Supply chain collaborative advantage: A firm’s perspective

Mei Cao, Qingyu Zhang

A firm’s perspective

Department of Business and Economics, University of Wisconsin-Superior, WI 54880, USA
Department of Computer and Information Technology, Arkansas State University, State University, AR 72467, USA

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Abstract

In the past decades, firms have strived to achieve greater collaborative advantages with their supply chain partners. The objective of the study is to uncover the nature and characteristics of supply chain collaborative advantage from a focal firm’s perspective. Collaborative advantage is defined as strategic benefits gained over competitors in the marketplace through supply chain partnering and partner enabled knowledge creation, and it relates to the desired synergistic outcome of collaborative activity that could not have been achieved by any firm acting alone. The research conceptualizes supply chain collaborative advantage as the five dimensions: process efficiency, offering flexibility, business synergy, quality, and innovation. Data were collected through a web survey of U.S. manufacturing firms in various industries. Reliable and valid instruments were developed through rigorous empirical analysis including structured interviews, Q-sort, and a large-scale study. Predictive validity is evaluated by demonstrating a strong and positive relationship between supply chain collaborative advantage and firm performance. The construct and measures in this study have provided a rich and structured understanding of collaborative advantage in a supply network. The results of the structural analysis indicate that supply chain collaborative advantage indeed has a bottom-line influence on firm performance.

1. Introduction

In the past decades, firms have strived to achieve greater collaborative advantages with their supply chain partners (Fawcett and Magnan, 2004; Lejeune and Yakova, 2005). Supply chain collaboration means two or more autonomous firms are working jointly to plan and execute supply chain operations (Simatupang and Sridharan, 2002). It can deliver substantial benefits and advantages to its partners (Mentzer et al., 2000). Collaborative relationships can help firms share risks (Kogut, 1988), access complementary resources (Park et al., 2004), reduce transaction costs and enhance productivity (Kalwani and Narayandas, 1995), and enhance profit performance and competitive advantage over time (Mentzer et al., 2000).

Although the collaborative advantage is acknowledged in the literature, its exact nature and attributes are not well understood. In addition, the research studies on the collaborative advantage in the context of supply chain are still sparse. Collaboration between supply chain partners is not merely pure transactions but leverages information sharing and market knowledge creation for sustainable competitive advantage (Malhotra et al., 2005; Vachon and Klassen, 2008; Bailey and Francis, 2008; Ding and Huang, 2010). For example, changing market demand information can be integrated into the production plans via supply chain collaboration for automotive manufacturers (Tomino et al., 2009).

Despite the popularity and benefits of interorganizational collaboration, many partner relationships fall short of meeting the participants’ expectations (Doz and Hamel, 1998; Barringer and Harrison, 2000). Few firms have truly capitalized on the potential of interorganizational collaboration (Barratt, 2003; Min et al., 2005). Collaboration seems to have great potential, but further investigation is needed to recognize its value (Goffin et al., 2006).

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2. Conceptual development

Supply chain collaborative advantage is based on a paradigm of collaborative advantage (Kanter, 1994; Dyer, 2000) rather than competitive advantage (Porter, 1985). According to the collaborative paradigm, a supply chain is composed of a sequence or network of interdependent relationships fostered through strategic alliances and collaboration (Chen and Paulraj, 2004). It is a relational view of interorganizational competitive advantage (Dyer and Singh, 1998).

By collaborating, supply chain partners can work as if they were a part of a single enterprise (Lambert et al., 2004). Such collaboration can increase joint competitive advantage, i.e., collaborative advantage (Jap, 2001). Supply chain collaborative advantage refers to strategic benefits gained over competitors in the marketplace through supply chain partnering and partner enabled knowledge creation, and such synergistic benefits could not be attained by acting independently (Jap, 2001; Vangen and Huxham, 2003; Malhotra et al., 2005). Supply chain partnering involves collaborative activities such as sharing information, synchronizing decisions, sharing complementary resources, and aligning incentives with partners’ costs and risks.

Collaborative advantage resides not within an individual firm but across the boundaries of a firm via its relationship with supply chain partners (Dyer, 1996; Dyer and Singh, 1998; Kanter, 1994; Jap, 2001). Ferratt et al. (1996) define collaborative advantage as the benefit gained by a group of firms as the result of their cooperation rather than their competition. They argue that, in healthcare industry, IT enables firms to achieve competitive advantage through collaboration not only with supply chain partners but also with competitors (Pouloudi, 1999; Naesens et al., 2009).

Collaborative advantage relates to the desired synergistic outcome of collaborative activity that could not have been achieved by any firm acting alone (Vangen and Huxham, 2003). Jap (1999) explains that collaboration can enlarge the size of the joint benefits and give each member a share of greater gain that could not be generated by each member on its own. Kanter (1994) argues that supply chain partnering, as the strongest and closest collaboration, is a living system that grows progressively in their possibilities. Collaboration involves creating new values together rather than mere exchange, and it is controlled not by formal systems but a web of connections and infrastructures that enhance learning and open new doors and unforeseen opportunities. Thus, collaboration-associated benefits may not be immediately visible; however potential long-term rewards are enticing and strategic (Min et al., 2005).

Hansen and Nohria (2004) argue it is increasingly difficult to sustain competitive advantage on the basis of the economics of scale and scope. Competitive advantage will belong to firms that can stimulate and support collaboration to leverage dispersed resources. They contend that the value creation from collaboration could be cost savings through the transfer of best practices, enhanced capacity and flexibility for collective actions, better decision making and increased revenue through resource synergy, and innovation through the combination and cross-pollination of ideas. Similarly, Lado et al. (1997) and Luo et al. (2006) suggest that collaboration produces various benefits including cost savings, resource sharing, learning, and innovation.

Synthesizing the above studies, this research conceptualizes supply chain collaborative advantage as the following five sub-dimensions: process efficiency, offering flexibility, business synergy, quality, and innovation. These collaborative advantages are viewed from the focal firm’s perspective (Duffy and Fearne, 2004) (Table 1).

Process efficiency refers to the extent to which a firm’s collaboration process with supply chain partners is cost-competitive among primary competitors (Bagchi and Skjoett-Larsen, 2005). The process could be information sharing process, joint logistics process, joint product development process, or joint decision making process. Process efficiency is a measure of success and a determinant factor of the ability of the firm to make profit (e.g., inventory turnover and operating cost). Process efficiency is improved through lower inventory and better delivery performance (Vachon and Klassen, 2008; Cachon and Fisher, 2000; Lee et al., 2000). Supply chain collaboration facilitates the cooperation of participating members along the supply chain to improve performance (Bowersox, 1990). The benefits of collaboration include cost reductions and revenue enhancements (Lee et al., 1997; Giannoccaro and Pontrandolfo, 2009).

Offering flexibility refers to the extent to which a firm’s supply chain linkage supports changes in product or service offerings (e.g., features, volume, and speed) in response to environmental changes. It is also called customer responsiveness in literature (Kiefer and Novack, 1999; Holweg et al., 2005). Offering flexibility is based on the ability of collaborating firms to quickly change process structures or adapt the information sharing process for modifying the features of a product or service (Gosain et al., 2004). In today’s market firms indeed pay attention to customers and more firms solicit customer inputs at the design stage resulting in better acceptance of the products and services later (Bagchi and Skjoett-Larsen, 2005).

Business synergy refers to the extent to which supply chain partners combine complementary and related resources to

### Table 1

<table>
<thead>
<tr>
<th>Construct</th>
<th>Definition</th>
<th>Literature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply chain collaborative</td>
<td>Strategic benefits gained over competitors in the marketplace through supply chain partnering</td>
<td>Jap, 2001; Dyer, 1996; Dyer and Singh, 1998; Ferratt et al., 1996; Kanter, 1994; Vangen and Huxham, 2003</td>
</tr>
<tr>
<td>Process efficiency</td>
<td>The extent to which a firm’s collaboration with supply chain partners is cost competitive</td>
<td>Bagchi and Skjoett-Larsen, 2005; Fisher, 1997; Lee et al., 1997; Simatupang and Sridharan, 2005</td>
</tr>
<tr>
<td>Offering flexibility</td>
<td>The extent to which a firm’s supply chain linkage supports changes in products or services available for customers</td>
<td>Beamon, 1998; Gosain, et al., 2004; Holweg et al., 2005; Kiefer and Novack, 1999; Narasimhan and Jayaram, 1998</td>
</tr>
<tr>
<td>Business synergy</td>
<td>The extent to which supply chain partners combine complementary and related resources to achieve spill-over benefits</td>
<td>Ansoff, 1988; Itami and Roehl, 1987; Larsson and Finkelstein, 1999; Lasker et al., 2001; Tanriverdi, 2006; Zuo, 2004</td>
</tr>
<tr>
<td>Quality</td>
<td>The extent to which a firm with supply chain partners offers reliable and durable products that create higher value for customers</td>
<td>Harvey and Gray, 1992; Li, 2002; Rondeau et al., 2000; Fynes et al., 2005</td>
</tr>
<tr>
<td>Innovation</td>
<td>The extent to which a firm works jointly with its supply chain partners in introducing new processes, products, or services</td>
<td>Clark and Fujimoto, 1991; Dyer and Singh, 1998; Handfield and Pannesi, 1995; Kessler and Chakraborti, 1996; Malhotra et al., 2001; Mowery and Rosenberg, 1998; Vesey, 1991</td>
</tr>
</tbody>
</table>
achieve spill-over benefits. Ansoff (1988) suggests that synergy can produce a combined return on resources that is greater than the sum of individual parts \((2+2=5)\). This joint effect results from the process of making better use of resources in the supply chain, including physical assets such as manufacturing facilities and invisible assets such as customer knowledge, technological expertise, and organizational culture (Itami and Roehl, 1987). Tanriverdi (2006) offers two major sources of synergy: super-additive value by complementary resources and sub-additive cost (or economies of scope) by related resources. Collaboration can help partners to maximize their assets utilization (e.g., truckload transportation and transportation capacity sharing) resulting in substantial capital relief (Min et al., 2005).

Lasker et al. (2001) claim that synergies between supply chain partners are more than a mere exchange of resources. By combining the individual firms’ resources, skills, and social capital, the collaboration can create something new and valuable together. Supply chain partners can also achieve synergy of common IT infrastructure, common IT management processes, and common IT vendor management processes (Larsson and Finkelstein, 1999; Zhu, 2004; Tanriverdi, 2006). As long as supply chain partners make decisions in the best economic interest of the supply chain as a whole, not its own portion, the gain or joint outcome will be expanded (Simatupang and Sridharan, 2005).

Quality refers to the extent to which a firm with supply chain partners offers quality product that creates higher value for customers (Harvey and Gray, 1992; Rondeau et al., 2000; Li, 2002; Fynesa et al., 2005). It is expected that firms that can respond fast to customer needs with high quality products, innovative design, and excellent after-sales service allegedly build customer loyalty, increase market share, and ultimately gain high profits. Garvin (1988) proposes eight dimensions of quality: performance, features, reliability, conformance, durability, serviceability, aesthetics, and perceived quality, which are comprehensive but measures for each are difficult to establish. Quality improvement can be achieved through supply chain collaboration (Fynesa et al., 2005).

Innovation refers to the extent to which a firm works jointly with its supply chain partners in introducing new processes, products, or services. Due to shorter product life cycles, firms need to innovate frequently and in small increments (Clark and Fujimoto, 1991; Vesey, 1991; Handfield and Pannesi, 1995; Kessler and Chakrabarti, 1996). By carefully managing their relationships with suppliers and customers, firms improve their ability to engage in process and product innovation (Hage, 1999; Kaufman et al., 2000). Innovation as a highly structured, knowledge-intensive activity embeds in networks that span organizational and geographical boundaries (Dyer and Singh, 1998; Mowery and Rosenberg, 1998; Sapolsky et al., 1999; Malhotra et al., 2001). By tapping joint creativity capacities, joint organizational learning, knowledge sharing, and joint problem solving between supply chain partners, firms can improve absorptive capacity and thus introduce new products and services fast and frequently.

3. Instrument development

The development of instruments for supply chain collaborative advantage was carried out in three steps: (1) item generation, (2) structured interview and Q-sort, and (3) large-scale analysis. First, to ensure the content validity of the constructs, an extensive literature review was conducted to define each construct and generate the initial items for measuring the constructs. Then, a structured interview and Q-sort were conducted to provide a preliminary assessment of the reliability and validity of the scales. The third step was a large-scale survey to validate the instruments.

3.1. Item generation

The objective of item generation is to achieve the content validity of constructs by reviewing literature and consulting with academic and industrial experts. The measurement items for a scale should cover the content domain of a construct (Churchill, 1979; Moore and Benbasat, 1991; Segars and Grover, 1998). To generate measurement items for each construct, prior research was extensively reviewed and an initial list of potential items was compiled. A five-point Likert scale was used to indicate the extent to which managers agree or disagree with each statement where 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, and 5 = strongly agree. The items measure collaborative advantages between supply chain partners from a focal firm’s perspective. In the questionnaire, supply chain partners are defined as a firm’s primary/key suppliers.

3.2. Structured interview and Q-sort

After the measurement items were created, the common pool of items was reviewed and evaluated by practitioners from four different manufacturing firms to pre-assess the reliability and validity of the scales. First, structured interviews were conducted to check the relevance and clarity of each sub-construct’s definition and the wording of question items. Then, interviewees were asked to sort out the questionnaire items into corresponding sub-constructs. Based on the feedback from the experts, redundant and ambiguous items were eliminated or modified.

Three Q-sort measures were used to evaluate the instruments. Inter-judge raw agreement score is the number of items that both judges agree to place into a certain category divided by the total number of items. Second, item placement ratio (i.e., hit ratio) is the items that are correctly sorted into the intended theoretical category divided by twice the total number of items. Third, Cohen’s kappa is the proportion of joint judgments where there is agreement after chance agreement is excluded. After two Q-sort rounds, two items were dropped and some items were reworded. Then the questionnaire items were distributed to six academicians who reviewed each item and indicated to keep, drop, modify, or add items. Finally, questionnaire items were sent out for a large-scale survey. Detailed Q-sort results are available from the authors.

3.3. Sampling design and large-scale data collection

To further purify the items and assess measurement properties, a large-scale web survey was conducted. The sample respondents were expected to have knowledge or experience in supply chain management. The target respondents were CEOs, presidents, vice presidents, directors, or managers in the manufacturing firms across the U.S. The sample respondents were expected to cover the following seven SIC codes: Furniture and Fixtures (SIC 25), Rubber and Plastic Products (SIC 30), Fabricated Metal Products (SIC 34), Industrial Machinery and Equipment (SIC 35), Electric and Electronic Equipment (SIC 36), Transportation Equipment (SIC 37), and Instruments and Related Products (SIC 38).

An email list of 5000 target respondents were purchased from Council of Supply Chain Management Professionals (CSCMP), a prestigious association of professionals in the area of supply chain management, and lead411.com, a professional list company that is specialized at providing executive level email lists. A web survey was conducted to reach as many respondents as possible and retrieve as much information as possible in short time. Excluding multiple names from the same organization, undelivered emails, and returned emails saying that target respondents were no longer with the company, the actual mailing list contained 3538 names.
To improve the response rate, three waves of emails were sent once a week. Out of the 227 responses received (16 incomplete), 211 are usable resulting in a response rate of 6.0%. Characteristics of the respondents appear in Table 2. A chi-square test is conducted to check non-response bias (see Table 2). The results show that there is no significant difference between the first-wave and second/third-wave respondents by all three categories (i.e., SIC code, firm size, and job title) at the level of 0.1. It exhibits that received questionnaires from respondents represent an unbiased sample.

### 3.4. Large-scale data analysis methods

Using confirmatory factor analysis with LISREL, steps were undertaken to check (1) unidimensionality and convergent validity, (2) reliability, (3) discriminant validity, (4) second-order construct validity, and (5) predictive validity. The assessment was conducted for all five constructs in one first-order correlated model so that the related multi-items measures are grouped together (Papke-Shields et al., 2002). Iterative modifications were undertaken by dropping items with loadings less than 0.7 and also items with high correlated errors, thus improving the model fit to acceptable levels (Hair et al., 1995). In all cases where refinement was indicated, items were deleted if such action was theoretically sound and the deletions were done one by one at each step (Hair et al., 1995). Model modifications were continued until all parameter estimates and model fits were judged to be satisfactory.

Unidimensionality is assessed by the fit indices and convergent validity is assessed by the significance of $t$-values of each measurement indicator. The overall model fit can be tested using the comparative fit index (CFI), non-normed fit index (NNFI), root mean square error of approximation (RMSEA), and normed chi-square (i.e., $\chi^2$ per degree of freedom) (Byrne, 1989; Bentler, 1990; Hair et al., 1995; Chau, 1997; Heck, 1998). Values of CFI and NNFI between 0.80 and 0.89 represent a reasonable fit (Segars and Grover, 1998) and scores of 0.90 or higher are evidence of good fit (Byrne, 1989; Joreskog and Sorbom, 1989; Papke-Shields et al., 2002). Values of RMSEA less than 0.08 are acceptable (Hair et al., 1995; Joreskog and Sorbom, 1989). The normed chi-square ($\chi^2$ divided by degrees of freedom) estimates the relative efficiency of competing models. For this statistic, a value less than 3.0 indicates a reasonable fit and a value less than 2.0 shows a good fit (Segars and Grover, 1998; Papke-Shields et al., 2002).

Following Hair et al. (1995), the composite reliability ($\rho_c$) and the average variance extracted (AVE) of multiple indicators of a construct can be used to assess reliability of a construct. When AVE is greater than 50% and $\rho_c$ is greater than 0.70, it implies that the variance by the trait is more than that by error components (Hair et al., 1995).

Discriminant validity can be assessed by three methods. One method is to perform a pair-wise comparison using a model with correlation constrained to 1 with an unconstrained model. A difference between the $\chi^2$ values of the two models, which is significant at $p < 0.05$ level, would indicate support for discriminant validity (Joreskog and Sorbom, 1989). The second method entails comparing the average variance extracted (AVE) to the squared correlation between constructs. If the AVE for each factor is greater than the squared correlation of this factor and another, there is evidence of discriminant validity (Fornell and Larcker, 1981). A more rigorous method involves constructing 95% confidence intervals for each pair of constructs using formula $\phi \pm 2\sigma_e$, where $\phi$ is the correlation between constructs and $\sigma_e$ is its associated standard error in an all-factor correlated model (see Fig. 1a). If the value 1.0 is not included in the interval, discriminant validity is achieved (Anderson and Gerbing, 1988).

An important aspect of construct validity is the validation of the second-order construct. The construct was validated by a second-order model with good model fit indices as discuss before (Jiang et al., 2000; Stewart and Segars, 2002). Furthermore, a $T$-coefficient was used to test whether a second-order construct exists accounting for the variations in its sub-constructs. $T$-coefficient is calculated as the ratio of the chi-square of the first-order model to the chi-square of the second-order model and a $T$-coefficient of higher than 0.80 indicates the existence of a second-order construct (Marsh and Hocevar, 1985; Doll et al., 1995; Stewart and Segars, 2002).

Predictive validity is the extent to which a scale predicts scores on criterion measures. It can be assessed by evaluating if the variable has significant relationships with other theory-driven outcome variables. Thus, predictive validity is tested by examining structural relationships.

### Table 2
Demographic data for the respondents (211 responses).

<table>
<thead>
<tr>
<th>Variables</th>
<th>Total responses</th>
<th>First-wave frequency</th>
<th>Second/third wave frequency</th>
<th>Chi-square test</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SIC</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>8</td>
<td>4</td>
<td>4</td>
<td>$\chi^2 = 10.00$</td>
</tr>
<tr>
<td>30</td>
<td>9</td>
<td>4</td>
<td>5</td>
<td>$p = 0.17$</td>
</tr>
<tr>
<td>34</td>
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<td>25</td>
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<tr>
<td>38</td>
<td>23</td>
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<td>8</td>
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<tr>
<td>Others</td>
<td>5</td>
<td>4</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td><strong>Firm size</strong></td>
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<td></td>
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<tr>
<td>1–50</td>
<td>10</td>
<td>7</td>
<td>3</td>
<td>$\chi^2 = 4.71$</td>
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<td>4</td>
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<tr>
<td>101–250</td>
<td>38</td>
<td>27</td>
<td>11</td>
<td>$p = 0.45$</td>
</tr>
<tr>
<td>251–500</td>
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<td>34</td>
<td>24</td>
<td></td>
</tr>
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<td>501–1000</td>
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<td>6</td>
<td></td>
</tr>
<tr>
<td>1001+</td>
<td>75</td>
<td>51</td>
<td>24</td>
<td></td>
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<tr>
<td><strong>Job title</strong></td>
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<tr>
<td>CEO/President</td>
<td>54</td>
<td>36</td>
<td>18</td>
<td>$\chi^2 = 4.73$</td>
</tr>
<tr>
<td>Vice president</td>
<td>99</td>
<td>62</td>
<td>37</td>
<td>$df = 4$</td>
</tr>
<tr>
<td>Manager</td>
<td>27</td>
<td>20</td>
<td>7</td>
<td>$p = 0.32$</td>
</tr>
<tr>
<td>Director</td>
<td>23</td>
<td>17</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Others</td>
<td>8</td>
<td>4</td>
<td>4</td>
<td></td>
</tr>
</tbody>
</table>
4. Results

In the following section, the results of large-scale analysis for each construct will be reported and discussed.

4.1. Large-scale measurement results

The construct of supply chain collaborative advantage was represented by five dimensions and 20 items (see the Appendix). An all-factor correlated LISREL measurement model (see Fig. 1a) was specified for supply chain collaborative advantage. Following Hair et al. (1995), iterative modifications were made by examining modification indices, correlated errors, and loadings to improve key model fit statistics.

The final model fit indices of CFI, NNFI, RMSEA, and normed \( \chi^2 \) are 0.94, 0.93, 0.074, and 2.15, respectively, meeting the recommended criteria and demonstrating good unidimensionality. Shown in Table 3, the item loadings for each factor are greater than 0.70 and significant at \( p < 0.01 \) based on \( t \)-values. All dimensions exhibit good convergent validity.

The estimates of AVEs for the five factors are 0.67, 0.77, 0.74, 0.71, and 0.74, respectively, greater than the critical value of 0.50. The composite reliabilities (\( \rho_e^2 \)'s) for the five factors are 0.89, 0.93, 0.92, 0.92, and 0.91, respectively, above the critical value of 0.70. The results of the AVEs and \( \rho_e^2 \)'s provide evidence of good reliability for each factor.

Table 4 reports the results of the three methods performed to assess discriminant validity. 10 pair-wise \( \chi^2 \) differences between constrained and unconstrained models for the 5 dimensions of CA are all significant at \( p < 0.01 \). Likewise, the squared correlations for each pair of dimensions are less than the AVE for each dimension. None of the confidence intervals for each bivariate correlation of dimensions include the value 1.0. The results support the case for discriminant validity.

4.2. Validation of second-order constructs

Supply chain collaborative advantage as a second-order construct was run with five sub-dimensions as the first order factors (see Fig. 1b). All the factor loadings and the error terms of each indicator are shown in Fig. 1b. The model fit indices of CFI, NNFI, RMSEA, and normed \( \chi^2 \) are 0.93, 0.92, 0.080, and 2.33, respectively, meeting the recommended criteria and demonstrating good model fit.

The second-order model explains the co-variations among first-order factors in a more parsimonious way. However, the variations shared by the first-order factors cannot be totally explained by the single second-order factor, and thus the fit indices of the higher-order model can never be better than the corresponding first-order model (Segars and Grover, 1998). The first-order model provides a target fit for higher-order models. The efficacy of second-order models can be assessed by examining the target (T) coefficient (where \( T=\text{first-order} \chi^2/\text{second-order} \chi^2 \)) (Marsh and Hocevar, 1985; Doll et al., 1995; Stewart and Segars, 2002). The T-coefficient 0.80–1.00 indicates the existence of a second-order construct.
Table 5 shows the calculated target coefficient between the first-order model and the second-order model for supply chain collaborative advantage. The $T$-coefficient is 0.925, suggesting that the second-order models should be accepted as a more accurate representation of model structure over the corresponding first-order model because they represent more parsimonious explanation of observed covariance. The results support the second-order constructs proposed in the conceptual development section.

4.3. Predictive validity

Many scholars contend that both customers and suppliers seek collaborative relationships as a way of improving performance (Ittner and Larcker, 1997; Duffy and Fearne, 2004; Sheu et al., 2006). Stank et al. (2001) suggest that both internal and external collaborations are necessary to ensure performance. Partnerships can improve profitability, reduce purchasing costs, and increase technical cooperation (Ailawadi et al., 1999; Han et al., 1993).

This study uses firm performance to evaluate the predictive validity of supply chain collaborative advantage. If supply chain collaborative advantage as a second-order construct has significant relationship with firm performance, there is evidence of predictive validity. Firm performance refers to how well a firm fulfills its financial and competitive goals compared with the firm’s primary competitors (Yamin et al., 1999). In this study, firm performance is measured by growth of sales, return on investment, growth in return on investment, and profit margin on sales. Test results of unidimensionality, convergent validity, and reliability for firm performance are provided in Table 6. As shown in Fig. 2, the path coefficient ($\gamma = 0.72, t = 9.62$) shows that supply chain collaborative advantage as a second-order construct is significantly related to firm performance, providing evidence of predictive validity.

### Table 3
Factor loadings ($t$-statistics), AVE, and reliability ($\rho_c$) for CA sub-constructs.

<table>
<thead>
<tr>
<th>Items</th>
<th>Process efficiency</th>
<th>Offering flexibility</th>
<th>Business synergy</th>
<th>Quality</th>
<th>Innovation</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAPE1</td>
<td>0.83 (–)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CAPE2</td>
<td>0.78 (12.81)</td>
<td>0.93 (–)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CAPE3</td>
<td>0.84 (14.33)</td>
<td>0.89 (21.38)</td>
<td>0.87 (19.67)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CAPE4</td>
<td>0.82 (13.78)</td>
<td>0.81 (16.76)</td>
<td>0.81 (16.76)</td>
<td>0.86 (–)</td>
<td></td>
</tr>
<tr>
<td>CAOF1</td>
<td>0.87 (14.33)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CAOF2</td>
<td>0.89 (21.38)</td>
<td>0.87 (19.67)</td>
<td>0.81 (16.76)</td>
<td>0.86 (–)</td>
<td></td>
</tr>
<tr>
<td>CAOF3</td>
<td>0.73 (0.83)</td>
<td>0.75 (0.63)</td>
<td>0.51 (0.35)</td>
<td>0.53 (–)</td>
<td></td>
</tr>
<tr>
<td>CAOF4</td>
<td>0.64 (1.00)</td>
<td>0.50 (0.38)</td>
<td>0.49 (0.26)</td>
<td>0.52 (–)</td>
<td></td>
</tr>
<tr>
<td>CABS1</td>
<td>0.86 (–)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CABS2</td>
<td>0.86 (15.88)</td>
<td>0.84 (15.26)</td>
<td>0.84 (15.26)</td>
<td>0.87 (–)</td>
<td></td>
</tr>
<tr>
<td>CABS3</td>
<td>0.87 (16.33)</td>
<td>0.87 (16.33)</td>
<td>0.87 (16.33)</td>
<td>0.87 (–)</td>
<td></td>
</tr>
<tr>
<td>CABS4</td>
<td>0.87 (16.33)</td>
<td>0.87 (16.33)</td>
<td>0.87 (16.33)</td>
<td>0.87 (–)</td>
<td></td>
</tr>
<tr>
<td>CAQL1</td>
<td>0.74 (13.72)</td>
<td>0.89 (19.80)</td>
<td>0.88 (19.44)</td>
<td>0.74 (–)</td>
<td></td>
</tr>
<tr>
<td>CAQL2</td>
<td>0.74 (13.72)</td>
<td>0.89 (19.80)</td>
<td>0.88 (19.44)</td>
<td>0.74 (–)</td>
<td></td>
</tr>
<tr>
<td>CAQL3</td>
<td>0.74 (13.72)</td>
<td>0.89 (19.80)</td>
<td>0.88 (19.44)</td>
<td>0.74 (–)</td>
<td></td>
</tr>
<tr>
<td>CAQL4</td>
<td>0.74 (13.72)</td>
<td>0.89 (19.80)</td>
<td>0.88 (19.44)</td>
<td>0.74 (–)</td>
<td></td>
</tr>
<tr>
<td>AVE</td>
<td>0.67</td>
<td>0.77</td>
<td>0.74</td>
<td>0.74</td>
<td>0.71</td>
</tr>
<tr>
<td>$\rho_c$ (Reliability)</td>
<td>0.89</td>
<td>0.93</td>
<td>0.92</td>
<td>0.92</td>
<td>0.91</td>
</tr>
</tbody>
</table>

### Table 4
Discriminant validity of supply chain collaborative advantage sub-constructs.

<table>
<thead>
<tr>
<th>Sub-Construct</th>
<th>CAPE</th>
<th>CAOF</th>
<th>CABS</th>
<th>CAQL</th>
<th>CAIN</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAPE</td>
<td>0.67*</td>
<td>0.58*</td>
<td>0.53</td>
<td>0.52</td>
<td>0.50</td>
</tr>
<tr>
<td>CAOF</td>
<td>0.76*</td>
<td>0.77</td>
<td>0.26</td>
<td>0.56</td>
<td>0.50</td>
</tr>
<tr>
<td>CABS</td>
<td>0.73</td>
<td>0.71</td>
<td>0.74</td>
<td>0.24</td>
<td>0.41</td>
</tr>
<tr>
<td>CAQL</td>
<td>0.72</td>
<td>0.72</td>
<td>0.74</td>
<td>0.49</td>
<td>0.74</td>
</tr>
<tr>
<td>CAIN</td>
<td>0.71</td>
<td>0.71</td>
<td>0.64</td>
<td>0.71</td>
<td>0.71</td>
</tr>
</tbody>
</table>

* Values on the diagonal are the average variance extracted for each sub-construct.
* Values represent correlations ($r$) for each pair of CA sub-constructs.
* The 95% confidence interval for correlations of each pair of CA sub-constructs.
* $\chi^2$ differences between each constrained model and unconstrained model.
* Values above the diagonal are squared correlations for each pair of CA sub-constructs.
* Significant at $p < 0.01$. 
5. Discussion and implications

The research has provided a more accurate definition of supply chain collaborative advantage. The definition contains four components: (1) collaborative advantages are achieved by supply chain partnering activities such as sharing information, synchronizing decisions, sharing complementary resources, and aligning incentives with partners’ costs and risks; (2) benefits are enlarged than acting independently; (3) there are some leverage effects or synergistic outcomes; and (4) it is not just collaborative transactions but involves joint knowledge creation and joint innovation. This definition puts more emphasis on business synergy and joint value creation and innovation. This emphasis enables firms to see the advantages from a long-term and strategic perspective, shifting from the only cost and short-term focus.

The current study has identified five dimensions that make up supply chain collaborative advantage: process efficiency, offering flexibility, business synergy, quality, and innovation. Collaborative advantage will be realized when all parties in the supply chain from suppliers to customers cooperate. Collaborative advantage is absent when supply chain members pursue their own objectives (Chopra and Meindl, 2007; Abreu et al., 2009). If each member views its action locally and is unable to see the impact of its action on other members, the chain as a whole suffers because the total benefit is diminished.

The study has developed valid and reliable instruments for supply chain collaborative advantage. All the scales have been tested through rigorous statistical methodologies including Q-sort method, confirmatory factor analysis, reliability, and the validation of second-order construct. All the scales are shown to meet the requirements for reliability and validity and thus can be used in future research. The accurate definitions and measures of collaborative advantage have provided a rich and structured understanding of what occurs in a supply chain or network. They also facilitate empirical research efforts because the relationships among constructs can be better captured with better definitions and measures.

To the author’s best knowledge, the study represents the first of its kind in the supply chain literature to define and operationalize collaborative advantage. The results strongly suggest that better collaboration among supply chain partners expands the gain pie due to synergy through complementary resources and collaborative processes (Jap, 2001; Tanriverdi, 2006; Simatupang and Sridharan, 2005).

The results empirically confirm that supply chain collaborative advantage directly improves firm performance. Previous research links collaboration directly to firm performance (Duffy and Fearne, 2004; Stank et al., 2001; Tan et al., 1998) without explicitly considering any intermediate variable such as collaborative advantage. This is an important finding since there exists doubt among researchers and practitioners in the economic justification of whether supply chain collaborative advantage can bring financial benefits to the focal firm. The statistical significance of the structural relationship suggests that supply chain collaborative advantage indeed has a bottom-line influence on firm performance.

In addition to the theoretical contributions of the study, there are practical implications that can be inferred. The definition and measures of collaborative advantages can help managers to define specific actions to be taken collaboratively to improve shared supply chain processes that benefit all members. The definition...
and measurements can serve as a powerful tool for managers to form effective collaborative relationships.

6. Limitations and future research

While the research has made significant contributions to research and practice, there are limitations that need to be considered when interpreting the study findings. Because of the limited number of observations (211), the revalidation of constructs was not carried out in this research. This needs to be addressed in the future research. New data may be collected to revalidate the measures and structural models.

Future research should also conduct factorial invariance tests. Using the instruments developed in this research, one may test for factorial invariance across different organization sizes and across industries. For example, an analysis of collaborative advantage by industry would be very beneficial. Future research should apply multiple methods to obtain data. The use of a single respondent to represent what are supposed to be supply chain wide variables may generate some inaccuracy and more than the usual amount of random error. Future research should seek to utilize multiple respondents from each participating organization as an effort to enhance reliability of research findings. More insights will be gained by collecting information from both sides of the manufacturer–supplier dyad rather than just from one organization.

Some researchers examine supply chain collaboration practices directed either upstream toward suppliers or downstream toward customers (Vachon and Klassen, 2008; Nyaga et al., 2010). They found out some similarities and some differences between two directions. In the future research, it would be interesting to investigate whether the measurement structure of collaborative advantage is similar or different between the upstream and downstream partners with the focal firm.

Appendix. Instruments

These items measure your firm's collaborative advantages with your supply chain partners (i.e., primary/key suppliers) and firm performance using a 5-point Likert-type scale to indicate the extent to which you agree or disagree to each statement as applicable to your firm: 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, and 5 = strongly agree.

Supply Chain Collaborative Advantage

<table>
<thead>
<tr>
<th>Process efficiency</th>
<th>Offering flexibility</th>
<th>Business synergy</th>
<th>Quality</th>
<th>Innovation</th>
<th>Firm performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAPE1</td>
<td>CAOF1</td>
<td>CABS1</td>
<td>CAQL1</td>
<td>CAIN1</td>
<td>FP1</td>
</tr>
<tr>
<td>CAPE2</td>
<td>CAOF2</td>
<td>CABS2</td>
<td>CAQL2</td>
<td>CAIN2</td>
<td>FP2</td>
</tr>
<tr>
<td>CAPE3</td>
<td>CAOF3</td>
<td>CABS3</td>
<td>CAQL3</td>
<td>CAIN3</td>
<td>FP3</td>
</tr>
<tr>
<td>CAPE4</td>
<td>CAOF4</td>
<td>CABS4</td>
<td>CAQL4</td>
<td>CAIN4</td>
<td>FP4</td>
</tr>
<tr>
<td>Our firm with supply chain partners meets what are agreed upon unit costs in comparison with industry norms</td>
<td>Our firm with supply chain partners offers a variety of products/services efficiently in comparison with industry norms</td>
<td>Our firm and supply chain partners have integrated IT infrastructure and resources</td>
<td>Our firm with supply chain partners offers products that are highly reliable</td>
<td>Our firm with supply chain partners introduces new products and services to market quickly</td>
<td>Growth of sales</td>
</tr>
<tr>
<td>Our firm with supply chain partners meets productivity standards in comparison with industry norms</td>
<td>Our firm with supply chain partners offers customized products/services with different features quickly in comparison with industry norms</td>
<td>Our firm and supply chain partners have integrated knowledge bases and know-how</td>
<td>Our firm with supply chain partners offers products that are highly durable</td>
<td>Our firm with supply chain partners has rapid new product development</td>
<td>Return on investment</td>
</tr>
<tr>
<td>Our firm with supply chain partners meets on-time delivery requirements in comparison with industry norms</td>
<td>Our firm with supply chain partners meets different customer volume requirements efficiently in comparison with industry norms</td>
<td>Our firm and supply chain partners have integrated marketing efforts</td>
<td>Our firm with supply chain partners offers high quality products to our customers</td>
<td>Our firm with supply chain partners has time-to-market lower than industry average</td>
<td>Growth in return on investment</td>
</tr>
<tr>
<td>Our firm with supply chain partners meets inventory requirements (finished goods) in comparison with industry norms</td>
<td>Our firm with supply chain partners has good customer responsiveness in comparison with industry norms</td>
<td>Our firm and supply chain partners have integrated production systems</td>
<td>Our firm and supply chain partners have helped each other to improve product quality</td>
<td>Our firm with supply chain partners innovates frequently</td>
<td>Profit margin on sales</td>
</tr>
</tbody>
</table>
References


