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The effects of e-business processes in supply chain operations: Process component and value creation mechanisms

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ABSTRACT

Using a process component lens, this paper decomposes an e-business process into technical, relational, and business components. We then draw on resource orchestration theory to identify two managerial actions, resources structuring and capabilities leveraging in using e-business process components, to explain how these three components work together to improve competitive performance in supply chain operations. Two interesting insights emerge from our empirical research corresponds to value creation mechanisms. First, we identify the critical three portfolio effects to promote platform architecture flexibility and partner engagement to develop e-business operations capabilities (EBOCs) in three major e-business processes. Second, we reveal the transformation effect of EBOCs in different e-business processes in obtaining competitive performance. The notion of portfolio and transformation mechanisms of e-business process components offers theoretical and practical implications for developing successful digital supply chain platform.

1. Introduction

A large body of practical evidence, such as Amazon, Dell, and Lenovo, indicates that e-business processes is now enhancing collaborative efficiencies in the supply chain, and create significant economic payoffs by improving electronic connectivity across boundaries and integrating different organizational resources and capabilities (Sanders, 2007; Xue, Ray, & Sambamurthy, 2013; Zhang, Xue, & Dhaliwal, 2016; Zhu, Zhao, Tang, & Zhang, 2015). Lots of successful e-business processes practices show that a focal firm who can effectively manage organizational resources sets are deemed to be more capable of materializing the benefits of digital supply chains operations (Cenamor, Sjodin, & Parida, 2017; Setia, Venkatesh, & Joglekar, 2013; Wu & Chiu, 2018). In this paper, e-business processes, defined as "*a form of business process that represents Internet-enabled information flows across organizational boundaries and links supply chain partners to support digital operations activities*" (Zhu, Zhao, Tang, & Zhang, 2015). While e-business processes have been considered as an effective way to facilitate digital supply chains operations (Williams, Roh, Tokar, & Swink, 2013), firms continue to face challenges of obtaining business value from their investment in e-business processes due to lack of inter-firm resource orchestration in those processes (Neirotti & Raguseo, 2017). Without a clear understanding of how business value can be obtained from e-business processes, IT managers have little guidance on the implementation of e-business for promoting digital supply chain innovation.

Although recent literature has examined the performance impacts of IT-enabled business processes (Liu, Wei, Ke, Wei, & Hua, 2016; Rai & Tang, 2010; Rai, Patnayakuni, & Seth, 2006), the influence of e-business processes on IT business value is often treated in a coarse manner. We seek to extend the existing research in two important ways. Firstly, most prior research purely suggest that firms should focus on the importance of IT resources embedded in inter-firm processes (Chi et al., 2017; Grover & Saeed, 2007; Liu et al., 2016; Oh, Teo, & Sambamurthy, 2012) when they invest in e-business technologies supporting supply chain management. Therefore, we need to further examine how to use these inter-firm resources and capabilities embedded at e-business processes to create the business value. Secondly, extant studies suggest resource reconfiguration in operations management plays a critical role in creating IT business value (Liu et al., 2016). However, the research focus in the area of supply chains has shifted from operation-oriented to strategy-oriented management, e.g., business process integration and capability leveraging (Shiau, Dwivedi, & Tsai, 2015; Tang & Rai, 2014). Research is needed to further examine more microscopic mechanisms of e-business processes value creation at the supply chain context.

Process component lens suggests that a business processes can be decomposed into different components that play critical roles in process operations (Crowston, 1997). These components keep *structural link*

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through the dependencies of organizational resources and business task for realizing a firm's goals. This lens provides valuable insight to explore the component interconnection for value creation (Zhu, Zhao, Tang, & Zhang, 2015, which allows us to track the route of each component at an e-business process level. Extending this notion to our research context, we propose that a firm should deploy different components by the resources orchestration for realizing the business value. For example, extant studies merely consider these processes as a single technological entity (Devaraj, Krajewski, & Wei, 2007), or focused on IT-enabled reconfiguration in adaptive partners activities (Malhotra, Gosain, & El Sawy, 2007). Consequently, the relationship between components of e-business processes and IT business value remains a black box. This condition triggers two important unanswered questions as follows:

RQ1: How does a focal firm leverage these process components to create business value in a supply chain?

RQ2: What are the critical value creation mechanisms appeared in an e-business process level?

In this paper, we identify three key components of e-business processes (i.e., technical, relational and business), and conceptualize related constructs for explaining the critical role of components in supporting digital supply chain operations. Drawing on resource orchestration theory (Sirmon, Hitt, & Ireland, 2007; Sirmon, Gove, & Hitt, 2008; Sirmon, Hitt, Ireland, & Gilbert, 2011), two resources managerial actions of *resources structuring* and *capabilities leveraging* are presented to explain *how* the use of these e-business processes components achieve competitive performance in supply chain operations. We provide a process component lens, which enhances our knowledge on the value creation mechanisms of e-business processes that has been sparsely investigated in the IS literature.

Our study makes three major contributions to the literature. First, our study opens the black box of e-business processes, and provides a more nuanced theoretical understanding of the interlinked technical, relational and business components that form the e-business processes. Second, this study confirms *portfolio effect* between platform architecture and partner engagement, and and extends previous research (Rai & Tang, 2010; Wang & Wei, 2007) about better structuring resource portfolios in different e-business processes to develop e-business operations capabilities. Third, our study reveals the critical *transformation effect* of e-business operations capabilities that enable a firm to obtain competitive performance through leveraging technology and relational resources portfolios that are embedded in the business processes. Our paper goes beyond the influence of IT on business value creation in a coarse manner, and enrich our insights on process contents.

This paper is organized as follows. First, Section 2 and Section 3 decomposes e-business processes and develops hypotheses. Section 4 describes the operationalization of constructs and data collection, followed by data analysis in Section 5. Research findings about value creation mechanisms are discussed in Section 6. We then discuss our theoretical contributions and management implications, and outline potential directions for future research.

2. Theory development

2.1. The components of e-business process

Process component literature suggests that business processes can be decomposed into three key components: (a) resources (b) actors and (c) activities (Crowston, 1997; Crowston, Rubleske, & Howison, 2006). E-business process has been considered as the digital business activities along with supply chain actors supported by web-based technical platform (Bala, 2013). Thus, it can be decomposed into *technical* (resources), *relational* (actors) and *business* (activities) components (Zhu, Zhao, Tang, & Zhang, 2015).

Technical component refers to the digital platform architecture that supports information and knowledge sharing using open-standard applications in e-business process (Cenamor et al., 2017). Specifically, we examine *platform architecture flexibility* to indicate technical components of e-business processes. Platform architecture flexibility allows a focal firm and its partners to achieve flexible link and real-time sharing across distributed applications, improve synchronize production and delivery, and to establish business routines and operating procedures (Boh & Yellin, 2006; Sedera, Lokuge, Grover, & Sarker, 2016; Zhu et al., 2015). We follow Bush, Tiwana, and Rai (Bush, Tiwana, & Rai, 2010) to conceptualize *platform architecture flexibility* as the extent to which a digital platform can easily and readily change the digital linkages across the supply chain to support open connection, compatible with our partners, and reused modular software.

Relational component captures the actors that participate in the supply chain, i.e., upstream suppliers, downstream distributors, and end customers (hereafter referred to as 'customers'). Firms increasingly depend on supply chain partners engagement in e-business processes (Gharib, Philpott, & Duan, 2017; Kumar & Pansari, 2016). By improving partner engagement in e-business processes operations, a focal firm can both find and source high quality materials (Mishra, Devaraj, & Vaidyanathan, 2013), increase interactions with markets and customers (Xue et al., 2013), and quickly understand and respond to customers' needs (Eng, 2008). We define *partner engagement* as the extent to which a focal firm has the procedures and policies in place to encourage supply chain partners involvement in e-business processes. In this paper, we focus on three key engagement types: (1) supplier engagement, (2) distributor engagement, and (3) customer engagement.

Business component refers to the digital operation activities that enable a firm to pursue transaction, collaboration and service processes to achieve business goals. In this paper, *e-business operations capabilities (EBOCs)* capture the business component of e-business processes. We define *e-business operations capabilities* as the digital operations abilities of a focal firm to share information and conduct supply chain activities including transactions, collaboration, and service in a digital format. Following the framework of Johnson and Whang (Johnson & Whang, 2002), we divide various e-business operation capabilities into three categories based on the supply chain partners that a focal firm interacts with: (1) online procurement capability, (2) online channel management capability, and (3) online service capability.

2.2. Resource orchestration theory and value creation of e-business processes

Process component lens suggests that the components of business processes keep *structural link* through organizational resources interconnecting and leveraging for achieving business value (Crowston, 1997; Crowston et al., 2006). Resource orchestration theory is useful for understanding the relationships among components of e-business processes to create business value.

Extending from resource-based view, the main logic of resource orchestration theory suggests that the effectiveness of organizational resources deployment is determined by leveraging various resources through a series of managerial actions (Chadwick, Super, & Kwon, 2015; Liu et al., 2016; Sirmon et al., 2011). Through effective resource structuring action, a firm can acquire resource portfolios, and combine the structured resources to build new capabilities. Capability leveraging involves a sequence of managerial actions to deploy capabilities and take advantage of specific market opportunities (Sirmon et al., 2007, 2008; Sirmon et al., 2011). The synchronization of these two managerial actions is critically important to create competitive advantage of a firm.

Resource orchestration theory is particularly suitable for understanding how to execute e-business processes through *resources structuring* and *capabilities leveraging* for creating IT business value in supply chain operations. First, a focal firm can acquire technical and relational resources portfolios to structure e-business processes. On the one hand, the platform architecture flexibility not only enables consistent and real time transfer of information that are distributed across partners (Gardner, Boyer, & Gray, 2015; Setia et al., 2013), but also improves the adaptability of electronic links with multiple business partners for digital business. On the other hand, getting partners actively engaged in the e-business processes allows a firm to bring external resources into its operations (Sarkar, Aulakh, & Madhok, 2009). A firm should develop organizational capabilities to integrate and reconfigure owned and partners' resources that are embedded in e-business processes contexts through effective resource structuring managerial action.

Second, leveraging e-business operations capabilities enables a firm manage digital business activities along with supply chain actors (Zhu, Zhao, Tang, & Zhang, 2015). This managerial action determines whether a focal firm can achieve IT business value. Resource orchestration theory suggest that leveraging firm's capabilities to a particular context and create competitive advantage through effective configuring actions (Sirmon et al., 2011). A firm should mobilize e-business operations capabilities at different processes level to form requisite capability configurations for supporting digital supply chain operations. Multiple e-business operations capabilities are needed to deploy resource portfolios effectively to generate a range of digital innovation to enhance competitive performance.

Following this logic, we suggest that *resources structuring* and *capabilities leveraging* are two underlying managerial actions to obtain competitive performance from the three components of e-business processes. Fig. 1 shows our research framework that includes above two actions along with three key components of e-business processes. The definitions of constructs used in this study are summarized in Table 1.

3. Research model and hypotheses

The unit of analysis in this study is a focal firm's e-business processes that support supply chain operations. Following two managerial actions discussed above, we focus on platform architecture flexibility, partner engagement, and e-business operations capabilities to examine how they work together to improve competitive performance in three major e-business processes (i.e., online procurement, channel management, and customer service). Our research model are presented in Fig. 2.

3.1. Resources structuring for e-business operations capabilities

As discussed in the previous section, the focal firm should develop acquiring resource portfolios of combine platform architecture flexibility and partner engagement to develop e-business operations capabilities. As the technical component of an e-business process, platform architecture flexibility provides adaptable electronic link of an e-business process through open standards, cross-functional compatibilities, and modular architecture (Bhatt, Emdad, Roberts, & Grover, 2010; Bush et al., 2010; Tafti, Mithas, & Krishnan, 2013). Open standards for digital platforms allow business partners to rapidly integrate, connect, and establish automated communication for supporting digital operations activities (Tafti et al., 2013). Cross-functional compatibilities facilitates digital collaboration across functional areas, enabling new joint business opportunities (Tafti et al., 2013). Furthermore, by using modular platform architecture(Cenamor et al., 2017), a firm can significantly enhance the flexibility of its business processes to dynamically reconfigure technical resources to meet evolving business requirements (Byrd & Turner, 2000). Therefore, platform architecture flexibility enables a firm to maintain adaptable collaboration with different partners for digital operations.

In addition, effective digital operations also need partner engagement to make investments in corresponding technologies and capabilities. Resource dependence theory postulates that few firms have the ability to internally control all resources required for effective functioning and consequently depend on and form relationships and governance with external firms to acquire resources (Chatterjee & Ravichandran, 2013; Pfeffer & Salancik, 2003). Firms should develop policy and procedures to encourage supplier engagement to ensure access to needed resources from their partners (Tillquist, King, & Woo, 2002). An effective resource structuring process creates indispensable linkage that combines partners' resources to improve digital operations capabilities. Therefore, both platform architecture flexibility and partner engagement are needed to develop e-business operations capabilities in processes content.

In an e-procurement process, a flexible platform architecture not only supports joint coordination of production plans and procurement schedules with suppliers, but also enables the focal firm to optimize business processes and improve collaboration activities to adjust or develop new suppliers' management mechanisms as needed (Chi, Wang, Lu, & George, 2018; Devaraj, Vaidyanathanb, & Mishra, 2012). However, these digital activities cannot be carried out effectively without supplier engagement. Developing policy and procedures to encourage supplier engagement can reduce relationship uncertainty and increases joint investments in critical tangible and intangible resources to support digital transactions and collaboration. For example, equal and long-term collaborative policies will stimulate suppliers to developing joint designs early in the purchasing process or sharing material demand information to optimize procurement schedules. Open and trusting partnerships will sure continual engagement of suppliers and decrease the risk of long-term investment in e-procurement (Chang, Tsai, & Hsu, 2013). Therefore, we posit:

H1. Both (a) platform architecture flexibility and (b) supplier engagement have positive impacts on online procurement capability.

Similarly, a flexible platform architecture also improves the efficiency of channel management by allowing the focal firm to integrate channel resources from different distributors and coordinate operations in its marketing delivery system (Oh et al., 2012). By supporting joint planning of promotion, transaction management, and order fulfillment across different functional channels, the digital platform enables the focal firm to develop an IT-enabled marketing strategy and create opportunities for process innovation (Rangaswamy & Van Bruggen, 2005). However, distributor engagement is indispensable for developing online channel management capability. Developing equal and long-term collaborative policies to encourage retailer engagement can improve

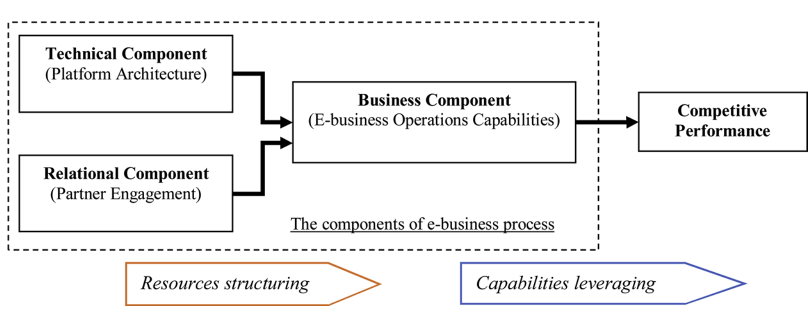

Fig. 1. Research framework.

Table 1
Construct definitions.

	Constructs	Definition	Source
Technical components	**Platform architecture flexibility (PAF)**	The extent to which a digital platform can easily and readily change the digital linkages across the supply chain to support open connection, compatible with our partners, and reused modular software	(Bush et al., 2010; Byrd & Turner, 2000)
Relational components	**Partner engagement (PE)**	The extent to which a focal firm has the procedures and policies in place to encourage supply chain partners involvement in e-business processes	(Chatterjee & Ravichandran, 2013; Heide & John, 1990; Tillquist et al., 2002)
	Supplier engagement (SE)	The relational resource of a focal firm to get its suppliers involved in online procurement through policies encouragement.	Developed
	Distributor engagement (DE)	The relational resource of a focal firm to get its distributors involved in online channel management through policies encouragement.	Developed
	Customer engagement (CE)	The relational resource of a focal firm to get its customers involved in customer service though policies encouragement.	Developed
Business components	**E-business operations capabilities (EBOCs)**	The digital operations abilities of a focal firm to share information and conduct supply chain activities including transactions, collaboration, and service in a digital format.	(Sanders, 2007)
	Online procurement capability (OPC)	The digital business ability of a firm to conduct procurement activities to realize negotiation-transaction, coordinate production schedules, and materials demand management.	(Chang et al., 2013; Mishra et al., 2007)
	Online channel management capability (OCMC)	The digital business ability of a firm to conduct channel management to realize unified promotion, product launches, pricing, and online transactions and order fulfillment.	(Oh et al., 2012; Saraf et al., 2007)
	Online service capability (OSC)	The digital business ability of a firm to conduct online services to realize customer communication, after-sales service support, and demand tracking and response.	(Eng, 2008; Roberts & Grover, 2012; Saraf et al., 2007)
IT business value	**Competitive performance (CP)**	The perceived strategic benefits for a firm gained over its major competitors.	(Rai & Tang, 2010)

shared decision-making and knowledge exchange such as promotion, product launches and pricing, and order fulfillment (Oh et al., 2012; Xia & Zhang, 2010). Through building open and trusting partnerships, distributor engagement enable to invest in complementary technology and process capabilities to support online channel management (Huang, Ouyang, Pan, & Chou, 2012). This leads to our next hypothesis:

H2. Both (a) platform architecture flexibility and (b) distributor engagement have positive impacts on online channel management capability.

Furthermore, a flexible digital platforms improves online service by integrating a company's offerings, its website, and knowledge of the customer experience to provide personalized service and rapid responses to customer demands (Roberts & Grover, 2012; Setia et al., 2013; Zhang, Guo, Hu, & Liu, 2017). These integrations depend on flexible architecture support for cross-functional operational optimization and collaborative management to better leverage online service capabilities for customers (Iriana & Buttle, 2007). However, these digital activities cannot be carried out effectively without customer engagement. Developing a series of new service policies to encourage supplier engagement is especially important in online service processes. For example, co-creation oriented service procedures will stimulate customer engagement to detect customer preferences, and rapidly respond to customer problems (Xie, Wu, Xiao, & Hu, 2016). Interactive customer care procedures will create a effective service system that is able to develop an agile service capability to better sense and respond to market changes (Gligor, Esmark, & Holcomb, 2015; Rosenzweig & Roth, 2007). This leads to our next hypothesis:

H3. Both (a) platform architecture flexibility and (b) customer engagement have positive impacts on online service capability.

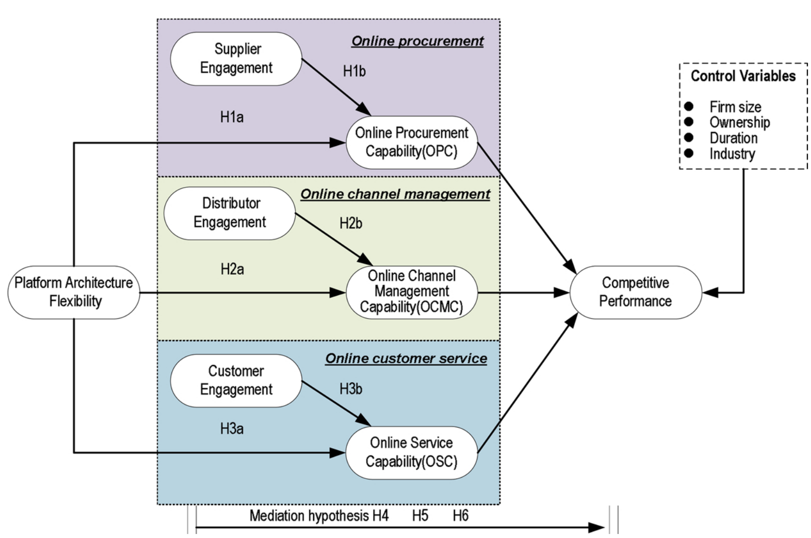

Fig. 2. Research model and hypotheses.

3.2. Capabilities leveraging for competitive performance

In this paper, we define *competitive performance* as the perceived strategic benefits for a firm gained over its major competitors. The performance benefits from transactions and collaborations include cost savings and profit improvement resulting from enhanced capacity and flexibility for collective actions, better opportunities for exploitation, and the ability to launch surprise actions in competitive markets (Oh et al., 2012). Through effectively deploying resource structuring, developing EBOCs will generates a range of digital innovation in supply chain operations to enhance competitive performance. The mediating role of EBOCs in explaining how platform architecture flexibility and partner engagement results in improved competitive advantage represents the leveraging actions of EBOCs in the proposed three e-business processes.

Online procurement capabilities potentially provide a distinct value proposition to the firm supported by platform architecture and supplier engagement. The value comes from the reduced procurement and inventory costs as the flexible collaboration with suppliers (Soto-Acosta & Merono-Cerdan, 2008). Platform architecture flexibility and supplier engagement create competitive performance in e-procurement process through sharing key planning, schedules, and ordering with suppliers. Thus firms should improve online procurement capabilities for an effective operations capability to coordinate design and shipping schedules together with suppliers (Devaraj et al., 2012), which reduces inventory and obsolescence. Such linked processes and detailed collaborative activities also help firms cope with changes in the marketplace and lower uncertainty, thus enhancing performance. Therefore, we propose:

H4. Online procurement capability mediates the positive effects of platform architecture flexibility and supplier engagement on competitive performance.

Similarly, online channel management capability can be used to leverage platform architecture and distributor engagement to create competitive performance through cross-functional digital channel operations. Platform architecture flexibility is considered as a foundational technical resource that indirectly contributes to performance in realizing unified product launches, pricing, promotion and transaction activities. On this basis, distributor engagement enable a firms to develop effective channel management to increase operational efficiency through knowledge sharing and operations process coupling with distributors (Oh et al., 2012). Thus, firms should build on platform architecture flexibility and distributor engagement to conduct online channel management capability to reduce the cost of transactions and facilitate fast turnover of products (Xia & Zhang, 2010). By pooling inventory and marketing across channels, a firm can be better positioned to gain new competitive performance. Therefore, we propose our next hypothesis:

H5. Online channel management capability mediates the positive effects of platform architecture flexibility and distributor engagement on competitive performance.

Additionally, providing online customer service can help a firm not only allocate technical resources efficiently in terms of sensing customer needs but also allow the firm to manage customer engagement (Narman, Holm, Ekstedt, & Honeth, 2013). Supported by flexible platform architecture, such as online community, mobile APPs, and recommendation system tools, online service capability enables to develop the firm's skills for acquiring knowledge about customer need and market changing when customers continually stick in self-adaption service processes, and create new value-added service to improve the customer experience (Chong, Lacka, Li, & Chan, 2018; Hao, Padman, Sun, & Telang, 2018). These customer service activities will lead to greater customer satisfaction and loyalty in the changing environment through platform architecture support and customer engagement, thus improving competitive performance. Therefore, we propose our final hypothesis:

H6. Online service capability mediates the positive effects of platform architecture flexibility and customer engagement on competitive performance.

4. Research design and data collection

As a large and growing global manufacturing base, China provides an ideal setting for our study. E-business is increasingly used by Chinese manufacturing firms to enhance their collaboration with supply chain partners, and has become a critical part of the Chinese economy in the recent "Internet Plus" economic transition period (ChinaFinance, 2015). Compared to e-commerce platforms or retailers (e.g., Amazon, and Alibaba) (Zhao, Wang, & Huang, 2008), manufacturing firms present complex operations structure linked with different partners, e.g., suppliers, distributors, and customers, which provides rich insights of e-business processes applications in the whole supply chain. Testing our research model using data collected from Chinese manufacturing firms provides us an opportunity to reveal nuance in the value creation mechanisms of e-business processes in emerging markets.

4.1. Survey procedure and research sample

Survey data was collected from manufacturing firms that interact with suppliers, distributors, and customers using e-business technologies. A list of manufacturing firms was obtained from the *Chinese Electronic Commerce Association* and the *Commission of the Economy and Information Technology*. After removing 350 firms without valid contact information, we had an industry stratified random sample of 600 firms for our survey.

We followed the key informant approach to collect data from one senior manager or IS manager in each firm who was highly knowledgeable about e-business operations (Zhu, Kraemer, & Xu, 2006). First, two rounds of email invitations stating the purpose of the study were sent to these managers. If the manager agreed to participate, we emailed the questionnaire with a deadline to respond. Four weeks later, we sent a paper invitation letter and questionnaire to non-respondents. 233 surveys were returned. After eliminating 37 responses with too much missing data, our final sample includes 196 firms resulted in a response rate of 33 percent. We tested for non-response bias using analysis of variance techniques (Armstrong & Overton, 1977). Considering the last group of respondents as most likely to be similar to non-respondents, we compared the first and last 25 percent of respondents on key research variables, which did not indicate any response bias across these variables. Table 2 presents summary information.

4.2. Measurement of constructs

The initial structured questionnaire was developed primarily based on measures identified in the IS and supply chain literature. After compiling the English version of the questionnaire, the draft survey items were first translated into Chinese by a bilingual research associate, and then verified and refined for translation accuracy by two IS researchers and two IS Ph.D. students. We refined the questionnaire sequentially through two-stage Q-sorting (Moore & Benbasat, 1991), which was conducted by the researchers along with face-to-face interviews with six senior managers. The questionnaire was then pilot tested in ten firms to solicit feedback and assess construct validity. The final questionnaire was modified based on feedback received from these steps. Although a seven-point scale would have increased the response options, it would have also potentially increased confusion in understanding the critical meanings of organizational operations. A five-point scale was sufficient to represent the options to the respondents about IT

Table 2
Demographical profile of the responding firms.

	Number	Percentage		Number	Percentage
Employee			**Sales (Million RMB)**		
< 100	40	20.4	< 10	34	17.3
101–1000	63	32.2	10–100	39	20.0
1001–5000	37	18.9	101–1000	42	21.4
> 5000	52	26.5	> 1000	70	35.7
Unknown	4	2.0	Unknown	11	5.6
Manufacturing industry			**E-business duration**		
Food	13	6.6	< 1 year	37	18.9
Textile and leather	5	2.5	2–3 year	59	30.1
Chemicals and medicine	54	27.6	4–5 year	39	19.9
Computer	39	19.9	> 5–6 year	55	28
Electronic equipment	22	11.2	Unknown	6	3.1
Telecommunication equipment	34	17.3			
Automobile and components	24	12.2			
Unknown	5	2.7			

operations and new technology usage (Dwivedi, Kapoor, Williams, & Williams, 2013; Kapoor, Dwivedi, Piercy, Lal, & Weerakkody, 2014; Kim, Oh, Shin, & Chae, 2009; Shareef, Kumar, Dwivedi, & Kumar, 2016). Consistent with the theoretical conceptualization, all scales were operationalized at the firm level using five-point Likert scales, as summarized in Appendix A.

Platform architecture flexibility (PAF) measured the technical ability of a digital platform to easily and readily change the linkages across the supply chain. The scale was operationalized as a reflective construct with three items examining scalable technology, compatible integrate, and modular components (Byrd & Turner, 2000).

For new measures of partner engagement, standard scale development procedures were used and new items were development based on a literature analysis together with senior manager interviews. Following recent construct measurement procedures (MacKenzie, Podsakoff, & Podsakoff, 2011), we first develop conceptualization of three constructs (see Table 1). Second, we identify the critical expressions of policy and procedures to encourage partner engagement according to existing literature. A measurement item pool was generated based on the conceptualization, ensuring that these items tapped the construct's domain. Third, measurement items were iteratively refined and validated based on feedback from six senior e-business or supply chain department managers. This iterative refinement process was aimed to ensure content clarity, and validity of the items, which ensure that the items were unambiguous and accurately tapped into the content of each construct. Finally, nine items were retained after exploratory factors testing, and four were dropped resulting in three constructs: (1) *supplier engagement (SE), (2) distributor engagement (DE)*, and (3) *customer engagement (CE)*. These three constructs were operationalized as reflective constructs because any item is individually reflective of partners being engaged and eliminating an indicator does not alter the conceptual domain.

E-business operations capabilities consist of three constructs. *Online procurement capability (OPC)* was based on the work of Mishra et al. (Mishra, Konana, & Barua, 2007) and uses the measurement scales developed by Soto-Acosta and Merono-Cerdan (Soto-Acosta & Merono-Cerdan, 2008). Four items for *online channel management capability (OCMC)* were adapted from (Oh et al., 2012). Following Eng's recommendation (Eng, 2008), *online service capability (OSC)* was measured using three items that capture critical components of online service capability.

Competitive performance (CP) was used to assess the perceived strategic benefits about market share, profitability, and sales growth for a firm gained over its major competitors (Rai & Tang, 2010). This construct was operationalized as are reflective construct. Respondents were asked to evaluate their competitive performance relative to that of competitors on these three aspects. Self-reported measures are appropriate in our context, because we are interested in the competitive performance in a supply chain for which objective measures are hard to obtain.

To control for firm-specific effects, we included four variables to account for performance impact: *firm size, duration, ownership. Large firms* (measured as number of employees) may obtain better competitive performance due to higher potential for product and resource synergy and scale economy (Zhu & Kraemer, 2002). *Duration* (number of years since e-business technologies were first used in supply chain operations) may affect competitive performance since such initiatives need time to assimilate in a firm and its supply chain. *Ownership* may affect competitive performance due to organizational and institutional restrictions for IT investment and management (Zhao, Huang, & Zhu, 2008). We specify ownership as state-owned and non-state-owned using dummy variables (state-owned = 1). Furthermore, we controlled for *industry* to account for performance differences associated with its industry's dynamics (Rai & Tang, 2010). The dynamics in high-tech and traditional industry differ in their potential influence on competitive performance. We divided the original firms into high-tech and traditional manufacturing groups follow China's four-digit SIC codes.

4.3. Common methods Bias assessment

Because each response came from a single key informant, common methods bias could have been present (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003). We conducted two types of analysis to assess the threat of common methods bias: (1) latent single common method factor (CMF) test, and (2) triangulation for competitive performance using secondary data.

First, we assessed the threat of common method bias using Covariance-based structural equation model (SEM) to conduct latent single common method factor (CMF) test (Podsakoff et al., 2003). Following Wagner and Bode's method (Wagner & Bode, 2014), we respectively calculate a base CFA model, and a CMF model that extended the base model with a single latent method factor that is uncorrelated with all the other latent variables. The inclusion of the CMF model only marginally improved model fit (base model: $\chi^2/$ df = 1.83, RMSEA = 0.047, CFI = 0.96, NFI = 0.91, GFI = 0.91, SRMA = 0.04; CMF model: $\chi^2/$ df = 1.80, RMSEA = 0.045, CFI = 0.96, NFI = 0.92, GFI = 0.91, SRMA = 0.05). This result suggests that the inclusion of the CMF does not significantly improve the model fit ($\triangle\chi^2$ (1) = 1.88, $p > 0.1$). We further calculated the standard loadings between the items with and without the methods factor. The high correlation coefficients ($r = 0.85$, $p < 0.05$) strongly support that common method variance does not pose a significant threat to the research model.

Following Wernerfelt and Montgomery's method (Wernerfelt & Montgomery, 1988), the second test was triangulation with objective performance variables (formative construct) from archival records data. We collected published performance data from the *Oriana Asia-Pacific company information database* on the 56 identifiable public firms in our sample for both the same year as the survey (*year t*) and the next year after survey (*year t + 1*). We captured three measures (net profit, total sales, and fixed assets) for each firm to calculate return on assets (ROA) and profit margin (PM) in both years[1] . Then, we collected average ratios of industry, and used these archival firm variables to calculate an exceed ratio for each of the following two items:

1 Comparative ratio of return on assets (CRROA) = [(*firm ROA- industry average ROA*) / *industry average ROA*]
2 Comparative ratio of profit margin (CRPM) = [(*firm PM–industry average PM*) / *industry average PM*]

If the ratio is greater than 0, then that means this firm has performed better than its industry competitors. We then estimated the correlation between the constructs measured using the manager survey measures and the latent constructs measured by these two objective measures. The results show a significant positive relationship between the survey measures and objective constructs in year *t* (average $r = 0.38$, $p < 0.05$) and in year *t + 1* (average $r = 0.33$, $p < 0.05$). This provides some assurance that managers' perceptions of their firms' competitive performance are significantly correlated with objective performance data. Collectively, these results provide sufficient assurance that common method bias is not a serious threat in this study.

5. Data analysis and results

The proposed research model is assessed using a covariance-based SEM analysis. Both measurement model and structural model were analyzed using LISREL 8.72.

5.1. Measurement model validation

First, confirmatory factor analysis (CFA) was used to evaluate the validity of the instrument. Overall, the measurement model fits the data well (χ^2/ df = 1.83, RMSEA = 0.047, CFI = 0.96, NFI = 0.91, GFI = 0.91, SRMA = 0.04). Convergent validity indicates the extent to which the items of a scale that are theoretically related are also related in reality. As shown at Table 3, all items load well on their hypothesized factors (above 0.72), which are significant at the 0.01 level[2] . The average variance extracted (AVE) values for all the constructs were above the limit of 0.50, suggesting good convergent validity. Table 4 showed that discriminant validity was also supported because the square root of the AVE for each construct is higher than correlations between it and all other constructs (Fornell & Larcker, 1981).

Second, construct reliability was measured using Cronbach's alpha and composite reliability (see Table 3). The results range from 0.80 to 0.91 for the eight constructs, indicating high internal consistency. Further, composite reliability was evaluated and the results are similar to Cronbach's alpha, indicating good reliability of these constructs (Gefen, Rigdon, & Straub, 2011).

5.2. Structural model and mediation test

A structural model, which represents the relationships among various latent constructs, was used to test the hypotheses. The overall model provided a good fit to the data (χ2/ df = 1.84, RMSEA = 0.058, CFI = 0.95, NFI = 0.90, GFI = 0.90, SRMA = 0.05). Fig. 3 shows the path analysis results, including standardized path coefficients, significance based on two-tailed t-tests for our hypotheses, and the amount of variance explained. The 40.1 percent R^2 of the overall model suggests that the perspective developed in this paper has substantial explanatory power for competitive performance. For control variables, only duration ($\beta = 0.11$, $p < 0.05$) has a positive impact on competitive performance, which suggests that firms with more e-business experience are able to obtain higher competitive performance.

As shown in Fig. 3, platform architecture flexibility and partner engagement have positive effects on OPC ($\beta_{PAF} = 0.47$, $p < 0.001$; $\beta_{SE} = 0.24$, $p < 0.05$), OCMC ($\beta_{PAF} = 0.21$, $p < 0.05$; $\beta_{DE} = 0.57$, $p < 0.001$), and OSC ($\beta_{PAF} = 0.35$, $p < 0.05$; $\beta_{CE} = 0.34$, $p < 0.05$). Thus, we find strong evidence for hypotheses H1a-b, H2a-b and H3a-b suggesting that firms that have a high degree of platform architecture flexibility and partner engagement tend to possess high e-business operations capabilities.

We then examined the mediation link of e-business operations capabilities in three processes with competitive performance. Only OCMC ($\beta = 0.28$, $p < 0.05$) and OSC ($\beta = 0.25$, $p < 0.05$) are significantly associated with competitive performance. For the mediating hypothesis of EBOCs, we tested the mediation effect using the bootstrapping procedure suggested by Zhao et al (Zhao, Lynch, & Chen, 2010). Compared with traditional mediation test methods such as the Baron and Kenny method (Baron & Kenney, 1986), the bootstrapping procedure does not require the normal distribution of mediation effect. The 95% confidence interval of the direct and indirect effects was obtained using 5000 bootstrap resamples. As shown in Table 5, the effect of PAF on CA through OPC is insignificant. Therefore, except for the path of PAF →OPC→CA, our results provide evidence that EBOCs mediate the performance impacts of platform architecture flexibility

Table 3
Factor loadings, reliability, and convergent validity of reflective constructs.

Construct	Item loading	Composite reliability	Cronbach's alpha	AVE
PAF: Platform Architecture Flexibility				
PAF1	0.86**	0.855	0.829	0.664
PAF2	0.83**			
PAF3	0.75**			
SE: Supplier Engagement				
SE1	0.88**	0.889	0.907	0.729
SE2	0.86**			
SE3	0.82**			
DE: Distributor Engagement				
DE1	0.86**	0.866	0.836	0.685
DE2	0.84**			
DE3	0.78**			
CE: Customer Engagement				
CE1	0.82**	0.820	0.918	0.605
CE2	0.79**			
CE3	0.72**			
OPC: Online Procurement Capability				
OPC1	0.86**	0.892	0.916	0.675
OPC2	0.86**			
OPC3	0.82**			
OPC4	0.74**			
OCMC: Online Channel Management Capability				
OCMC1	0.87**	0.872	0.893	0.631
OCMC2	0.74**			
OCMC3	0.83*			
OCMC4	0.73**			
OSC: Online Service Capability				
OSC1	0.78**	0.836	0.800	0.630
OSC2	0.81**			
OSC3	0.79**			
CP: Competitive Performance				
CP1	0.86**	0.834	0.907	0.627
CP2	0.76**			
CP3	0.75**			

Note: ***p* < 0.01, **p* < 0.05.

[1] Dehning, Richardson and Zmud (2007) found that return on assets (ROA) and profit margins (PM) present the most important influence on overall of supply chain competitive performance.

[2] We also performed exploratory factor analysis (EFA) and found a similar factor structure for the constructs.

Table 4
Descriptive statistics and correlations.

	Mean	S.D.	1	2	3	4	5	6	7	8
1. Platform architecture flexibility	3.44	0.86	**0.82**							
2. Supplier engagement	3.49	0.85	0.60**	**0.85**						
3. Distributor engagement	3.32	0.98	0.57**	0.65**	**0.83**					
4. Customer engagement	3.36	0.96	0.53*	0.55**	0.41*	**0.77**				
5. Online procurement capability	3.17	0.99	0.62**	0.61**	0.53V	0.54*	**0.82**			
6. Online channel management capability	3.15	0.97	0.59**	0.52*	0.61**	0.38*	0.39*	**0.79**		
7. Online service capability	3.37	0.92	0.56**	0.50*	0.53*	0.60**	0.62**	0.66**	**0.79**	
8. Competitive performance	2.24	0.86	0.42**	0.31*	0.43*	0.35*	0.53*	0.56**	0.56**	**0.79**

Note: Square root of average variance extracted (AVE) is reported on the diagonal for multi-item constructs with bold font.
* $p < 0.05$.
** $p < 0.01$.

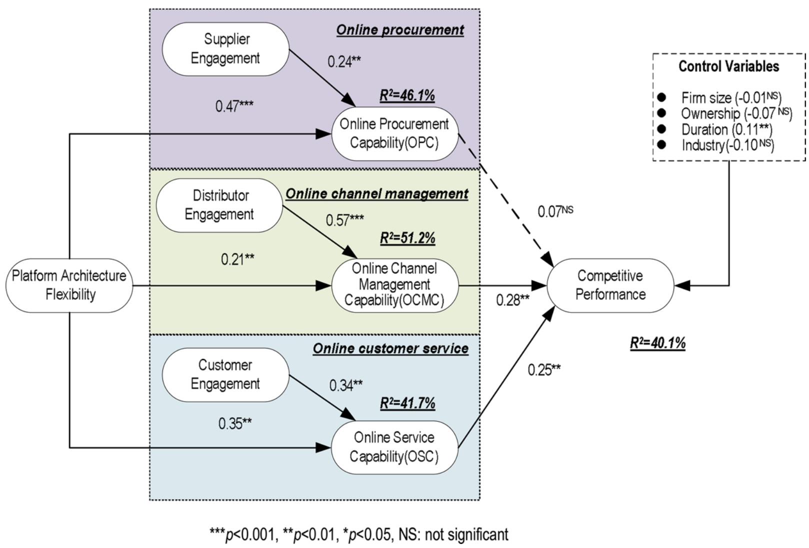

Fig. 3. Results of path Analysis.

Table 5
Mediation analysis using bootstrapping method.

IV	MV	DV	Indirect effect		Mediation Role	Hypothesis Results
			Effect value	Confidence interval 95%		
PAF	OPC	CP	0.032	[−0.102,0.166]	No	H4(×)
	OCMC	CP	0.161	[0.030,0.300]	Yes	H5(√)
	OSC	CP	0.144	[0.051,0.242]	Yes	H6(√)
SE	OPC	CP	0.297	[0.156,0.439]	Yes	H4(√)
DE	OCMC	CP	0.144	[0.011,0.277]	Yes	H5(√)
CE	OSC	CP	0.084	[0.041,0.209]	Yes	H6(√)

Note: IV: independent variable; MV: mediation variable; DV: dependent variable.

and partner engagement. Thus, hypotheses H4 was partial supported, and hypotheses H5 and H6 were all statistically supported. These results suggest that competitive performance mainly depends on the digital operations activities related to product sales and customer service.

5.3. Endogeneity checks

We conducted two robustness checks to examine the sensitivity of the results in this study. First, since our data is cross-sectional in nature, we evaluated potential endogeneity issues that may rise from self-selection effects and omitted variable bias. Three potential drivers of platform architecture flexibility and partner engagement choice observed in prior studies must be accounted. These include (a) IT strategy alignment, (b) firm size, (c) industry of firm. IT strategy alignment measured by five items adopted from (Chi, Zhao, & George, 2015). IT strategy alignment suggest that greater strategic alignment between business and IT will encourage firms to invest technology and relational resources. Larger firms may more likely to control and integration organizational resources (Zhu & Kraemer, 2002). Firms in more dynamic industries, such as high-tech manufacturing, are likely to develop digital platform and encourage partner engagement to quickly response to volatile environment. We adopted a two-stage least squares (2SLS) regression with above instrumental variables. Results show that hypotheses 1a-1c and 2a-2c were consistently supported, which were similar with SEM results.

We further conducted a two-step Heckman analysis using Stata 14.0 to evaluate the potential reverse causality between competitive performance and critical components of e-business processes. As shown in Fig. 3, supplier engagement (SE), online channel management capability (OCMC) and online service capability (OSC) are positive link to competitive performance (CP), we used OLS regression to test the relationship as the first stage. The Results (the model 1 of Table 6) of highly consistent with our SEM results in Fig. 3. Next, to apply the two-stage Heckman approach, we followed the literature (Bharadwaj, Bharadwaj, & Bendoly, 2007; Hsieh, Rai, & Xu, 2011) to respectively dichotomize responding firms into two groups according to the average scores of SE, OCMC and OSC. Firms with scores above the mean coded as one and firms that were below the mean coded as zero. We separately estimated three Probit models to explain the dichotomized SE, OCMC, and OSC by CA. These Probit models (the model 2, 4, 6 of Table 6)

Table 6
Results from Heckman analysis.

	(1)SEM DV = CA	Two stage Heckman analysis		Two stage Heckman analysis		Two stage Heckman analysis	
		(2) Stg 1: Probit DV = SE	(3) Stg 2: OLS DV = CP	(4) Stg 1: Probit DV = OCMC	(5) Stg 2: OLS DV = CP	(6) Stg 1: Probit DV = OSC	(7) Stg 2: OLS DV = CP
Endogenous Factors							
Competitive performance (CP)		0.620***		1.290***		0.903***	
Inverse Mills Ratio			−0.379**		0.091*		−0.484
Significant Antecedents of CA							
Supplier engagement(SE)	0.193**		0.457***		0.204**		0.169**
Online channel management capability(OCMC)	0.260***		0.227**		0.159*		0.202**
Online service capability(OSC)	0.219**		0.156*		0.206**		0.493***
Controls							
Firm size	0.007	0.059	−0.005	0.095	−0.001	−0.052	0.011
Ownership	−0.326**	−0.260	−0.288**	0.393	−0.336**	0.251	−0.281**
Duration	0.080***	0.117	0.06	−0.037	0.088*	0.05	0.056
Industry	−0.113	−0.017	−0.062	1.104	−0.156	0.421	−0.145
Intercept	0.913***	−2.711	0.372	−4.711	1.39***	−3.567	0.011
R^2	0.471	0.147	0.532	0.308	0.484	0.202	0.573
Maximum VIF	2.05	——	2.72	——	3.04	——	2.79

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

showed positive link from CA to the dichotomized SE, OCMC, and OSC ($p < 0.001$), suggesting that SE, OCMC, and OSC could be endogenous. After computing the values of Inverse Mills Ratio (IMR) based on the Probit models, we added it into OLS models to account for the endogenous effects. After controlling for IMR, the coefficients on the antecedents, and controls remained qualitatively unchanged (the model 3, 4, 7 of Table 6). The results of above Heckman analysis suggest that our original results are robust after addressing potential reverse causation.

5.4. Post hoc analysis for resources structuring

A path comparison method proposed by Cohen et al. (Cohen, Cohen, West, & Aiken, 2003) was used to test the differential influence compared with platform architecture flexibility and partner engagement on EBOCs. Followed the literature (Li, Hsieh, & Rai, 2013), we compute the unstandardized latent variable scores for all the constructs and then calculated the unstandardized path coefficients using multiple regression analysis. As shown in Table 7, we found the following results: (1) PAF had a stronger impact on OPC than SE in online procurement process, (2) the impact of DE is stronger than PAF in online channel management process, (3) in online service process, there is no significant difference between the impacts of PAF and DE on OSC. Above results showed three different portfolios structure between platform architecture flexibility and partner engagement to gain on EBOCs.

6. Discussion and contributions

6.1. Research findings

For the first research question about process components of an e-business process, this study extends Crowston's work (Crowston, 1997; Crowston et al., 2006) on conceptualization of process components, and use process component lens to open the black box of e-business processes. Our study provides a nuanced theoretical understanding of the interlinked technical, relational and business components that form the e-business processes and create IT business value. For the second research question, we draw on resource orchestration theory (Sirmon et al., 2007, 2008; Sirmon et al., 2011) to identify two managerial actions, *resources structuring* and *capabilities leveraging* in using e-business process components, to explain how these three components work together to improve competitive performance in supply chain operations. Two interesting findings emerge from our empirical research corresponds to value creation mechanisms.

Firstly, *three portfolio effects* of resources structuring between platform architecture flexibility and partner engagement to gain on EBOCs are identified in this paper. By comparing the effects of technical and relational resource on EBOCs, the strong evidence suggesting that when platform architecture flexibility has a high effect on OPC, partner engagement has a low influence ($\beta_{PCF\rightarrow OPC} > \beta_{PE\rightarrow OPC}$, $p < 0.05$), and *vice versa* in OCMC ($\beta_{PCF\rightarrow OCMC} < \beta_{DE\rightarrow OCMC}$, $p < 0.001$). A balanced condition is appeared at OCSC ($\beta_{PCF\rightarrow OCMC} \approx \beta_{DE\rightarrow OCMC}$, No differences detected). Although most studies of resource orchestration theory are conceptual propositions (Sirmon et al., 2011), our research further crystallizes the resource orchestration by empirically examining the *portfolio effects* to create resources structuring in using e-business processes for supporting supply chain operations.

Secondly, our results further reveal the mediation role of EBOCs in different e-business processes for obtaining competitive performance. The result suggests that competitive performance mainly depends on downstream processes, such as online channel management and online service processes, which confirms the findings of previous studies (Barua, Konana, Whinston, & Yin, 2004; Frohlich & Westbrook, 2002; Saraf, Langdon, & Gosain, 2007). However, our results also confirm that OPC in the online procurement process lacks a significant effect on competitive performance ($\beta = 0.07$, $p > 0.05$). A possible explanation is that when OPC act as an increasingly standard digital operations capability, it lost heterogeneity value in response to new market

Table 7
Portfolio effects between technical and relational component.

Standardized Path coefficient	Unstandardized Path coefficient	Results	Conclusion
$\beta_{PCF\rightarrow OPC}$ ($\beta = 0.47$)vs. $\beta_{PE\rightarrow OPC}$ ($\beta = 0.24$)	$B = 0.49$ vs. $B = 0.24$	T = 1.80*	**Portfolio effect A:**$\beta_{PCF\rightarrow OPC} > \beta_{PE\rightarrow OPC}$
$\beta_{PCF\rightarrow OCMC}$($\beta = 0.21$) vs. $\beta_{DE\rightarrow OCMC}$ ($\beta = 0.57$)	$B = 0.23$ vs. $B = 0.54$	T = −2.62***	**Portfolio effect B:**$\beta_{PCF\rightarrow OCMC} < \beta_{DE\rightarrow OCMC}$
$\beta_{PCF\rightarrow OSC}$($\beta = 0.35$) vs. $\beta_{CE\rightarrow OSC}$($\beta = 0.34$)	$B = 0.30$, vs. $B = 0.33$	T = −0.08^{NS}	**Portfolio effect C:** $\beta_{PCF\rightarrow OCMC} \approx \beta_{DE\rightarrow OCMC}$ (No differences detected)

Note: One-tailed tests were performed as the directional differences were hypothesized **$p < 0.001$, *$p < 0.05$, NS $p > 0.05$.

opportunities in supply chain operations. However, OPC is also important to a firm's competitive performance, but in a different way than OCMC and OSC. For example, OPC may generates spill-over effects on channel management when a focal firm improve vertical integration (Xue et al., 2013), because OPC can help firms achieve cross-selling through supply-side resource synergy. Thus, our study goes deeper into the components structure of e-business processes, and provides new evidence to explain the different role of business components in different e-business processes.

6.2. Theoretical implications

Little empirical work has been done to examine the role of components in promoting the business value of e-business processes (Devaraj et al., 2012; Setia et al., 2013).This research enhances our knowledge on the value creation mechanisms of e-business processes that has been sparsely investigated in the IS literature (Devaraj et al., 2007). There are some significant theoretical contributions from our study for researchers interested in designing and managing e-business processes to support digital operations.

Firstly, our study provides a theoretical framework on understanding how firms can design e-business processes for digital supply chain operations, and empirical identifies related measurement constructs (platform architecture flexibility, partner engagement, and e-business operations capabilities) to offer suggestions on an actionable set of e-business process operations. Previous literatures has not deeply explored the operations structure of processes (Setia et al., 2013), but often considered e-business processes as a single entity (Devaraj et al., 2007; Saeed, Grover, & Hwang, 2005). Our research directs attention toward the role of technical, relational and business components of an e-business process as value generators for enhanced competitive performance. To the best of our knowledge, this research is one of the first attempts to apply process components lens to study IT-enabled value creation of e-business processes.

Secondly, our study suggests that a firm should deploy platform architecture flexibility and partner engagement through *portfolio effects* for conducting EBOCs that explains the resources structuring of e-business processes. While prior IS studies have focused little on the effect of simultaneous technical connectivity and partner actions (Gosain, Malhotra, & El Sawy, 2004; Rai & Tang, 2010; Wang & Wei, 2007), we surface the balanced role of platform architecture flexibility and partner engagement, and extend our knowledge about better leverage the three portfolios structure between technologies and relational resources in different e-business processes.

Finally, our research further identifies *transformation effect* of online channel management capability and online service capability for creating IT business value in supply chain operations. We extend prior capabilities perspective (Barua et al., 2004; Frohlich & Westbrook, 2002; Saraf et al., 2007) by providing new process level insights for expounding the role of EBOCs on inter-firm processes operations to create competitive performance. We argue that EBOCs enable a firm to reconfigure technical and relational resource that are embedded in downstream e-business processes. Thus, EBOCs also allow us to track the route of e-business processes across different partners interface for creating IT business value.

6.3. Practical implications

Our findings provide IS managers, operations managers, and business executives with some important insights into e-business processes planning and operations innovation in supply chain management. Firstly, our study provides a framework to design and optimize the structure of e-business processes components that help IS managers to understanding the critical mechanisms that promote IT business value. For example, designing effective e-procurement process following structure of processes components that focuses on technical, relational, and business can be acted as the critical strategy for developing digital procurement operations. It is important that IS managers should be aware of the potential linkage among three different components that form the e-business processes and make resources structuring.

Secondly, operation managers should direct managerial attentions to developing applications for resources structuring in supply chain operations, and not limit attention to individual technologies or partnerships. This is especially valuable because it enables firms to integrate technical and relational resource to promote digital operations efficiently. They also should note that it is a misperception that platform architecture and partner engagement should be leveraged in the same pattern to enable EBOCs in different e-business processes. *Three portfolio effects* of resources structuring provide an effective blueprint to help managers to understand the different types of portfolio in the pursuit of EBOCs at process levels.

Thirdly, business executives need to develop an understanding of e-business technical investment links to enhance competitive performance through *transformation effect*. For example, how to evaluate potential EBOCs in different processes from their investments in e-business technology and partnership management will be key knowledge contributions to help manufacturing firms and e-commerce firms to accrue business value. Our findings also inform business executives about the strategic potential of their IT investments in e-business processes, and provide specific advices and steps for enhancing the intermediation role of EBOCs.

6.4. Limitations

While we developed our research model on a sound theoretical base and conducted the empirical study following the best practices in the field, our study is still subject to certain limitations that may be worth examination in future research. Firstly, our data collection adopted a single-informant approach from a firm perspective. A paired data study using subjective measurement and objective performance may improve reliability of the findings. Secondly, though we drew on resource orchestration theory as the critical theoretical framework and assessed EBOCs, we only evaluate three critical e-business processes from supply chain operations. However, emerging e-business processes are appeared in consumer sided recently years, such as online payment, social interaction, and online transaction. It would be useful to extend our model using process components perspective, even if such data are collected in these e-business processes. Thirdly, this study did not consider the moderating effect of environmental turbulence, such as industry competition and intensity of new technological breakthroughs. Dynamic capability which can reconfigure existing operational processes capabilities into new ones that better match the environment is considered as an important variable in improving competitive advantages. Future research can explore dynamic capability mechanisms to improve the efficiency of EBOCs when facing environmental turbulence. Thus, this can be a useful avenue to extend our work. In spite of these potential limitations, we believe our study offers important theoretical and practical implications for understanding the nature of e-business processes that enable firms to create business value.

7. Conclusion

While e-business processes offer the promise of improving supply chain operations, there is a need to better understand how these processes create business value to meet the emerging e-business opportunities (Zhu & Lin, 2019). In this paper, we decompose an e-business process into technical, relational and business components, and offer two mechanisms to theoretically explain the linkage of process components to business value creation. Our study provides empirical evidence that a firm can leverage platform architecture flexibility and partner engagement to conduct EBOCs, and enhance competitive performance through *portfolio* and *transformation effect* embedded in e-business processes. This paper delves into the elusive black box of e-business processes, and provides a multidisciplinary perspective on the value creation mechanisms of e-business processes in supply chain operations.

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Appendix A. Survey instruments

	Items	Reference
PAF: Platform architecture flexibility 5-point Likert scale (1 = Not at all, 5 = A lot)		(Bush et al., 2010; Byrd & Turner, 2000)
PAF1	Our digital platform is scalable to support open connection between our partners' systems and our systems.	
PAF2	Our digital platform is compatible with our partners to transmit, integrate and process data.	
PAF3	Our digital platform consists of modular software components, most of which can be reused in other business applications.	
SE: Supplier engagement 5-point Likert scale (1 = Not at all, 5 = A lot)		Newly developed
SE1	Equal collaboration policies are established to increase the willingness of suppliers to engage.	
SE2	Long-term collaborative policies are established to promote engagement actions of suppliers.	
SE3	Open and trusting partnerships are developed to assure continual engagement of suppliers.	
DE: Distributor engagement 5-point Likert scale (1 = Not at all, 5 = A lot)		Newly developed
DE1	Equal collaboration policies are established to increase the willingness of distributors to engage.	
DE2	Long-term collaborative policies are established to promote engagement actions of distributors.	
DE3	Open and trusting partnerships are developed to assure continual engagement of distributors.	
CE: Customer engagement 5-point Likert scale (1 = Not at all, 5 = A lot)		Newly developed
CE1	New service policies are established for our e-business website to increase the willingness of customers to engage.	
CE2	Online service guidance policies (e.g., online after-sales support) is provided to improve customers' feeling of familiarity.	
CE3	New service policies is provided to increase customer's experiences in online transactions.	
OPC: Online procurement capability 5-point Likert scale (1 = Not at all, 5 = A lot)		(Mishra et al., 2007; Soto-Acosta & Merono-Cerdan, 2008)
OPC1	Our online procurement operations process is reengineered to support procurement negotiation-transaction management.	
OPC2	Production schedules are shared online with suppliers to support schedule management.	
OPC3	Procurement order catalogs are shared online with suppliers to support material management.	
OPC4	Material demand information is shared online with suppliers to support procurement demand management.	
OCMC: Online channel management capability 5-point Likert scale (1 = Not at all, 5 = A lot)		(Oh et al., 2012; Saraf et al., 2007)
OCMC 1	Our online transaction process is reengineered to support order management.	
OCMC 2	Marketing policies are shared online with distributors to support promotion policy management.	
OCMC 3	Order catalogs are shared online with distributers to support pricing and product launches.	
OCMC 4	Production schedules are shared online with distributers to support order fulfillment.	
OSC: Online service capability 5-point Likert scale (1 = Not at all, 5 = A lot)		(Eng, 2008; Saraf et al., 2007)
OSC 1	Various online communication services are provided to support interaction with customers.	
OSC 2	Various value-added services are provided on the website to attract potential customers.	
OSC 3	Various after-sales services are provided to address customers' feedback and suggestions.	
CA: Competitive performance 5-point Likert scale (1 = Very low, 5 = Very high)		(Rai & Tang, 2010)
CP 1	Our firm's market share is ….. compared with our main competitors.	
CP 2	Our firm's profit is. …. compared with our main competitors.	
CP 3	Our firm's sales volume growing is …..compared with our main competitors.	

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