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IT RESOURCES, SUPPLY CHAIN COORDINATION COMPETENCY AND FIRM PERFORMANCE: AN EMPIRICAL STUDY

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Abstract

The much publicized potential benefits of information technology (IT) have given rise to an increased use of IT in supply chain management in recent years. However, the impact of IT investment on firm performance remains unresolved. Drawing on the tenets of resource-based view and supply chain management literature, we propose that IT-supported supply chain collaboration activities can transform IT resources into supply chain coordination competencies to achieve customer satisfaction. Based on data from an online survey of 310 Australian fast-growth small-to-medium-sized enterprises, we tested our proposed model using structural equation modeling (SEM). The results of our SEM exercise show that IT resources do contribute to increasing customer satisfaction. While the adoption of IT may be duplicated by other firms, our findings demonstrate that through a process of integrating firm-specific IT resources with their causally complex supply chain collaboration processes, firms can develop their resource bundles into a unique set of IT-enabled supply chain coordination competency over time. Confirming the catalytic role of supply chain collaboration activities and coordination competencies in transforming IT resources into rent-generating assets, we offer an explanation to the inconsistent effects of IT investments on firm productivity.

Keywords: *IT Resources, Supply Chain Collaboration Activities, Supply Chain Coordination Competency, Customer Satisfaction, Resource-based View of Firms.*

1 INTRODUCTION

The use of information technology (IT) in managing the supply chain process has drawn increasing attention in the corporate world. Primarily, this is due to the much publicized potential benefits of IT, which include lowering suppliers' prices, improving customer response speed and service flexibility, reducing transaction costs, increasing higher customer service levels, and reducing supply chain inventories (Lee and Whang 2001). For instance, a recent study by Forrester Research indicates that U.S. manufacturers are increasingly dependent on the benefits brought about by IT to improve supply chain agility, reduce cycle time, achieve higher efficiency, and deliver products to customers in a timely manner (Radjou 2003). However, IT investment in the supply chain process is no guarantee of stronger organizational performance. The debate on the "IT-productivity" paradox and other anecdotal evidences suggest that the impact of IT on firm performance remains unclear (Brynjolfsson 1993; Lucas Jr. and Spittler 1999). The adoption of a particular technology is easily duplicated by other firms and often fails to provide a sustained competitive advantage for the adopting firms (Powell and Dent-Micallef 1997). IT adoption is no exception. Not surprisingly, determining how IT as a resource can create sustained competitive advantage for firms remains an unresolved issue (Barney et al. 2001).

Following Powell & Dent-Micallef (1997) and Wu et al. (2006), we argue that the value of IT resources can be enhanced when they are embedded in organizational processes. Building IT capabilities from IT infrastructure to support supply chain collaboration activities enables organizations to develop firm-specific supply chain capabilities that are valuable (to their clients), immobile (not lost even a key personnel may leave the firm), and difficult for competitors to imitate, leading to the creation of core competencies and competitive advantage (Javidan 1998). For instance, Vickery et al. (2003) have found that integrative information technologies, which enhance information flows along supply chains, contribute to superior customer service performance through supplier partnering and customer relationship building. Likewise Wu et al. (2006) also found that adopting sophisticated IT and aligning IT resources with channel members do not contribute directly to market performance. However, their values can be escalated by integrating information flow and optimizing resource use across the supply chain to enable the development of higher order supply chain capabilities to generate rents for all partners (Wu et al., 2006).

Drawing on the tenets of resource-based view (RBV) (Barney 1991) and supply chain management literature, we propose that a firm's IT related resources can be strategically harnessed to support its supply chain collaboration activities, transforming them into supply chain coordination competencies to achieve customer satisfaction. We draw on the RBV because the theory provides a platform upon which the indirect role of IT resources in value creation could be explored, enabling researchers to use intermediate-level dependent variables at the business process level, such as supply chain collaboration activities, to examine how investments in IT resources could lead to competitive advantage (Wade and Hulland 2004). Our aim is to develop a process model that demonstrates the developmental paths of supply chain coordination competencies spawning from IT resource investment.

This paper is structured as follows. The theoretical background section introduces the tenets of RBV which forms the backbone of our conceptual model for hypothesis formulation. The research method section outlines the procedures used for data collection, validation of the measurement properties of the constructs, and the test of the proposed research model. Findings are presented in the results section. The paper concludes with a discussion of the findings, implications for research and practice, study limitations, and potential avenues for future research.

2 THEORETICAL BACKGROUND

RBV accredits firm performance improvements to availability of, or access to, valuable, rare, inimitable, non-substitutable and relatively immobile resources or resource bundles (Barney 1991). RBV advocates that organizations succeed and achieve sustainable competitive advantage through treatment of resources and capabilities as central considerations in strategy formulation and as primary sources of competitive advantage. According to RBV, resources and capabilities represent two distinctive entities. First, resources are used by firms to create and produce products; while capabilities are developed and emerge from utilization of resources in repeatable patterns (Sanchez et al. 1996). Second, resources are generally regarded as inputs or outputs of organizational processes, it is difficult to embed resources within organizations and their processes. Capabilities, however, are firm-specific and embedded in firm processes and routines, transforming inputs into outputs to generate value (Makadok 2001). Thus, capabilities are unique organizational processes developed to provide reliable services, create product innovations, generate operational flexibility, shorten product development cycles, and respond to evolving market trends (Amit and Schoemaker 1993). Makadok (2001, p. 387) posits that firms create value from two complementary, but distinct, mechanisms: “resource-picking” and “capability-building”. Firms possessing bundles of advantage-generating resources and costly-to-imitate capabilities are regarded as commanding fundamental drivers of superior performance.

In IS literature, RBV has been used to explain how firms create value from IT assets and organizational skills to leverage IT assets (e.g., Bharadwaj 2000; Wade and Hulland 2004). IT resources (e.g., hardware and software) rarely act alone in creating and sustaining competitive advantage (Clemons and Row 1991). IT payoffs depend more on a firm’s capability to “fit the pieces together”, i.e., on the ability to develop processes to exploit relationships among complementary resources, rather than the strength of their resources. Firms generate competitive advantage not solely from their IT assets but from blending organizational resources with their e-business technologies to develop sustainable value that resides in organizational skills and processes rather than in IT assets (Bharadwaj 2000; Ravinchandran and Lertwongsatien 2005). In sum, RBV offers a theoretical perspective explaining why firms implementing e-business technologies without developing complementary IT capabilities may not necessarily achieve competitive advantage.

IS researchers (Bharadwaj 2000; Mata et al. 1995; Santhanam and Hartono 2003) argued that IT capability, as an IT-based organizational capability, not only creates value but also helps organizations to gain sustainable competitive advantage. In this study, we examine the effect of IT capability, manifested in the efficacy of a firm’s back-end integration (Zhu and Kramer, 2005; Zhu 2004; Bi et al., 2010), on transforming routine supply chain collaboration activities into supply chain coordination competency.

Coordination is central to supply chain operations. A firm’s ability to coordinate its supply chain operations better than its competitors’ is key to attaining superior performance through meeting customer needs and gaining customer satisfaction. From the RBV perspective, IT-enabled supply chain coordination competency may thus be defined as an exceptional ability to combine e-business technologies, such as IT infrastructure, and IT capabilities, such as back-end integration, with a firm’s resource endowments, such as supply chain collaboration mechanisms, to fulfilling customer needs and gaining customer satisfaction. Because of time-compression diseconomies (Dierickx and Cool 1989), IT-enabled supply chain coordination competency is firm-specific, and could create highly differentiated value for firms and their supply chain partners.

3 RESEARCH MODEL AND HYPOTHESIS DEVELOPMENT

While firms can build their sustainable competitive advantage by strategically leveraging on valuable, rare, hard-to-imitate, and hard-to-substitute resources, the key to superior performance depends on how these resources are utilized. As Peteraf (1993) contends, having resources of advantage-generating qualities does not necessarily, and consequentially, confer competitive advantage. Resources that lack one or more of these characteristics can still lead to competitive advantage (Carmeli and Cohen 2001). The important thing is for firms to develop processes and formulate strategies to utilize these resources to build capabilities. The combination of resource qualities and strategies to exploit resources is crucial to ensuring the formation of capabilities, then competencies, and finally core competencies, which Javidan (1998) calls a competencies hierarchy. In Javidan's (1998) view, competitive advantage may evolve from a firm's resources via four processes: conversion of resources into capabilities, development of capabilities into competencies, amalgamation of competencies into core competencies, and transformation of core competencies into competitive advantage. Difficulty in rising from one level to another (i.e., resources to capabilities to competencies to core competencies) increases with the ascent, with the value to the firm inflating in increasing magnitude.

Drawing on Javidan's (1998) view, we contend that, in the context of supply chain management, building supply chain coordination capabilities requires that firms develop appropriate processes and formulate strategies to adapt their available IT resources to support their supply chain collaboration activities. The repeated adaptation of IT resources to support on-going supply chain collaboration activities would, overtime, lead to the development of a socially complex, and causally ambiguous set of hard-to-imitate IT-enabled supply chain coordination capabilities embedded within organizational processes. These processes would include integration of internal cross-functional IT applications and databases as well as external e-business functionalities with supply chain partners.

Due to the complexity of the resource-building process and time-compression diseconomies, Javidan (1998) argues that interactions between different capabilities through integration and organizational learning, involvements and commitments would eventually lead to the development of competencies and, ultimately, core competencies. At the end of the core competency conversion process is the creation of competitive advantage (see also Prahalad and Hamel (1990)). Adapting Javidan's (1998) argument to the supply chain coordination competency building process, we posit that developing IT-enabled capabilities in the form of superior back-end integration to support supply chain collaboration activities would lay the foundation for building supply chain coordination competencies. Figure 1 depicts our conceptualized supply chain coordination competency model, in which the advantage-generating resources are a firm's IT infrastructure, back-end integration and supply chain collaboration activities.

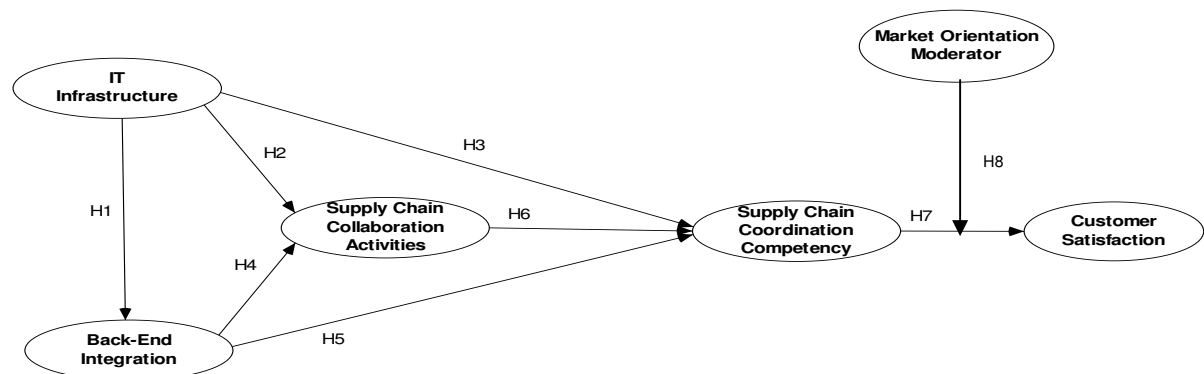


Figure 1. Proposed Research Model

Referred commonly to as physical IT assets, which include computers, communication facilities, shareable technical platforms and databases (Ross et al. 1996), IT infrastructure not only provides a solid platform upon which firms could leverage e-business technologies to conduct business activities but also develop an agile and flexible technology structure (e.g., integrated database) to respond to customer demands and market changes for business development (Bharadwaj 2000). A solid IT infrastructure, as such, could foster strong links between firms and their trading partners, leading to high levels of collaboration, coordination, and integration (Zhu 2004; Zhu and Kraemer 2005). Firms with an adaptive IT infrastructure are thus expected to be more capable of: 1) building an integrated, robust back-end functionality (Bi et al. 2010); 2) enhancing the conduct of supply chain collaboration activities (Wu et al. 2006); and 3) facilitating the nurturing of supply chain coordination competency (Cao and Zhang 2011). Accordingly, we hypothesize that:

H₁. IT infrastructure is related positively to back-end integration.

H₂. IT infrastructure is related positively to supply chain collaboration activities.

H₃. IT infrastructure is related positively to supply chain coordination competency.

Zhu and Kramer (2005), Dong et al. (2009), and Bi et al. (2010) have unanimously found that backend integration is an intangible IT resource. Back-end integration drives collaborative connections among supply chain partners (Dong et al. 2009), enhances supply chain responsiveness to market changes (Bi et al., 2010), and improves supply chain processes and efficiency (Zhu and Kramer 2005). As an integrated IT resource, a superior backend-integration is expected to enhance the flow of information among supply chain partners (Vickery et al. 2003), adding value to such activities as information sharing, exchange and integration (Vickery et al. 2003), collaborative planning, forecasting, and replenishment (Esper and Lisa 2003), and transactions among supply chain partners (Dong et al. 2009). Therefore, we posit that:

H₄. Back-end integration is related positively to supply chain collaboration activities.

H₅. Back-end integration is related positively to supply chain coordination competency.

In the context of supply chain operations, a firm's ability to collaborate effectively with supply chain partners is a prerequisite to achieving supply chain coordination efficiency (Cao and Zhang 2011). Typical supply chain collaboration activities that could be advantageously enhanced by IT infrastructure would include joint production planning and sales forecasting with supply chain partners as well as process integration with suppliers and distributors (Johnson et al. 2007), joint resource planning and work scheduling (Kim et al. 2006). The routinization of these activities facilitated by a robust set of IT infrastructure and an integrated, seamless back-end functionality is a necessary precursor to building supply chain coordination competency. This leads us to our next hypothesis:

H₆. Supply chain collaboration activities are related positively to supply chain coordination competency.

A broad and encompassing performance outcome of business operations is customer satisfaction, be it in the context of marketing (Anderson et al. 1994) or supply chain management (Mukhopadhyay and Kekre 2002). Customer satisfaction, which reflects customers' overall evaluation of a firm's services or its product based on their total purchase and consumption experience with the product or the firm's services over time (Anderson et al. 1994), is a competitive advantage. While other organizational performance measures may be examined, Vickery et al. (2003) have found that satisfactory customer service is an antecedent to financial performance: it fully (as opposed to partially) mediates the effects of supply chain integration on financial performance.

Effective supply chain coordination can increase customer satisfaction because supply chain coordination enables firms to extend their business boundaries and integrate customers into their value

creation processes. As Frohlich and Westbrook (2001) have found, supplier and customer integration through IT use, among other strategies, could improve a firm's performance in terms of customer service, on-time delivery, delivery lead time, productivity, quality, cost, market share, and profitability. Supported by the use of IT-related resources, supply chain coordination competency can generate considerable impacts on a firm's performance improvement through customer satisfaction, leading us to our next hypothesis:

H₇. Supply chain coordination competency is related positively to customer satisfaction.

In the field of technology innovation, market orientation is a critical organizational contextual factor (Han et al. 1998; Powell and Dent-Micallef 1997). Using target rivals as a frame of reference, market-oriented businesses regularly seek to assess their own strengths and weaknesses (Han et al. 1998) to increase their sensitivity to competition and accelerate their innovation adoption process (Gatignon and Robertson 1989). Market-oriented businesses have unique firm abilities to generate market intelligence to help identify, analyze, and respond to competitors' moves (Narver and Slater 1990). Businesses engaged in continuous environmental scanning and adaptation are poised to lead their industry in implementing innovative e-business practices and in taking advantage of IT investments at appropriate time (Gatignon and Xuereb 1997). Market-oriented businesses also tend to be forward-looking, proactively responding to, and even shaping, customer needs (Jaworski and Kohli 1993). Wu et al. (2003) further note that market-oriented firms tend to utilize e-business technologies to enhance communication with suppliers, customers and internally, as well as to increase coordination processes along their value chain. We, therefore, hypothesize that:

H₈. Market orientation would enhance the relationship between supply chain coordination competency and customer satisfaction.

4 RESEARCH METHODOLOGY

4.1 Target Population and Survey Sample

The data used for testing our proposed model was collected through an online survey of 1,335 Australian fast-growth SMEs compiled by Business Review Weekly (BRW). There is precedence in academic research (Gartner and Starr 1999; Markman and Gartner 2002) to utilize databases originating from professional business journals. The BRW Fast Growth enterprises are similar to Fortune's FSB 100 annual list of North America's fastest growing small companies. Key inclusion or exclusion criteria for SMEs to enter the BRW fast-growth project are that their previous year's turnover must exceed AUD\$500,000; they must have fewer than 200 full-time employees; they cannot be a subsidiary of an Australian or overseas corporation; and they must not receive more than 50% of their revenue from a single client. Except for the turnover criterion, which is subject to indexing, the other criteria have remained constant. Fast-growth companies from this sample fall within (Ghobadian and O'Regan 2000) definition of SMEs.

We have chosen to test our proposed model using fast-growth SMEs because SMEs are a dominant part of the Australian economy (OECD 2007). SMEs, in general, have also been relatively unsuccessful in exploiting the potential of e-business (Eikebrokk and Olsen 2007). Fast-growth SMEs, on the other hand, are more entrepreneurial in their business orientation and are less risk averse. Many fast-growth SMEs have achieved leadership positions by leveraging their IT resources (Tiessen et al. 2001).

4.2 Data Collection Procedures

A personalized email highlighting the academic nature of the study was sent to either the founder or CEO of all 1,335 fast-growth SMEs. In our emails, we emphasized the importance of having respondents with a good understanding and overview of their firm's e-business activities to participate in our survey, urging the founder or CEO to personally complete the online questionnaire, where possible. A follow-up email was sent three weeks after the initial one, and a second reminder email another two weeks later. Respondents were assured of confidentiality. A total of 310 responses were obtained, which gave a gross response rate of 28.1%, after discounting 195 incorrect email addresses and 32 SMEs which declined to participate. All responses were filled by either the company founder or its CEO.

We first tested the sample for non-response bias, using the approach suggested by Armstrong and Overton (1977). Differences in responses to all the constructs between early respondents (i.e., those that completed the survey upon the first invitation) and late respondents (i.e., those who replied to follow-up emails) were compared. Independent sample *t*-tests on each construct failed to reveal significant differences between early and late respondents (all *p*-values > .05), suggesting that non-response bias was not an issue.

The profile of the responding firms in our study (Table 1) shows that our sample contains companies in all major industry sectors. There is also equal distribution of companies in terms of their age (or years of establishment). All responding firms had achieved a growth rate in excess of 20% in 2008. Over 70% of them were actively engaged in e-business, measured by the extent to which the responding firms used Extranet to communicate, and electronic data interchange to share information and conduct transactions.

4.3 Common Methods Bias

As our study used a self-administered questionnaire and respondents were in a senior management position qualified to assess firm performance, measurement was subject to cognitive biases due to participants "seeking to present themselves in a favorable manner" (Thompson and Phua 2005, p. 541). Anticipating such a possibility, we incorporated Marlowe and Crowne's (1961) Social Desirability Scale in our online questionnaire, inviting participants to complete this section as part of the survey. The incorporation of Marlowe and Crowne's (1961) Social Desirability Scale in our questionnaire enabled us to assess all study items for social desirability response bias in order to address internal validity and psychometric aspects of instruments. Marlowe and Crowne's (1961) Social Desirability Scale has been used widely for checking cognitive biases (Ballard 1992; Fraboni and Cooper 1989). In this study, we tested common method bias using structural equation modeling (SEM) procedures recommended by Podsakoff et al. (2003) to examine the influence of social desirability on the research constructs. We found no significant relationships between the social desirability construct and the research constructs (all *p*-values > .05). Accordingly, social desirability does not contribute significantly to the model, suggesting that there is no common method bias.

	% (n=310)
Industry	
Information Technology	18.8
Property & Business Services	18.1
Personal & Other Services	9.6
Finance & Insurance	8.9
Communications	6.6
Others ^a	38
Company Age	
Less than 5 years	49
More than 5 years	51
Previous Year Growth Rate	21.9-759.5
CEO/Founder's Education Level	
Tertiary	53.9
MBA	16.6
Year 12	13.7
PhD or Doctorate	1.8
Other	14.0

Note. ^aOther industry sectors include Construction, Retail Trade, Manufacturing, Health & Community services, Wholesale Trade, Education, Transport & Storage, Accommodation, café, restaurants, Mining, Cultural & recreational services.

Table 1. Profile of Responding Firms

4.4 Constructs

Measurement items were developed based on a comprehensive review of the literature (Table 2). Development of respective measurement models incorporate successive stages of theoretical modeling, statistical testing, and refinement (Straub 1989).

Constructs	Indicators
1. IT Infrastructure (ITIF) <i>Adapted from Bharadwaj (2000), Lin and Lin (2008)</i>	Our company has a good telecommunication infrastructure. Our company's IT systems infrastructure is very flexible in relation to company's future needs. Our company's IT systems enable us to effectively cooperate electronically with suppliers/partners and customers.
2. Back-end Integration (BI) <i>Adapted from Zhu and Kraemer (2005)</i>	There are well-integrated multiple web applications encompassing different areas in our company. Our company shares common databases for various applications, rather than having a separate database for each application. Our company's databases are electronically integrated with our supply chain partners.
3. Supply Chain Collaboration Activities (SCCA) <i>Adapted from Kim et al. (2006)</i>	Our company collaborates actively in forecasting and planning with our business partners. Our company projects and plans future demand collaboratively with our business partners. Collaboration in demand forecasting and planning with our business partners is something we always do.
4. Supply Chain Coordination Competency (SCCC) <i>Adapted from Wu et al. (2006) and Kim et al. (2006)</i>	Our company conducts transaction follow-up activities more efficiently with our business partners than do our competitors with theirs. Our company spends less time on supply chain coordination transactions with our business partners than our competitors with theirs. Our company conducts supply chain coordination transactions at less cost than do our competitors with theirs.
5. Customer Satisfaction (CUSS) <i>Adapted from Wu et al. (2003)</i>	Compared with our competitors, our customers are more satisfied with our company. Our customers encourage other people to do business with our company. Our customers are more loyal to our company.

Constructs	Indicators
6. Market Orientation (MTOR) <i>Adapted from Narver and Slater (1990)</i>	Our managers often exchange information and view about our competitors. Our top managers regularly discuss our competitors' strengths and weaknesses. Our company believes that analyzing and responding to competitors' actions is crucial to maintain our competitive advantage.

Table 2. Constructs and Indicators

4.5 Instrument Validation

Data were analyzed with AMOS 17.0, using confirmatory factor analysis (CFA) procedures with the maximum likelihood (ML) estimation method. Prior to conducting the CFA, we ran an exploratory factor analysis (EFA) on all indicators. Principal axis factoring with direct oblimin rotation yielded consistent groupings with our hypothesized measurement models. All constructs were tested for reliability, validity, and fit. Based on an assessment of CFA fit statistics, measurement models were further refined to obtain sound fit. Respectively, Tables 3 and 4 show correlations and descriptive statistics and measurement properties of constructs. As reported below, instrument validation proceeded through four steps: calculation of construct reliability; variance extracted estimates; and evaluation of convergent and discriminant validity.

	Mean	SD	1	2	3	4	5
1. ITIF	5.53	1.08	1				
2. BI	4.12	1.63	.39**	1			
3. SCCA	4.31	1.64	.26**	.34**	1		
4. SCCC	4.40	1.25	.38**	.34**	.45**	1	
5. CUSS	5.67	0.98	.21**	.10	.20**	.36**	1

Note. * $p < .05$. ** $p < .01$.

Table 3. Correlation Matrix, Mean Scores and Standardized Deviations

4.5.1 Construct Reliability

Construct reliability, a measure of consistency, assesses the degree to which items are free from random error. Indicator and composite reliability are two measures of construct reliability (Fornell and Larcker 1981). While indicator reliability represents the proportion of variation that is explained by a construct it purports to measure, composite reliability reflects the internal consistency of indicators (Werts et al. 1974). In the present study, indicator reliability values range between .50 and .88, and composite reliability values exceed the recommended value of .70 (Nunnally and Bernstein 1994).

4.5.2 Variance Extracted Estimate

Variance extracted estimate reflects the overall amount of variance in indicators accounted for by a latent construct (Fornell and Larcker 1981). In this study, all estimates exceed the recommended value of .50 (Hair et al. 2006).

Constructs	Cronbach's α	Construct Reliability	Variance Extraction	Range of Standardized Loadings	Range of Indicator Reliability
1. ITIF	.81	.82	.70	.74 - .93	.55 - .86
2. BI	.86	.87	.69	.75 - .93	.56 - .87
3. SCCA	.75	.74	.50	.65 - .81	.42 - .66
4. SCCC	.89	.89	.73	.84 - .87	.71 - .76
5. CUSS	.89	.89	.81	.88 - .91	.78 - .83
6. MTOR	.82	.86	.67	.74 - .90	.54 - .81

Note. All factor loadings are significant at $p < .001$ level

Table 4. Confirmatory Factor Analysis: Standardized Loadings and Reliability

4.5.3 Construct Validity

Construct validity was established by measuring convergent and discriminant validity of measurement items (Phillips and Bagozzi 1986; Straub 1989). Convergent validity assesses the consistency across multiple operationalizations. Values for t -statistics for all factor loadings were found to be significant (all p -values < .001), indicating that measures satisfy convergent validity criteria (Gefen et al. 2000). According to Fornell and Larcker (1981), average variance extracted for each construct should be greater than the squared correlation between constructs when assessing discriminant validity, the extent to which different constructs diverge from one another. In this case, results suggest that items share more common variance with related than non-related constructs, with all constructs meeting this criterion.

4.6 Data Analysis

Confirmatory and full structural model fit were assessed using multiple indices (Hair et al. 2006), including the normed chi-square (χ^2/df) (Jöreskog 1978), comparative fit index (CFI), Tucker-Lewis Index (TLI), root mean-square error of approximation (RMSEA), and standardized root mean-square residual (SRMR). All seven measurement models tested were found to meet the criteria set for these indices (i.e., χ^2/df ratio < 3 (Carmines and McIver 1981); CFI and TLI > .90 (Hair et al. 2006); RMSEA < .05 (Browne and Cudeck 1993); and SRMR < .06 (Hu and Bentler 1999)).

5 RESULTS

Given the acceptable measurement models, we estimated a full latent variable structural model (Anderson and Gerbing 1988) using same goodness of fit criteria to test our structural model and respective hypotheses. Table 5 summarizes the results of hypotheses testing, revealing reliable and robust fit between our theoretical model and sample covariances: $\chi^2(83)=122.660$, $p=.003$, $\chi^2/df=1.478$, CFI=.986, TLI=.983, SRMR=.041, and RMSEA=.039. These indices suggest a good model fit. The squared multiple correlation (SMC) values, which are similar to R^2 in regression analysis, show that this model accounts for 31% of the variance in IT-enabled supply chain capability, 34% of the variance in Supply Chain Coordination Competency, and 13% of the variance in customer satisfaction. Table 5 shows that all hypothesized relationships, except H_2 , are supported.

The moderating effect of MTOR on relationships between supply chain coordination competency and customer satisfaction (H_8) was tested using multi-group analyses. We divided our data into two sub-samples (i.e., low and high MTOR groups), based on the median scores of MTOR. The difference between the mean MTOR score of the two sub-samples was tested using t -test to ensure statistical significance, which was confirmed ($p < .01$). χ^2 difference tests were subsequently employed to assess statistical significance between the low and high MTOR groups on the path between supply chain coordination competency and customer satisfaction. The test result reveals that the moderating effect of MTOR is insignificant (Table 6).

Hypothesis	Standardized Paths Estimates	Conclusion
H ₁ . IT Infrastructure → Back-end Integration	.49***	Supported
H ₂ . IT Infrastructure → Supply Chain Collaboration Activities	.13	Not Supported
H ₃ . IT Infrastructure → Supply Chain Coordination Competency	.25***	Supported
H ₄ . Back-end Integration → Supply Chain Collaboration Activities	.32***	Supported
H ₅ . Back-end Integration → Supply Chain Coordination Competency	.17*	Supported
H ₆ . Supply Chain Collaboration Activities → Supply Chain Coordination Competency	.34***	Supported
H ₇ . Supply Chain Coordination Competency → Customer Satisfaction	.36***	Supported
Model Fit Indices		
$\chi^2(83)=122.660, p=.003,$		
$\chi^2/df=1.478$		
CFI=.986, TLI=.983		
SRMR=.041		
RMSEA=.039		

Note. * $p<.05$. ** $p<.01$. *** $p<.001$.

Table 5. Proposed Hypotheses and Test Results

	χ^2	df	CFI	TLI	RMSEA	Model Comparison	$\Delta\chi^2$	Δdf	p
M1	34.889	20	.986	.980	.049				
M2	35.584	21	.987	.981	.047	M2 vs M1	.695	1	>.05

Note. * $p<.05$. ** $p<.01$. *** $p<.001$.

M1=unconstrained model; M2=equal regression weights between SCCC and CS for low and high sub-samples.

Table 6. Moderating Effect of Market Orientation

6 DISCUSSION AND CONCLUSION

In this research, we explored the role of back-end integration and supply chain collaboration activities as two catalysts in transforming a firm's IT resources into supply chain coordination competency using structural equation modeling technique. We selected customer satisfaction as a measure of business performance. We also tested the effect of market orientation in moderating the relationship between supply chain coordination competency and customer satisfaction.

The results of our structural equation modeling exercise show that all of our hypothesized relationships, with the exception of that between IT Infrastructure and supply chain collaboration activities and the moderating effect of market orientation, are supported. Given that we have formulated our conceptual model of supply chain coordination competency based on Javidan's (1998) competencies hierarchy, our results support the notion that IT resources do contribute significantly to increasing firm performance. While the adoption of IT and IS may be easily duplicated by other firms, our findings demonstrate that through a process of integrating firm-specific IT resources (both IT infrastructure and back-end integration) with their causally complex and socially ambiguous supply chain collaboration processes, firms can develop these resource bundles into a set of supply chain coordination capabilities. Through repeated use over time, these capabilities could be transformed into supply chain coordination competency. Our study thus confirms the contributory role of IT resources in creating values for supply chain operations.

Our findings suggest that the impact of IT investment on firm's performance needs to be explored indirectly, and with reference to specific contexts, such as a firm's supply chain system. In the context of supply chain operations, the ability to leverage IT resources to build supply chain capabilities to coordinate the activities of supply chain partners is a competency and, hence, a valuable source of

competitive advantage. Among other things, these capabilities help firms to create business value through information sharing, enabling transaction activities to be performed in a timely manner (Zhu and Kraemer 2002), and allowing firms to organize procurement, production, and distribution operations synchronously along the supply chain (Devaraj et al. 2007; Zhu and Kraemer 2002). Offering an explanation to the inconsistent effects of IT investments on firm productivity (Brynjolfsson, 1993) is a major contribution of our study.

This study also bridges insights from IS, operations and supply chain management literature to examine the business benefits of IT-driven supply chain capabilities. This investigation reaffirms the importance of coordination in supply chain operations, suggesting the need for firms to build strong supply chain linkages: business partnerships and customer relationships, confirming the observation of Rayport and Jaworsky (2004): “as the focus of competition shifts from what companies do to how they do it, the new frontier of competitive advantage lies in the quality of interactions and relationships companies can establish with their customers and market” (p. 58).

This study has two important implications for management. First, we offer a framework for managers to understand the contribution of IT investments in creating supply chain and business value. For managers intending to identify firm-specific IT resources and core processes to foster the development of firm-specific e-capabilities and e-competencies, our model based on the development of supply chain coordination competency from IT-enabled supply chain capabilities could be a useful starting point.

Second, our model shows that supply chain coordination competency impacts significantly on customer satisfaction. This finding reflects the importance of building strong relationships both with business or supply chain partners and customers to nurture e-business capability to gain long-term business benefits.

7 LIMITATIONS AND FUTURE RESEARCH

This study has three notable limitations. First, a cross-sectional research design was adopted with data collected at a single point in time. IT-enabled supply chain capabilities are dynamic. Firms require time to reconfigure their resources to adapt to changes in the technological and business environments. Future research might consider using longitudinal designs to address issues relating to the evolution of IT-enabled supply chain capabilities and the development of supply chain coordination competency.

Second, utilizing single-informant (CEO and/or founder) in each responding company presents issues of data credibility. Single informant studies are well-known for their susceptibility to reporting bias. Future research might consider obtaining data from managers across the IT, marketing, and operational functions.

A third limitation relates to sample characteristics upon which the present hypotheses are tested. The current investigation is drawn from a relatively small proportion of self-selected fast-growth SMEs in a specific geographic region. While the present hypothesized model might be applicable to larger firms as well as firms in other geographic locales, further research is needed to expand the generalizability of the findings.

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