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Supply chain integration through community cloud: Effects on operational performance

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ABSTRACT

In this paper we analyze the effects exerted by a specific type of cloud technology (community cloud computing) on a particular type of supply chain integration (integration of informational and physical flows). We also analyze the combined effect of community cloud computing and physical-informational supply chain integration on firms' operational results. To test the hypotheses in this paper we use a sample of 394 companies randomly selected from a population of 2036 companies with a staff of at least 50 employees, taken from the DUNS 50,000 database for companies in Spain. We use factorial analyses and structural equation modeling to test our hypotheses. Our three hypotheses are confirmed, indicating that the community cloud exerts a positive and significant effect both on the informational-physical integration of the supply chain and on operational performance. The value of this study lies in the fact that it enables academics and practitioners to understand which parts of a relatively new technology (cloud technology and its sub-types) might contribute to integrating flows in the supply chain and, ultimately, impacting operational performance.

1. Introduction

The role played by information technology (IT) on company structure, behavior and performance has been a constant stimulus for research in recent decades. One of the factors affecting research into the organizational impact of information technology is the continuous change faced by companies having to deal with a shifting environment. These technologically-changing environments provide firms with new capabilities and resources that can be quickly implemented in the organizational arena. However, these unceasing changes sometimes involve modifications to the business structure and targets that can result in challenging, hostile, managerial situations that have to be fully understood and addressed for business sustainability and, ultimately, a competitive advantage to be achieved.

In this paper we analyze the role played by a specific type of technological breakthrough that has been progressively implemented by companies in recent years. We also take a closer look at cloud computing and, in particular, at community cloud computing. In cloud computing (Buyya et al., 2011, 2009; Fingar, 2009; Hayes, 2008) resources are not located in firms, but in virtualized, distributed environments that are geographically disperse, and can be accessed on an on-demand basis through web-based technologies. Community cloud computing can be defined as the cloud infrastructure provisioned for exclusive use by a specific community of users from organizations that have shared concerns (e.g., mission, security requirements, policy, and compliance considerations). It may be owned, managed, and operated by one or more of the organizations in the community, a third party or some combination of them, and it may exist on or off premises (Mell and Grance, 2011).

One important finding in the literature is that while IT is valuable, it is dependent upon internal and external factors relating to chain partners. Viewed from the IT-enabled organizational capability perspective (Bharadwaj, 2000), some authors consider IT as a set of complementary resources that augments the value of other organizational resources and capabilities that will lead to further business performance improvement (Melville et al., 2004). The literature on IT-enabled organizational capabilities suggests that supply chain process integration (Rai et al., 2006) is a

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capability that can turn the value of IT into business performance. This paper investigates the role played by a specific type of cloud computing (community cloud computing) in supply chain integration through the integration of the physical and informational flows between companies. We have adopted an operational view because it is a field in which there is a research gap, with a significant lack of prior research addressing company cloud computing and Supply Chain Integration (SCI) and their relation to operational effectiveness. We have adopted an operational point-of-view rather than simply a financial approach due to the fact that this technology might be strictly connected, at least at the first stage of development, to the ways that operations and information flows are organized and executed in the company (Dominy, 2012). Therefore, it is more likely during the initial stages of development that cloud computing -and, specifically, community cloud computing- which is designed to bind, share and connect the links in the firm's value chain, can also have a major impact on the components of the supply chain.

From a theoretical point-of-view, we have used the arguments of classic extended Resource Based View (RBV), Knowledge Management and Social Capital Theory to build the theoretical framework for this study. This theoretical framework highlights the roles of trust, identification and knowledge, while creating an appropriate atmosphere among the supply chain members that enables them (the supply chain members) to improve the company's operational results by means of greater SCI.

The paper has been organized as follows: In the following section we briefly study the background and describe the arguments leading to the hypotheses in greater depth. The third section of the paper includes a description of the sample and methods used in the empirical analysis. The fourth section is devoted to the analysis and results drawn from the empirical findings of the paper, while the last section includes a discussion and the major conclusions of the paper. Additional research directions and limitations are also outlined in the final section of the present study.

2. Background and hypotheses

Cloud computing has emerged as a new technological option with huge potential for companies and is currently transforming IT infrastructure (Iyer and Henderson, 2010; Winans and Brown, 2009). With revolutionary effects on business (Abdulaziz, 2012; Marston et al., 2011), cloud computing is a term that figuratively refers to the bundle of virtualized and distributed resources configured in a diffuse, all-pervasive way. In cloud computing (Buyya et al., 2011, 2009; Fingar, 2009; Hayes, 2008), resources are not located within firms but in virtualized and distributed environments that are geographically disperse and accessible on an on-demand basis using web-based technologies, combining Internet connectivity and pay-per-use systems as the foundation of the business model (Vaquero et al., 2009). There are several classifications of cloud computing technologies. One of these (Mell and Grance, 2011; Ryan and Loeffler, 2010) organizes the cloud spectrum into four deployment models: (1) Private cloud: an internal cloud infrastructure which covers a single organization; (2) Community cloud: distributed infrastructure provisioned by a group of closely-linked business partners in order to share business resources; (3) Public cloud: infrastructure that can be openly used by the general public and that may be owned, managed, and operated by a business, academic, or government organization, or some combination of them, and (4) Hybrid cloud: the hybrid cloud infrastructure is a composition of two or more distinct cloud infrastructures (private, community, or public) that remain unique entities, but are bound together by standardized or proprietary technology that enables data and application portability (e.g., cloud bursting for load balancing between clouds). In view of these definitions, community cloud computing is a type of cloud computing that could be especially applicable to the supply chain (Cheng et al., 2014).

Community cloud computing can be implemented in conjunction with other cloud-based service models (Mell and Grance, 2011; Ryan and Loeffler, 2010), such as: (1) Software as a Service (SaaS), where the capability provided to the consumer is to use the provider's applications running on a cloud infrastructure. The applications are accessible from various client devices through either a thin client interface, such as a web browser (e.g., web-based email), or a program interface; (2) Platforms as a Service (PaaS), the capability provided to the consumer is to deploy onto the cloud infrastructure consumer-created or acquired applications created using programming languages, libraries, services, and tools supported by the provider, and (3) Infrastructure as a Service (IaaS), according to which the capability provided to the consumer is to provision processing, storage, networks, and other fundamental computing resources where the consumer is able to deploy and run arbitrary software, which can include operating systems and applications.

In the prior literature, the advantages and disadvantages of cloud computing have been analyzed in comparison with traditional or conventional IT (Tuncay, 2010; Paquette et al., 2010; Marston et al., 2011; Dutta et al., 2013; Trigueros-Preciado et al., 2013; Shkurti and Muça, 2014). Cloud computing is able to provide firms with capabilities (Iyer and Henderson, 2010) and increase their business value (Abdulaziz, 2012). Cloud computing benefits can be also related to other advantages, such as instant global platforms, the elimination of hardware infrastructure and software licenses, reduced cost, simplified scalability and the elimination or reduction of disaster recovery risks and the associated high costs (Tuncay, 2010). In the case of small and medium-sized enterprises (SMEs), community cloud computing offers some remarkable advantages (Trigueros-Preciado et al., 2013), such as cost reductions in software, hardware and IT staff; scalability and flexibility in IT use, and access to IT resources which companies would otherwise not be able to employ. Integrated cloud-based supply chain systems reduce the labor cost of traditional communication means in SMEs and improve operating efficiency and the quality of management decision making (Cheng et al., 2014). According to the literature, some cloud services may also have several benefits over traditional IT models, including flexibility, configurability, general cost effectiveness and low implementation costs (Durowoju et al., 2011). It has been found that the greatest benefits of cloud computing technology in the accounting and financial industry (Shkurti and Muça, 2014) are perceived to be cost savings in both hardware and software, while information security and reliability are mentioned as its main shortcomings. Cloud computing also has its risks. The major risks in the governmental use of cloud computing are security related (Paquette et al., 2010), while there are other more important risks in private use related to the current legal and technical complexity of cloud computing (Dutta et al., 2013). Cloud computing used in SMEs (Trigueros-Preciado et al., 2013) has been found to be associated with several drawbacks, such as: security issues; the distrust generated by releasing data to third parties; the availability and quality of service, and the possible difficulties caused by changing suppliers and complying with legal data protection requirements. Other prior research has found that the impact of cloud services on security is directly related to supply chain performance (Durowoju et al., 2011). The overall security risks are lower in the specific case of community cloud computing, since this is cloud infrastructure provisioned for exclusive use by a specific community of users from organizations with shared concerns, such as mission, security requirements, policy, and compliance considerations. Community cloud