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Electronic commerce-enabled supply chain process integration and business value

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Abstract

Purpose – The purpose of this paper is to develop and test a model to analyze the relationships between three aspects of technical electronic commerce (EC)-based information system (IS) resources; the supply chain process integration; and business value.

Design/methodology/approach – The paper is consistent with the perspective on IS-enabled organizational capabilities and resource based view of the firm. A questionnaire-based survey was conducted to collect data from 214 supply chain, logistics, or procurement/purchasing managers of leading manufacturing firms.

Findings – The findings suggest that supply chain process integration, a key EC-enabled organizational capability, can enhance business value. We found that this capability serve as a catalyst in transforming technical EC-based IS resources (technical quality of EC applications, EC advancements, and EC alignment) into higher value for a firm.

Research limitations/implications – Among other limitations, this paper does not address human IS resources as the other potential determinants of firm's supply chain capabilities. Moreover, this study relies on cross-sectional data.

Practical implications – The results suggest that supply chain process integration is an important intermediate organizational capability through which value of EC-based IS resources can be materialized. The technical aspects of EC-based IS resources need to be developed to effectively form supply chain capabilities.

Originality/value – The paper is perhaps one of the first to show theoretically and empirically how firms, in particular in developing countries, can generate business value from EC-enabled supply chain process integration; also it broadens the scope of EC alignment in relation to process integration and business value to the entire supply chain.

Keywords Manufacturing industries, Managers, Electronic commerce, Information systems, Supply chain integration, Business value, Business performance, Resource-based view

Paper type Research paper

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1. Introduction

Investment in electronic commerce (EC) applications, as a subset of information system (IS) has become a strategic imperative for firms that wish to compete successfully in the electronic business environment. Although the adoption behavior of EC has emerged into an active research area in the IS discipline, only a small number of studies focused on the business value of EC. We note that in addition to adoption stage, post-adoption stages should also be assed in a try to study EC business value since in accordance with process-oriented view (Barua *et al.*, 1995), the multi-stage process existing before the business value of IS, as well as reach and richness of post-adoption activities cannot be realized through merely examining the initial adoption or investment (Zhu and Kraemer, 2005).

Since contemporary businesses are facing time-to-market pressures and hyper-competition in the highly competitive and turbulent business environment (Overby *et al.*, 2006; Rai *et al.*, 2006), EC-enabled business value is regarded to be an imperative for business success (Zhu *et al.*, 2004). However, IS literature has traditionally shown contradictory results regarding the impact of the IS assets on business value (Benitez-Amado *et al.*, 2010a). Viewed from resource based view (RBV), the relationship between firm's IS resources and business value has been scrutinized through two different sets of research models titled "direct-effect models" and "indirect-effect models" (Liang *et al.*, 2010). The direct effect RBV-based models try to link firm's IS resources and firm performance (as two main construct) and to investigate the direct relationship between them (Bardhan *et al.*, 2006; Bhatt and Grover, 2005). Although several prior studies have tried to directly link firm IS resources to performance gain, they have sometimes been inconstant to justify this link (Liang *et al.*, 2010). For example, researchers such as Cragg *et al.* (2002) and Tallon *et al.* (2000) were inconclusive in offering authoritative evidences of benefits resulting from IS investment. The rubric of the "productivity paradox," indicating a weak relationship between IS investment and productivity was culminated by the affirmations of Carr (2003) in his paper "IT doesn't matter". Carr (2003) discusses that recent ubiquitous and inexpensive IS are available to all firms. Referring to RBV assuming inimitability and scarcity of organizational resources as the attributes required for performance advantage (Barney, 1991); common and easily-accessible IS cannot provide businesses with supernormal rent (Carr, 2003). Correspondingly, Ray *et al.* (2005) found that IS resources possessed by firm including technical skills of IS unit, managers' technology knowledge, and IS spending do not exercise direct effect on the performance of the customer service process. Contrary, several researchers have provided consolidate evidence of significant link between firm's IS resources and performance gain using direct effect RBV-based models (Zue and Kraemer, 2002). Bhatt and Grover (2005) and Bardhan *et al.* (2006), respectively, reported that firm's IS resources are directly significantly related with competitive differentiation advantage and performance gain.

Consistent with discussed paradox, the most recent literature on the business value of IS rationalized these relationships through the so-called IS-enabled organizational capabilities perspective (Rai *et al.*, 2006). From this perspective, IS has an indirect, not a direct, impact on firm performance through higher order process capabilities. IS-enabled organizational capabilities perspective explains that firm's IS resources can augment critical organizational capabilities, which can result in improved value gain (Bharadwaj, 2000; Bharadwaj *et al.*, 2007). In this regard, physical and managerial capabilities (Fink and Neumann, 2009), relationship learning (Jean and Sinkovics, 2010), entrepreneurial culture (Benitez-Amado *et al.*, 2010a), and in particular, supply chain capabilities (Byrd and Davidson, 2003; Rai *et al.*, 2006; Wu *et al.*, 2006) are some critical organizational capabilities investigated as mediator between IS resources and firm performance. According to Tanriverdi (2005), through the use of related and complementary IS resources and subsequently by creating cross-unit business synergies, IS-based coordination mechanism can be created and organizational capabilities would be enhanced.

In the context of EC and business value, most of prior research have mostly developed and used direct-effect model and provided evidence of significant link between firm's EC-based IS resources and business value/performance gain (Ordanini and Rubera, 2010; Zue and Kraemer, 2002). The e-business value EC was found to lead to improved firm performance in sale, internal processes and customer/supplier relationships through market expansion, improved information sharing efficiency, and improved transactional efficiencies (Ordanini and Rubera, 2010; Zue and Kraemer, 2002; Zue *et al.*, 2004). However, and to best of our knowledge, little has been done to understand the relationship between EC-based IS resources and higher order organizational capabilities. We believe that similar to corresponding IS stream, assessing the mediating role of higher order organizational capabilities as the catalyst in transforming the value of EC-based IS resources into higher performance gain for a firm can provide better justification for investment in EC, and assist with resolving of IS productivity paradox. As such, the research model of this study posits that firm's complementary EC-based IS resources affect its performance through improving supply chain process integration.

2. Proposed research model and hypothesis development

In this research, an integrated model to examine the indirect effect of EC-based IS resources through the mediating role of supply chain process integration is shown in Figure 1. Since business value, organizational resources, and organizational capabilities are three major constructs in the RBV-based models investigating IS-enabled value gain, the RBV-based research model of this study is consisted of these three constructs.

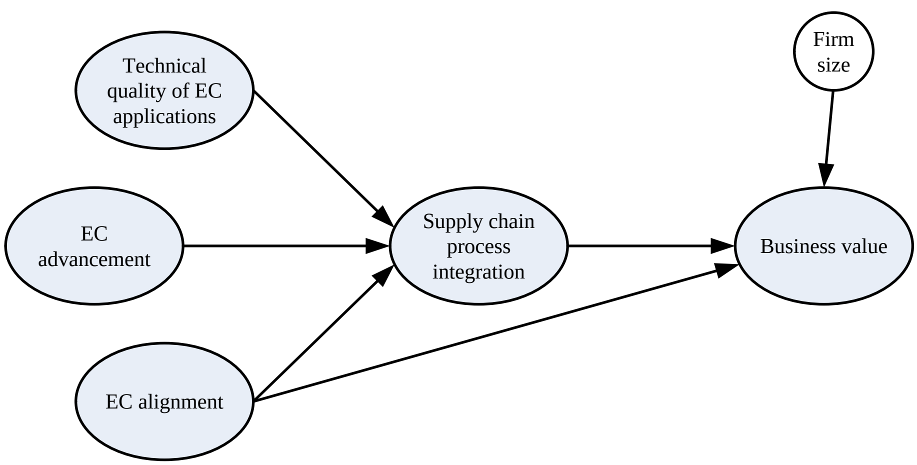


Figure 1.
Research model

2.1 Business value

IS business value has been considered as a multidimensional variable by previous IS scholars (Melville *et al.*, 2004). The term IS-enabled business value is generally used to refer to the organizational performance effects of IS in terms of firm innovativeness, productivity/efficiency improvement, customer service enhancement, cost reduction, improved information sharing efficiency, and competitive advantage (Benitez-Amado *et al.*, 2010a, b; Bhatt and Grover, 2005; Ray *et al.*, 2005). However, organizational or firm performance has mostly been characterized as effectiveness in terms of its financial and operational performance (Liang *et al.*, 2010; Saraf *et al.*, 2007). Previous researches have applied a number of indicators to measure firm performance and suggested different categorizations of these indicators. For example, Liang *et al.* (2010) suggest that finance, efficiency, and others are three general categories of firm performance indicators.

This research is concerned with business value is term of a firm's aggregate performance relative to its market (sale) efficiency, financial efficiency, and internal process efficiency as three aspects of business performance. Market efficiency includes market share, sales volume, and customer development (Zhu *et al.*, 2004). Financial efficiency is defined in terms of firm's accounting based profitability (return on investment (ROI), return on assets (ROA), and overall profitability) compared with competitors (Byrd and Davidson, 2003; Wu *et al.*, 2006). The third dimension, process efficiency focuses on internal processes efficiency, staff productivity, costs of operation, and flexibility of operations (Karimi *et al.*, 2007; Zhu, 2004).

2.2 Supply chain capabilities

The role of firm's IS resources in managing the supply chain processes has drawn growing attention in the corporate world (Wu *et al.*, 2006). As companies began to interact with their suppliers electronically over the last decade, supply chain management (SCM) has inherited the forefront of organizational practice to form inter-functional operations within their organizations and to forge electronic connections with key customers (Byrd and Davidson, 2003; Iyer *et al.*, 2009). The main objectives of the SCM function include cost reduction, improvement and innovation of end-to-end processes between firms and their customers and suppliers, improved communication and interaction among supply chain partners, and improved performance and productivity in a way that benefits all contributors in the supply chain (Rai *et al.*, 2006; Ranganathan *et al.*, 2004). Referring to the "IS-productivity paradox" and other anecdotal evidences questioning the impact of IS on firm performance, several recent researchers have proposed that IS-enabled supply chain capabilities can serve as a catalyst in transforming IS-related resources into business value gain (Bharadwaj, 2000; Ranganathan *et al.*, 2004; Tan *et al.*, 2010). Accordingly, considerable attention has also been devoted to the supply chain capabilities since it has been recognized as one of the today's competitive advantages in a global market place (Rai *et al.*, 2006; Wong and Boon-itt, 2008). Supply chain capabilities allude to the ability of firms to identify, utilize, and assimilate both internal and external resources/information to facilitate the entire supply chain activities (Rai *et al.*, 2006; Wu *et al.*, 2006; Zolait *et al.*, 2010). In this research, we consider supply chain capability as supply chain process integration.

2.2.1 Supply chain process integration and business value. The previous literature on supply chain capabilities and its impact on firm performance suggests that two capabilities across the supply network including activity integration (Kim *et al.*, 2006; Wu *et al.*, 2006) and information sharing or exchange (Kim *et al.*, 2006; Rai *et al.*, 2006; Sahin and Robinson, 2002) are some of the main dimensions of supply chain process integration. Therefore, supply chain process integration is conceptualized as a second-order construct that includes two dimensions: activity integration and information sharing.

Activity integration is a bio-dimensional process including interfirm activity integration and interfirm system integration (Kim *et al.*, 2006). Interfirm activity integration is defined as the extent to which supply chain partners are actually engaged in collaborative planning and forecasting (Kim and Cavusgil, 2009; Powell, 1992). According to Damgaard *et al.* (2008), activity integration capability can enable firm to achieve competitive advantage since closely integrated partners are capable of effectively adjusting their business plan and strategies collaboratively in line with changing market conditions. On the other hand, interfirm system integration is another dimension of activity integration. Interfirm system integration can be defined as the extent that a firm's supply chain communication system (SCCS) is ready and, therefore, able to support potential interfirm activity integration (Kim and Cavusgil, 2009). Kim *et al.* (2006) and Esper and Williams (2003) limited the scope of interfirm system integration to important collaborative channel activities such as planning and forecasting with other channel members. Kim and Cavusgil (2009) discuss that interfirm system integration is not manifestly a sufficient condition but an indispensable condition for efficient interfirm activity integration. Decrease in any technical obstacles and incompatibilities possibly hampering communication between supply chain partners is a significant outcome of deployment of high degree of interfirm system integration (Byrd and Turner, 2001), which will further result in performance gain (Kim *et al.*, 2006). In spite of limited number of researches investigating interfirm activity integration and interfirm system integration as two distinct capabilities (Kim and Cavusgil, 2009), the literature does not explicitly consider these capabilities as distinct dimensions (Kim *et al.*, 2006). Therefore, in this research, activity integration is defined as both interfirm activity and interfirm system integration without applying any distinction between these two dimensions. Accordingly, collaboration in projecting, planning, and forecasting future demands, as well as compatibility of EC applications with these capabilities are constructs of activity integration in this research.

Information sharing (exchange) is the most obvious and immediate outcome of IS usage in SCM (Kim *et al.*, 2006). Information sharing is defined as the ability of a firm to share knowledge with its supply chain partners in an effective and efficient manner (Wu *et al.*, 2006). The exchange process includes all types of information: operational, tactical, and strategic information (Rai *et al.*, 2006). Consistent with Rai *et al.* (2006), as well as a recent study by Welker *et al.* (2008) on information sharing mechanisms among supply chain, the information on inventory and sale specification, production and delivery schedule, and demand forecasting and planning are considered as indicators of information sharing in this research. Information sharing can result in cost reductions in both broad terms and specific costs including freight, inventory, and information handling (Tan *et al.*, 2010). Likewise, some inventory-related metrics can be enhanced due to information sharing (Manabe *et al.*, 2005). Sharing and exchanging inventory holding information can decrease total inventory in the supply chain network (Rai *et al.*, 2006). Accuracy and timeliness of supplier deliveries and reduced time to process a purchase request are other advantages of information sharing (Tan *et al.*, 2010). Rai *et al.* (2006) discuss that improved operational efficiencies (resulted from enhanced coordination of allocated resources, activities, and roles throughout the supply chain) can be achieved through production and delivery schedules. Information sharing also positively affects supply chain proximity and flexibility, subsequently supply chain performance (Chan and Chan, 2009), while supply chain proximity exerts a positive impact on firm financial and marketing performance (Narasimhan and Nair, 2005). Moreover, the consequences of the bullwhip effect can be significantly minimized through information sharing capability within supply network (Shore and Venkatachalam, 2003). Investigating channel relationships in supply chain and firm performance, Kim *et al.* (2006) discuss that firm market performance is directly positively affected by information sharing. With regard to the evidence of direct relationship between firm performance and information sharing (Tan *et al.*, 2010), this integration capability has been identified as one of the most fundamental abilities in the supply chain process integration (Shore and Venkatachalam, 2003; Wu *et al.*, 2006):

H1. The supply chain process integration has a positive effect on firm business value.

2.3 EC-based IS resources

IS and technologies are valuable organizational resources and critical enablers of firm performance (Tan *et al.*, 2009). Consistent with RBV, the IS construct can be defined in terms of IS-based resources. Melville *et al.* (2004) operationalized the IS resource as physical capital (e.g. IS infrastructure and specific business applications) and human capital (e.g. technical and managerial knowledge), and organizational capital resources. Similarly, a recent research by Benitez-Amado *et al.* (2010b) operationalizes technological IS resources, managerial IS resources, and IS staff's technical skills as three dimensions of firm's IS resources. Fink and Neumann (2009), however, discuss that "technical-oriented approach", "component-oriented approach", and "process-oriented approach" are three different approaches to identify and evaluate IS resources and their competence. In this research, we follow technical-oriented approach and addresses the technical aspects of EC-based IS resources and their relative impacts over business value.

2.3.1 Technical quality of EC applications. It has been reported that technical IS resources are the most used measure to investigate firm's IS resources (Wu *et al.*, 2006). Technical IS resources referring to the physical aspect of IS resources including the specification and quality of hardware, software, databases, applications, and networks has also been named as technological IS resources by previous researchers (Benitez-Amado *et al.*, 2010b; Ray *et al.*, 2005). Byrd and Davidson (2003) discuss that the technical quality of IS department is a momentous element of IS resources controlled by firm that significantly affects the IS-enabled supply chain capabilities and subsequently firm performance. The performance and the efficiency of hardware, operating systems, communication service, and business application software, as well as end-user support of adopted IS are some value measures of IS technical quality (Weill and Broadbent, 1998). This discussion provides support for Byrd and Turner (2001) and Mata *et al.* (1995) who found that IS technical quality is critical to maintaining sustained competitive advantage from an organization's IS resources. Therefore, we note that in addition to other investments in business resources, organizations need significant investment in technical quality of IS resources to develop higher order organizational capabilities, as IS resources have been considered to be key enablers of firm innovation (Koellinger, 2008). Investments in IS can enable IS department and business employees to access information and to collaborate with other workers and departments in the firm itself, and within supply partners in ways that they have not previously interacted (Benitez-Amado *et al.*, 2010a). Technical IS resources also improve supply chain efficiency by facilitating the creation of business-to-business/business-to-customer data integration processes and enabling the standardization of data interchange interfaces through facilitating the standardization of business processes as it provides an asset to codify and modularize business process knowledge (Bardhan *et al.*, 2006). Therefore, and consistent with prior literature suggesting the positive relationship between higher order organizational capabilities (e.g. information sharing and coordination with trading partners) and technical quality of IS resources (Byrd and Davidson, 2003; Fink and Neumann, 2009), we believe that higher technical quality of EC applications such as electronic supply chain management (ESCM) systems (e.g. regarding the compatibility with existing procedure) will provide the focal firm and its trading partners with capabilities for better information sharing, collaborative planning and forecasting, and support for activity integration. Thus, it is hypothesized that:

H2. The technical quality of EC applications has a positive effect on supply chain process integration.

2.3.2 EC advancement. We also believe that the advancement of EC applications is another strategic resource controlled by firms facilitating higher order organizational capabilities and consequently business value gain. In our model, EC advancements mainly refers to the deployment of the most advanced EC applications for the focal firms to improve their SCCS in supply chain relationships. It is expected that organizations successfully enhance efficiency in their business activities and processes through advanced EC applications since firms with advanced technology outperform their competitors (Kim *et al.*, 2006). Consistent with the RBV suggesting the complementarities of firm resources in value creation (Tippins and Sohi, 2003), using advanced IS such as sophisticated EC applications is expected to facilitate three sub-processes of relationship learning including information exchange, joint sense making, and relational-specific memory in supply chain relationships so that value of advanced IS can be enhanced by complementing with information-intensive inter- and intra-organizational process (Jean and Sinkovics, 2010). As such, and due to its wide availability in the market, generic IS alone cannot be a source of competitive advantage (Kim *et al.*, 2006) and thus only when a business integrates the advanced technology (e.g. advanced EC applications) with its core strengths, assets, or capabilities (e.g. strong channel and customer relationships through administrative innovations) business value gain would be facilitated (Barney, 1991). Accordingly and consistent with RBV, we believe that using advanced EC applications ahead of competitors will make IS resources firm specific and imperfectly mobile across firms, providing the adopting firm with additional business value not achievable by late users.

Advanced EC applications in SCCS can help build stronger supply chain capabilities in several ways. These applications such as collaborative planning, forecasting, and replenishment (CPFR) or advanced ECSM systems can help uncover patterns in data and accelerate the speed of information acquisition and information exchange, thus assist with processing large quantities of information shared across supply chain

(Jean and Sinkovics, 2010). These applications can provide supply chain partners with interpreting information in a more timely and accurate way (Malhotra *et al.*, 2005). Moreover, the deployment of advanced EC applications in the supply chain system can result in better coordination and reduce transaction costs between partners, and can also improve interfirm integration between channel partners (Wu *et al.*, 2006). The advancement of EC in SCCS such as IS-enabled interpretation systems can result in creation of new knowledge through enabling the information obtained from supply chain partners to be organized, rearranged, and processed to (Malhotra *et al.*, 2005). Likewise, advanced and efficient EC applications in SCCS provide business partners with greater ability to respond to market changes and customer requests in a timely manner (e.g. by enabling just-in-time inventory techniques) along with efficient information exchange and coordination activities (Stank *et al.*, 1999; Wu *et al.*, 2006).

Given the potential impact that advanced EC applications have on the various supply chain processes and relationships including information sharing, joint sense making, collaborative planning and forecasting, and activity integration, the following hypothesis is stated:

H3. EC advancement has a positive effect on supply chain process integration.

2.3.3 EC alignment. Strategic IS alignment reflects the incorporation of the business strategies, goals, and mission into the IS strategy during the IS planning process (Kearns, 2005). Accordingly considerable concern has been expressed by chief executive and information officers over alignment between IS strategies and business strategies (Zviran, 1990). In the context of SCM, IS alignment is defined as the extent to which a firm's IS is compatible with that of its channel partners (Powell, 1992). IS alignment refers to extend to which IS is embedded across the supply chain and it requires channel partners to coordinate and align their business processes and strategies with each other in order to achieve efficiency (Wu *et al.*, 2006).

Although it has been reported that due to ease of access to common IS, firms can enhance efficiency in their business activities and processes by adopting advanced IS (Stank *et al.*, 1999; Tippins and Sohi, 2003), yet, alignment of IS are equally important for the functional adequacy of SCCS as well (Hausman and Stock, 2003). Kearns (2005) discusses that non-existence of IS alignment might result in lower returns, market place confusion, and erosion of the firm's competitive position due to incoordination of EC strategies and overall direction of company. In this regard, it has been reported that IS alignment can positively affect both competitive advantage and firm performance (Chan and Huff, 1993; Lederer and Mendelow, 1989). The rationale behind is that through the process of business processes alignment in the supply chain network, firms would be competent to develop a higher level of supply chain process capabilities that are otherwise barely attainable when acting alone. These capabilities necessitate the integration of resources across the supply chain process, and IS alignment provides the basis for such integration (Wu *et al.*, 2006). Similarly, the flow of information and resource sharing within firms can be enhanced through improvement in IS alignment (Garcia *et al.*, 2003). Finally, IS alignment can provide businesses with enhanced collaboration with partners (aimed at addressing the changing market needs), superior coordination of strategic planning process, improved supply chain responsiveness, and organizational effectiveness (Philip and Booth, 2001; Segars *et al.*, 1998).

Therefore, in this research, it is assumed that EC alignment defined as the extent to which EC applications such as electronic data interchange (EDI) used for SCCS are well aligned with a focal firm and its supply partners (regarding technology, supply chain strategies, and other criteria) is positively related with supply chain capabilities and business value gain:

H4. EC alignment has a positive effect on supply chain process integration.

H5. EC alignment has a positive effect on firm business value.

2.4 Control variable

Firm size has traditionally been used as a control variable when firm performance is used as a dependent variable. Larger businesses could derive greater synergy effects from human and financial resources that lead to better performance (Wu *et al.*, 2006). In this research, total number of full-time equivalent employees and sales volume of past year was used as a measure of firm size. We believe the control of business size enables us to identify the nature of relationship between supply chain capabilities and firm performance more effectively.

3. Research methodology

3.1 Instrument development

We primarily tried to develop the measurement items by adapting form validated existing scales from prior literature. For new measures and for those significantly adapted or changed, we acted on the foundation of guidelines and exemplars in the literature (Straub, 1989; Sethi and King, 1991). Three well-established IS scholars having high experience in survey research and expertise in the subject domain were asked to assess the instrument. The questionnaire and all scales were translated to Persian through assistance of two native professional English translators. The IS scholars further helped us with the process of "back-translation" of items into English to ensure the validity of questionnaire. After incorporating suggested changes and in order for testing and assuring face validity of the questionnaire, we piloted the questionnaire on eight supply chain and logistics managers in all three provinces and within different industries through face-to-face interview. Based on the feedback from the pilot study, some questions were rephrased to improve their clarity. As a result, some minor revisions were applied to the questionnaire before final data collection. In the proposed research model, business value and supply chain process integration are second order construct. The first-order indicators for business value are market efficiency, financial efficiency, and product/process efficiency. The first-order indicators for supply chain process integration, however, include activity integration and information sharing. The measurement items of applied instrument are shown in Table I in which for all scales, each item was measured using a seven-point Likert scale.

3.2 The sampling frame

The sampling frame of this study consists of all leading manufacturing firms located in central industrial part of Iran. We believe that supply chain managers, logistics managers, or procurement/purchasing managers who are directly responsible for a firm's supply chain activities are the most appropriate informant in the context of this study (Rai *et al.*, 2006; Kim *et al.*, 2006). The data were collected by means of an electronic

Table I. Operationalization of the constructs of research model

Label		Item	Source
Business value (1-7, strongly disagree to strongly agree/very inferior to very superior)			
Meff1	Market efficiency	Our company performs much better than competitors in market share of products	Zhu *et al.* (2004) and Wu *et al.* (2006)
Meff2		Our company performs much better than competitors in increased sale of products	
Meff3		Our company performs much better than competitors in customer relationships	
Feff1	Financial efficiency	How would you characterize your company's ROA compared to that of your competitors?	Byrd and Davidson (2003)
Feff3		How would you characterize your company's ROI compared to that of your competitors?	
Feff3		How would you characterize your company's overall profitability compared to that of your competitors?	
Peff1	Process efficiency	Our EC technology infrastructure has provided us with decreased inventory costs	Zhu and Kraemer (2005)
Peff2		Our EC technology infrastructure has provided us with coordination with suppliers	
Peff3		Our EC technology infrastructure has provided us with staff productivity	
Peff4		Our EC technology infrastructure has provided us with decrease in costs of operation	
Supply chain capabilities (1-7, strongly disagree to strongly agree)			
Aci1	Activity integration	My company projects and plans future demand collaboratively with our partner	Rai *et al.* (2006) and Wu *et al.* (2006)
Aci2		Collaboration in demand forecasting and planning with our partner is something we always do in my company	
Aci3		My company always forecasts and plans activities collaboratively with our partner	
Aci4		My company can forecast and plan collaboratively with our partner through EC-based SCCS applications	
Aci5		Collaboration in demand forecasting and planning with our partner is always possible through our EC applications	
Ins1	Information sharing	Production and delivery schedules are shared across the supply chain	
Ins2		Collaboration in demand forecasting and planning is consistently conducted with our business partners	

(continued)

Table I.

Label	Item	Source
Ins3	Our downstream partners (e.g. distributors, wholesalers, retailers) share their actual sales data with us	
Ins4	Inventory data are visible at all steps across the supply chain	
Technical quality of EC applications (1-7, "very inferior to" and "very superior to" closest competitors)		
ECq1	How would you characterize your firm's hardware and operating systems performance?	Byrd and Davidson (2003)
ECq2	How would you characterize your firm's communications services (i.e. LAN, EDI and firm own web site)?	
ECq3	How would you characterize your firm's advanced business applications software (i.e. ESCM systems and CPFR) performance?	
ECq4	How would you characterize the level of EC applications investment and expenditure in your company?	
EC advancement (1-7, strongly disagree to strongly agree)		
Adv1	Our company uses the most advanced EC applications for SCM	Jean and Sinkovics (2010) and Kim *et al.* (2006)
Adv2	Relative to our competitors, our EC applications for SCM is more advanced	
Adv3	My company is always first to use new EC applications for SCM in our industry	
Adv4	In our industry my company is regarded as an EC advancement leader for SCM	
EC alignment (1-7, strongly disagree to strongly agree)		
Alig1	My company's EC applications for SCCS is well aligned with our partner	Wu *et al.* (2006)
Alig2	My company invests in EC applications to align our SCCS infrastructure with our partner	
Alig3	Our partner invests in EC applications to align their SCCS infrastructure with us	
Alig4	Both my company and our partner always work together for the best EC alignment	
Alig5	EC advances for SCCS, between my company and our partners, are well aligned for best supply chain performance	

survey administered in late 2010 and through a key informant technique, which is consistent with prior studies on IS created business value (Benitez-Amado *et al.*, 2010a; Jean and Sinkovics, 2010). A sample of 1,163 qualified and leading manufacturing firms was identified from various sources and through cooperation with provincial "administrations of industries and mines" and "the enterprises of industrial cities" in three different provinces. We identified the companies' names, contact persons, and their e-mail addresses and telephone numbers. At the second step, an e-mail including cover letter explaining objectives of the study, an official request letter of participation from mentioned authorities, and electronic version of survey instrument, as well as instruction regarding the participation to the survey through web site where the survey instrument was located was sent, and we requested them to fill up the questionnaire through either replying back the electronic version of survey instrument or web-based version. Consistent procedures previously used in the IS literature (Tanriverdi, 2005), we finally conducted the follow up activities by sending some reminders through e-mail and phone to encourage potential respondents to participate in the study. Finally, 214 valid questionnaires were received for a response rate of 18.40 percent. Table II reports the characteristics of the responding firms, which suggests that majority of firms' respondents are from automotive and food and barrage industries as they represent 35.51 percent of firm types. Moreover, only 7.94 percent of firms studied are considered as small firms. According to the Iran Small Industries and Industrial Park Organization (ISIPO) statement, small enterprise is defined by the number of employees and it refers to enterprise with fewer than 50 employees. In accordance with this statement, 92.2 percent of Iranian enterprises have fewer than 50 employees, consequently are categorized as small enterprise (ISIPO, 2008). As we have selected our sample of study from leading manufacturing firms which were actively involved in ESCM as hub firms, it can be inferred that Iranian small manufacturing firms are not mature enough regarding e-business readiness as is expected.

To demonstrate that the responses received were representative of the population studied, multivariate analyses of variance were, therefore, undertaken to determine whether differences in response regarding gender (since majority of respondent are male) and participants' responsibility (supply chain, logistics, or procurement/purchasing manager) were associated with different response profiles. The results indicated no significant difference in any of the variables of interest. To compare early with late responses, we defined the first 25 percent of the received questionnaires as early responses and the last 25 percent were regarded as late responses (Jean and Sinkovics, 2010). The *t*-test results revealed no significant difference on sample characteristics in two groups. Likewise, we made similar comparisons across participants who responded through e-mail version and those who completed the survey by web-based version of questionnaire. The analysis suggested that the two groups were statistically similar on all demographic and study variables.

4. Data analysis

With regard to the objective of this research, the two-step structural equation modeling approach was used. We first tested the measurement models individually. Subsequently, measurement models were tested simultaneously prior to testing the structural model (Anderson and Gerbing, 1988). Analysis based on the maximum likelihood estimation method was carried out using AMOS 18 (Build 992).

Table II. Characteristics of responding firms

	Frequency	Percent	Cumulative (%)
Respondent gender			
Male	146	68.22	68.22
Female	68	31.78	100.00
Respondent age			
Supply chain managers	78	36.45	36.45
Logistics managers	64	29.90	66.35
Procurement/purchasing managers	72	33.65	100.00
Industry			
Automotive	41	19.16	19.16
Computer and communication	13	6.07	25.23
Electronic equipment	14	6.54	31.77
Food and beverage	35	16.35	48.12
Industrial machinery	22	10.28	58.40
Optical and medical instruments	18	8.41	66.81
Petrochemical	26	12.15	78.96
Wood, tissue, and paper products	17	7.95	86.91
Other	28	13.09	100.00
Operating experience			
1-5	36	16.82	16.82
5-10	61	28.50	45.32
10-15	57	26.64	71.96
15-20	42	19.63	91.59
Above 20	18	8.41	100.00
Number on employees			
<50	17	7.94	7.94
50-100	29	13.55	21.49
100-250	62	28.97	50.46
250-500	80	37.39	87.85
Above 500	26	12.15	100.00
Annual sale (million USD)			
Below 10	43	20.09	20.09
10-50	55	25.70	45.79
50-100	56	26.17	71.96
100-200	37	17.29	89.25
Above 200	23	10.75	100.00

4.1 Measurement model

The proposed research model involves 32 items describing eight latent variables including three exogenous variables and two endogenous variables. The data obtained were tested for reliability and validity using confirmatory factor analysis (CFA). This step was used to test if the empirical data conformed to the presumed model. To test the construct validity of measurement theory, the factor loading, reliability, and average variance extracted (AVE) should be provided to estimate the relative amount of convergent validity among item measures. Table III shows that all standardized factor loadings, composite reliabilities and Cronbach's alpha values exceed from ideal benchmark value of 0.7 as recommended by Fornell (1982). In addition, all AVE ranging from 0.635 to 0.793 exceed from threshold generally accepted in the literature with values of 0.5 recommended by Hair *et al.* (2006). This finding provides adequate evidence of convergent validity. Moreover, the items used in this study demonstrated satisfactory

Variable	Factor loading (> 0.7)	Cronbach's alpha	Composite reliability (> 0.7)	Average variance extracted (> 0.5)
Business value				
Market efficiency	–			
Meff1	0.82	0.796	0.839	0.635
Meff2	0.81			
Meff3	0.76			
Financial efficiency	–			
Feff1	0.88	0.905	0.920	0.793
Feff3	0.86			
Feff3	0.93			
Process efficiency	–			
Peff1	0.78	0.864	0.897	0.687
Peff2	0.84			
Peff3	0.89			
Peff4	0.80			
Supply chain capabilities				
Activity integration	–			
Aci1	0.91	0.915	0.939	0.755
Aci2	0.88			
Aci3	0.90			
Aci4	0.81			
Aci5	0.84			
Information sharing	–			
Ins1	0.78	0.821	0.879	0.645
Ins2	0.79			
Ins3	0.84			
Ins4	0.80			
Technical quality of EC applications	–			
ECq1	0.88	0.886	0.931	0.770
ECq2	0.88			
ECq3	0.85			
ECq4	0.90			
EC advancement	–			
Adv1	0.77	0.855	0.892	0.674
Adv2	0.87			
Adv3	0.81			
Adv4	0.83			
EC alignment	–			
Alig1	0.90	0.893	0.920	0.697
Alig2	0.85			
Alig3	0.79			
Alig4	0.83			
Alig5	0.80			

Table III.
Assessment of the measurement model

discriminant validity. For adequate discriminant validity, the AVE from the construct should be greater than the variance shared between the construct and other constructs in the model (Chin, 1998). In all cases, the AVE for each construct is larger than the correlation of that construct with all other constructs in the model as suggested by Table IV (Table IV lists the correlation matrix, with correlations among constructs

Table IV.
Correlations of latent variables

	1	2	3	4	5	5	7	8
1. EC alignment	*0.797*							
2. EC advancement	0.317**	*0.890*						
3. Technical quality of EC applications	0.268**	0.198*	*0.829*					
4. Information sharing	0.412**	0.576**	0.330**	*0.880*				
5. Activity integration	0.362**	0.369**	0.552**	0.588**	*0.803*			
6. Process efficiency	0.516**	0.108	0.318**	0.495**	0.522**	*0.877*		
7. Financial efficiency	0.442**	0.268**	0.638**	0.418**	0.743**	0.418**	*0.821*	
8. Market efficiency	0.618**	0.178*	0.556**	0.722**	0.716**	0.535**	0.608**	*0.835*

Note: Significance at: $^{*}p < 0.05$ and $^{**}p < 0.01$ levels

and the square root of AVE on the diagonal). In addition, the correlations matrix (Table IV) did not indicate any exceptionally correlated variables (the highest correlation among principal constructs is $r = 0.743$), evidence of common method bias usually results in very high correlations ($r > 0.90$) (Pavlou and El Sawy, 2006).

On the other hand, the measurement model test presents a good fit between the data and the proposed measurement model. The fitness of the model is supported by various goodness-of-fit statistics which are shown in Table V. The χ^2/df (820.50/265) were used because of the inherent difficulty with sample size. The χ^2/df value was 3.096, which is consistent with Marsh and Hocevar (1985) suggestion between two and five. The root mean square error of approximation (RMSEA) is 0.036, which fall between the recommended range of acceptability (between 0.03 and 0.08) (Hair *et al.*, 2006). The standardized root-mean-square residual (SRMR) also shows the model fit since it is lesser than the cutoff value of 0.08 recommended by (Hair *et al.*, 2006). The goodness of fit index (GFI), comparative fit index (CFI), and normed fit index (NFI) all pass the threshold generally accepted in the literature with values of 0.9 (Wu and Wang, 2005), thus show that measurement model has a good fit with the data.

4.2 Structural model

As the second step of structural equation modeling approach, the validity of structural model needs to be assessed since the measurement model has been already specified and validated with CFA. In order to assessing the validity of research structural model, it should be noted that the recursive structural model cannot provide any better fit than measurement model (e.g. providing a lower χ^2 comparing

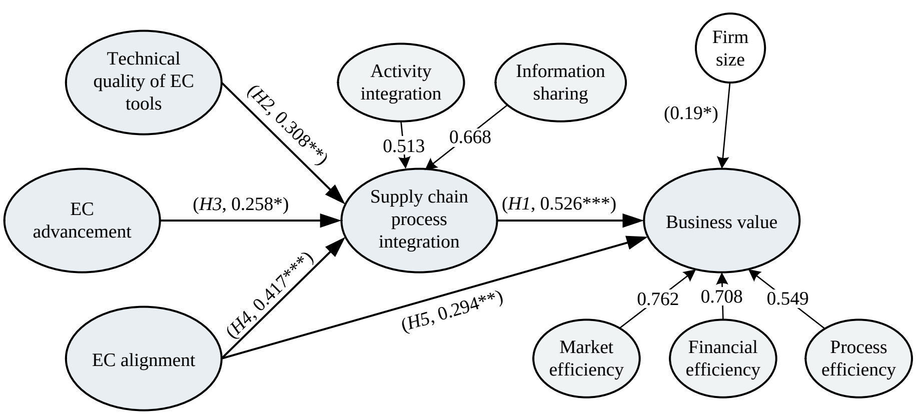
Table V.
Model fit evaluation measures

Measure	Model fit condition	Value: Measurement model	Value: Structural model
RMSEA	$0.03 < \text{RMSEA} < 0.08$	0.036	0.039
SRMR	< 0.08	0.0418	0.0454
CFI	> 0.90	0.972	0.959
NFI	> 0.90	0.940	0.927
GFI	> 0.90	0.919	0.908
The χ^2/degrees of freedom	$2 < \chi^2/\text{df} < 5$	(820.50/265) 3.096	(828.8/267) 3.104

measurement model) (Hair *et al.*, 2006). Thus, structural theory might lack validity if structural model fit is significantly worse than CFA fit (Anderson and Gerbing, 1992). The goodness of fit indices of structure model are shown in Table V, which shows the good fit. As a result, the structural model is suggestive of adequate structural fit since it is demonstrating an insignificant $\Delta\chi^2$ value with its CFA model ($\Delta\chi^2 = 8.3$) which is <2 percent. Furthermore, no evidence of interpretational confounding exists since comparing the CFA loading estimates with those standardized factor loading from the structural model shows inconsiderable fluctuations (<0.01) (Hair *et al.*, 2006).

Figure 2 shows the significant structural relationship among the research variables and the standardized path coefficients in which all of the hypotheses were strongly supported. For *H1*, the result indicates that supply chain process integration has positive effect on business value ($\beta = 0.526$, $p < 0.001$). Consistent with *H2* technical quality of EC applications is positively related to supply chain process integration ($\gamma = 0.308$, $p < 0.01$). The result also confirms that EC advancement has positive effects on supply chain process integration which provides support for *H3* ($\gamma = 0.258$, $p < 0.05$). Moreover, and consistent with *H4* and *H5*, EC alignment have positive effects on supply chain process integration ($\gamma = 0.417$, $p < 0.001$) and business value ($\gamma = 0.294$, $p < 0.01$), respectively. Finally, firm size, as the control variable, revealed to have relatively significant effect on business value ($\gamma = 0.19$, $p < 0.05$) so that larger firms were found to achieve higher business value gain.

To assess the mediation effect of supply chain process integration on the relationship between the EC alignment and business value, two other alternative models were estimated. First, only the direct effects of EC alignment on business value was estimated (assuming there is no relationship between EC alignment and supply chain process integration). Second, the direct effect of EC alignment on the business value was excluded from the original model (assuming that the effect of EC alignment on business value is fully mediated by supply chain process integration) and then the model was analyzed. The comparisons between the original and two alternative models revealed that the highest total effect of EC alignment on business value is provided in the original model. Similarly, the original model also provided the highest model fits (regarding the indices in Table V). This finding supports our perception that the effect



Note: $*p < 0.05$, $**p < 0.01$, $***p < 0.001$

Figure 2. Structural pass model with standardized path coefficient

of EC alignment on business value should be considered through the mediating role of supply chain process integration.

5. Discussion

Drawing on the RBV of the firm, we explored the role of supply chain capabilities as a key mediator between EC investment and business value gain. Although our study shows theoretically and empirically how firms can generate business value from EC-enabled organizational capabilities in SCM context, a topic that has received little attention to date, this issue that why a new theoretical model for justifying EC investment and use should be developed in this research given that there are already a significant number of researches in similar research streams might be of some concern. It should be mentioned that businesses in developing countries face challenges different from those in developed countries and differs greatly in adopting and benefiting from EC (Tan *et al.*, 2007), and EC investment and use in developing countries context has only recently gained attention in the academic press (Molla and Licker, 2005a). The literature suggests that in most of the developing countries, EC implementation and institutionalizing has been hindered by the quality, availability, and cost of accessing necessary infrastructure while developed countries have employed a relatively well-developed, accessible, and affordable infrastructure for EC. Likewise, the readiness of businesses to govern and regulate EC is an essential element, but one lacking in developing countries, for the trust necessary to conduct e-business (Molla and Licker, 2005b). Since web and communications technologies are complex and offer a variety of functionalities ranging from the static presentation of content to the dynamic capture of transactions with provisions for security and personalization, organizations in developing countries must understand these technologies and decide how to draw upon their functionalities for effectively developing EC initiatives (Chatterjee *et al.*, 2002; Sutanonpaiboon and Pearson, 2006). Owing to the contextual differences (both organizational and environmental) between these two socio-economic arenas, it is recently warranted to understand how businesses in developing countries could overcome the environmental and organizational EC readiness impediments and benefit from EC. For example, Table VI shows the ICT development index (benchmarking tools to monitor information society developments worldwide) of countries that has hosted the surveys in prior literature on EC commerce. These statistics may signify that businesses in developed and developing countries differ in respect to information technology and EC context.

		ICT development index (IDI), 2008 and 2007				IDI access sub-index, 2008 and 2007			
Country	Development	IDI 2008	Ranking 2008	IDI 2007	Ranking 2007	Use 2008	Ranking 2008	Use 2007	Ranking 2007
USA	Developed	6.54	19	6.33	17	7.11	28	7.03	21
Singapore	Developed	6.95	14	6.47	15	8.02	10	7.81	10
Canada	Developed	6.49	21	6.30	18	7.51	18	7.33	13
Iran	Developing	3.08	84	2.73	86	3.36	83	3.06	80
South Africa	Developing	2.79	92	2.64	91	3.14	94	2.88	90
China	Developing	3.23	79	3.03	81	3.75	73	3.61	70

Table VI. Comparison between ICT development of developed and developing countries

This paper provides empirical evidence for the EC-enabled supply chain integration especially for Iranian manufacturing firms who lack the resources and capability comparing to huge and overpowering firms with billion dollars annual sale studied in developed countries (Kim *et al.*, 2006; Rai *et al.*, 2006). Accordingly, our study can help businesses in developing countries with better strategies for justifying IS investment. However, our finding is not merely limited to the developing countries context as its exploratory findings in signifying the noteworthiness of effects of supply chain capabilities in transforming technical quality of EC-based IS resources to business value are in line with parallel research streams in developed countries (Jean and Sinkovics, 2010; Kim and Cavusgil, 2009; Rai *et al.*, 2006; Wu *et al.*, 2006).

The results suggest that supply chain process integration is a valuable capability that leads to business value enhancement and the three aspects of technical IS resources (technical quality of EC applications, EC advancement, and EC alignment) lead to the development of supply chain process integration. We found that supply chain capabilities are able to transform EC-related resource into a higher business value for a firm, in particular in terms of market efficiency, financial efficiency, and process efficiency. Through embedding EC-based IS resources into a firm's supply chain system, the firm is able to enhance channel-specific assets through effective information exchange and better activity integration with supply chain partners aimed at effective collaborative planning and forecasting. This study also highlighted the significance of EC-based IS resources in achievement of supply chain strategy through IS-enabled upstream and downstream integration as part of the operational and manufacturing strategy.

This study signifies that technical aspect of EC-based IS resources, a specific dimension of IS resource for businesses in supply networks, helps in enhancing the value creation process of supply chain process integration. Within the technical aspects of EC applications, EC alignment was found to have the largest effect on supply chain process integration which is consistent with prior literature (Seggie *et al.*, 2006; Wu *et al.*, 2006). This implies that the alignment of different business processes in the supply chain network provides businesses with competence to form a higher level of supply chain capability that is otherwise hard to achieve when acting alone as EC alignment provides the basis for necessary integration of resources across the supply chain processes. Moreover, the result revealed that supply chain capabilities are also affected by EC advancement which is accordance with previous researches by Jean and Sinkovics (2010) and Kim *et al.* (2006). The advancement of EC applications for SCCS enables trading partners to effectively conduct collaborative forecasting and planning and facilitates the breath and quality of information exchange between them. Likewise, and consistent with Byrd and Davidson (2003), the study found that technical quality of EC applications significantly influence the formation of higher supply chain capabilities so that the higher performance and the efficiency of these applications will facilitate supply chain integration efficiency by improving the coordination of the flow of goods and information across supply network. This finding suggests that consistent with RBV; EC-based advantage for firms tends to diminish fairly quickly owing to the relatively low barriers to imitation and acquisition of similar EC application by other firms. Therefore, by implementing advance EC resources ahead of competitors, enhancing the performance and the efficiency of EC resources across supply chain, and with higher system compatibility and integration between channel partners, EC resources controlled by firms becomes unique and imperfectly mobile across their rivals, which can provide them with exclusive benefits through higher efficiency than those of their rivals for at least a certain time period.

This research also demonstrated that that EC-enabled supply chain process integration leads to significantly enhanced business value gain which is consistent with the perspective of IS-enabled organizational capabilities that perceives IS resources as impacting positively on firm performance by means of other higher order process capabilities (Benitez-Amado *et al.*, 2010a, b; Rai *et al.*, 2006). Information flow integration imposed the largest effect on the formation of supply chain process integration capability which is consistent with Rai *et al.*'s (2006) finding, which is followed by activity integration. Information sharing provides manufactures with competence to improve forecasts, synchronize production and delivery, coordinate inventory-related decisions, and develop a shared understanding of performance bottlenecks with their supplier partners (Rai *et al.*, 2006). Activity integration, however, enables firms with the ability to integrate business processes and activities with its partners, which can be used to achieve sustained performance gain and subsequently competitive advantage as closely integrated partners can more effectively adjust their business plans and strategies collaboratively according to evolving market conditions (Kim and Cavusgil, 2009).

Similarly, our results suggest that supply chain process integration significantly mediates the impact of EC-based IS resources on business value gain, thus imply that examining the impact of EC applications in a specific setting such as a firm's supply chain system can assist to better assess the effect of IS resource on value gain aimed at resolving the "IS productivity paradox". Our results indicate that market efficiency has a very strong and significant weight in the formation of the business value construct, followed by financial efficiency and product/process efficiency. This finding suggests that supply chain process integration enhances marketing excellence relative to competition by squeezing out delays, redundant tasks, and inefficient flows. It provides supply chain partners with an opportunity to jointly codify valuable market knowledge into explicit strategies. More specifically, information sharing capability through the integrated SCCS can potentially increase the sales volume of supply partners by reaching customers directly and promptly whenever a new product is introduced, and by tapping into markets that were inaccessible on account of distribution or other infrastructure constraints (Wu *et al.*, 2003, 2006). Likewise, supply chains integration provides operational visibility, coordination of plans, and streamlined flow of goods that condense the time interval between a customer's request for a product or service and its delivery, and thus can positively affect the top and bottom line financial performance (Hult *et al.*, 2004; Rai *et al.*, 2006). Integration of supply chain processes also boosts product/process efficiency as it can assist businesses with simplifying the organizational process and reducing lead times with suppliers (Christopher and Ryals, 1999), and allows a firm the ability to produce and deliver products or services to customers at lower cost and higher speed through the improvement in coordination between supply chain partners (Wu *et al.*, 2006).

5.1 Contributions to research and practice

We believe that the suggested model and relative results make a unique contribution to the research and practice. Using cross-sectional survey data from a sample of leading Iranian manufacturing firms from 17 different industries we found that:

- The development of technical aspects of EC-based IS resources such as technical quality of EC applications, EC advancement, and EC alignment helps firms with the development of higher order process capabilities like supply chain process integration.
- The supply chain process integration is a critical capability that increases business value gain through which EC-based IS resources influence firm market, financial, and process efficiency.

Moreover, and to the best of our knowledge, this is the first study examining the effects of technical aspects of EC-based IS resources on supply chain process integration while incorporating the concept of activity integration in this organizational capability. Therefore, our study makes three key contributions to the literature by first both theoretically and empirically showing how firms can develop supply chain process integration by focusing on key roles of EC-based IS resources. Second, this paper reveals theoretically and empirically how manufacturing firms, in particular in developing countries can generate business value from EC-enabled organizational capabilities, a topic that has received little attention to date. Third, and contrary to previous research examining the role of strategic alignment between IS and overall business strategy of a firm, our study broadens the scope of EC alignment to the entire supply chain and signifies its impact over formation of supply chain process integration.

The research findings also have important implications for IS, supply chain, and business managers. Managers need to note that according to RBV, EC-based IS resources offer value when they are embedded in specific organizational processes thus the role of supply chain capabilities in realizing the value of these resources should be recognized. Therefore, development of technical aspects of EC-based IS resources aimed at increasing the firm's ability to develop supply chain process integration is imperative. Supply chain process integration enhances operational performance relative to competition by decreasing inventory and operation costs, delays, redundant tasks, as well as, enables market penetration and provides agility to ensure that sales opportunities associated with the launch of new products and entry into new markets are captured (Rai *et al.*, 2006). Moreover, deployment of the state-of-the-art EC applications for SCCS, especially before it is diffused widely is imperative since it can improve information sharing and coordination between channel partners more effectively. However, it should be noted that reliance on advanced IS technologies alone does not improve supply chain capabilities directly, both in terms of information exchange and coordination activities. Our findings suggest that EC alignment with channel partners is equally indispensable, if not more since EC alignment is imperative for both formation of supply chain process integration and business value gain, thus, a simultaneous investment in EC by all trading partners is needed to achieve the full potential of conducting value chain activities.

5.2 Limitation and future research

There are specific limitations to our work that can be addressed in future research. The context of this study is limited to the perspective of Iranian manufacturing firms, which limits the generalizability of our findings to this specific business sector. Future research that examines our model in other cultural contexts and business context such as retail sectors may improve generalizability of our findings. Moreover, this study relied on single informant from each firm in testing the study model. Although managerial insights and experience of supply chain/logistics managers are valuable sources of information in studying a firm business value, the relationships between constructs could have been inflated because of biases. To minimize such biases, future researches are needed to consider collecting data from multiple informants in each business unit. On the other hand, our study is cross-sectional in nature, while we acknowledge that the nature of higher order organizational capabilities is dynamic and continuous. Therefore, although this will add layers of complexity, collecting data over time from the participating managers can offer richer implications, thus it would be interesting to validating the findings of this study using a time-series data. Finally, our study has only examined a subset of technical EC-based resources. Future research should continue to study other IS resources; in particular human IS resources such as technical quality of EC users and expertise and management commitment to EC for SCM as warranted by prior literature (Byrd and Davidson, 2003).

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