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Emerald Article: Adoption of cloud computing technologies in supply chains: An organizational information processing theory approach

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Adoption of cloud computing technologies in supply chains

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Abstract

Purpose – The purpose of this paper is to employ organizational information processing theory to assess how a firm's information processing requirements and capabilities combine to affect the intention to adopt cloud computing as an enabler of electronic supply chain management systems. Specifically, the paper examines the extent to which task uncertainty, environmental uncertainty, and inter-organizational uncertainty affect intention to adopt cloud computing technology and how information processing capability may moderate these relationships.

Design/methodology/approach – The paper uses a multiple method approach, thus examining the hypothesized model with both quantitative and qualitative methods. To begin, the paper incorporates a Delphi study as a way in which to choose a practically relevant characterization of the moderating variable, information processing capability. The authors then use a survey method and hierarchical linear regression to quantitatively test their hypotheses. Finally, the authors employ interviews to gather additional qualitative data, which they examine via use of content analysis in order to provide additional insight into the tenability of the proposed model.

Findings – The quantitative analysis suggests that significant two-way interactions exist between each independent variable and the moderating variable; each of these interactions is significantly related to intention to adopt cloud computing. The qualitative results support the assertion that information processing requirements and information processing capability affect intention to adopt cloud computing. These findings support the relationships addressed in the hypothesized model and suggest that the decision to adopt cloud computing is based upon complex circumstances.

Research limitations/implications – This research is limited by the use of single key informants for both the quantitative and qualitative portions of the study. Nonetheless, this study enhances understanding of electronic supply chain management systems, and specifically cloud computing, through the application of organizational information processing theory. The authors' mixed-methods approach allowed them to draw more substantive conclusions; the findings provide a theoretical and empirical foundation for future research in this area, and also suggest the use of additional theoretical perspectives.

Practical implications – This study provides insight that can help supply chain managers to better understand how requirements, when coupled with capabilities, may influence the decision to adopt cloud computing as an enabler of supply chain management systems.

Originality/value – As an emerging technology, cloud computing is changing the form and function of information technology infrastructures. This study enhances the understanding of how this technology may diffuse within the supply chain.

Keywords Cloud computing, Technology adoption, Electronic supply chain management systems, Information processing theory, Supply chain management, Computing, Information technology

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Introduction

Today's internet, built upon ubiquitous connectivity, low-cost processing capacity, open standards and loosely coupled information technology (IT) infrastructure, has been widely recognized as a tremendous enabler for business collaboration (Chen *et al.*, 2007). In the global marketplace, the internet is a tool by which businesses may uncover additional opportunities and is viewed as a requirement to develop a technology-driven competitive advantage (Liu and Orban, 2008). The internet-based cloud computing model, while intangible in context, offers a means by which technologically savvy organizations may leverage previously unavailable tangible IT capacity for a fraction of the traditional resource commitment. Synthesizing from several sources, cloud computing may be defined as a connectivity-facilitated virtualized resource (e.g. software, infrastructure, or platforms) that is dynamically reconfigurable to support various degrees of organizational need, which allows for optimized systems utilization (IBM, 2009; IBM Global Technology Services, 2010; Vaquero *et al.*, 2008). Inasmuch, cloud computing technologies may be especially useful for managing the supply chain.

For organizations within a complex supply chain, flexibility is among the greatest advantage of the cloud computing model. Flexibility has been repeatedly shown to be a key component of effective supply chain management (SCM), both at the organizational level and supply chain level (Duclos *et al.*, 2003; Fawcett *et al.*, 1996; Fredericks, 2005; Goldsby and Stank, 2000; Swafford *et al.*, 2006). When compared to traditional computing systems, cloud computing facilitates scalable on-demand computing power, rapid deployment, and reduced support infrastructure, all while facilitating lower cost of ownership (Aymerich *et al.*, 2008; IBM Global Technology Services, 2010). Also contributing to the cloud's flexibility, this technology is not limited by specific configurations, particular vendors, or specialized uses. Rather, cloud computing is an IT that may be employed in many different fashions and forms by various members of different organizations, which can make the technology even more useful in a collaborative supply chain context (IBM Global Technology Services, 2011).

As an emerging IT that is an integrated component of the internet, it is worthwhile to consider the application of cloud computing within supply chains. IT is widely recognized as a resource that is critical for the successful management of supply chains and has been shown to enhance supply chain performance and planning (Autry *et al.*, 2010; Chen *et al.*, 2007; Frohlich, 2002; Frohlich and Westbrook, 2001; Hall *et al.*, 2012; Hazen and Byrd, 2012; Li and Lin, 2006). A number of recent studies suggest that internet-enabled electronic supply chain management systems (eSCMS) may facilitate the development of a more effective and efficient supply chain (Boyer and Hult, 2005; Boyer and Olson, 2002; Gimenez and Lourenco, 2008; Olson and Boyer, 2005; Wang *et al.*, 2006). As a component of today's internet, cloud computing technology may support some of the traditional advantages of eSCMS. Among the most frequently noted advantages of eSCMS are the operational and strategic enhancements in communication, coordination, and collaboration across organizational boundaries (Autry *et al.*, 2010; Liu *et al.*, 2010). As a result, many organizations that participate in a supply chain perceive eSCMS as an essential component of their respective supply chain strategy (Boyer and Hult, 2005; Frohlich, 2002; Liu *et al.*, 2010).

Nevertheless, organizations struggle with a myriad of uncertainties related to the adoption of complex eSCMS technologies (Autry *et al.*, 2010; Prater, 2005; Zhu *et al.*, 2006). As a practical matter, such uncertainties are often cited as impediments to firm adoption of eSCMS (Ke *et al.*, 2009; Yao *et al.*, 2007). Recently, the issue of adoption of eSCMS has been examined through a number of different contextual research lenses. For instance, adoption of SCM technologies have been studied using theoretical frameworks such as the technology acceptance model, institutional theory and socio-political theory (Autry *et al.*, 2010; Ke *et al.*, 2009; Liu *et al.*, 2010). Absent in the SCM literature is an extensive examination of the adoption of eSCMS from the theoretical perspective of organizational information processing theory. Advancing such theoretical development is one contribution of this study.

We also recognize that organizational-level assessment of dependent variables like adoption, acceptance, and fit of technology remain sparse in the supply chain literature. Moreover, of the previously published studies that address this area, most utilize a singular methodological approach – survey. In the current study, we utilize a multiple method approach through which we examine the phenomenon in question using both quantitative and qualitative methods. From this methodological foundation, we attempt to present a more complete and detailed understanding of the phenomenon in question (Mangan *et al.*, 2004; Sanders and Wagner, 2011). As a result, this study enhances the methodological base used to study this area.

Finally, recent research in the area has begun to move past the limited characterizations of eSCMS as application-specific systems and toward enterprise architecture (Ke *et al.*, 2009; Liu *et al.*, 2010). Specifically, Autry *et al.* (2010) produced an extensive listing of eSCMS applications with definitions and key benefits. In doing so, the researchers implicitly acknowledged the importance in examining eSCMS in a less granular context for the purpose of accounting for the complexity of these systems. We assert that this context provides a more complete reflection of eSCMS in today's ordinary course of business. Therefore, in this research, we limit our examination to one specific and increasingly relevant technology, cloud computing. We assert that cloud computing as a generalized systems tool may serve as a technical infrastructure support component for many of the specific applications listed by Autry *et al.* (2010) by providing an infrastructure to enable the applications that facilitate communication, coordination, and collaboration across organizational boundaries that are the desired outcomes of eSCMS adoption. Therefore, an additional contribution of this study is found in the holistic perspective provided through the examination of the artifact of cloud computing. We believe this perspective offers significant value to both researchers and practitioners alike.

This research attempts to bridge gaps in the extant literature at the intersection of SCM and IT. We seek to understand whether a firm's information processing requirements and information processing capability affect organizational intention to adopt cloud computing as an enabler of eSCMS. Therefore, we rely upon organizational information processing theory as a framework through which to address this research purpose.

The remainder of this paper is organized as follows. In the next section, we describe the theoretical background of the current study, present our research model, and develop a set of hypotheses that address relationships between information processing requirements and intention to adopt cloud computing. Within this section, we also describe our Delphi method, analysis, and results, which we use as the basis to identify pertinent information processing capabilities. Then, we outline our mixed-method approach to data collection. Next, we report the results of the quantitative portion of our study. We then further describe our qualitative method of analysis and findings, and compare them with the findings of our quantitative study to draw conclusions. Our discussion section describes implications for practice and research, and highlights opportunities for future investigation in this area. Finally, the paper concludes with a brief summary of limitations and contributions.

Theoretical background and hypothesized model

eSCMS, particularly those that are internet enabled, have been heralded as a potential remedy for many of the operational issues that commonly hinder supply chain effectiveness and efficiency (Boyer and Hult, 2005; Lee and Whang, 2004; Rai *et al.*, 2006). Within the technological arena of internet-enabled systems, advances in cloud computing technologies now seem to offer organizations the opportunity to improve the flexibility of their technology infrastructure while reducing the total cost of ownership for systems (IBM, 2009). For example, organizations can leverage cloud-based IT services from providers like Amazon Web Services, Google, and IBM to quickly scale systems to meet their respective organizational needs for capacity, collaboration, and coordination without sacrificing any control, and perhaps most advantageous, pay for only the capacity that they actually utilize (Lohr, 2007).

Although there has been a flurry of practical industry developments related to cloud computing, little academic research exists that examines the cloud computing from a theoretical perspective. A review of the published research on cloud computing reveals that most studies either focus on exploring the architectures and applications of the cloud environment or propose lists of opportunities and obstacles for firms considering cloud computing (Armbrust *et al.*, 2010; Buyya *et al.*, 2009). While these studies do make a significant contribution to the literature, it is important that scholars begin to examine the phenomena of cloud computing in a broader organizational context from a theoretical perspective. To this end, this study conceptualizes cloud computing technology as a potentially vital component of eSCMS and applies appropriate theory in which to examine adoption.

Recent research efforts have conceptualized and examined eSCMS in a number of different theoretical contexts (Autry *et al.*, 2010; Ke *et al.*, 2009; Liu *et al.*, 2010). In this study, we extend the eSCMS research tradition by basing our work on Galbraith's (1974) organizational information processing theory (not to be confused with Miller's (1956) information processing theory, which is concerned with the individual level of analysis). We utilize this theory to provide an alternative rational as to why organizations adopt eSCMS. The organizational information processing theory characterizes organizations as systems that possess both a need and ability to process information as a means to reduce uncertainty (Galbraith, 1974). The theory consists of three elements: first, information processing requirements; second, information processing capabilities; and finally, the fit between requirements and capabilities (Tushman and Nadler, 1978). We now discuss these elements in the context of cloud computing technology adoption.

Information processing requirements

The information processing requirements of a firm are defined as the disconnection between the information necessary and the information available to the organization for decision making (Premkumar *et al.*, 2005). This requirements gap creates uncertainty. SCM is often defined by heightened levels of uncertainty and there exists a large body of research devoted to examining and reducing such uncertainties (e.g. Sanchez-Rodrigues *et al.*, 2008, 2010b; van der Vorst and Beulens, 2002; van der Vorst *et al.*, 1998; Wilding, 1998). Hubbard (2010) defines uncertainty as a state of limited knowledge in which it is not possible to exactly describe potential future outcomes. Using this general definition and operating under the assumption that organizations are open systems, the organizational information processing theory categorizes distinct sources of uncertainty: environmental, task and inter-organizational, to which organizations must respond (Tushman and Nadler, 1978). Within supply chains, these sources of uncertainty increase decision complexity and subsequently affect each organization's need for information (Premkumar *et al.*, 2005).

Environmental uncertainty arises from the fact that scarcity of resources contributes to instability, in the form of competition, in the external environment. Organizations, as transformation agents of resources, require inputs from the external environment. It is through their interfaces with the external environment that organizations expose themselves to the associated environmental uncertainty. Within supply chains, each participant has environmental interfaces, and therefore is exposed to environmental uncertainty (Peck, 2005; Peck and Juttner, 2000). Thus, all members of a supply chain must be responsive to the uncertainty that is created through interfaces with the external environment. To this end, organizations require information to reduce the environmental uncertainty that they face while attempting to make resource decisions (Christopher and Lee, 2004; Christopher *et al.*, 2004). For example, a transportation provider must directly account for the environmental uncertainty associated with fluctuations in the availability of a commodity like oil. There are numerous environmental uncertainties including natural disasters, geo-political turmoil, and diminishing reserves that contribute to the availability of said resource. All of these forms of environmental uncertainty can enhance levels of risk and impact an organization (Juttner, 2005; Juttner *et al.*, 2003). It is from this supposition regarding environmental uncertainty that we develop our first hypothesis:

H1. Environmental uncertainty is a significant predictor of intention to adopt cloud computing technologies.

Next, the interdependent nature of tasks performed by an organization contributes to the level of uncertainty to which the organization must respond. In this form, uncertainty is attributed, in part, to the complexity associated with the successful completion of the aggregate task (Melville and Ramirez, 2008). Simply, the more complicated the task, the greater the degree of uncertainty (Tushman and Nadler, 1978). Task uncertainty is not unique to the supply chain environment, but is seemingly universal among all organizations as it is an internally derived form of uncertainty (Premkumar *et al.*, 2005). As a result, organizations seek to reduce task uncertainty through the application of information to their decision-making processes. For example, manufacturing firms may utilize information to support quality improvement initiatives aimed at improving their manufacturing and production processes and eliminating waste in the form of product defects, which are the product of variability. It is from this practically grounded perspective that we develop the following hypothesis associated with a firm's task uncertainty:

H2. Task uncertainty is a significant predictor of intention to adopt cloud computing technologies.

Lastly, interaction among organizations also creates an additional source of uncertainty to which firms must respond (Premkumar *et al.*, 2005; Tushman and Nadler, 1978). Among organizations that participate in a supply chain, there is a requirement for information sharing, collaboration, and connectivity if firms are to perform at an optimal level (Sanders *et al.*, 2011; Tokar *et al.*, 2011). There are many factors that affect the uncertainty of the relationships between supply chain members

(Sanchez-Rodrigues *et al.*, 2010a). Inter-organizational uncertainty may be derived from the nature of the relationship between units, the responsibilities of each unit and the ability to fulfill them, the leadership of each unit, or a combination of any of the aforementioned factors (Melville and Ramirez, 2008). Furthermore, this uncertainty escalates as the number of relationships increase. To properly communicate, coordinate and collaborate and therefore make appropriate resource decisions, members of a supply chain use information to reduce the uncertainty associated with these complex interactions (Christopher and Peck, 2004). Thus, our third hypothesis addresses such uncertainty:

H3. Inter-organizational uncertainty is a significant predictor of intention to adopt cloud computing technologies.

Information processing capability

In this study, we seek to understand the organizational adoption of cloud computing technologies as a component of eSCMS. Consistent with this objective, we define information processing capability as an organization's capacity to utilize and structure information in a meaningful fashion that supports decision making (Tushman and Nadler, 1978). Previous research suggests that IT is a key aspect of an organization's information processing capability (Melville and Ramirez, 2008; Premkumar *et al.*, 2005). Tushman and Nadler (1978) assert that, within organizations, formalized information systems, and particularly ones that are IT based, are the most complex and costly but provide the highest capacity to facilitate organizational information processing. Based upon this supposition, other researchers have proposed various IT artifacts as surrogates through which to measure an organization's information processing capability (Melville and Ramirez, 2008; Premkumar *et al.*, 2005).

In the supply chain literature, communication, collaboration, and coordination technologies like EDI, eSCMS, and IT-based production controls have all been utilized as proxies for an organization's information processing capability (Melville and Ramirez, 2008; Premkumar *et al.*, 2005). In this study, we continue this tradition by specifically assessing cloud computing as a key aspect of the IT infrastructure of the firm. We assert that cloud computing is a particularly appropriate artifact through which to assess organizational information processing capability because cloud-based infrastructure supports many of the heretofore examined individual artifacts for eSCMS used in communication, collaboration, and coordination. Therefore, we suggest that, as a component of IT infrastructure, cloud-based technologies have a broader organizational impact than any single application like EDI applications or IT-based production controls. The nature of cloud-based technologies makes them scaleable, rapidly deployable, and reconfigurable to meet differing organizational needs and demands. These parameters mirror the definition of IT infrastructure flexibility in the IT literature (Byrd and Turner, 2000).

The IT literature provides several dimensions of technical IT infrastructure flexibility. Byrd and Turner (2000) present one aspect of flexibility as compatibility, which they define as the ability to share information across any type of technology platform. This parameter may be an appropriate measure for control and coordination of communications among partners in a supply chain. Furthermore, this dimension is particularly apt for assessing the information processing capability of a supply chain member organization because it captures the perspective of an organization's information systems to adapt to meet the needs of the users throughout the organization as a whole rather than assessing the single usefulness of a specific application or software program to facilitate a specific task.

A thorough review of the existing literature in the areas of SCM and information systems provided initial insights for the selection of a suitable proxy to assess information processing capability. However, due to the relative newness of the artifact of interest in this study, cloud computing technologies, we felt it most appropriate to validate our selection of such a proxy with input from practitioners in the supply chain community. Because of the dynamic nature of supply chain capabilities (Defee and Fugate, 2010) and wide breadth of utilization of IT within organizations, this is a common approach used to validate the assessment of an organization's information processing capability (Premkumar *et al.*, 2005; Starr *et al.*, 2000). To this end, we conducted a three-round Delphi survey to elicit a cohesive set of capabilities that practitioners found to be most important when considering the adoption of cloud computing technologies.

Identifying the most salient capabilities: a Delphi pre-study. The initial round of the Delphi survey commenced with the e-mailing of a link to our web-based survey to 44 IT executives employed by manufacturing, retail, and logistics firms. Each of the 44 executives had previously agreed to participate in the current study. In response to the open-ended question for the first round, "If you and your firm where considering adopting a cloud-computing IT, what issues do you perceive as important regarding that *technology* and its adoption by your firm in your *information systems and supply chain strategy*?," we identified 11 unique responses (Table I) from 29 different executives (65.9 percent response rate). For the purposes of identification and consolidation, issues were analyzed and grouped by three independent coders.

Issue	Description	Round 2 rank	Round 3 rank
Security	The technical controls and assurance mechanisms employed by the cloud vendor	1.96	1.75
Reliability/stability	The guaranteed availability of the resource provided	3.87	3.67
Access (internal/external)[a]	The ability to access the resource from anywhere	3.91	3.83
Inter-organizational connectivity[a]	The capability to use the resource with other organizations	4.01	4.26
Software/applications available	The function of the technology to meet organizational needs	4.24	4.87
Connectivity with existing technology[a]	The ability to interconnect current systems with the cloud technology	4.78	5.32
Cross-platform sharing[a]	The ability to move data between separate systems	5.91	6.76
External technical support	Third party external support for the cloud product	6.34	6.92
Control/ability to self-configure	Ability to adapt cloud product to changing needs	7.71	7.83
Scalability/capacity	Ability to grow/constrict use as needed	8.29	9.13

Note: [a]The issue as described by the survey participants coincides with aspects of the known construct of compatibility

Table I.
Description of issues identified and respective rankings from Delphi rounds

For the second round, we again e-mailed the group of 29 executives who initially participated and asked them to access the survey webpage and rank each issue from most important (1) to least important (11). For the second round of the Delphi study, 27 of the 29 participants completed the required item ranking (also shown in Table I). Two participants failed to complete the entire ranking of the 11 items and their responses were excluded from the analysis. Following the second round, the average rank was computed for each of the 11 items, as shown in Table I. The items were added to the survey webpage in their respective rank order.

In Round 3 of the Delphi study, the remaining 27 participants were asked to review the entire list and the average rank for each item. Given the information regarding the items produced by the group, each individual participant was asked to again rank each item. A total of 25 participants completed the third round of the Delphi. Following the third round of the survey, Kendall's *W* (Kendall and Gibbons, 1990) was computed to assess concordance between the individual rankings of the identified items. Group consensus is the desired product of a Delphi process (Okoli and Pawlowski, 2004). Kendall's coefficient of concordance (*W*), is a commonly used measure to assess the relative strength of consensus among a group's agreement. Kendall's *W* is a measure to determine the degree to which a set of ranked scores agree (Siegel, 1956). A significant *W* indicates that the participants applied essentially the same standard judging the importance of the issues and achieved an accord. Kendall's *W* proved to be significant after the third round of the survey ($W = 0.5031$, $p < 0.05$). Therefore, no additional ranking rounds were deemed necessary as an accord had been achieved among the participants.

It is noteworthy that several issues identified seem to overlap with the descriptions of compatibility as presented by Byrd and Turner (2000) in the information systems literature. This overlap prompted us to further consider the use of compatibility, as defined, operationalized, and measured by Byrd and Turner (2000), as a proxy for information processing capability. Specifically, the issues that the practitioners described as "Access (internal/external)," "Inter-organizational connectivity," "Connectivity with existing technology," and "Cross-platform sharing," all seem to align with the compatibility construct, as considered by Byrd and Turner (2000). Therefore, in this study, we adopt the definition and measure of compatibility as representative of an organization's information processing capability because it appears to be both practically appropriate as well as grounded in the extant literature.

Requirements-capability fit

The existing literature regarding organizational information processing theory suggests a fit relationship between the previously discussed information processing requirements and a firm's information processing capability (Premkumar *et al.*, 2005; Tushman and Nadler, 1978). In this study, we define the concept of fit between an organization's information processing requirements and information processing capability per Venkatraman's (1989) taxonomy as congruence between two variables. In his seminal work, Venkatraman (1989) posits that the effect between the two variables will have a significant impact on the outcome of interest. Therefore, we conceptualize the information processing capability of the firm as a moderating influence on an organization's intention to adopt cloud computing technologies. Specifically, our first three hypotheses posit that uncertainties will significantly correlate with intention to adopt. However, we believe that the degree of information processing capability will enhance the magnitude of these relationships. Thus, we assess the moderating role of organizational information processing capability through the following hypotheses:

H4a. Information processing capability moderates the relationship between environmental uncertainty and intention to adopt cloud computing technology.

H4b. Information processing capability moderates the relationship between task uncertainty and intention to adopt cloud computing technology.

H4c. Information processing capability moderates the relationship between inter-organizational uncertainty and intention to adopt cloud computing technology.

The complete model that is evaluated in this research is presented in Figure 1, and the constructs and operational metrics are summarized in Table II.

Research methodology

Data collection consisted of two separate phases. Initially, a survey questionnaire was used to gather data for statistical hypothesis testing. Next, structured interviews were conducted with a subset of survey respondents to gain contextual insight into the quantitative results. In the following subsections, we discuss the sample frame and survey design used in the quantitative portion of the study. We then report the results of the quantitative analysis in the following section, before further describing the qualitative methods and results.

Sample frame and data collection

The target population for this study consists of firms operating in the USA whose primary function is in manufacturing, retail, distribution, or transportation. We selected these types of organizations as they collectively comprise a broad and, perhaps, generalizable perspective of organizations commonly found within supply chains. Data collection was facilitated through three separate national industry organizations, which wish to remain anonymous. The sampling frame for the study

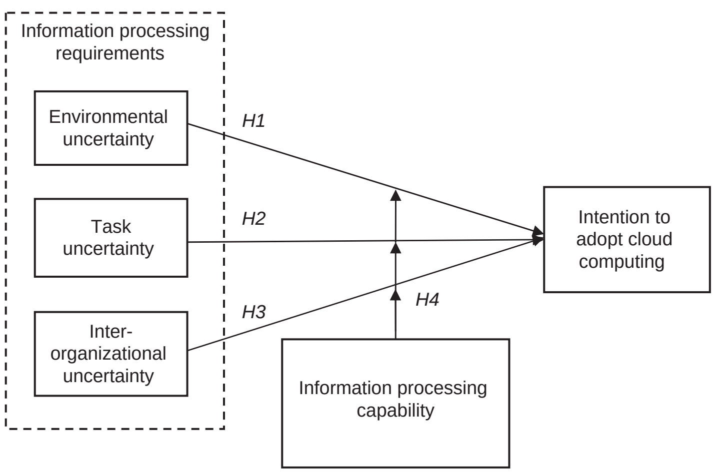


Figure 1.
Hypothesized model within the context of organizational information processing theory

Information processing requirements	Operational metrics assessed	Literature sources
Environmental uncertainty	Stability of user of products, competition for raw materials, competition for customers, regulation of your industry, and public perception of your industry	Duncan (1972), Galbraith (1974), Pagell and Krause (1999), Swamidass and Newell (1987)
Inter-organizational uncertainty	Stability of suppliers upstream, stability of product portfolio, stability of customers downstream	Beamon (1998), Galbraith (1974), Melville and Ramirez (2008), Perona *et al.* (2001)
Task uncertainty	Stability of organizational technology, intensity of knowledge required in processes, modularity and interchangeability of products	Eimaraghy and Urbanic (2004), Galbraith (1974), Li *et al.* (2010), Melville and Ramirez (2008), Novak and Eppinger (2001), van Hoek (1998)
Information processing capability	Ability to access systems across platforms, transparent interfaces between systems, capable of change, seamless access across physical locations, multiple entry points for users, wide variety of data types, ease of data exchange	Byrd and Turner (2000), Galbraith (1974), Melville and Ramirez (2008), Premkumar *et al.* (2005), Tushman and Nadler (1978)

Table II. Summary of key constructs and operationalized metrics for the information processing theory

was derived from individuals in these organizations who had expressed intent to attend a national industry association function, sponsored by each respective organization. From this contact information, 1,232 organizations were contacted to solicit participation. Contact was made by a representative acting on behalf of each of the industry associations. This provided a high level of assurance to each of the participating associations and their constituent members that their contact information would not be utilized in any capacity beyond the explicit purpose of this study. Therefore, we had no direct access to the participants during this phase of the study.

Invitations for participation were e-mailed to one individual in each of the 1,232 firms tasked at the manager level or above in the functional areas of IT or operations management. The invitation to participate in the current study was e-mailed to all potential participants on the same date. Because non-response bias can threaten the validity of a study employing survey methods (Wagner and Kemmerling, 2010), we assessed non-response bias using wave analysis as suggested by Rogelberg and Stanton (2007). Of the responses received over the four-week data collection period, we found no statistically significant differences among those who completed the survey in the early period vs those respondents who completed the survey in the later period. This analysis suggests that non-response bias may not be significantly manifest in the data; therefore, no remedial actions were taken.

A total of 396 individuals completed the initial questionnaire. After a thorough review of the surveys submitted, 357 were deemed to be complete and therefore useable, resulting in an effective response rate of 29 percent. A total of 39 surveys were not completed correctly and were removed from the sample. Of the 357 surveys retained, 200 responses were from manufacturing firms, 108 responses came from retail organizations, 26 responses came from distributors, and 23 responses were provided by transportation organizations. Because the solicitations for participation were facilitated via industry association representatives, we were unable to follow up directly on the initial solicitation. The demographic information solicited via our survey is provided in Table III.

Because each respondent held the position of manager or executive, he or she is assumed to be well versed in the organizational aspects of their firm. Further, the use of a single respondent is appropriate in this situation because this individual is likely in a position of decision-making authority over technological innovations (Liu *et al.*, 2010). Coupled with the qualitative data from structured interviews, the use of survey responses from a single key informant in this context provides a well-rounded picture of the firm-level technology adoption process in a supply chain environment. In the remainder of this section, we describe the measures used for the quantitative survey study.

Measures

In this study, we measured adoption intention by using the subjects' responses to three survey items as to whether, if given the opportunity, they would adopt cloud computing technologies for their respective firm within one year's time. A number of previous studies have measured strategic adoption of complex technologies into supply chain operations in a similar fashion and timeframe (Ke *et al.*, 2009; Liu *et al.*, 2010). Moreover, we choose to measure intention rather than actual adoption of the technology due to the relative newness of cloud computing as a business tool. In the literature, there is extensive support for the notion that measuring intention, when placed in context with respect to time, is an accurate proxy for action (Ke *et al.*, 2009; Liu *et al.*, 2010). To facilitate this measurement, we followed the guidelines established by Ajzen (2005) and adapted items employed by Teo *et al.* (2003), Khalifa and Davison

	N	%
Job title of respondent		
IT manager	294	82.4
Operations manager	51	14.3
IT executive	12	3.4
Organization type		
Manufacturing	200	56.0
Retail	108	30.3
Distribution	26	7.3
Transportation	23	6.4
Firm size (number of employees)		
1-250	290	81.2
251-1,000	39	10.9
1,000 +	28	7.8
IT department size (number of employees)		
1-10	288	80.7
10 +	69	19.3
Total revenue		
$1-$10 million	40	11.2
$10-$100 million	199	55.7
over $100 million	118	33.1

Note: $N = 357$

Table III.
Sample demographics

(2006), and Liu *et al.* (2010). All items for this study were assessed with a five-point Likert scale ranging from "strongly disagree" to "strongly agree."

We used five items to measure the perception of environmental uncertainty. Consistent with our definition outlined in Table II, items were adopted directly from Pagell and Krause (1999), who created a measure based on the combined efforts of Duncan (1972) and Swamidass and Newell (1987). Task uncertainty reflects the dynamic nature of the operating processes and procedures of an organization. We adopted four questions from van Hoek (1998) to assess the perceived level of task uncertainty, which are based on dimensions of uncertainty previously identified in the literature noted in Table II (Eimaraghy and Urbanic, 2004; Li *et al.*, 2010; Melville and Ramirez, 2008; Novak and Eppinger, 2001; van Hoek, 1998). Previous research shows that several factors that contribute to inter-organizational uncertainty (Beamon, 1998; Melville and Ramirez, 2008; Perona *et al.*, 2001). For the current study, we adopt three items used in the research cited in Table II to assess inter-organizational uncertainty.

In consideration of the findings of our Delphi study and our review of the information systems literature, we examine compatibility as a key information processing capability. Compatibility, as defined by Byrd and Turner (2000) is the ability to share information across any type of technology platform. We assessed compatibility using a measure developed by Byrd and Turner (2000). As noted in Table II, there are additional capabilities that may also be addressed; however, we posit that compatibility is the most salient information processing capability in the context of our study, as demonstrated by the results of our Delphi study.

We used five control variables that, from a review of the literature, we determined might affect a firm's intention to adopt cloud computing technologies: organization type, firm size, IT department size, total revenue, and job title of respondent. Of note, we conducted between group analyses and found no statistically significant differences. A demographic summary of the control variables is provided in Table III.

A table of correlation coefficients for all model variables is illustrated as Table IV. The correlation coefficients between the scale variables are Pearson's product moment correlation coefficients. The correlation coefficients reported between the scale variables and categorical control variables are point-biserial correlation coefficients. The correlation coefficients reported between the categorical control variables are φ coefficients (e.g. Cohen *et al.*, 2003, pp. 28-31). The correlations reported in Table IV suggest adequate levels of discriminant validity of our measures. Cronbach's α values, measures of internal consistency reliability, are reported on the diagonal. Finally, as referred to by Podsakoff and Organ (1986), we conducted Harman's one factor test (Brewer *et al.*, 1970; Greene and Organ, 1973; Harman, 1960) to assess common method bias. The unrotated factor solution indicated that no factor accounts for a significant portion of the variance in our data, which suggests that common method bias is not a significant threat to the validity of this study's results.

Quantitative analysis and results

We used hierarchical regression analysis of the outcome variable on the mean-centered scale averages of all independent and moderator variables, as well as the control variables. Mean centering was used to guard against possible multicollinearity and to aid in interpretation of the results (Cohen *et al.*, 2003). The independent variables were introduced to the model in three successive steps. In the first step of the analysis, all of the control variables were entered into the model as predictors of intention to adopt. The results of entire hierarchical regression analysis are provided in Table V. As noted

Table IV.
Study variable correlations

	Mean	SD	1	2	3	4	5	6	7	8	9	10	11	12	13
1 Intention to adopt	4.27	0.53	(0.88)												
2 Environmental uncertainty	3.37	0.55	0.23**	(0.60)											
3 Task uncertainty	3.93	0.55	−0.09	0.07	(0.75)										
4 Inter-organizational uncertainty	4.34	0.55	−0.04	−0.02	0.32**	(0.60)									
5 Information processing capability	3.64	0.41	−0.23	−0.13	−0.13*	0.35	(0.53)								
Job title															
6 Operations manager			−0.03	−0.08	−0.04	0.17**	0.06								
7 IT executive			0.06	0.00	0.02	−0.11*	0.11*	0.08							
Firm size															
8 1-250 employees			0.27**	−0.08	0.10	0.33**	−0.04	0.14*	−0.39**						
9 251-1,000 employees			0.13*	0.12	−0.14**	−0.34**	−0.13	−0.14**	0.33*	−0.73**					
Organization type															
10 Manufacturing			0.15**	−0.08	−0.32**	−0.05	0.18**	0.06	0.13*	−0.11*	−0.02				
11 Retail			0.01	−0.05	0.17**	0.11	−0.09	−0.04	−0.09	0.08	−0.02	−0.74**			
IT department size															
12 1-10 employees			−0.34**	−0.15**	0.07	−0.00	−0.10	0.10	−0.22**	0.22**	−0.37**	−0.06	0.08		
Total revenue															
13 \$1-\$10 million			−0.01	−0.05	−0.08	−0.03	−0.01	−0.06	−0.07	0.17**	−0.12*	−0.17**	−0.08	0.04	
14 \$10-\$100 million			0.16**	−0.06	−0.04	−0.01	−0.07	−0.01	−0.08	0.24**	−0.01	−0.15**	0.06	−0.01	−0.40**

Notes: $N = 357$. $^{*}p < 0.05$; $^{**}p < 0.01$

	Step 1		Step 2		Step 3	
	b	*β*	*b*	*β*	*b*	*β*
Constant	3.82**		3.91**		3.96**	
Job title[a]						
Operations manager	−0.02	−0.01	0.00	0.00	0.02	0.02
IT executive	0.38**	0.13	0.47**	0.16	0.50**	0.17
Company size[b]						
1-250 employees	1.07**	0.79	1.05**	0.77	0.96**	0.71
251-1,000 employees	0.93**	0.55	0.78**	0.46	0.82**	0.48
Organization type[c]						
Retail	−0.20**	−0.17	−0.18*	−0.16	−0.17**	−0.15
Manufacturing	−0.23**	−0.22	−0.23**	−0.22	−0.22**	−0.21
IT department size (10 or less[d])	−0.37**	−0.27	−0.37**	−0.28	−0.34**	−0.25
Total revenue[e]						
Sales below $10 million	−0.10	−0.06	−0.11	−0.07	−0.08	−0.05
Sales $10-$100 million	−0.06	−0.05	−0.06	−0.06	−0.09	−0.09
Environmental uncertainty			0.15**	0.16	0.12**	0.13
Task uncertainty			−0.11*	−0.11	−0.13**	−0.14
Inter-organizational uncertainty			−0.05	−0.05	0.02	0.00
Information processing capability			−0.13*	−0.10	0.36**	0.28
Environmental × information processing capability					0.27**	0.14
Task × information processing capability					−0.83**	−0.53
Inter-organizational × information processing capability					0.39**	0.19
R^2	0.402		0.459		0.549	
R^2 change	0.402		0.057		0.090	
F change	25.91**		9.04**		22.65**	

Notes: [a]Job title was coded so that IT managers serve as the baseline relative to which the other dummy coded variables are measured; [b]company size was coded so that firms with more than 1,000 employees serve as the baseline relative to which other dummy coded variables are measured; [c]organization type was coded so that transportation serves as the baseline relative to which other dummy coded variables are measured; [d]IT department size was coded so that departments with more than ten employees serve as the baseline relative to which other dummy coded variables are measured; [e]total revenue was coded so that firms with sales in excess of $100 million serve as the baseline relative to which other dummy coded variables are measured. $^{*}p < 0.05$; $^{**}p < 0.01$

Table V.
Results for hierarchical regression

in Table V, each of the subsequent steps of the hierarchical regression explains a significantly greater portion of the variance in adoption intent than the previous step. Our final model, which includes all control variables, study variables, and interactions, explains 54.9 percent of the variance in the intention to adopt cloud computing technologies.

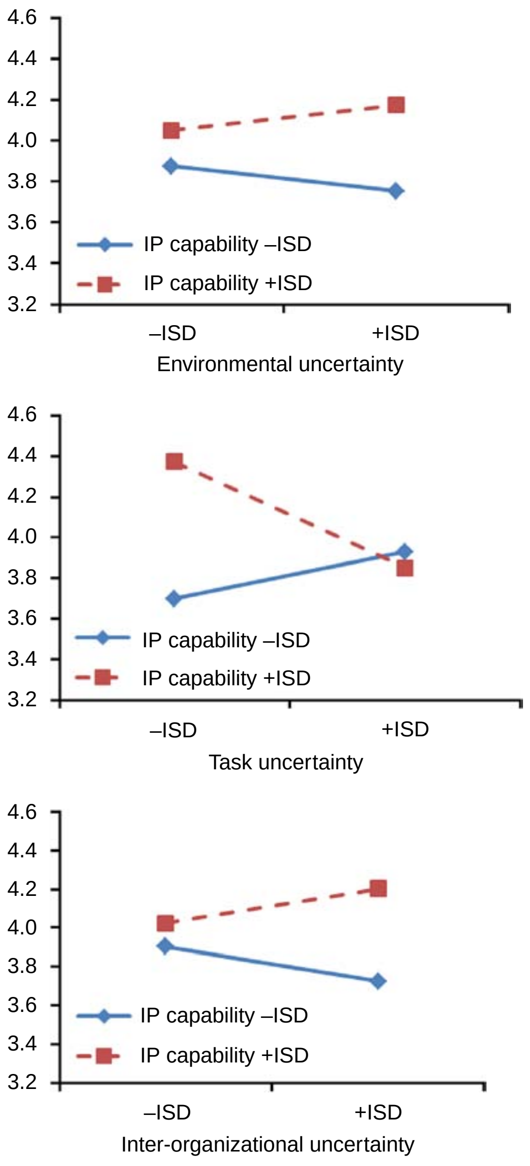
In the second step of the analysis, the mean-centered scale variables were entered into the model. *H1* posited a significant association between firms' perception of environmental uncertainty and intention to adopt cloud technologies. The results suggest a significant and positive relationship between environmental uncertainty and intention to adopt cloud computing technology ($b = 0.15$, df $= 343$, $p < 0.01$); thus, *H1* is supported. *H2* posited that organizational perceptions of task uncertainty will be significantly associated with intention to adopt cloud computing. Results suggested a significant, negative relationship between task uncertainty and intention to adopt cloud computing technologies ($b = -0.11$, df $= 343$, $p < 0.05$); thus, *H2* is supported.

H3 posited a significant association between firms' perception of inter-organizational uncertainty and intention to adopt cloud computing. The results did not support *H3* ($b = -0.05$, $df = 343$, $p > 0.05$); however, significant interaction effects were found, which may alter the interpretation of these findings.

Of interest in testing *H4* are the interactions among information processing capability and the three uncertainty measures (environmental, task, and inter-organizational); thus, in the third step of the hierarchical regression analysis, these three two-way interactions were entered into the model. The two-way interaction between environmental uncertainty and information processing capability significantly and positively relates to intention to adopt ($b = 0.27$, $df = 340$, $p < 0.01$), thus supporting *H4a*, which suggests that information processing capability will moderate the relationship between environmental uncertainty and intention to adopt cloud computing. Additionally, the two-way interaction between task uncertainty and information processing capability is significant ($b = -0.83$, $df = 340$, $p < 0.01$), thus supporting *H4b*, or a significant moderation of information processing capability on the task uncertainty – intention to adopt cloud computing relationship. Finally, the interaction between inter-organizational uncertainty and information processing capability was significantly related to intention to adopt cloud computing technology ($b = 0.39$, $df = 340$, $p < 0.01$), supporting a significant moderation of information processing capability on the relationship between inter-organizational uncertainty and intention to adopt cloud computing.

To further illustrate the significant moderating effects, Figure 2 illustrates the interaction plots showing the relationship among the two-way interactions and the intention to adopt cloud computing. Following the recommendation of Aiken and West (1991), we created these plots for the baseline cases of all control variables, and included the mean value of the other study variables that are not considered in the specific two-way interaction. Further, we created high and low values of the interactive variables using the mean $\pm$ 1SD. Because the scale variables do not deviate significantly from a normal distribution, this gives the approximate 16th and 84th percentiles of the distribution for the interacting variables.

The top panel of Figure 2 shows that in firms with low (mean$-$1SD) information processing capability, the relationship between environmental uncertainty and intention to adopt cloud computing is negative, but a test of the simple slope reveals that this negative relationship is not significantly different from zero ($t = -0.224$, $p > 0.10$). However, in firms with high (mean + 1SD) information processing capability, higher levels of environmental uncertainty are associated with significantly higher intention to adopt cloud computing ($t = 4.793$, $p < 0.001$). In the middle panel of Figure 2, it is clear that the relationship between task uncertainty and intention to adopt cloud computing is positive in firms with low (mean$-$1SD) information processing capability. The simple slope test yields a significant slope coefficient ($t = 3.41$, $p < 0.01$). Further, the relationship between task uncertainty and intention to adopt is negative in firms with high (mean + 1SD) information processing capability ($t = -7.67$, $p < 0.001$). Finally, the bottom panel of Figure 2 illustrates the negative relationship between inter-organizational uncertainty and intention to adopt cloud computing in firms with low (mean$-$1SD) information processing capability. The simple slope test gives further support of this negative relationship ($t = -02.46$, $p = 0.014$). For firms with high (mean + 1SD) information processing capability, however, higher levels of perceived inter-organizational uncertainty are associated with a significantly higher intention to adopt cloud computing ($t = 2.52$, $p = 0.012$).



Note: y-axis is mean intention to adopt score based on five-point Likert scale

Figure 2.
Moderating effects of information processing (IP) capability on the relationship between uncertainty and intention to adopt cloud computing technology

Qualitative method and content analysis

The use of qualitative research has gained significant traction in a number of business disciplines (Boyer and Swink, 2008; Harwood and Garry, 2003; Morris, 1994). One general reason for the increased utilization of qualitative research methods is the proposition that conclusions arrived at via multiple investigative techniques are less susceptible to systematic bias inherent in the repetitive application of a single methodological design (Tangpong, 2011). Content analysis is a qualitative research method that is well established in various business disciplines; however the technique as an observational method to collect data is not as well established in the SCM literature (Hazen *et al.*, 2012; Montabon *et al.*, 2007).

Content analysis is a research technique that facilitates the assessment of all forms of documentable communications (e.g. writings, news reports, audio and video recordings, etc.). This is typically accomplished through the establishment of a coding schema that is used to classify and organize the content of interest (Krippendorff, 2004). The technique may be used as the singular method of data collection or in conjunction with other methods, such as the previously described survey in the current study (Bhattacherjee and Premkumar, 2004). In this study we incorporate content analysis as part of our mixed-method design; the final phase of our study was a multi-phase content analysis of responses given by a subset of survey participants to a series of open-ended questions about the perceptions of the adoption of cloud computing technologies. The purpose of this analysis was to triangulate and further evaluate the findings presented in our quantitative results and perhaps gain additional understanding regarding the nature and scope of the intention to adopt cloud computing technologies.

There are no firm guidelines for determining non-probabalistic sample size for interviews (Guest *et al.*, 2006). Nonetheless, we sought to contact a minimum of 25 participants to ensure that we reached saturation (Guest *et al.*, 2006). Of the 357 participants who completed our original survey, 34 agreed to participate in the open-ended questionnaire, which was administered and digitally recorded in an interview format. These 34 subjects were in attendance at one of three industry trade shows that were sponsored by the previously described national associations who facilitated the initial electronic survey. Each individual noted that he or she had completed the previous electronic survey, which had indicated to participants that we would be available at the three industry trade shows to conduct follow-up interviews. We conducted these interviews at three separate trade shows over the course of seven weeks. Of the 34 participants that agreed to participate in the interview process, two participants failed to complete the interview due to time constraints. Thus, a total of 32 individuals answered the open-ended questions presented to them during the recorded interview process. From these 32 subjects, a total of 96 textual responses were obtained. All of the 96 responses were deemed to pertain to the subject in question and none were excluded from the sample.

In the first phase of the classification of the content, each of the three coders, who are educated and knowledgeable about supply chain operations and IT, listened to audio recordings and reviewed electronic transcripts of the interviews. Initially, the coders were asked to classify the qualitative data by construct into three general themes of "Positive effect," "Negative effect," or "Neutral effect" on the subject's intention to adopt cloud computing. This classification was made to create frequency distributions for each construct that could be utilized to assess the overall impact of the construct on adoption intention. As a control, two of the coders were unfamiliar with the study and unaware of the quantitative results. This control is recommended for mixed-method research and is useful to mitigate any potential bias caused by ex-ante theoretical or empirical knowledge of the study (Bhattacherjee and Premkumar, 2004). The three coders were provided with a list of the constructs from the study, formal definitions, illustrative examples, and a coding scheme. Each rater was then asked to review the complete set of 96 responses and classify the comments according to the scheme provide to them.

Initially, the three coders agreed on 85 percent of the classifications. In reviewing the discrepancies among the coders, most of the disagreement occurred as a result of vague and ambiguous statements made by the subjects. In these cases, we asked the coders to discuss among themselves the comments and attempt to reach a mutual conclusion regarding the statements and the best categorization of each. In an effort to provide additional external validity to the process, an external researcher well versed in the constructs of interest and the application of content analytic techniques, was asked to review the final classifications. It was his opinion that the 96 responses were, indeed, appropriately categorized by the three coders.

For the construct of environmental uncertainty, the coders classified all 18 applicable comments as either a "Neutral" (72.22 percent) or a "Negative" (27.88 percent) effect on the adoption of cloud computing technologies. No comments were classified as "Positive" regarding the effect of environmental uncertainty on the adoption intention of cloud technologies. In sharp contrast, the three other constructs – task uncertainty, inter-organizational uncertainty, and information processing capability – all received several comments that the coders classified as relating a "Positive" effect to adoption. The frequency distribution and categorization of all comments are reported in Table VI.

Following the initial classification of the content, the three coders were asked to analyze each of the comments for the four constructs and develop their own categories to further classify the comments representing each construct. The goal of the second phase of the content analysis was to develop a typology of the issues that relate to practitioner's intention to adopt cloud computing technologies. The coders were instructed to read the comments for each construct for substance and group comments of similar substance together within each construct. The coders were instructed using the following example comment taken from the interview of a subject. The example comment for the construct environment reads "I would be concerned that our data would not be secure and it could be exposed if it were stored in the cloud." This could be classified into a general category titled "Security." For each construct, an additional example was provided to the coders. These examples, as developed by the research team, are reported in Table VII.

Once the coders completed their independent classifications, the group met via teleconference to discuss the categories that were defined by each individual. Initially, the three coders agreed on all but two categories. After a short discussion, the coders agreed that the difference in the two categories was syntactical and that each was representing the same issue with different words. At this point, the coders mutually agreed on a common set of categories and operational definitions for each, as reported in Table VIII. Using this typology, the coders proceeded to develop an aggregate

Construct	Number of positive comments	Number of negative comments	Number of neutral comments	Number of total comments
Environment	0	5	13	18
Task	15	1	13	29
Inter-organizational	10	3	16	29
Information processing capability	8	1	11	20

Table VI. Frequency distribution of the comments of interview participants frequency distribution of the comments for each of the four study constructs, as shown in Table IX.

From the frequency distribution created by the three coders (as shown in Tables VI and IX), one can identify interesting characteristics regarding intention to adopt cloud computing technologies. The results of the content analysis provide the beginnings of a topology that reflects the relative importance of the various subcategories for each of the constructs. These findings will be discussed in the following section.

Discussion

In this study, we employ organizational information processing theory as a framework through which to examine a firm's intention to adopt cloud computing information technologies as an enabler of eSCMS. We operationalized our assessment of a firm's information processing requirements as environmental uncertainty, task uncertainty, and inter-organizational uncertainty, and also examined the moderating role of information processing capability.

Table VII. Examples provided to content raters as instructions for classification for Phase 2 of the content analysis

Construct	Example	Potential category
Environment	"I would be concerned that our data would not be secure from outsiders if it were stored in the cloud"	Security
Task	"If our applications were cloud-based, we could access our data better"	Access
Inter-organizational	"Purchase orders to suppliers would be easier if we were cloud-enabled"	Communication
Information processing capability	"Cloud technologies would help our units work together more effectively"	Collaboration

Table VIII. Common categories created by the raters for Phase 2 of the content analysis

Construct	Category	Commonly created definition
Environment		
	Security	The access, confidentially, and integrity of data and systems
	Economy	Relating to the global marketplace
	Support	Third party vendor support of cloud technology
	Cost	The cost of adopting, managing, and using a systems
Task		
	Flexibility	The ability to change or modify the system to support organizational needs
	Functionality	The breadth and scope of the capability of the system to match processes
	Access	The ability to access the systems and data
	Integration	Interfacing multiple systems
Inter-organizational		
	Communication	Communicating with supply chain partners
	Collaboration	Workflow between supply chain partners
Information processing capability		
	Connectivity	Internal and external connections with other systems
	Usability	The fit of systems to business processes
	Collaboration	The ability to share resources

Category (total comments)	Sub classification	Number of comments	% of total comments
Environment (18)			
	Security	9	50
	Economy	4	22
	Support	2	11
	Cost	3	17
Task (29)			
	Flexibility	9	31
	Functionality	8	28
	Access	6	21
	Integration	6	21
Inter-organizational (29)			
	Communication	18	62
	Collaboration	11	38
Information processing capability (20)			
	Connectivity	12	60
	Usability	3	15
	Collaboration	5	25

Table IX. Frequency distribution of comments by subcategory

We used quantitative and qualitative methods to aggregate a robust perspective from which to address our research purpose. The results of the quantitative analysis of the data provide support for the assertion that there are both significant direct and interaction effects that influence a firm's adoption intention. Most important were the significant interaction effects between information processing capability and all three of the information processing requirement variables (environmental, task, and inter-organizational). This suggests that the complex relationships proposed by organizational information processing theory help to describe how requirements and capability combine to affect intention to adopt. The qualitative findings support the results of the quantitative analysis and provide greater insight into how the factors encompassed by organization information processing theory affect the intention to adopt cloud computing technologies. In the remainder of this section, we describe the implications of these findings for research and practice.

Implications for theory and research

Our quantitative assessment found that environmental, task, and inter-organizational uncertainties combine with existing information processing capabilities to affect an organization's intention to adopt cloud computing technologies. These findings serve to extend organizational information processing theory by demonstrating the theory's applicability within the context of SCM and cloud computing adoption. Furthermore, our qualitative findings provide the basis for a richer perspective regarding the aforementioned quantitative assessments in that we can better assess intention behaviors and attitudes within decision making (Tokar, 2010).

As reported in Tables VIII and IX, each of the constructs addressed in our investigation can be decomposed further. For instance, security concerns, economic instability, vendor support, and costs appear to be the sources of environmental uncertainty that have the greatest effect on adoption intention. Of these factors, security was mentioned most often by our participants. This is consistent with the findings of Armbrust *et al.* (2010), who note that security, to include confidentially and auditability of data, is one of the most cited objections to cloud computing. Similarly, our content analysis detailed that a more negative opinion existed among the subjects interviewed regarding the external environment and its relationship to adopting cloud computing technologies. This was in direct contrast to the more positive opinion the subjects exhibited about their respective task and inter-organizational environments, as well as their firm's information processing capabilities. Past research has identified many perceived obstacles and opportunities in regard to the adoption of cloud computing (Armbrust *et al.*, 2010; Buyya *et al.*, 2009). Our study complements and extends the literature in this area in that the findings demonstrate how such perceived obstacles and opportunities directly impact an organization's intention to adopt cloud technologies. In addition, we provide more granular details regarding precisely how uncertainty may influence the adoption decision. Future research is encouraged to apply quantitative methods to validate these qualitative findings.

In light of the quantitative and qualitative evidence, we assert that these general trends that contrast environmental uncertainty against the factors that are more colloquially internal to the subject's perspective (i.e. task and information systems) could represent an anchoring effect in the respondents perspective regarding their intentions to adopt cloud computing technologies. In fact, further inspection of the subject comments related to the adoption of cloud computing technologies and environmental uncertainty focusses strongly on the potential for extremely negative effects from said adoption. This type of decision-making pattern, the overweighting of negative but unlikely outcomes has been widely studied in economics. For instance, Kahneman (2011) developed a unified generalizable explanation for this decision pattern known as the "prospect theory," which suggests that individuals use personal heuristics to make decisions based on the potential value of gains and losses, and not necessarily based on final outcomes. The quantitative and qualitative data analysis in this study suggests that the prospect theory may be an appropriate lens through which researchers should examine complex process of technology adoption decisions.

Implications for practice

Our findings suggest that the decision to adopt cloud computing is based upon several interrelated decision criteria. Organizations looking to adopt cloud computing technologies should weigh levels of uncertainty against existing information processing capabilities in order to inform their decision on whether or not to adopt cloud computing. However, our results indicate that different types of uncertainty faced by organizations elicit different responses. In general, firms faced with higher levels of environmental and inter-organizational uncertainty may be more apt to adopt cloud computing, whereas firms faced with higher levels of task uncertainty may look to other options to build capacity or rely upon existing information system infrastructure. Furthermore, the degree of information processing capability significantly moderates the effects of all three types of uncertainty, which suggests that existing capabilities play a significant role in the adoption decision.

The complex relationships identified in this study preclude us from offering generalized advice to all supply chain firms regarding whether or not the cloud may satisfy their computing needs. Instead, we conclude that each unique organizational circumstance and the specific computing applications that the organization seeks to support with cloud technologies should be considered when making the adoption decision. Specifically, we direct practitioners to Figure 2 in order to help determine how their specific circumstance may or may not favor cloud computing adoption.

Limitations and conclusion

Although the current study makes contributions in the realm of theory, methodology, and practice within the SCM literature, it nevertheless has limitations. First, our survey was limited to individuals in four specific organization types – manufacturing, logistics, distribution, and retailing. While we assert that these types of organizations comprise a significant representation of supply chain participants, we do understand that it is an incomplete sample and we cannot extrapolate or generalize our findings beyond those firms that participated in the research described herein. Future research may wish to extend our study to additional types of organizations and countries.

In addition, our survey data collection is comprised of single key respondents (most of which are IT managers) from each firm represented in the study. IT and operations managers were sought for our sample frame because our study seeks to assess an organization's intention to adopt a particular type of technology. Although others in the organization might have a perspective, they would not necessarily be in a position to act as decision makers and precipitate an adoption of the technology of interest on behalf of the organization. While the use of key respondents is not an ideal means for eliciting highly reliable perceptions, it is nonetheless a commonly accepted practice in survey research that we believe provided an adequate opportunity to examine the relationships suggested in this study (Liu *et al.*, 2010). Future research could validate or extend our model using a different sample profile. Finally, the content analysis of the qualitative data is limited to the subjective classifications of three experts. Although measures were taken to ensure that there was a satisfactory level of competence and each expert was applying the same classification criteria to the data, there may be variations in the thought processes of the coders that are not detected or obvious in the classification and weight of the comments that were analyzed.

Despite these potential limitations, this study successfully applies organizational information processing theory to the adoption of technology in supply chain organizations. We believe this study makes a significant contribution for multiple reasons. First, from a broader perspective, given the prevalence of the adoption of internet-enabled technologies like cloud computing in supply chain firms, one would expect the importance of the subject addressed herein to increase with the passage of time. Additionally, our research provides additional linkages between traditional management theory and supply chain practice. This extension provides for a more complete grounding of the observable phenomena that occur in the ordinary course of supply chain operations with rigorously tested theory. Also, we utilized a mixed-methods approach, which provided a more complete understanding of the dynamic effects and interactions in question than would have been achieved using either methodological approach in singularity. Finally, through the current study, we have suggested another relevant lens – the prospect theory of decision making – through which additional research may be conducted to enhance the understanding of technology adoption in the supply chain.

References

Aiken, L.S. and West, S.G. (1991), *Multiple Regression: Testing and Interpreting Interactions*, Sage, Newbury Park, CA.

Ajzen, I. (2005), *Attitudes, Personality and Behavior*, McGraw-Hill, New York, NY.

Armbrust, M., Fox, A., Griffith, R., Joseph, A.D., Datz, R., Konwinski, A., Lee, G., Patterson, D., Rabkin, A., Stoica, I. and Zaharia, M. (2010), "A view of cloud computing", *Communications of the ACM*, Vol. 53 No. 4, pp. 50-8.

Autry, C.W., Grawe, S.J., Daugherty, P. and Richey, R.G. Jr (2010), "The effects of technological turbulence and breadth on supply chain technology acceptance and adoption", *Journal of Operations Management*, Vol. 28 No. 6, pp. 522-36.

Aymerich, F.M., Fenu, G. and Surcis, S. (2008), "An approach to a cloud computing network", *First International Conference on the Applications of Digital Information and Web Technologies, Ostrava, Czech Republic*, pp. 113-18.

Beamon, B.M. (1998), "Supply chain design and analysis: models and methods", *International Journal of Production Economics*, Vol. 55 No. 3, pp. 281-94.

Bhattacherjee, A. and Premkumar, G. (2004), "Understanding changes in belief and attitude toward information technology usage: a theoretical model and longitudinal test", *MIS Quarterly*, Vol. 28 No. 2, pp. 229-54.

Boyer, K.K. and Hult, G.T.M. (2005), "Extending the supply chain: integrating operations and marketing in the online grocery industry", *Journal of Operations Management*, Vol. 23 No. 6, pp. 642-61.

Boyer, K.K. and Olson, J.R. (2002), "Drivers of internet purchasing success", *Production and Operations Management*, Vol. 11 No. 4, pp. 480-98.

Boyer, K.K. and Swink, M. (2008), "Empirical elephants – why multiple methods are essential to quality research in operations and supply chain management", *Journal of Operations Management*, Vol. 26 No. 3, pp. 337-48.

Brewer, M.B., Campbell, D.T. and Crano, W.D. (1970), "Testing a single-factor model as an alternative to the misuse of partial correlations in hypothesis-testing research", *Sociometry*, Vol. 33 No. 1, pp. 1-11.

Buyya, R., Yeo, C.S., Venugopal, S., Broberg, J. and Brandic, I. (2009), "Cloud computing and emerging IT platforms: vision, hype, and reality for delivering computing as the 5th utility", *Future Generation Computer Systems*, Vol. 25 No. 6, pp. 599-616.

Byrd, T.A. and Turner, D.E. (2000), "Measuring the flexibility of information technology infrastructure: exploratory analysis of a construct", *Journal of Management Information Systems*, Vol. 17 No. 1, pp. 167-208.

Chen, M., Zhang, D. and Zhou, L. (2007), "Empowering collaborative commerce with web services enabled business process management systems", *Decision Support Systems*, Vol. 43 No. 2, pp. 530-46.

Christopher, M. and Lee, H. (2004), "Mitigating supply chain risk through improved confidence", *International Journal of Physical Distribution & Logistics Management*, Vol 34 No. 5, pp. 388-96.

Christopher, M. and Peck, H. (2004), "Building the resilient supply chain", *International Journal of Logistics Management*, Vol. 15 No. 2, pp. 1-13.

Christopher, M., Lowson, R. and Peck, H. (2004), "Creating agile supply chains in the fashion industry", *International Journal of Retail and Distribution Management*, Vol. 32 No. 8, pp. 367-76.

Cohen, J., Cohen, P., West, S.G. and Aiken, L. (2003), *Applied Multiple Regression/Correlation Analysis for the Behavioral Sciences*, Lawrence Earlbaum Associates, Mahwah, NJ.

Defee, C.C. and Fugate, B.S. (2010), "Changing perspective of capabilities in the dynamic supply chain era", *International Journal of Logistics Management*, Vol. 21 No. 2, pp. 180-206.

Duclos, L.K., Vokurka, R.J. and Lummus, R.R. (2003), "A conceptual model of supply chain flexibility", *Industrial Management and Data Systems*, Vol. 103 No. 6, pp. 446-63.

Duncan, R.B. (1972), "Characteristics of organizational environments and perceived environmental uncertainty", *Administrative Science Quarterly*, Vol. 17 No. 3, pp. 313-27.

Eimaraghy, W.H. and Urbanic, R.J. (2004), "Assessment of manufacturing operational complexity", *CIRP Annals – Manufacturing Technology*, Vol. 53 No. 1, pp. 401-6.

Fawcett, S.E., Calantone, R.J. and Smith, S.R. (1996), "An investigation of the impact of flexibility on global reach and firm performance", *Journal of Business Logistics*, Vol. 17 No. 2, pp. 167-96.

Fredericks, E. (2005), "Infusing flexibility into business-to-business firms: a contingency theory and resource-based view perspective and practical implications", *Industrial Marketing Management*, Vol. 34 No. 6, pp. 555-65.

Frohlich, M.T. (2002), "E-integration in the supply chain: barriers and performance", *Decision Sciences*, Vol. 33 No. 4, pp. 537-56.

Frohlich, M.T. and Westbrook, R. (2001), "Arcs of integration: an international study of supply chain strategies", *Journal of Operations Management*, Vol. 19 No. 2, pp. 180-200.

Galbraith, J.R. (1974), "Organization design: an information processing view", *Interfaces*, Vol. 4 No. 3, pp. 28-36.

Gimenez, C. and Lourenco, R. (2008), "E-SCM: internet's impact on supply chain processes", *International Journal of Logistics Management*, Vol. 19 No. 3, pp. 309-43.

Goldsby, T.J. and Stank, T.P. (2000), "World class logistics performance and environmentally responsible logistics practices", *Journal of Business Logistics*, Vol. 21 No. 2, pp. 187-208.

Greene, C.N. and Organ, D.W. (1973), "An evaluation of causal models linking the received role with job satisfaction", *Administrative Science Quarterly*, Vol. 18 No. 1, pp. 95-103.

Guest, G., Bunce, A. and Johnson, L. (2006), "How many interviews are enough? An experiment with data saturation and variability", *Field Methods*, Vol. 18 No. 1, pp. 59-82.

Hall, D.J., Skipper, J.B., Hazen, B.T. and Hanna, J.B. (2012), "Inter-organizational IT use, cooperative attitude, and inter-organizational collaboration as antecedents to contingency planning effectiveness", *International Journal of Logistics Management*, Vol. 23 No. 1, pp. 50-76.

Harman, H.H. (1960), *Modern Factor Analysis*, University of Chicago Press, Chicago, IL.

Harwood, T.G. and Garry, T. (2003), "An overview of content analysis", *The Marketing Review*, Vol. 3 No. 4, pp. 479-98.

Hazen, B.T. and Byrd, T.A. (2012), "Toward creating competitive advantage with logistics information technology", *International Journal of Physical Distribution and Logistics Management*, Vol. 42 No. 1, pp. 8-35.

Hazen, B.T., Hall, D.J. and Hanna, J.B. (2012), "Reverse logistics disposition decision-making: developing a decision framework via content analysis", *International Journal of Physical Distribution and Logistics Management*, Vol. 42 No. 3, pp. 244-74.

Hubbard, D. (2010), *How to Measure Anything: Finding the Value of Intangibles in Business*, John Wiley & Sons, Hoboken, NJ.

IBM (2009), "The benefits of cloud computing", available at: ftp://public.dhe.ibm.com/common/ssi/ecm/en/diw03004usen/DIW03004USEN.PDF (accessed February 5, 2012).

IBM Global Technology Services (2010), "Getting cloud computing right", available at: http://public.dhe.ibm.com/common/ssi/ecm/en/ciw03078usen/CIW03078USEN.PDF (accessed February 5, 2012).

IBM Global Technology Services (2011), "Strategies for assessing cloud security", available at: http://public.dhe.ibm.com/common/ssi/ecm/en/sew03022usen/SEW03022USEN.PDF (accessed February 5, 2012).

Juttner, U. (2005), "Supply chain risk management: understanding the business requirements from a practitioner perspective", *International Journal of Logistics Management*, Vol. 16 No. 1, pp. 120-41.

Juttner, U., Peck, H. and Christopher, M. (2003), "Supply chain risk management: outlining an agenda for future research", *International Journal of Logistics Research and Applications*, Vol. 6 No. 4, pp. 197-210.

Kahneman, D. (2011), *Thinking, Fast and Slow*, Farrar, Straus and Giroux, New York, NY.

Ke, W., Liu, H., Wei, K.K., Gu, J. and Chen, H. (2009), "How do mediated and non-mediated power affect electronic supply chain management system adoption? The mediation effects of trust and institutional pressures", *Decision Support Systems*, Vol. 46 No. 4, pp. 839-51.

Kendall, M. and Gibbons, J.D. (1990), *Rank Correlation Methods*, Oxford University Press, New York, NY.

Khalifa, M. and Davison, R.M. (2006), "SME adoption of IT: the case of electronic trading systems", *IEEE Transactions on Engineering Management*, Vol. 53 No. 2, pp. 275-84.

Krippendorff, K. (2004), *Content Analysis: An Introduction to its Methodology*, Sage Publications, Thousand Oaks, CA.

Lee, H.L. and Whang, S. (2004), "E-business and supply chain integration", *International Series in Operations Research and Management Science*, Vol. 62 No. 2, pp. 123-38.

Li, B. and Lin, B. (2006), "Accessing information sharing and information quality in supply chain management", *Decision Support Systems*, Vol. 42 No. 3, pp. 1641-56.

Li, G., Yang, H., Sun, L., Ji, P. and Feng, L. (2010), "The evolutionary complexity of complex adaptive supply networks: a simulation and case study", *International Journal of Production Economics*, Vol. 124 No. 2, pp. 310-30.

Liu, H. and Orban, D. (2008), "Gridbatch: cloud computing for large-scale data-intensive batch applications", *8th IEEE International Symposium on Cluster Computing and the Grid, Lyon*, pp. 295-305.

Liu, H., Ke, W., Wei, K.K., Gu, J. and Chen, H. (2010), "The role of institutional pressures and organizational culture in the firm's intention to adopt internet-enabled supply chain management systems", *Journal of Operations Management*, Vol. 28 No. 5, pp. 372-84.

Lohr, S. (2007), "Google and I.B.M. join in 'cloud computing' research", available at: www.csun.edu/pubrels/clips/Oct07/10-08-07E.pdf (accessed February 10, 2012).

Mangan, J., Lalwani, C. and Gardner, B. (2004), "Combining quantitative and qualitative methodologies in logistics research", *International Journal of Physical Distribution and Logistics Management*, Vol. 34 No. 7, pp. 565-78.

Melville, N. and Ramirez, R. (2008), "Information technology innovation diffusion: an information requirements paradigm", *Information Systems Journal*, Vol. 18 No. 3, pp. 247-73.

Miller, G.A. (1956), "The magical number seven, plus or minus two: some limits on our capacity for processing information", *Psychological Review*, Vol. 63 No. 2, pp. 81-97.

Montabon, F.L., Sroufe, R.P. and Narasimhan, R. (2007), "An examination of corporate reporting, environmental management practices and firm performance", *Journal of Operations Management*, Vol. 25 No. 5, pp. 998-1014.

Morris, R. (1994), "Computerized content analysis in management research: a demonstration of advantages and limitations", *Journal of Management*, Vol. 20 No. 4, pp. 903-31.

Novak, S. and Eppinger, S.D. (2001), "Sourcing by design: product complexity and the supply chain", *Management Science*, Vol. 47 No. 1, pp. 189-204.

Okoli, C. and Pawlowski, S.D. (2004), "The Delphi method as a research tool: an example, design considerations and applications", *Information & Management*, Vol. 42 No. 1, pp. 15-29.

Olson, J.R. and Boyer, K.K. (2005), "Internet ticketing in a not-for-profit, service organization: building customer loyalty", *International Journal of Operations & Production Management*, Vol. 25 No. 1, pp. 74-92.

Pagell, M. and Krause, D.R. (1999), "A multiple-method study of environmental uncertainty and manufacturing flexibility", *Journal of Operations Management*, Vol. 17 No. 3, pp. 307-25.

Peck, H. (2005), "Drivers of supply chain vulnerability: an integrated framework", *International Journal of Physical Distribution & Logistics Management*, Vol. 35 No. 4, pp. 210-32.

Peck, H. and Juttner, U. (2000), "Strategy and relationships: defining the interface in supply chain contexts", *International Journal of Logistics Management*, Vol. 11 No. 2, pp. 33-44.

Perona, M., Cigolini, R., Adani, M., Biondi, R., Guzzetti, S., Jenna, R., Chessa, M. and Agellara, S. (2001), "The integrated management of logistic chains in the white goods industry. A field research in Italy", *International Journal of Production Economics*, Vol. 69 No. 2, pp. 227-38.

Podsakoff, P.M. and Organ, D.W. (1986), "Self reports in organizational research: problems and prospects", *Journal of Management*, Vol. 12 No. 4, pp. 531-44.

Prater, E. (2005), "A framework for understanding the interaction of uncertainty and information systems on supply chains", *International Journal of Physical Distribution and Logistics Management*, Vol. 35 No. 7, pp. 524-39.

Premkumar, G., Ramamurthy, K. and Saunders, C.S. (2005), "Information processing view of organizations: an exploratory examination of fit in the context of interorganizational relationships", *Journal of Management Information Systems*, Vol. 22 No. 1, pp. 257-94.

Rai, A., Patnayakuni, R. and Seth, N. (2006), "Firm performance impacts of digitally enabled supply chain integration capabilities", *MIS Quarterly*, Vol. 30 No. 2, pp. 225-46.

Rogelberg, S.G. and Stanton, J.M. (2007), "Introduction: understanding and dealing with organizational survey nonresponse", *Organizational Research Methods*, Vol. 10 No. 2, pp. 195-209.

Sanchez-Rodrigues, V., Potter, A. and Naim, M.M. (2010a), "Evaluating the causes of uncertainty in logistics operations", *International Journal of Logistics Management*, Vol. 21 No. 1, pp. 45-64.

Sanchez-Rodrigues, V., Potter, A. and Naim, M.M. (2010b), "The impact of logistics uncertainty on sustainable transport operations", *International Journal of Physical Distribution and Logistics Management*, Vol. 40 Nos 1/2, pp. 61-83.

Sanchez-Rodrigues, V., Stantchev, D., Potter, A., Naim, M.M. and Whiteing, A. (2008), "Establishing a transport operation focused uncertainty model for the supply chain", *International Journal of Physical Distribution and Logistics Management*, Vol. 38 No. 5, pp. 388-411.

Sanders, N.R. and Wagner, S.M. (2011), "Multidisciplinary and multimethod research for addressing contemporary supply chain challenges", *Journal of Business Logistics*, Vol. 32 No. 4, pp. 317-23.

Sanders, N.R., Autry, C.W. and Gligor, D.M. (2011), "The impact of buyer firm information connectivity enablers on supplier firm performance: a relational view", *International Journal of Logistics Management*, Vol. 22 No. 2, pp. 179-201.

Siegel, S. (1956), *Nonparametric Statistics for the Behavioral Sciences*, McGraw-Hill, New York, NY.

Starr, E.C., Kambil, A., Whitaker, J.D. and Brooks, J.D. (2000), "One size does not fit all – the need for an e-marketplace portfolio", *Advances in Supply Chain Management*, Vol. 3 No. 1, pp. 96-9.

Swafford, P., Ghosh, S. and Murthy, N. (2006), "The antecedents of supply chain agility of a firm: scale development and model testing", *Journal of Operations Management*, Vol. 24 No. 2, pp. 170-88.

Swamidass, P.M. and Newell, W.T. (1987), "Manufacturing strategy, environmental uncertainty and performance: a path analytic model", *Management Science*, Vol. 33 No. 4, pp. 509-24.

Tangpong, C. (2011), "Content analytic approach to measuring constructs in operations and supply chain management", *Journal of Operations Management*, Vol. 29 No. 6, pp. 627-38.

Teo, H.H., Wei, K.K. and Benbasat, I. (2003), "Predicting intention to adopt interorganizational linkages: an institutional perspective", *MIS Quarterly*, Vol. 27 No. 1, pp. 19-49.

Tokar, T. (2010), "Behavioural research in logistics and supply chain management", *International Journal of Logistics Management*, Vol. 21 No. 1, pp. 89-103.

Tokar, T., Aloysius, J.A., Waller, M.A. and Williams, B.D. (2011), "Retail promotions and information sharing in the supply chain: a controlled experiment", *International Journal of Logistics Management*, Vol. 22 No. 1, pp. 5-25.

Tushman, M.L. and Nadler, D.A. (1978), "Information processing as an integrating concept in organizational design", *Academy of Management Review*, Vol. 3 No. 3, pp. 613-24.

van der Vorst, J.G.A.J. and Beulens, A.J.M. (2002), "Identifying sources of uncertainty to generate supply chain redesign strategies", *International Journal of Physical Distribution and Logistics Management*, Vol. 32 No. 6, pp. 409-30.

van der Vorst, J.G.A.J., Beulens, A.J.M., de Wit, W. and van Beek, P. (1998), "Supply chain management in food chains: improving performance by reducing uncertainty", *International Transactions in Operations Research*, Vol. 4 No. 6, pp. 487-99.

van Hoek, R.I. (1998), "Logistics and virtual integration: postponement, outsourcing and the flow of information", *International Journal of Physical Distribution & Logistics Management*, Vol. 28 No. 7, pp. 508-23.

Vaquero, L.M., Rodero-Merino, L., Caceres, J. and Lindner, M. (2008), "A break in the clouds: towards a cloud definition", *ACM SIGCOMM Computer Communication Review*, Vol. 39 No. 1, pp. 50-5.

Venkatraman, N. (1989), "The concept of fit in strategy research: toward verbal and statistical correspondence", *Academy of Management Review*, Vol. 14 No. 3, pp. 423-44.

Wagner, S.M. and Kemmerling, R. (2010), "Handling nonresponse in logistics research", *Journal of Business Logistics*, Vol. 31 No. 2, pp. 357-81.

Wang, E.T.G., Tai, J.C.F. and Wei, H.-L. (2006), "A virtual integration theory of improved supply-chain performance", *Journal of Management Information Systems*, Vol. 23 No. 2, pp. 41-64.

Wilding, R. (1998), "The supply chain complexity triangle: uncertainty generation in the supply chain", *International Journal of Physical Distribution & Logistics Management*, Vol. 28 No. 8, pp. 599-616.

Yao, Y., Palmer, J.W. and Dresner, M.E. (2007), "An interorganizational perspective on the use of electronically-enabled supply chains", *Decision Support Systems*, Vol. 43 No. 3, pp. 884-96.

Zhu, K., Kraemer, K.L. and Xu, S. (2006), "The process of innovation assimilation by firms in different countries: a technology diffusion perspective on e-business", *Management Science*, Vol. 52 No. 10, pp. 1557-76.

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