unclear regarding the impact of cloud computing on organizational agility. Therefore, this study investigates the link between cloud computing and organizational agility based on survey data from users of the Alibaba cloud in China. The empirical analysis is conducted using the partial least squares (PLS) based structural equation modeling with SmartPLS 2.0. We propose that two cloud computing related capabilities (i.e., CI flexibility and CI integration) are critical for firms to improve their agility. Based on the IT—agility contradiction, we analyze the moderating effect of IT spending on cloud computing. This study provides a new perspective for understanding cloud computing technology in practice and theory.

1. Introduction

Because of rapid economic development, firms must quickly respond to market changes and become more innovative in order to survive and develop under fierce competition (Arteta & Giachetti, 2004; Lee, Sambamurthy, Lim, & Wei, 2015; Roberts & Grover, 2012a). However, traditional IT architecture may impede a firm's agility because of its high cost and stereotyped technology infrastructure (Lu & Ramamurthy, 2011; Oosterhout, Waarts, & Hillegersberg, 2006; Retting, 2007). This restriction has been mitigated by the development of cloud computing (Battleson, West, Kim, Ramesh, & Robinson, 2016; Kranz, Hanelt, & Kolbe, 2016; Marston, Li, Bandyopadhyay, Zhang, & Ghalsasi, 2011).

Cloud computing is one of the most recent innovations in information technology, and means an IT service pattern where both hardware and software services are delivered on demand to customers across a network in a self-service mode, independent of location and the device used (Ali, Warren, & Mathiassen, 2017; Marston et al., 2011; Wang et al., 2016). In comparison with traditional IT, cloud computing includes special features such as elasticity, scalability, shared resources, pay per use and a shared environment (Armbrust et al., 2010; Chen & Wu, 2013; Son, Lee, Lee, & Chang, 2014; Wang et al., 2016), which enable more economical and flexible IT solutions. These solutions allow firms to address complex and dynamic environments and improve operational and strategic agility (Iyer & Henderson, 2010; Marston et al., 2011; Sultan, 2011).

Although there have been some studies concerning the promotion effect of cloud computing on firm agility, e.g., (Berman, Kesterson-Townes, Marshall, & Srivathsa, 2012; Garrison, Wakefield, & Kim, 2015; Iyer & Henderson, 2010; Marston et al., 2011), unfortunately they usually either provide only partially qualitative description and reasoning, or neglect elucidating the effect mechanism of cloud computing with relevant data support. Specifically, existing studies cannot determine "how does cloud computing affect organizational agility?", and "in practice, is it possible for cloud computing to promote firm agility?"

Furthermore, earlier studies have determined that a firm's IT spending improves its agility by expediting decision-making processes, increasing accuracy and promoting information communication (Fink & Neumann, 2007; Oosterhout et al., 2006; Zhang & Sharifi, 2007). However, in recent years, more scholars have come to believe that huge investment in IT may not necessarily foster agility, and the high costs, limited hardware ability and a stereotyped software framework of traditional IT may reduce and even hinder a firm's agility (Goodhue & Chen, 2009; Lu & Ramamurthy, 2011; Overby, Bharadwaj, & Sambamurthy, 2006; Weill, Subramani, & Broadbent, 2002). Firms

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generally rely on IT to enhance their agility, but they have difficulty in reaching their goals and suffer from an "IT spending-agility" paradox (Lu & Ramamurthy, 2011). The revolution in the IT framework of cloud computing may overcome the limited hardware capability and software framework inflexibility that are characterized in traditional IT systems and are closely related to firm agility. Thus, we believe that the unique characteristics of cloud computing can lead to firms having more agility with more IT spending, and this raises the research question: does the "IT spending-agility" paradox exist in the practical environment of cloud computing?

Therefore, in order to fill the research gap, we propose a conception of cloud infrastructure capabilities based on the unique characteristics of cloud computing and the theory of IT infrastructure capability. We separate the cloud infrastructure capability into two dimensions, i.e., cloud infrastructure flexibility (CI flexibility) and cloud infrastructure integration (CI integration), based on technical features, which jointly affect a firm's agility. We also introduce IT spending based on cloud computing as a moderating variable to investigate the effects of different investment levels. Three research questions are discussed in this paper:

(1) Does cloud computing enable or impede on a firm's agility?
(2) How does cloud computing impact on a firm's agility?
(3) Based on question (2), what changes can be observed if IT spending differs?

Furthermore, there are some boundary conditions to the study. First, there are three kinds of application models of cloud computing: public cloud, private cloud, and community cloud (Marston et al., 2011; Wang et al., 2016). The public cloud service (e.g., cloud services by Amazon and Google) is generally more accessible and has greater research value (Armbrust et al., 2010). Therefore, the cloud computing that is considered in this study primarily focuses on public cloud services, such as Amazon, Google and saleforce.com. Second, this study focuses on the positive factors of cloud computing, and does not include certain disadvantages such as data loss, security and privacy (Ali et al., 2017; Senyo, Addae, & Boateng, 2018; Wang et al., 2016), which represent a constraint in the study. The main reason is that we find that most of the negative factors usually appear in the private cloud and the community cloud through a literature review, e.g., (Battleson et al., 2016; Garrison et al., 2015; Schniederjans & Hales, 2016; Yu, Li, Li, Zhao, & Zhao, 2018). Comparatively, public cloud services are usually provided by large and well-known enterprises (e.g., Amazon, Google, Alibaba and Tencent, etc.), because of their great human and material resources. Therefore, we believe that some disadvantages such as data loss, security and privacy mentioned in existing studies will be improved in the public cloud environment. However, we do not claim that the negative aspects of cloud computing are not important. Some organizations may choose the private cloud as they have more control, and can secure their own infrastructure, such as banks, security organization, etc. This boundary condition of the study may to some extent restrict the generality of the results.

Our study brings several contributions to the literature. First, we propose the construct of cloud infrastructure capabilities based on the unique characteristics of cloud computing, and divide it into two dimensions: CI flexibility and CI integration. Second, we investigate the influence mechanism of cloud computing on organizational agility, and we draw a conclusion that the use of cloud computing is necessary for organizations to improve agility under fierce competition. Third, we discover that IT spending based on cloud computing may set boundary conditions for the impacts of cloud infrastructure capability on organizational agility. This study extends the topic of "IT–Agility Contradiction" research such as by (Chakravarty, Grewal, & Sambamurthy, 2013; Lee et al., 2015; Lu & Ramamurthy, 2011), and empirically indicates that "IT–Agility Contradiction" does not exist under cloud computing. Firms can improve competence in order to sense market changes and take timely actions by increasing the IT spending in cloud computing.

2. Research background

2.1. Cloud computing

Cloud computing refers to an IT service pattern where both hardware and software services are transported on demand to customers across a network in a self-service mode, independent of location and device (Ali et al., 2017; Marston et al., 2011; Wang et al., 2016). Cloud computing is one of the most recent IT innovations and possesses certain unique features that differ from traditional IT (Bhattacherjee & Park, 2014; Marston et al., 2011; Son et al., 2014; Yu et al., 2018): (1) Ubiquity; Regardless of time and location restrictions, connecting to the cloud for resources can be easily accessible through various networks without using any complicated hardware facilities; (2) Resource Sharing; Computing and conserving resources occur at the cloud end, and are then distributed to certain consumers, formatting a resource pool; (3) Elasticity; In terms of customers' demands, they have the ability to decrease or increase relevant IT resources, such as CPU, bandwidth, storage, and software modules to satisfy the various requirements regarding the scale of the IT resources; (4) Scalability; Original and new business is conducted and extended, and the rapid deployment of application software and hardware can be achieved for users; (5) Pay per Use; Considering their own practical needs, users can utilize the cloud service to the exist extent that is required. Relevant fees are charged in terms of the amount of space that is used. Although these features mentioned above have been widely cited by many researchers, they laid great emphasis on the technical level, without further discussing how firms can make the best use of these features.

2.2. Cloud infrastructure capabilities

In essence, cloud computing is a new generation IT infrastructure (Armbrust et al., 2010; Demirkan & Delen, 2013), in which the IT infrastructure capability is critical for firms to create value through IT (Bharadwaj, 2000; Lu & Ramamurthy, 2011; Ravichandran & Lertwongsatien, 2005; Tallon & Pinsonneault, 2011). IT infrastructure capability means a firm's capability to configure shareable platforms, for instance data services, application services and network services (Lu & Ramamurthy, 2011). IT infrastructure capability is also one of the pivotal dimensions of IT capability in current IS (information systems) research (Bharadwaj, 2000; Lu & Ramamurthy, 2011; Ross, Beath, & Goodhue, 1996; Tallon & Pinsonneault, 2011). Table 1 offers a summary of studies that examined IT infrastructure capability, with the key characteristics /dimensions.

Table 1 suggests that the key characteristics/dimensions of IT infrastructure capability can be categorized into two types: flexibility-related and integration-related. Most studies have highlighted the flexibility of IT infrastructure and its importance to business. For instance, Bhatt, Emdad, Roberts, and Grover (2010) claimed that IT infrastructure flexibility refers to whether the IT infrastructure is modular, compatible and scalable, and can deal with multiple operation applications. A flexible IT infrastructure can enhance a firm's ability in rapidly delivering technical solutions (Ravichandran & Lertwongsatien, 2005), and can help a firm in knowledge exchange and process alignment (Liu, Ke, Wei, & Hua, 2013). Similarly, a high level of flexibility in IT infrastructure can help a firm's rapid IT implementation, which is important because it enables the firm to respond swiftly to emerging opportunities and threats (Ray, Muhanna, & Barney, 2005).

On the other hand, prior studies suggest that the integration dimension of IT infrastructure capability involves characteristics such as data consistency, universal connectivity, shared information, and cross-functional application integration (Rai, Rav, & Nainika, 2006). A well-integrated IT infrastructure requires firms to integrate data and