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A Contextual Analysis of the Impact of Strategic Sourcing and E-procurement on Performance

Abstract

Purpose – The objective of this study is to investigate the relationships among strategic sourcing, e-procurement and firm performance, along with the moderating effects of business characteristics and environmental factors on these relationships.

Design / Methodology / Approach. - This empirical investigation relies on structured survey responses from 137 managers of US manufacturing firms. The partial least squares based structural equation modeling approach is used for data analysis.

Findings – The research results confirm that both strategic sourcing and e-procurement have a positive effect on firm performance. In addition, e-procurement is also found to have a positive impact on strategic sourcing. In addition, the research results suggest that business characteristics and the environment, especially the degree of competition, market turbulence, firm size, and stage in product life cycle moderate these relationships significantly. The positive effects of strategic sourcing and e-procurement on firm performance are particularly enhanced under the right conditions.

Research limitations / Implications. - Like most past empirical studies, this study also relies on subjective responses from key executives. Like most prior research, supply chain-related questions are sought to be answered through responses from a single, focal firm in the supply chain.

Originality / Value. - This research is the first, to the best of our knowledge, in providing insights into the joint effects of strategic sourcing and e-procurement, and how business characteristics and the environment affect their roles on firm performance. In addition, firm performance is evaluated as a multi-dimensional construct involving financial, operational and supply chain aspects, with the measurements consisting of several second-order constructs. The study makes both theoretical and practical contributions.

Keywords: Strategic sourcing, e-procurement, performance, business characteristics and business environment

Paper type – Research paper.

A Contextual Analysis of the Impact of Strategic Sourcing and E-procurement on Performance

Introduction

In recent years, the strategic importance of the purchasing function has been increasingly emphasized within the overall context of supply chain management (Anderson and Katz, 1998; Carter and Narasimhan, 1996; Carr and Smeltzer, 1997). In addition, alongside more strategic purchasing, it has been mentioned that the rapid development of e-business information technology, specifically e-procurement, can contribute to more effective purchasing processes within the supply chain context (Johnson and Whang, 2002).

Smeltzer *et al.*, (2003) defined strategic sourcing as a comprehensive process of acquiring inputs as well as managing supplier relations by achieving the organization's long term objectives. Narasimhan and Das (1999) view strategic sourcing as the use of supplier capabilities in the process of design and manufacturing to achieve strategic objectives. Sislian and Satir (2000) defined it as a framework that can assist managers in the process of making buying decisions, considering competitive advantage as a primary factor. Anderson and Katz (1998) defined strategic sourcing as a procurement framework with total cost of ownership helping firms add value and improve their competitive positions.

Purchasing integration through strategic sourcing promotes better buyer-supplier relationships and supplier development (Narasimhan and Das, 2001). To achieve successful strategic sourcing, firms need to maintain good relationships with suppliers and seek to achieve their long-term goals (Chan and Chin, 2007). The research of Humphreys *et al.*, (2000) also highlights the importance of selecting suppliers and their development. These definitions and findings have pointed out four essential dimensions of strategic sourcing: 1) the strategic role of

purchasing, 2) effective internal coordination between purchasing function with other functions, 3) effective information sharing with suppliers, and, 4) supplier development and supply base management (Kocabasoglu and Suresh, 2006). Accordingly, we adopt these four dimensions as the key elements of strategic sourcing.

Strategic sourcing has been shown to have a significant impact on several aspects of firm performance. For instance, Carr and Pearson (1999, 2002) and Carr and Smeltzer (1999) empirically showed that strategic purchasing has a positive impact on a firm's financial performance. Strategic purchasing contributes to cultivating effective communication and long term relationship between suppliers and buyers and they are antecedents of financial performance (Chen *et al.*, 2004).

In conjunction with strategic sourcing, there has also been a major technological transformation in purchasing, by way of e-business technologies, which can provide organizations with a wide range of benefits such as savings in transaction costs, inventory reduction, and the establishment of communication networks between buyers and suppliers (Min and Galle, 1999; Deeter-Schmelz *et al.*, 2001). Johnson and Whang (2002) categorized various forms of e-business technology into three types: e-commerce, e-procurement, and e-collaboration. E-procurement refers to the use of e-business technologies in purchasing (Presutti, 2003).

Many studies have pointed out the potential benefits from e-procurement. Croom (2000) identified four main benefits: lower procurement process cost, greater visibility on expenditure control, increase in procurement control and benefits from managing suppliers. E-procurement promotes better management of information and knowledge of suppliers and better control of supplier operations (Muffatto and Payaro, 2004). E-procurement may result in greater transparency in procurement (Puschmann and Alt, 2005); increased speed, quantity and quality

of information processing (Essig and Arnold, 2001). Additionally, e-procurement gives buyers' more options on supplies with lower transaction cost (Petersen *et al*, 2007).

Many firms are currently considering of adopting both strategic sourcing and e-procurement initiatives with the goal of improving performance. Despite the presence of a growing body of knowledge on the impact of strategic sourcing and e-procurement independently, there has been little or no research to date on how they jointly affect the firm performance. This study investigates combined impact of strategic sourcing and e-procurement as a firm's capability on the performance based on theory of dynamic capabilities (Teece *et al.*, 1997). Thus, a major objective of this study is to empirically examine the impact of both these initiatives on firm performance, within a dynamic supply chain context.

There is now a sizable amount of literature on various supply chain practices and their impact on performance. However, a notable weakness among past studies has been the relative neglect of business characteristics, environmental factors and other contextual variables on how the various initiatives affect supply chain performance (Van der Vaart and Van Donk, 2008). In accordance with this major observation, we also investigate the role of business characteristics and the environment on the relationship among strategic sourcing, e-procurement and performance.

Literature Review

Studies on Performance Impact of Strategic Sourcing

In an early work, Carter and Narasimhan (1996) found six strategic factors affecting performance, measured by market position, customer satisfaction and market share. Carr and Pearson (1999) proved that strategic purchasing is positively associated with firm's financial performance, and with buyer-supplier relationships and supplier evaluation systems. Carr and Smelzer (1999)

showed that strategic purchasing not only affects firm performance positively but also improves the relationship with suppliers. The study of Narasimhan and Das (1999) confirmed that strategic sourcing has a positive impact on modification flexibility but not on volume flexibility and new product development flexibility. Das and Narasimhan (2000) found that buyer-supplier relationship development, supplier capability auditing and purchasing integration are positively related with manufacturing performance.

Narasimhan *et al.*, (2001) showed that purchasing competence has significant positive effects on TQM and customer satisfaction. Likewise, Narasimhan and Das (2001) examined the impact of purchasing integration and practices on manufacturing performance. Carr and Pearson (2002) proved that purchasing/supplier involvement is positively associated with strategic sourcing that positively influences the firm's financial performance. The research of Chen *et al.*, (2004) investigated that strategic purchasing affects three factors which are communication with suppliers, limited number of suppliers and long-term orientation relationship with suppliers. The study of Gonzalez-Benito (2007) showed that both purchasing efficacy and purchasing strategic integration have a positive relationship with two aspects of business performance: commercial and financial.

Studies on Performance Impact of E-Procurement

Among studies on the impact of e-procurement, Boyer and Olsen (2002) found that purchasing performance is improved with Internet purchasing. Wu *et al.*, (2003) assessed the impact of firm characteristics, competitive environment and intensity of e-business adoption on performance. Wu *et al.*, (2007) also found that the use of coordination e-procurement applications was found to have both direct and indirect effects on perceived efficiency gains.

Johnson *et al.*, (2007) presented findings that e-business technologies targeted at reducing dyadic coordination costs were found to lead to improved financial performance. E-procurement helped to establish common processes, to convert from transactions to strategic activities and to save spending (Smart 2010). In Devaraj *et al.*,(2007) e-business technologies might support customer integration and supplier integration as well as operating performance in the supply chain. In the recent study of Ordanini and Ruberea (2008), it was found that the Internet boosted the integration process capability in procurement.

Based on the above literature review, it was evident that more studies needed to be conducted, investigating the joint impact of strategic sourcing and e-procurement. In addition, previous research has generally neglected to empirically test the influence of business characteristics on supply chain integration and performance (Van der Vaart and Van Donk, 2008). Fischer (1997) argued that the effectiveness of supply chain management depends on various business characteristics such as product life cycle and process. Ramdas and Spekman (2000) stated that business conditions can be measured by market dynamics and product life cycle, and found that supply chain performance differs based on business conditions. Other business conditions such as delivery time and process type can also be applied to examine the impact on supply chain integration (Van Donk and Van der Vaart, 2004). Research of Akesson *et al.*, emphasizes that firms need to apply their sourcing strategies depending on firms' actual business characteristics (Akesson *et al.*, 2007). Thus, the inclusion of business characteristics was also considered to be important in this study.

Research Model and Hypothesis

Figure 1 shows the hypothesized conceptual framework adopted for this study, with strategic sourcing and e-procurement as the major antecedents for firm performance.

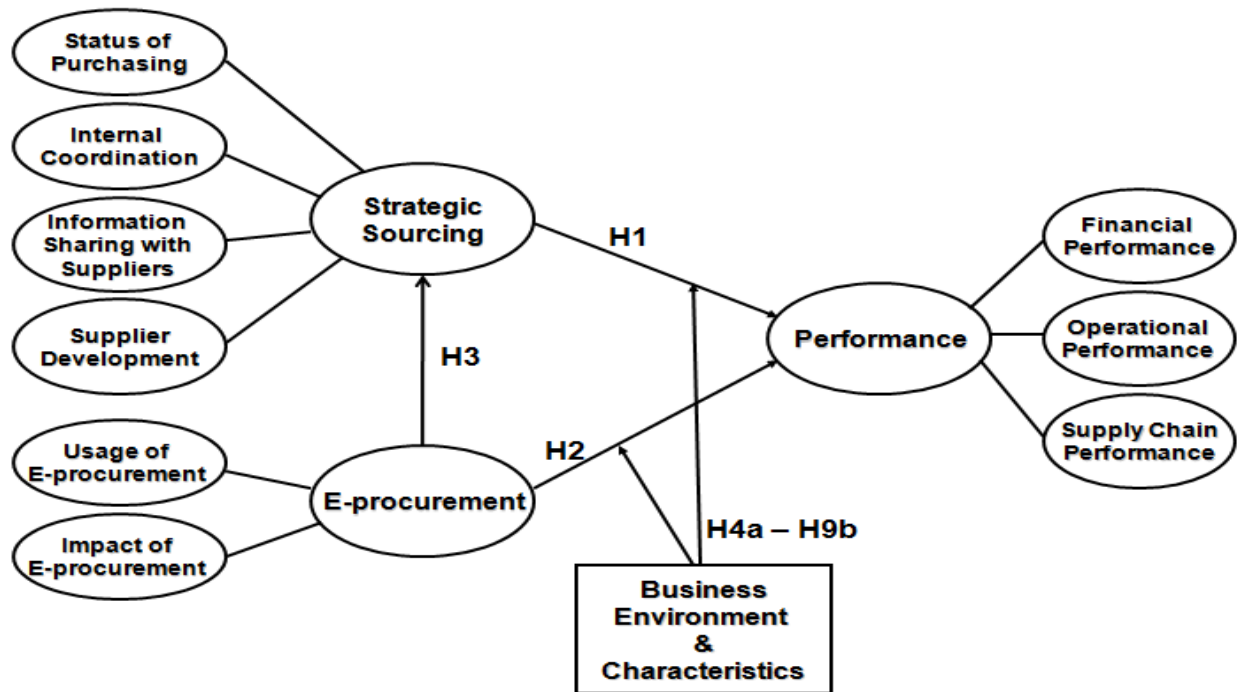


Figure 1. Conceptual Model

More recently, the theory of dynamic capabilities was introduced based on the foundations of RBV (Pandža *et al.*, 2003). The main idea of dynamic capabilities is how a firm can acquire or develop firm-specific resources or capabilities to achieve competitive position in dynamic business environments (Eisenhardt *et al.*, 2000; Winter 2003). Teece *et al.*, (1997) extracted two main aspects of dynamic capabilities from the term, dynamic and capabilities. The term dynamic indicates the capacity to renew competencies so as to achieve congruence with changing business environments. The term capabilities refer to strategic management of a firm's resources including internal and external skills and functional competencies to respond rapidly to changing business environment.

Dynamic capability theory is applied in the context of purchasing. Improving resources by implementing strategic sourcing helps firms to find competitive advantages. Therefore,

improvement on the resources promotes developing dynamic capabilities (McKelvie & Davison, 2009). In the context of the relationship with suppliers, dynamic capability helps firms to have sustainable competitive advantage. Managing suppliers as well as the relationship with them improve the performance in supply chain in dynamic business environment. More importantly, sustainable supply management develops responsiveness in supply chain, resulting in improving dynamic capability (Reuter *et al.*, 2010). E-procurement is also considered as one of the most significant tools to react with dynamic business environments due to nature of e-procurement. The e-procurement is required toward dynamic and turbulent market environments if the firms need innovation and can integrate procurement functions in their existing operations (Daniel and Wilson, 2003). More importantly, in dynamic business environments, finding new channel of B2B markets with e-procurement provides companies quick wins and innovation opportunities (Wilson and Daniel, 2007). Based on the above reasoning, this study adopted dynamic capabilities due to two main reasons. First, this study examines the impact of dynamic business environments and characteristics on the relationship between strategic sourcing and e-procurement on firm performance. Second, a strategic management approach to sourcing and e-procurement are considered as capabilities for gaining competitive advantage.

The relationship between strategic sourcing and firm performance has been examined in past research (e.g., Carr and Pearson, 1999; 2002; Carr and Smeltzer, 1999; Chen *et al.*, 2004). Depending upon the dynamic capability theory, implementing strategic sourcing helps firms to acquire their resources for gaining competitive advantages. By validating this relationship between strategic sourcing and firm performance, this study attempts to support that strategic sourcing is non-substitutable purchasing practice in improving the performance. Although previous studies provide empirical evidences that strategic sourcing makes a positive impact on

the performance, we propose that strategic sourcing influence positively on all three dimensions of firms' financial, operational and supply chain performance. However, past research has not investigated this relationship in conjunction with e-procurement, and in the context of additional variables such as business environment and characteristics. Thus, in the broader context of these additional factors, we hypothesize that:

H1. Strategic sourcing positively affects firm performance.

The e-procurement construct was reflected by the two sub-constructs of usage of e-procurement and impact of e-procurement. This research investigates both aspects of e-procurement: usage characteristics and its localized impact. The usage of e-procurement utilized three scale items and the impact of e-procurement was measured with eight items. The relationship between e-procurement and firm performance has been investigated in past research (Wu *et al.*, 2003; Boyer and Olson 2002; Johnson *et al.*, 2007; Wu *et al.*, 2007; Ordanini and Rubera, 2008). Adopting e-procurement generates arguments regarding whether it helps firms to have competitive advantages or not. Following the theory of dynamic capability, we empirically examine that e-procurement provides firms competitive advantage by purchasing with minimized transaction cost and transparency. Moreover, in this study we analyze the impact of e-procurement on performance in conjunction with strategic sourcing and other contextual variables. This results in the following hypothesis:

H2. E-procurement positively affects firm's performance.

Next we relate construct of e-procurement to that of strategic sourcing. Limited empirical research to date has reported that e-procurement has benefited strategic sourcing efforts, by enabling more effective management of suppliers and their performance. Burlington Northern Santa Fe experienced 8% improvement on revenues from the sale of the locomotives and 10 %

improvement on locomotive filers compared to manual auctions after adopting e-procurement on strategic sourcing implementation (Atkinson, 2000). Implementing strategic sourcing and e-procurement together can be expected to generate synergistic benefits. According to the study of Fredricksson and Jonsson, sourcing characteristics influence the supply chain and minimize negative impacts on low-cost sourcing (Fredricksson and Jonsson, 2009). E-procurement frees up procurement efforts and resources, enabling a more strategic approach, besides resulting in cost savings, better supply performance measurement, supplier agreements which reduce unnecessary buying efforts, and capturing more data on purchases to increase the volume (Corini, 2000). The study of Rajkumar (2001) also showed that e-procurement enabled purchasing to more efficiently execute automated transaction processes and reduce cycle times, which enabled purchasing to focus on more strategic sourcing activities. E-procurement transforms all routine purchasing transactions with high efficiency leading to that all other sourcing functions focus on strategic sourcing activities. The four dimensions of strategic sourcing may be expected that e-procurement may positively affect all above, except the first of these four dimensions. Based on above reasoning, we hypothesize that:

H3. E-Procurement has a positive impact on strategic sourcing.

Attempting to fill the voids in the extant literature in supply chain management literatures, the modeling framework also attempted to investigate moderating effects on the relationships between strategic sourcing and the performance and between-procurement and performance. In other words, this research examines how business environments and business characteristics affect on the relationship between strategic sourcing and performance and between e-procurement and performance in a positive way. For business environment, the two factors of competitive intensity and market turbulence were tested. Competitive intensity indicates the level

of competition which the firm's major products face in the market. Market turbulence represents the level of market contingency, and the demand change in the market. Ward *et al.*, (1995) have shown that three dimensions of business environment have significant impacts on performance: munificence, dynamism and complexity. Fynes *et al.*, (2005) examined the moderating effects of competitive intensity, technological change and customer type on the relationship between supply chain relationship quality and supply chain performance. This study applies dynamic capabilities theory that focuses on dynamic markets with rapid and unpredictable changes in business environments. Because previous literatures did not consider the business environments as well as business characteristics in the relationship among strategic sourcing, e-procurement and performance, dynamic capability theory has not been examined about whether strategic sourcing and e-procurement can improve the performance responding to changes in business environments and business characteristics. Thus, in dynamic business environments, this research examines the role of strategic sourcing and e-procurement in obtaining competitive advantages. Based on the previous literatures that strategic sourcing and e-procurement improves the firm performance, we propose that these two purchasing practices also make a positive impact on firm performance in dynamic and competitive business environments in order to validate dynamic capability theory. For this study we hypothesize that:

H4a. The degree of competitive intensity has a moderating effect on the relationship between strategic sourcing and firm performance.

H4b. The degree of competitive intensity has a moderating effect on the relationship between e-procurement and firm performance

H5a. The degree of market turbulence has a moderating effect on the relationship between strategic sourcing and firm performance.

H5b. The degree of market turbulence has a moderating effect on the relationship between e-procurement and firm performance.

Next, the moderating effects of the following four business characteristics were tested: firm size, stage of product life cycle, manufacturing type and process type. Firm size was measured by the firm's annual sales (\$) in accordance with Carr and Pearson (1999; 2002). For e-business technologies, firm size was analyzed as a control variable in Wu *et al.*, (2003) and Johnson *et al.*, (2007). Like business environments, business characteristics are also examined by applying dynamic capability theory. With different business characteristics, firms can achieve competitive advantages so that strategic sourcing and e-procurement make a positive impact on the performance. Because previous studies (Carr and Pearson, 1999; 2002; Wu *et al.*, 2003; Johnson *et al.*, 2007) include firm size as one of the most important business characteristics, this research included firm size as an additional variable to be considered in the relationship between strategic sourcing, e-procurement and performance, resulting in the following hypotheses:

- H6a.* Firm size has a moderating effect on the relationship between strategic sourcing and firm performance.
- H6b.* Firm size has a moderating effect on the relationship between e-procurement and firm performance.

The stage of product life cycle was divided into four stages: introduction, growth, maturity and decline. There are some limited precedents in past literature for testing for stage in product life cycle. Narasimhan *et al.*, (2006) proposed a research model which emphasized the influence of product life cycle on selection of suppliers. The study of Rink and Fox (1999) contended that managers should change their approach to procurement based on stage in product life cycle. Likewise, Birou *et al.*, (1998) asserted that functional alignment between purchasing and product life cycle generates the effective use of resources in organizations. Depending on the product life cycle stage, the relationship among strategic sourcing, e-procurement and performance can be changed with facing different business environments. Thus, this study investigates the role of the

product life cycle in the relationship between strategic sourcing, e-procurement and performance, leading to the following hypotheses:

- H7a.* A firm's stage of major product life cycle has a moderating effect on the relationship between strategic sourcing and firm performance.
- H7b.* A firm's stage of major product life cycle has a moderating effect on the relationship between e-procurement and firm performance.

The third dimension considered is the manufacturing type: make-to-stock (MTS), make-to-order (MTO), engineer-to-order (ETO) and assemble to order (ATO), as in Bozarth and Chapman (1996). It is hypothesized that purchasing characteristics and impact may differ based on the type of manufacturing context. Depending on manufacturing types, firms can achieve competitive advantages on how these four types affect on the relationship among strategic sourcing, e-procurement and performance. Thus, this study empirically tests how manufacturing type makes an impact on the relationship between strategic sourcing, e-procurement and performance, which leads to following hypotheses:

- H8a.* A firm's manufacturing type has a moderating effect on the relationship between strategic sourcing and firm performance.
- H8b.* A firm's manufacturing type has a moderating effect on the relationship between e-procurement and firm performance.

Process type was divided into four types: job shop, batch, repetitive assembly and continuous flow, as identified in Hayes and Wheelwright (1979). The decision on process choice should be arranged in line with the aggregate plan, production scheduling and materials management to improve firm's performance, as noted by Safizadeh and Ritzman (1997). Like manufacturing type, these four process types also provide different impacts on the relationship among strategic sourcing, e-procurement and performance in achieving competitive advantages. Since previous

research did not consider process type, this study examined its role in the relationship between strategic sourcing, e-procurement and performance. This leads to following hypothesis:

H9a. A firm's current process type has a moderating effect on the relationship between strategic sourcing and firm performance.

H9b. A firm's current process type has a moderating effect on the relationship between e-procurement and firm performance.

Methodology

Measure Development

The construct of strategic sourcing was assumed to consist of four sub-constructs, as identified in Kocabasoglu and Suresh (2006): status of purchasing, internal coordination, information sharing with suppliers, and supplier development. For status of purchasing, three items were utilized, adapting from Carr and Smeltzer (1997; 2000), which capture the level of involvement of the purchasing function in planning. The items for internal coordination were adapted from Narasimhan and Das (1999) which measure the integration among functions as well as cross-functional communication with three items. Information sharing with suppliers was measured with three items that are based on the work of De Toni and Nassimbeni (1999) and McGinnis and Vallopra (1999a; 1999b). The three items for the development of suppliers were modified from Krause (1999), Shin *et al.*, (2000) and Das and Narasimhan (2000), and they capture the direct involvement and assistance to suppliers.

Firm performance was measured by the three aspects of firm's financial performance, operational performance and supply chain performance. Financial performance was measured based on four scale items. Operational performance utilized two items, one for cost savings in manufacturing and one for cost reductions in inventory holding. Supply chain performance was measured on responsiveness to customers' expectations and customer satisfaction. The scales for

these eight items were adapted from Narasimhan and Das (1999a), Tan *et al.*, (1999), Tracey and Tan (2000), Stock *et al.*, (2000), Scannell *et al.*, (2000) and Gilbert and Ballou (1999).

The data for this study was collected using structured surveys. The survey instruments are developed from past research. All items were assessed using a five-point Likert scale. The survey was first tested through semi-structured interviews with purchasing professionals, business consultants, and academics in the U.S. and Netherlands. The interviewees were asked for suggestions to improve the clarity of the survey, that was then refined based on the suggestions received.

Next, the new version was sent to a random group of purchasing and supply management executives, who were members of the Buffalo chapter of the Institute for Supply Management (ISM). Two hundred surveys were mailed out, out of which 20 complete responses were received. The responses were reviewed to detect further potential problems with the questionnaire. The respondents for the final survey were selected from purchasing and supply management executives of manufacturing firms in the U.S., who were members of ISM. The survey was sent to 1950 potential respondents. Two weeks after the initial mailing, a reminder postcard was sent. In order to improve the response rate, this research followed Frohlich's techniques, with pre-paid postage envelope and multiple mailings of the reminder postcard (Frohlich, 2002). In the end, 144 responses were obtained as 137 responses were usable for data analysis.

Response bias is considered as an important issue in the empirical research corresponding to low rate of the response rate. Therefore, this research ensures whether there is a response bias exists or not. Following the directions of the study of Wagner & Kemmerling, (2010) by

comparing respondents to non-respondents on characteristics known a priori, this research compared sales levels, firm size between responders and non responders. ANOVA analysis indicates no statistical significance between these two groups, which means that the response bias between responders and non responders does not exist in this research. In order for examining common method bias, we conducted Harman's single-factor test (Podsakoff and Organ, 1986). By using a principal component factor analysis, all variables of factor loadings and the unrotated factors solution were examined. No single factor emerged to explain the variance, with the first factor accounts for twenty-one percent of the total variance. Therefore, this research has no problem with common method variances.

Results

This study applied the partial least squares (PLS) technique of structural equation modeling (SEM) to investigate the structural model. PLS can specify both the relationships among constructs and as measurements of all constructs (Wold, 1989). PLS has an advantage working with no distributional assumption about populations (Haenlein and Kaplan, 2004). The other advantage of PLS faces with less restrictions with regard to a sample size (Falk and Miller, 1992).

Measurement Model

For assessing reliability, factor loadings of indicators on latent constructs are necessary to be greater 0.7 in order to establish strong reliability (Fornell and Larker, 1981). However, for newly created constructs, a value greater than 0.6 is acceptable as a good indicator (Hair *et al.*, 1998). Cronbach's α was also used to assess reliability with the acceptable score, 0.7 for existing constructs. Based on these criteria, all indicators of the measurement model shown in Table I are seen to be of acceptable reliability.

Table I. Measurement Model

Main Constructs and Indicators	Factor Loadings	Cronbach's α	Composite Reliability (CR)	Avg. Variance Extracted
Status of purchasing a. Top management support b. Importance of purchasing c. Purchasing in strategic planning	0.9021 0.9179 0.8700	0.998	0.925	0.804
Internal coordination a. Purchasing in sales b. Purchasing in concurrent engineering c. Purchasing in cross-functional training	0.6371 0.7895 0.7596	0.815	0.774	0.535
Information sharing with suppliers a. Production schedule b. Synchronized production scheduling c. Cost	0.8884 0.9157 0.7733	0.997	0.896	0.742
Supplier development a. Financial assistance b. Technological assistance c. Training in quality issues	0.6866 0.9003 0.8427	0.750	0.854	0.664
E-Procurement (Usage) a. E-proc. usage for std. items b. E-proc. usage for industry-specific items c. E-proc. usage for MRO items	0.8019 0.8328 0.8124	0.729	0.825	0.560
E-Procurement (Impact) d. Order processing costs e. Time for order generation f. Costs of material g. Clerical and administrative work h. Info. errors and discrepancies i. Procurement lead times j. Variation in supplier lead time k. Supply flexibility and reliability	0.8537 0.8308 0.6323 0.8110 0.7459 0.7643 0.7098 0.7274	0.999	0.917	0.581
Financial Performance a. Pretax ROA b. After-tax ROA c. ROI d. Growth in ROI	0.9006 0.8922 0.9205 0.8434	1.000	0.938	0.791
Operational Performance a. Manufacturing cost b. Inventory carrying cost	0.8679 0.8851	1.000	0.862	0.768
Supply Chain Performance a. Customer Satisfaction	0.9212	1.000	0.903	0.824

b. Responsiveness	0.8940			
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Composite reliability (CR) and average variance extracted (AVE) were used in this study to assess convergent validity. Values above the threshold value of 0.7 for composite reliability suggest good internal consistency (Hulland, 1999). Additionally, AVE, representing proportion of average variance between constructs and indicator variables needs to be greater than 0.5 to suggest good convergent validity (Chin, 1998). All measures of CR and AVE in Table I are seen to indicate good convergent validity. For evaluating discriminant validity, this study followed the suggestion of Fornell and Larker (1981): the square root of AVE should be greater than correlations of variables to prove discriminant validity. Accordingly, the value of diagonal elements should be greater than those of off-diagonal elements (Fornell and Larker, 1981, Hulland, 1999). Thus the values shown in Table II indicate good discriminant validity.

In this study, following the suggestion of Van der Vaart and Van Donk (2008), performance was assumed to consist of financial, operational and supply chain performance. In Table I, it is seen that the second order factor loadings in performance indicators are greater than those of first order construct, and they are all above 0.8. More importantly, as seen in Table II, square root of AVE in performance is higher than correlations between performance and the first order factors of strategic sourcing and e-procurement, meeting the condition specified by Chin and Gopal (1995).

Table II. Correlation between Latent Variables and Square Root of AVE

	Performances	E-Procurement	Strategic Sourcing
Performances	(0.670)*		
E-procurement	0.227	(0.762)*	
Strategic Sourcing	0.180	0.050	(0.596)*
*Square Root of AVE			

Financial performance, operational performance and supply chain performance formed second order constructs of performance. Comparing the coefficients of these three second order factors, financial performance had the highest path coefficient of 0.926, and the path coefficients for operational performance and supply chain performance were, respectively, 0.615 and 0.557. All three path coefficients are statically significant at $p < 0.01$. This indicates that financial performance is relatively more important than operational and supply chain performance as an indicator of firm performance.

Main Effects

The results confirm that four dimensions of strategic sourcing positively affect financial, operational and supply chain performance which support hypothesis 1. The results indicate statistical significance on this positive relationship. (a path coefficient: 0.174,t-score:2.5824, $p < 0.01$). Hypothesis 3 was also supported by our research result as implementing e-procurement has a significant positive relationship with strategic sourcing. (a path coefficient:0.198,t-score:2.6845, $p < 0.01$) Similarly, the study results also show that e-procurement positively affects performance which support hypothesis 2. The results show statistical significance on this positive relationship.(a path coefficient: 0.225,t-score:2.9874, $p < 0.01$)

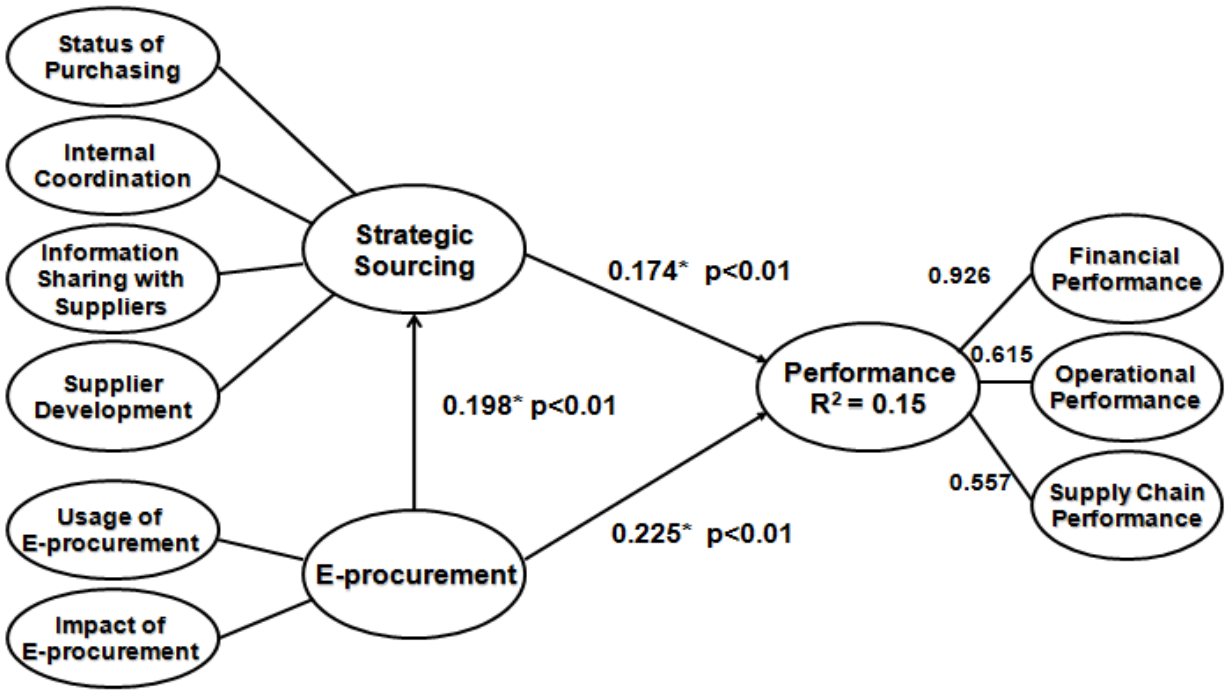


Figure 2. Research Results

Moderating Effects of Business Environment and Business Characteristics

Analysis of Moderating Effects

The moderating effects of business environment the relationship among strategic sourcing, e-procurement and firm performance were analyzed as follows. Interaction effects can be evaluated with PLS by comparing R^2 between the main model, and the full model including both main model and interaction model (Chin *et al.*, 2003). Accordingly, the moderating effects of competition, market turbulence and firm size were analyzed along the lines of Carte and Russell (2003). The difference in variance was tested between moderating and main effects using the following F-statistics: $F(df_{interaction} - df_{main}, N - df_{interaction} - 1) = (\Delta R^2 / (df_{interaction} - df_{main})) / ((1 - R^2_{interaction}) / (N - df_{interaction} - 1))$. Following Chin *et al.*, (2003), moderating effects are also

validated by comparing R^2 between main and moderating effects using Cohen's $f = (R^2 \text{ (interaction model)} - R^2 \text{ (main effects model)}) / (1 - R^2 \text{ (main effect model)})$ (Cohen, 1998).

First, the research results show that the degree of competition in the market has significant moderating effects on the relationship between strategic sourcing and firm performance, and also on the relationship between e-procurement and firm performance. The effect size of interaction between strategic sourcing and performance indicates a small effect size (f statistics: $2.72p < 0.1$, Cohen's $f : 0.02$) The effect size of interaction between e-procurement and performance indicates a small effect size. (f statistics: $6.56p < 0.025$, Cohen's $f : 0.05$). Thus, the degree of competition in the market does affect the relationship among strategic sourcing, e-procurement and performance. This indicates that the relationships between strategic sourcing and performance and between e-procurement and performance become stronger if markets happen to be more competitive, supporting both hypothesis H4a and H4b. In addition, because the relative interaction size for e-procurement is greater than that for strategic sourcing, e-procurement appears to serve to improve firm performance more than strategic sourcing in more competitive markets.

Likewise, the study results show that the degree of market turbulence has significant moderating effects on the relationship between strategic sourcing and firm performance, and on the relationship between e-procurement and firm performance. The effect size of interaction between strategic sourcing and performance indicates a small effect size. (f statistics: $3.58 p < 0.1$, Cohen's $f : 0.03$) The effect size of interaction between e-procurement and performance indicates a medium effect size. (f statistics: $12.58p < 0.01$, Cohen's $f : 0.09$) Thus, the degree of

market turbulence affects the relationships among strategic sourcing, e-procurement and performance, supporting both hypotheses 5a and 5b. This suggests that the positive relationships between strategic sourcing and performance and between e-procurement and performance are greater when faced with greater market turbulence. Again, because the relative interaction size for e-procurement is greater than that for strategic sourcing, e-procurement appears to improve firm performance more than strategic sourcing in more turbulent markets.

Regarding the moderating effects of firm size, the effect size of interaction between strategic sourcing and performance indicates a small effect size. (f statistics: 5.97 $p < 0.05$, Cohen's f : 0.05) The effect size of interaction between e-procurement and performance indicates a medium effect size. (f statistics: 8.30 $p < 0.01$, Cohen's f : 0.06) Thus, the firm size does have a moderating effect on the relationship among strategic sourcing, e-procurement and firm performance, indicating that as the firm size increases, the positive relationships hypothesized are stronger supporting hypotheses 6a and 6b.

Table III. The Results of Moderating Effects

	Degree of Competition in the Market	Degree of Market Turbulence	Firm Size
Strategic Sourcing → Firm Performance	f statistics: 2.72, $p < 0.1$, Cohen's f : 0.02, a small effect size	f statistics: 3.58, $p < 0.1$, Cohen's f : 0.03, a small effect size	f statistics: 5.97, $p < 0.05$, Cohen's f : 0.05, a small effect size
E-Procurement → Firm Performance	f statistics: 6.56 $p < 0.025$, Cohen's f : 0.05, a small effect size	f statistics: 12.58, $p < 0.01$, Cohen's f : 0.09, a medium effect size	f statistics: 8.30, $p < 0.01$, Cohen's f : 0.06 a medium effect size.

Analysis of Subgroup Effects

Subgroup analysis was performed with PLS for the business characteristics variables of stage of product life cycle, manufacturing type, and process type. Dividing the firms into multiple groups based on these business characteristics, this study examined the significance of differences in path coefficients corresponding to business characteristics using bootstrapping procedures (Chin, 1998, Fisher and Gregoire, 2006).

First, based on the firm's stage of product life cycle, the results indicate different relationships among strategic sourcing, e-procurement and firm performance. In the introduction stage, the path coefficients were -0.142 from strategic sourcing to performance, and 0.386 from e-procurement and performance, with t-scores of 0.7213 and 0.8387, respectively, which were not statistically significant. Likewise, in the growth stage, the respective path coefficients were 0.222 and 0.488 for strategic sourcing and e-procurement, respectively, with t-scores of 1.8693 and 3.4605, which were statistically significant at $p < 0.05$ in both relationships. The rest of the values, for maturity and decline stages show significant relationships in growth and maturity stages, the results support hypotheses 7a and 7b, that a firm's stage of the main product life cycle has a moderating effect on the relationship between strategic sourcing and firm performance, and also a moderating effect on the relationship between e-procurement and firm performance.

Secondly, for type of manufacturing, the results again indicate different types of relationships among strategic sourcing, e-procurement and firm's performance. It may be seen that for engineer-to-order firms, the path coefficients for strategic sourcing and e-procurement were 0.086 and 0.424, respectively, with t-scores of 0.3495 and 0.7865, which were not statistically significant. The result shows that only for assemble-to-order firms, and in addition, only for the relationship between strategic sourcing and firm performance was there a significant

relationship. Thus, it may be stated that there was partial support for hypothesis 8a, that a firm's manufacturing type has a moderating effect on the relationship between strategic sourcing and firm performance. There was no support for hypothesis 8b, that a firm's manufacturing type has a moderating effect on the relationship between e-procurement and firm performance.

Finally, the results indicate slightly different relationships among strategic sourcing, e-procurement and firm performance depending on the firm's process type. For batch situations, the path coefficient for e-procurement is seen to be significant while the path coefficient for strategic sourcing is seen to be significant for continuous flow situations. Thus the results show partial support for both hypotheses 9a and 9b, that a firm's current process type has a moderating effect on the relationship between strategic sourcing and firm performance, and on the relationship between e-procurement and firm performance.

Table IV. Subgroup Effects: PLC Stage, Manufacturing Type and Process Type

	SS => Performance			EP => Performance		
	Path coeff.	t-stat	Significance	Path coeff.	t-stat	Significance
PLC Stage						
Introduction	- 0.142	0.7213		0.386	0.8387	
Growth	0.222	1.8693	p < 0.05	0.488	3.4605	p < 0.05
Maturity	0.345	2.1201	p < 0.05	0.315	0.9728	
Decline	0.454	1.0036		0.316	0.4107	
Mfg. Type						
ETO	0.086	0.3495		0.424	0.7865	
MTO	-0.012	0.0576		0.520	1.1783	
ATO	0.305	1.9954	p < 0.05	0.189	0.6355	
MTS	0.065	0.3437		0.365	0.7748	
Process Type						
Job Shop	0.065	0.4143		0.365	0.7809	
Batch	-0.070	0.3217		0.547	1.8518	p < 0.05
Repetitive Assembly	-0.032	0.0176		0.511	0.2707	
Continuous Flow	0.313	2.5163	p < 0.05	0.226	0.9811	

Table V. Hypothesis and Results

Hypothesis	Results
<i>H1.</i> Strategic sourcing positively affects firm performance.	Supported
<i>H2.</i> E-procurement positively affects firm's performance.	Supported
<i>H3.</i> E-Procurement has a positive impact on strategic sourcing	Supported
<i>H4a.</i> The degree of competitive intensity has a moderating effect on the relationship between strategic sourcing and firm performance.	Supported
<i>H4b.</i> The degree of competitive intensity has a moderating effect on the relationship between e-procurement and firm performance	Supported
<i>H5a.</i> The degree of market turbulence has a moderating effect on the relationship between strategic sourcing and firm performance.	Supported
<i>H5b.</i> The degree of market turbulence has a moderating effect on the relationship between e-procurement and firm performance.	Supported
<i>H6a.</i> Firm size has a moderating effect on the relationship between strategic sourcing and firm performance.	Supported
<i>H6b.</i> Firm size has a moderating effect on the relationship between e-procurement and firm performance	Supported
<i>H7a.</i> A firm's stage of major product life cycle has a moderating effect on the relationship between strategic sourcing and firm performance.	Supported
<i>H7b.</i> A firm's stage of major product life cycle has a moderating effect on the relationship between e-procurement and firm performance.	Supported
<i>H8a.</i> A firm's manufacturing type has a moderating effect on the relationship between strategic sourcing and firm performance.	Partially Supported
<i>H8b.</i> A firm's manufacturing type has a moderating effect on the relationship between e-procurement and firm performance	Not Supported
<i>H9a.</i> A firm's current process type has a moderating effect on the relationship between strategic sourcing and firm performance.	Partially Supported
<i>H9b.</i> A firm's current process type has a moderating effect on the relationship between e-procurement and firm performance	Partially Supported

Discussions

In this paper, an empirical investigation of the joint effects of strategic sourcing and e-procurement was conducted within a supply chain context. Many firms are currently considering of adopting both strategic sourcing and e-procurement initiatives. However, despite the presence of a growing body of knowledge on the impact of strategic sourcing and e-procurement independently, there has been little research on how they jointly affect firm, and supply chain performance.

Theoretical Implications

There is now a sizable body of literature on supply chain integration, supply chain initiatives and their impact on performance; but a notable weakness among past studies has been the relative neglect of business characteristics, environmental factors and other contextual variables on how the various initiatives affect supply chain performance (Van der Vaart and Van Donk, 2008). This empirical research also analyzed moderating effects of two business environment variables, and four business characteristics on the relationship between strategic sourcing and performance, and the relationship between e-procurement and performance. Therefore, this research fills the gap in supply chain management literatures by considering factors such as dynamic and competitive market conditions, manufacturing and process types, product life cycle as well as firm size.

This research makes significant theoretical contributions. It adopts a theoretical background of dynamic capabilities that is based on a firm's processes for using and allocating resources to match and adjust to market changes. Because this research investigated the impact of business environments on the relationship among strategic sourcing, e-procurement and performance, it contributes that strategic sourcing and e-procurement help firms to gain competitive advantages in dynamic and turbulent business environments and business characteristics by providing empirical result to the support of dynamic capability theory. In responding to market change, firms allocated resources to strategic sourcing and e-procurement in order to gain advantages in competitive and dynamic markets, leading to improved performance. Therefore, this research provides empirical evidences that firms can spend their resources in implementing strategic sourcing and e-procurement in order to react to dynamic and competitive business environment.

Past studies have also, for the most part, focused on only one dimension of a firm's performance, financial performance, when investigating the impact of strategic sourcing. Thus in this study, three performance dimensions, namely the firm's financial, operational and supply chain performances were considered. By using second order constructs which reflect these three dimensions of firm's performance, this study provides broader and integrated measurements to assess firm's performance. It was shown that strategic sourcing positively affects not only firm's financial performance but also its operational and supply chain performance thus adding to the extant literature.

Regarding the impact of e-procurement, the results of this study add to the body of empirical evidence showing positive impacts of e-procurement on a firm's financial, operational and supply chain performance. More importantly, implementing e-procurement boosted efficiency of strategic sourcing since it enable purchasing function to focus on strategic efforts of sourcing in the organizations. Thus, implementing e-procurement for firms which practices strategic sourcing creates synergy effects for firms to improve their performance.

The modeling framework considered in this study, along with the survey methods, make theoretical contributions by explicitly considering moderating effects of business characteristics and environment on the relationships among strategic sourcing, e-procurement and performance. This study also made theoretical contribution as dynamic capability was empirically validated on the relationship between strategic sourcing, e-procurement and performance. With reflecting business environments, the research results indicate stronger impact of strategic sourcing and e-procurement on the performance which makes dynamic capability theory work by achieving competitive advantage. Regarding the moderating effects of the business environment variables, both degree of competition and market turbulence were to seen to have a strong moderating

effect on the relationship between strategic sourcing and firm performance, and also the relationship between e-procurement and firm performance. As market turbulence and competition levels increase, strategic sourcing and e-procurement play an enhanced role in improving firm performance. This is somewhat in line with the assertion of Van der Vaart and Van Donk (2008) that if business environment becomes more complex, a higher level of supply chain integration may be required. The results from this data set also indicated that the impact of e-procurement is more than that of strategic sourcing when faced with high levels of competition and turbulence in the market. Interestingly, operational performance also showed greater levels of improvement in high levels of competition and market turbulence. In addition, impact of e-procurement was seen to be greater in higher levels of turbulence in the market.

Among business characteristics, firm size was seen to be an important factor: the positive relationship between strategic sourcing and performance and between e-procurement and performance were seen to be stronger for larger firms. With respect to the business characteristic of stage of product life cycle, it was seen that the positive impact of strategic sourcing on performance was more pronounced in growth and maturity stages of the product life cycle. The research result also shows that e-procurement had a positive impact on firm's performance only in the growth stage.

The moderating effects of manufacturing type and process type were generally seen to be less strong compared to other business characteristics. The positive impact of strategic sourcing on firm performance was seen only for assemble-to-order situations among four manufacturing types. This may be related to some assertions in past research. For instance, Narasimhan and Das (2001) asserted that an assemble-to-order product line requires purchasing integration to increase returns. However, more research is required to investigate these aspects further. In contrast to

strategic sourcing, the impact of e-procurement was not seen to be influenced by the difference in manufacturing type. In the case of process type, a positive relationship was statistically significant between strategic sourcing and performance only for continuous flow situations. Likewise, a positive relationship was statistically significant between e-procurement and performance only for batch processing situations

Managerial Implications

The research results clearly have many practical implications. It is clear that by implementing strategic sourcing and e-procurement, a firm can expect to improve its financial, operational and supply chain performance. Since adopting e-procurement in the organization positively influences strategic sourcing, these two procurement practices in supply chain generate better performance for the firms. In other words, if firms implement both strategic sourcing and e-procurement, managers experience joint and synergy impact in order to improve firm's performance. This research provides empirical evidences of benefits in strategic sourcing and e-procurement so that it can give positive attitude toward strategic sourcing in managers' decision making in implementing two purchasing practices. When managers consider about implementing strategic sourcing or e-procurement, this research give managers better options in adopting two practices together in improving performance. In addition, implementing strategic sourcing and e-procurement would generate cost as well as risk. However, this research provides strong empirical evidences that implementing both strategic sourcing and e-procurement would improve the performance.

More importantly, dynamic and competitive business environments are reflected in the context of strategic sourcing e-procurement and performance. It has managerial implications that strategic sourcing and e-procurement is an effective purchasing practice to respond to dynamic

and business environments for improving the performance. As business environments become more dynamic and competitive, the impacts and usefulness of strategic sourcing and e-procurement becomes greater in improving the performance leading to the bigger role of strategic sourcing and e-procurement in supply chain management. It also emphasizes that managers need to consider business environments of their own organizations when they decide to implement strategic sourcing and e-procurement for improving performance. This research serves to reinforce the utility of these initiatives in addition to highlighting the specific conditions such as product life cycle, manufacturing types and process types under which they may yield significant benefits.

Conclusions

Based on the previous literatures that strategic sourcing and e-procurement positively affects on firms' performance, this study investigates impacts of strategic sourcing and e-procurement on performance in different business conditions. Additionally, it examines joint impact of two supply chain practices on three dimensions of performance: financial, operational and supply chain performance. Our research results present that strategic sourcing and e-procurement make a positive impact on the performance and e-procurement positively affects on strategic sourcing. More importantly, as the degree of competitive intensity and market turbulence is increased, the effects of strategic sourcing and e-procurement on performance are also increased. In addition, depending on the product life cycle, process type and manufacturing types, this study found moderating effects on the relationship among strategic sourcing, e-procurement and performance.

Limitations

This study does have many of the same limitations as past studies, especially when considering that the information is elicited from single respondents within the firms. The

respondents were key executives in manufacturing industry who are sufficiently high in the hierarchy, with an overall view of the firm internally and externally. Though this is accepted practice in empirical research, a broader respondent base may enable researchers to observe and analyze the interactions and interdependencies between firms in the supply chain context. In addition, this study has a low response rate for the survey research although techniques which were suggested by Frohlich (2002) for increasing the response rate were applied.

Further Research

As future research extension, it would also be good to consider procurement issues in service sectors and public sectors. Future research can investigate strategic sourcing and e-procurement from the suppliers' viewpoint as well. This research can be also expanded to Europe or Asia since it collected the data from US. Much work remains to be done in strategic sourcing, e-procurement and their impact on supply chain performance, and this study may be viewed as a first study exploring their joint impact, in the context of various business conditions and characteristics, opening up a new line of inquiry.

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Appendix.

	SP	IC	IS	SD	EPU	EPI	FP	OP	SCP
SPa	0.9021	0.2013	0.1210	0.3336	0.2225	0.2314	0.3636	0.3941	-0.012
SPb	0.9179	0.2478	0.2106	0.1123	0.1698	0.2000	-0.1475	0.3330	0.2789
SPc	0.8700	-0.2341	0.1111	0.1478	0.2257	0.3374	0.1010	-0.2345	-0.002
ICa	0.0021	0.6371	-0.2351	0.2101	0.0023	0.0147	0.3387	0.2254	0.0001
ICb	0.0102	0.7895	0.2999	0.1471	-0.2236	-0.1147	--0.224	0.0030	0.0078
ICc	0.0999	0.7596	-0.056	0.0147	0.1236	0.1585	0.2241	0.3347	0.0003
ISa	-0.088	-0.074	0.8884	-0.079	-0.032	0.0320	0.2302	0.2701	0.3112
ISb	0.3080	0.2811	0.9157	0.0247	0.3012	0.2058	0.3335	0.1257	0.2415
ISc	0.2824	0.3950	0.7733	0.1455	0.2566	0.1888	0.3001	0.2578	0.0099
SDa	-0.103	-0.229	0.0003	0.6866	-0.058	-0.2254	-0.0347	0.0058	-0.2228
SDb	-0.096	-0.145	-0.202	0.9003	-0.0254	-0.0687	0.001	-0.0674	-0.0997
SDc	0.0024	0.3042	0.1745	0.8427	0.0100	0.0478	0.2210	0.0999	0.2444
EPUa	0.2781	0.2258	-0.3241	-0.1111	0.8019	-0.2555	0.0038	0.0690	0.0314
EPUb	0.2298	0.0153	-0.0320	-0.0221	0.8328	0.0258	0.1444	0.1777	0.2007
EPUc	-0.088	-0.0009	-0.1427	0.1123	0.8124	-0.089	-0.1411	-0.2022	0.0356
EPIa	0.0060	0.1584	0.0251	0.3369	-0.0002	0.8537	0.3225	0.0147	0.3361
EPIb	-0.120	-0.0023	-0.0847	0.0134	0.1597	0.8308	0.0023	-0.025	0.0444
EPIc	0.3854	0.3357	0.2919	0.1367	0.2003	0.6323	0.3333	0.2225	0.1616
EPI d	-0.117	-0.0762	0.0531	-0.0220	-0.0660	0.8110	-0.0891	-0.0747	0.0032
EPIe	0.2222	0.2369	0.1189	0.0789	0.1999	0.7459	0.1148	0.0150	0.2287
EPIf	0.0368	0.3226	0.1785	0.3147	0.2981	0.7643	0.0063	0.2525	0.2899
EPIg	-0.008	0.0256	0.0471	0.1238	-0.1478	0.7098	-0.2325	-0.0879	0.1117
EPIh	-0.253	-0.3368	-0.1235	0.0003	0.0005	0.7274	0.0339	0.2001	-0.0680

FPa	0.0087	-0.1477	0.2156	0.1147	-0.0003	0.0008	0.9006	0.0001	0.0248
FPb	0.2587	0.3354	0.2574	0.0023	0.3000	0.2002	0.8922	0.2111	0.0158
FPc	-0.087	0.0014	0.1365	-0.0057	0.3621	-0.2414	0.9205	0.2147	0.0163
FPd	0.3241	0.0247	0.1005	0.2304	0.1005	-0.005	0.8434	0.1052	0.0069
OPa	0.1058	0.3210	0.2158	0.2291	0.0149	0.0003	0.0147	0.8679	0.1989
OPb	-0.241	--0.023	-0.1478	-0.2514	-0.002	0.005	0.1004	0.8851	0.2000
SCPa	-0.002	0.0047	0.3258	0.0254	0.1174	0.1113	-0.0015	-0.002	0.9212
SCPb	0.0045	0.0007	0.0018	0.0032	0.1555	0.2341	0.3666	0.0145	0.8940

Factor Loadings are in bold.

SP: Status of Purchasing, IC: Internal Coordination, IS: Information Sharing with suppliers, SD: Supplier Development, EPU: E-procurement usage, EPI: E-procurement Impact, FP: Financial Performance, OP: Operational Performance, SCP: Supply Chain Performance