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Antecedents and Consequence of Internet-enabled Supply Chain Integration: An Exploratory

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ABSTRACT

Understanding the antecedents and consequence of Internet-enabled Supply Chain Integration (IeSCI) is an important concern to researchers and practitioners. Although the existing research has identified economic and legitimacy-oriented motives that lead IeSCI, there is a lack of research investigating how these motives are interrelated. In addition, the findings of previous studies on the consequence of IeSCI adoption have been mixed and even controversial. Drawing upon transactional cost economics (TCE) and institutional theory, this study develops a research model on the interrelationships between economic and legitimacy-oriented motives, the IeSCI dimensions, and firm performance. Results from a survey show that the firm's economic and legitimacy motives have positive effects on the adoption of IeSCI dimensions (i.e., information integration, planning synchronization and operational coordination). Meanwhile, economic and legitimacy motives are significantly interrelated. In addition, information integration and operational coordination can improve firm operational and customer service performance. Contributions and implications of this study are discussed.

Keywords

Internet-enabled Supply Chain Integration, economic motive, legitimacy motive

INTRODUCTION

Fostering Supply Chain Integration (SCI) with trading partners via the Internet has been regarded as a crucial element of firm strategies and thus the core of supply chain management (Frohlich 2002; Frohlich et al. 2001; Frohlich et al. 2002; Rai et al. 2006; Vaart et al. 2008; Vickery et al. 2003). In particular, the Internet-enabled Supply Chain Integration (IeSCI) enables firms to integrate their fragmented, silo-oriented supply chain with low cost, rich content, and more applicable and easier to implement format (Rai et al. 2006). It is well touted that IeSCI allows firms to respond to the challenges at strategic, tactical, operational, and technological levels, and subsequently derive superior profitability and competitive advantage (Frohlich 2002; Frohlich et al. 2002; Lee 2000; Lee et al. 2004). However, the adoption of IeSCI remains insufficient and the industry is still plagued with supply chain failures (Vaart et al. 2008). In addition, it is reported that firms engaged in IeSCI have not materialized the purported benefits of IeSCI (Devaraj et al. 2007; Rai et al. 2006; Vaart et al. 2008; Vickery et al. 2003). Thus, it is of great significance to investigate the antecedents and consequences of IeSCI adoption.

It is well established in the literature that organizations expend rational effort on economic justification and evaluation of the institutional pressures simultaneously when they are deciding whether to adopt a new practice (Perrow 1985). In addition, organizational theorists assert that an organization's expectations about the implication of an innovation are socially constructed and thus influenced by institutional factors. This notion suggests that expectations of economic gains and maintaining legitimacy are not independent of each other (Martinez et al. 1999; Roberts et al. 1997). As such, a model without incorporating the inter-relationship between economic and legitimacy motives is incomplete and may be dubious. However, an assumption underlying the existing research primarily focuses on either the effects of economic or legitimacy-oriented motives, except the work by Grewal et al. (2001), Son and Benbasat (2007), and Ketokivi and Schroeder (2004).

Also, few studies have investigated how economic and legitimacy motives are interrelated. The importance and lacking of such research motivate us to conduct the research reported in the current paper.

On the other hand, the findings of previous research on the relationship between IeSCI and performance have been mixed, and even controversial (Fabbe-Costes et al. 2007; Vaart et al. 2008). While a few studies indicate that IeSCI improves performance (e.g., Cagliano et al. 2006; Frohlich et al. 2001), others found that the integration is more rhetoric than reality (e.g., Power 2005). To enhance our understanding of the consequence of IeSCI adoption and better guide firms to avoid throwing good money after bad, it is imperative to resolve the inconsistency in the extant literature and crystallize how performance may be enhanced by the adoption of IeSCI.

The mixed empirical research findings can be attributed to the inconsistency of conceptualization and measurement of IeSCI (Vaart and Donk 2008; Frohlich and Westbrook 2002). The existing empirical research on IeSCI has conceptualized IeSCI as either as a one-dimensional construct or a *static* process consisted of integration of different business functions (e.g., Stank et al. 2001). Yet, Lee and Whang (2004) contend that IeSCI is a continuous *dynamic* process that involves information integration, planning synchronization and workflow coordination. These dimensions of IeSCI reflect escalating degrees of coordination and collaboration between participating organizations (Frohlich 2002). It is suggested by strategic management literature that different motives for adoption may have different effects on the actual implementation of the innovation (Perrow 1985). In particular, different motives may lead firms to adopt different dimensions of IeSCI. Thus, regarding IeSCI as a multi-dimensional construct, we intend to investigate motives are differentially related to the adoption of different dimensions of IeSCI and how the adoption of dimensions of IeSCI is related to firm performance.

Drawing upon Transactional Cost Economics (TCE) and institutional theory (DiMaggio et al. 1983; Powell et al. 1991; Williamson 1979), we develop our research model. Data collected from 255 senior executives in China provide general support for our research model.

THEORETICAL UNDERPINNINGS AND RESEARCH MODEL

The extant literature has identified a set of motivations for the adoption of inter-organizational collaborative innovations in general and IeSCI adoption in particular (e.g., Amit et al. 2001; Frohlich 2002; Grewal et al. 2001; Ke et al. 2009; Oliver 1990; Teo et al. 2003). These motivations can be categorized into economic and legitimacy-oriented motives. Economic motives focus on economic benefits that may be derived from the innovation. According to TCE, organizations strive to minimize the total costs, comprising both transaction and production costs, by selecting the best organizational governance structure (e.g., market, hierarchy or hybrid) for the particular situations encountered (Williamson 1979). Thus, managers expend effort on rational evaluation and cost-benefit analysis of an innovation when deciding whether to adopt it. As noted by Powell and DiMaggio (1991), the dramatic changes in the information and communication technology have important implications for governance structure design and inter-organizational practices in particular. Indeed, Amit and Zott (2001) propose that e-business such as IeSCI offers adopting organizations four types of value, namely efficiency, novelty, lock-in and complementarities.

Empirically, researchers have found that expectations about efficiency, exploration, agility and complementarities are critical drivers for the organization's adoption of inter-organizational innovation (e.g., Barringer et al. 2000; Frohlich et al. 2002; Grewal et al. 2001; Oliver 1990; Son et al. 2007). Specifically, efficiency motive refers to the degree to which an organization emphasizes the improvement of economic efficiency of business processes (Grewal et al. 2001; Son and Benbasat 2007); exploration motive is defined as the degree of an organization's emphasis on organizational experimentations with new business approaches, models and opportunities (Barringer et al. 2000); agility motive is the extent to which an organization stresses quick and smooth response to the sudden and unexpected shifts in the supply chain (Swofford et al. 2006); and complementarities motive is the degree to which a firm attempts to complement unique resources and strengths with that of supply chain partners (King et al. 2003).

While studies applying TCE offers insights into how organizations, as agents with bounded rationality, adopt inter-organizational innovations with an emphasis on economic benefits, studies applying TCE are criticized for its being “undersocialized” (Granovetter 1985). The institutional approach rejects the premise that organizational phenomena are the products of rational choice based on technical considerations as suggested by TCE (Westney 1993). Rather, the institutional fields impose constraints on the organization’s search for optimal efficiency since organizations operate in institutional, as well as competitive environments (DiMaggio et al. 1983; Oliver 1991; Roberts et al. 1997). In particular, institutional theorists contend that pressures emanating from the institutional fields push organizations to adopt shared notions and organizational governance structures so that they can acquire or maintain legitimacy, which is critical for their survival (DiMaggio et al. 1983). Legitimacy-oriented motives include normative, mimetic and coercive pressures (DiMaggio et al. 1983). Normative pressures refer to the pressures that stem from collective expectations to conduct work professionally, mimetic pressures stem from perceived success of competitors’ actions, while coercive pressures arise from broad-based societal expectations as well as from inter-organizational dependence (DiMaggio et al. 1983). Indeed, drawing upon institutional theory, empirical researchers found that legitimacy-oriented motives are important antecedents of the adoption of e-business such as IeSCI (e.g., Grewal et al. 2001; Son et al. 2007; Teo et al. 2003).

The existing studies on the antecedents of IeSCI have two limitations. First, they assume that economic and legitimacy-oriented motives are independents of each other and thus do not explore the interrelationship between economic and legitimacy-oriented motives. However, it is established that the organization’s expectations about a given structural design is dependent on the prevailing institutional environment (Ouchi 1980; Roberts et al. 1997). Second, prior studies treat IeSCI adoption as a one-dimensional construct and ignore the extent to which the supply chain is integrated. Thus, the literature is mute about how economic and legitimacy-oriented motives affect the actual adoption or implementation of IeSCI. Previous studies suggest that IeSCI has multiple dimensions (e.g., Fabbe-Costes et al. 2007; Frohlich 2002; Romano 2003; Stank et al. 2001). For instance, Romano (2003) posits that IeSCI involves functional, logistic, information and process integration. Stank et al. (2001) suggest that IeSCI has the dimensions of customer, internal, material/service supplier, technology and planning, measurement and relationships integration. Yet, these studies, except the work by Lee and Whang (2004), neglect that IeSCI is an innovative practice with a continuous nature (Fabbe-Costes et al. 2007). Lee and Whang (2004) suggest that IeSCI has dimensions of escalating degrees, namely, information integration, planning synchronization, and workflow coordination. Information integration refers to the sharing of information among members along the supply chain, planning synchronization refers to the joint design and execution of plans for forecasting and replenishment, and workflow coordination refers to highly streamlined workflow activities between supply chain partners (Lee et al. 2004).

On the other hand, the positive effects of IeSCI on organizational performance have not gained consistent empirical support although the mainstream of logistics and supply chain management well touts the benefits of IeSCI. In particular, it is theoretically purported that IeSCI helps integrated organizations enhance operation efficiency, product and market development, and thus allows them to derive competitive advantage which cannot be achieved individually (Frohlich et al. 2001; Rai et al. 2006). However, the findings of empirical research investigating the consequence of IeSCI adoption are mixed, and even controversial. While a few studies found that IeSCI improves organizational performance (e.g., Cagliano et al. 2006; Frohlich 2002), other researcher suggest that IeSCI may be more rhetoric than reality (e.g., Power 2005). Therefore, scholars are intrigued to and start to question whether IeSCI really can improve organizational performance or it is simply the Emperor’s new suit (e.g., Fabbe-Costes et al. 2007; Vaart et al. 2008). In particular, a few scholars contend that the mixed findings are due to inconsistent conceptualization of the IeSCI construct and thus issue a call for research to study the nuances of IeSCI (e.g., Fabbe-Costes et al. 2007; Frohlich 2002; Vaart et al. 2008).

RESEARCH FRAMEWORK

To address the shortfalls in the extant literature, we follow Lee and Whang (2004) and regard IeSCI as a multi-dimensional construct. Also, we investigate the relationships between economic and legitimacy-oriented motives, their effects on the adoption of dimensions of IeSCI. In addition, we examine the effects of IeSCI adoption on a firm’s substantive performance. Figure 1 depicts our research model.

The extant literature suggests that institutional factors influence the formation of economic expectation of a governance structure (Roberts et al. 1997). The organization, with bounded rationality, has cognitive limitations, which make it unlikely

to form completely accurate assessment of the economic implications of every structure design (Dow 1987). Instead, the decision makers will refer to the institutional environment for guidance. As a result, the evaluation of the structure's economic implications is socially constructed and dependent on the prevailing institutional environment (Ouchi 1980).

In the context of IeSCI, legitimacy-oriented motives serve as a source of information about the economic benefits of IeSCI. The economic benefits of IeSCI themselves are not observable and the transactional costs associated with IeSCI as an innovation are relatively tacit (Ghoshal et al. 1996). With the ambiguous information, decision makers tend to use cognitive simplification processes to overcome uncertainty and conquer the information process challenge (Huff 1990). In particular, decision makers will seek guidance from the experiences of others in comparable situations (Powell et al. 1991). The successful stories of their counterparts would generate mimetic pressures, which will lead decision makers to formulate positive expectations about IeSCI (Frohlich et al. 2002). Similarly, the organization infers the economic benefits of IeSCI from coercive and normative pressures. Normative pressures, representing collective expectations of professional practices, signal that the aftermath interdependencies of IeSCI will be system-wide would be managed collectively, rather than be held hostage to opportunistic schemes (Martinez et al. 1999). Also, coercive pressures usually are exerted, together with favorable information and references provided by powerful parties in the field (Ke et al. 2009; Ke et al. 2008). When decision makers are processing such information, their understanding of the economic implications of IeSCI is elevated accordingly.

H1: An organization's legitimacy-oriented motives for IeSCI adoption namely, (1) normative pressures, (2) mimetic pressures, and (3) coercive pressures, are positively related to economic motives.

The TCE has suggested that expectations about the economic benefits lead the organization to adopt governance structural innovation (Williamson 1985). Indeed, this thesis has gained consistent support from a plethora of empirical studies (e.g., Frohlich et al. 2002; Grewal et al. 2001; Son et al. 2007). According to the extant supply chain management literature, IeSCI offers four categories of economic benefits, i.e., efficiency, exploration, agility and complementarities (Frohlich et al. 2002; Lee et al. 2004). Thus, we expect that economic motives derived from these value expectations will be drivers for the organization's IeSCI adoption. Also, to differentiate the escalating degrees of coordination and collaboration, we follow Lee and Whang (2004) and conceptualize IeSCI as a construct of three dimensions namely information integration, planning synchronization and operational coordination.

H2: An organization's (a) efficiency, (b) exploration, (c) agility and (d) complementarities motives have positive effects on its adoption of (1) information integration (2) planning synchronization and (3) operational coordination, respectively.

On the other hand, the institutional theory suggests that the driving force behind an organization's adoption of a governance structure is a desire to achieve a fit with the institutional field (DiMaggio et al. 1983; Martinez et al. 1999). In particular, the organization acquiesces to pressures from a variety of constituents to acquire or maintain legitimacy although it may result in inefficiency. Indeed, empirical studies have lent support to this argument (e.g., Grewal et al. 2001; Ke et al. 2009; Son et al. 2007; Teo et al. 2003). As such, legitimacy-oriented motives would lead the firm to adopt IeSCI so that the firm would appear to be in agreement with the prevailing norms, rules, beliefs, or expectations of external constituents (Grewal et al. 2001; Ke et al. 2009; Oliver 1990; Son et al. 2007; Teo et al. 2003). Thus, we expect that legitimacy-oriented motives (i.e., normative, mimetic and coercive pressures) would lead the organization to adopt IeSCI.

H3: An organization's perceived (a) normative, (b) mimetic and (c) coercive pressures have a positive effect on its adoption of (1) information integration, (2) planning synchronization and (3) operational coordination, respectively.

To systematically investigate the relationships between IeSCI and organization's performance, this research follows existing literature (Devaraj et al. 2007) by focusing on two aspects of organization's performance, namely, operational performance and customer service performance. The extant literature lends support for relationship between IeSCI and the organization's performance (e.g., Devaraj et al. 2007; Vaart et al. 2008). Specifically, Cagliano et al. (2006) and Fabbe-Costes et al. (2007) suggest that IeSCI has positive influence on operational performance while Vickery et al. (2003) and Lee (2000) posit that

IeSCI helps the organization improve customer service. However, it is criticized that the previous SCI-performance research examines IeSCI and performance without differentiating dimensions of these two constructs. As such, we follow Vaart et al. (2008) and differentiate the types of performance and IeSCI dimensions in the research. We propose the following hypotheses:

H4a: Information integration has positive effects on the firm's operational performance.

H4b: Information integration has positive effects on the firm's customer service quality.

H5a: Planning synchronization has positive effects on the firm's operational performance.

H5b: Planning synchronization has positive effects on the firm's customer service quality.

H6a: Operational coordination has positive effects on the firm's operational performance.

H6b: Operational coordination has positive effects on the firm's customer service quality.

RESEARCH METHODOLOGY

To test our research model, we employed the survey method to collect data in China. Specifically, senior executives, such as the vice president of information technology, chief technology officer, and chief operations officer, were chosen as the key survey informants. We contacted 1,000 firms, randomly chosen from a list provided by a Chamber of Commerce located in the east of China, and then sent out questionnaires to the 600 firms that agreed to complete our survey. Follow-up emails and telephone calls were made to improve the response rate. We finally received 255 completed questionnaires, which provided us with a response rate of approximately 26%.

An English questionnaire was developed based on previously validated measures. All items were measured with 5-point Likert scales, ranging from "strongly disagree" to "strongly agree". In particular, the items for efficiency, exploration, agility, and complementarities motive were adapted from Grewal et al. (2001), Frohlich and Westbrook (2002), Swafford et al. (2006), and Lambe et al. (2002), respectively. The measures for the institutional pressures, namely coercive, normative, and mimetic pressures, were adapted from Teo et al. (2003) and Son et al. (2007). We used the scales from Devaraj et al. (2007) to measure information integration, from Lee and Whang (2004) to assess planning synchronization, and from Fynes et al. (2005) to measure operational coordination. Further, operational and customer service performance items were adapted from Rai et al. (2006). We also measured the firm's ownership, industry, firm size and IT department size as control variables in the questionnaire. Given the survey was executed in China, we translated the questionnaire into Chinese firstly and then back-translated to English so as to ensure equivalence of meaning between the English and Chinese versions.

Data Analysis

According to Chin (1998), if a latent variable is assumed to be caused by its items, it is a formative construct. In our study, the construct of economic motive and legitimacy motive were identified as the second-order formative constructor. As such, partial least square (PLS) was chosen to analyze the data.

Measurement Model

Before testing our structural model, we assessed the measurement model's convergent validity and discriminant validity. For convergent validity, we assessed the reliability of items, Cronbach alpha, composite reliability of constructs, and Average Variance Extracted (AVE). As shown in Table 1, the results of Confirmatory Factor Analysis (CFA) indicated that the loadings of all items were above the benchmark level of 0.60 and values of Cronbach alpha ranging from 0.66 to 0.89 were also higher than the recommended level of 0.60. Also, the values of composite reliability ranging from 0.82 to 0.93 were above 0.70, the recommended level; and AVE scores ranged from 0.60 to 0.77 and were above the 0.50 recommended level. The results showed that our measurement model had satisfactory convergent validity. On the other hand, as shown in Table 2,

the square roots of AVEs for were greater than the correlations between related constructs, which confirmed the discriminant validity of the measurement model.

Construct	Items	Cronbach alpha	Composite Reliability	AVE
Efficiency Motive	3	0.74	0.85	0.66
Agility Motive	3	0.66	0.82	0.60
Exploration Motive	3	0.70	0.83	0.63
Complementarities Motive	3	0.74	0.85	0.66
Normative Pressures	4	0.89	0.92	0.75
Mimetic Pressures	4	0.80	0.87	0.63
Normative Pressures	4	0.85	0.90	0.70
Information Integration	6	0.88	0.91	0.62
Planning Synchronization	4	0.89	0.93	0.76
Operational Coordination	4	0.81	0.87	0.63
Operational Performance	3	0.76	0.86	0.68
Customer Service	3	0.85	0.91	0.77

Table 1. Results of Confirmatory Factor Analysis

	Mean	S.D.	EFM	EXM	AGM	COM	COP	NOP	MIP	IFI	PSY	OPC	OPP	CUS
Efficiency Motive	4.03	0.73	0.81											
Exploration Motive	3.77	0.77	0.41	0.77										
Agility Motive	3.65	0.75	0.52	0.62	0.79									
Complementarities Motive	3.65	0.80	0.41	0.50	0.55	0.81								
Coercive Pressures	3.05	0.96	0.25	0.32	0.23	0.21	0.87							
Normative Pressures	3.43	0.89	0.31	0.29	0.29	0.26	0.59	0.79						
Mimetic Pressures	3.26	0.90	0.28	0.35	0.26	0.20	0.62	0.68	0.83					
Information Integration	3.51	0.94	0.37	0.34	0.36	0.37	0.45	0.51	0.43	0.79				
Planning Synchronization	3.15	0.98	0.24	0.30	0.27	0.26	0.49	0.53	0.53	0.71	0.87			
Operational Coordination	3.24	0.95	0.28	0.34	0.29	0.35	0.64	0.63	0.57	0.66	0.69	0.80		
Operational Performance	3.73	0.76	0.31	0.34	0.34	0.32	0.37	0.40	0.39	0.48	0.42	0.45	0.82	
Customer Service	3.91	0.78	0.31	0.30	0.29	0.27	0.27	0.37	0.29	0.45	0.28	0.40	0.71	0.88

Table 2. Mean, standard deviation, and correlation

Note: The diagonal elements are the square root of the AVE.

Structural Model

Figure 1 shows the results of the structural model. In this study, one indicator for economic motive, namely agility motive, did not have significant formative weights. To retain the content validity, we retained this non-significant sub-construct our model as suggested by Rai et al. (2006). The results also showed that the dummy variables, namely ownership and industry, and control variables, namely firm size and IT department size, did not have significant effects on the dependent variables. In addition, the model explains 17 to 52 percent of the variances of related constructs. Most hypotheses were supported, except H5a and H5b (on the relationship between planning synchronization and operation performance and customer service, respectively). In particular, the results showed that a firm’s legitimacy motives ($\beta=0.41$, $p<0.01$) was positively related to its economic motive and thus H1 was supported. Meanwhile, the significant relationships between the firm’s legitimacy motives and its information integration ($\beta=0.43$, $p<0.01$), planning synchronization ($\beta=0.54$, $p<0.01$), and operational coordination ($\beta=0.65$, $p<0.01$) were significant and thus supported H2a-2c. Similarly, economic motive had significant impact on information integration ($\beta=0.29$, $p<0.01$), planning synchronization ($\beta=0.13$, $p<0.05$), and operational coordination ($\beta=0.14$, $p<0.01$). Thus, H3a-3c were supported. In addition, information integration was positively related to operational performance ($\beta=0.30$, $p<0.01$) and customer service ($\beta=0.42$, $p<0.01$), respectively, and therefore H4a and H4b were supported. Further, it was shown that operation coordination had significant influence on operational performance ($\beta=0.22$, $p<0.05$) and customer service ($\beta=0.28$, $p<0.01$). Hence H6a and H6b also were supported.

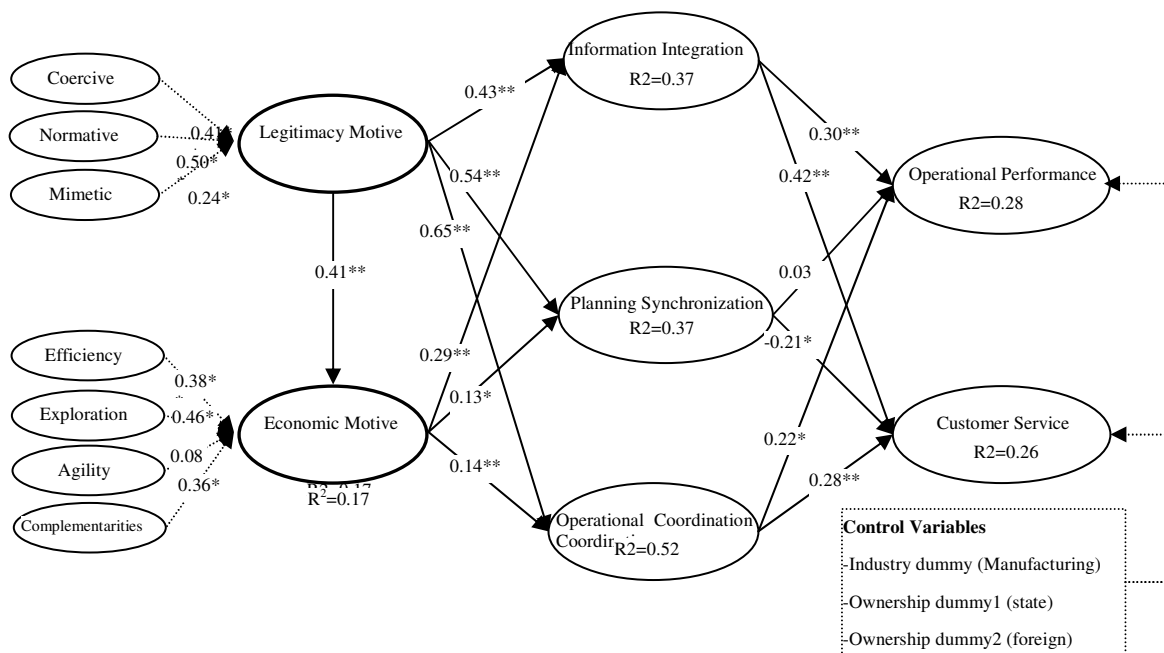


Figure 1. PLS results of the research framework

DISCUSSION AND CONCLUSION

This study explores the antecedents and consequences of IeSCI adoption. In particular, we investigate how economic and legitimacy motives jointly influence the adoption of different dimensions of IeSCI. In addition to assessing their direct effects, we also investigate how legitimacy motives affect economic motives. The data analysis results lend support for the hypothesized relationships among the motives and IeSCI adoption and thus are in accord with the previous empirical studies (e.g., Son and Benbasat 2007; Grewal et al. 2001). Also, the hypotheses on the relationships between dimensions of IeSCI and different aspects of firm performance are generally supported. Specifically, we found that both information integration and operational coordination have positive effects on operational performance and customer service quality. Different from what is expected, planning synchronization has no effect on operational performance. Also, planning synchronization has a significant negative effect on customer service quality. Such findings on the differential influences of dimensions of IeSCI on different aspects of firm performance may help explain the mixed findings of previous studies. In the meantime, we urge that

more research be conducted to investigate the relationships between dimensions of IeSCI and their effects on firm performance.

Our study contributes to the emerging research in the area of organizational adoption of IeSCI in the following ways. First, this study extends the applicability of organizational motivation theory to the IeSCI adoption context. It proposes a systematic framework to understand the motivations for the adoption of inter-organizational innovations, namely economic expectations of the firm and the forces of the shared norms and expectations in the institutional field. Second, this research extends the work of Frohlich and Westbrook (2002) by identifying specific salient factors rooted in each of instrumental and non-instrumental motivations and exploring the relationship between these factors. Third, this research enriches our understanding of the consequences of IeSCI adoption. Regarding IeSCI as a multi-dimensional construct, we found how different dimensions of IeSCI may lead to different performance outcomes.

This research also has important managerial implications for firms pursuing IeSCI. First, our results provide insights into how managers can promote the Internet-enabled integration across the supply chain. In particular, managers may leverage the institutional pressures to push the adoption of IeSCI, given that legitimacy-oriented factors can enhance firms' economic incentives for IeSCI adoption. Second, the current research provides guidance for managers on benefits that may be derived from the adoption of different dimensions of IeSCI. Depending on its business target, the firm may choose to focus on developing certain aspect of IeSCI.

Our study has several limitations. First of all, the data are collected from a single informant from a senior executive from each firm. Although the use of a single respondent is common among recent empirical studies, future research should collect data from multiple persons in the top management teams to avoid the common method bias. Second, although we identified salient factors for both economic and legitimacy motivations, we do not mean to provide an exhaustive list of all possible motivational factors. Future research can extend our study by examining the effects of other motivations.

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