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The impact of operations and supply chain strategies on integration and performance☆

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ABSTRACT

This study aims to develop a comprehensive model that facilitates an understanding of relationships among operations strategies (OSs), supply chain strategies (SCSs), supply chain integration (SCI), and firm performance. It is a start to understand the role of operations strategies in supply chain design. We adopt structural equation modelling to test the relationships based on data collected from 604 Chinese manufacturers. The results show that a lean supply chain is appropriate for firms placing higher priorities on cost, quality and delivery strategies, while an agile supply chain is appropriate for firms competing on the flexibility strategy. Furthermore, both lean and agile SCSs require higher levels of SCI in terms of internal and external integration, but lean SCSs have a significantly higher impact on external integration than agile SCSs. The study refreshes the links between order winner/qualifier and supply chain strategies. Clear-cut differences exist concerning the role of operations strategy in supply chain management, indicating that appropriate supply chain design is very important for firms to achieve their operations objectives. This study contributes to a better understanding of the match between operations strategies and supply chain strategies, and offer a practical insights on investments in the development of supply chain integration.

1. Introduction

As an electronic firm with more than one million employees and 60 billion USD annual sales, Foxconn adopts a special operations and supply chain strategy and activity – lean strategy and supply chain integration (SCI). Foxconn reduces wasters and costs through several ways. Internally, they build the organization culture of "time is money", teamwork and resource sharing, process improvement, and continuous quality control to enhance efficiency and reduce costs. Externally, they use just-in-time (JIT) and vendor-management-inventory (VMI) methods to integrate with suppliers to reduce purchasing costs. They also involve designers of Apple to help them to improve product quality, which leads to the wonderful product of iPhone.

Many studies have investigated operations strategies (OSs) since Skinner's (1969) seminal work. However, one of the major weaknesses in this field is that the OS theory fails to make contextual considerations in terms of supply chain, especially in a developing economy, in which technologies are relatively weak and levels of management are low (Demeter and Boer, 2011). The changes to the business unit's strategy and environment must necessitate the change of its supply chain strategy, but there is no clear answer about how to change in the current literature (Perez-Franco et al., 2016). Thus, it is interesting and instructive to reconsider OSs from the perspective of supply chain management (SCM) in an emerging market like China. Furthermore, the decisions on production and supply chain network design become increasingly important for the firm to obtain competitive advantage (Macchion et al., 2015).

With the increasing importance of SCM, supply chain strategies (SCSs) should play important roles in defining firms' OSs. From a strategic SCM perspective, a supply chain's design should be aligned with a firm's missions and strategies (Qi et al., 2011) and the SCSs work as a logical bridge between firms' higher level strategy and its supply chain activities (Perez-Franco et al., 2016). Fisher (1997) argues that a firm's SCSs should match its product characteristics. The literature has generally testified to such a relationship (e.g., Qi et al., 2009). However, a firm's operational focus is to determine an order

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winner (a criterion that differentiates a firm's products/services from those of others) or order qualifier (a screening criterion that allows a firm's products/services to be candidates for purchasing in the market) in terms of OS strengths (e.g., cost, quality, delivery and flexibility) but not SCS strengths. Product characteristics comprise the post-hoc description of a firm's products that have already appeared in the market, and order winners and qualifiers are the attributes a firm's products should have even prior to the product design stage. Therefore, order winners and qualifiers are factors that should be determined during the strategy development process. In fact, the determination of order winners and qualifiers is the key process of the development of a firm's OSs (Jacobs and Chase, 2011). In accordance, Jacobs and Chase (2011) argue that OSs and SCSs should be considered systematically to build effective supply chains for manufacturers with various order winners. In the SCS literature, most studies such as those by Naylor et al. (1999), Mason-Jones et al. (2000), Christopher (2000) and Towill and Christopher (2002) have conceptually argued over the relationships among order winners, order qualifiers and SCSs. Recently, Roh et al. (2014) investigated the relationship for responsive supply chain strategy and suggested more supply chain strategies. A large-scale and rigorous empirical study is imperative to explore such a relationship (Naim and Gosling, 2011).

In addition, SCI practices are important for the effectiveness of SCM. Much of the prior SCI literature has focused on validating the benefits of SCI practices (Huo et al., 2014a, 2014b). When a firm has a predetermined strategy, the kind of SCI that is appropriate for its corresponding SCS design is a significant issue. However, few studies have explored enablers of SCI (Wang et al., 2016), especially from the strategic perspectives, which are very important to understanding the role of SCI in a supply chain (Zhao et al., 2011).

While China has become a global manufacturing center and plays an important role in global supply chains, SCM in China attracts both practitioners and academia (Zhao et al., 2007). Most previous studies on operations and supply chain strategies have been conducted in the context of Western cultures (e.g. Droge et al., 2004; Germain and Iyer, 2006). There is a need for testing and validating theories of operations and supply chain strategies in different cultural settings. The collectivism culture in China provide a fertile ground for testing and validating these theories developed in Western cultures. Furthermore, firms in China have different histories and varying cultures and management philosophies in the collective culture, SCI is deemed more important in maintaining relationships, as compared to that in an individualistic culture. Therefore, we conduct this study using data collected from Chinese manufacturers.

This study builds and empirically tests a comprehensive model to describe how OSs influence SCSs and how SCSs influence SCI practices that lead to financial performance in the Chinese supply chain context. By extending firm-oriented OSs to supply-chain-oriented SCSs and linking with SCI practices, this study contributes to OSs, SCSs, and SCI literature and practices in several ways. First, this study reveals impacts of four types of OSs on two types of SCSs. Second, this study investigates effects of SCSs on SCI. Third, this study explores relationships between SCI and financial performance. Fourth, this study provides guidelines for managers to decide how to devote their efforts and resources regarding different types of OSs, SCSs, and SCI, as well as how to manage various types of SCI to achieve financial performance.

2. Theoretical foundations and conceptual model

2.1. Literature review

An OS comprises ‘broad policies and plans for using the resources of a firm and should be integrated with corporate strategy’ (Jacobs and Chase, 2011, p. 23). These policies and plans are commonly described according to the priorities of four competitive dimensions in Skinner's (1969) seminal work, including cost, quality, flexibility and delivery. Previous literature pays much attention to understanding the compatibility of OS with environments, managerial choices and competitive strategies (e.g., Corbett, 2008; Paiva and Vieira, 2011). Although OS has been well understood from an organization-wide perspective, evolving practices and theories may require a new understanding of OS in the supply chain context. SCM requires supply chain-based strategies and practices beyond the firms’ boundaries. Recent work focused on exploring the connections of OSs with knowledge management (Hussain et al., 2015), competitive strategies (Khalili Shavarini et al., 2013), competitive advantages (Liu and Liang, 2015), or sustainability practices (Longoni and Cagliano, 2015). However, very few OS studies are investigated from the SCM perspective. For example, Quesada et al. (2008) linked order winning strategies with supply chain integration. There is a call for further investigation of the role of OSs in forming SCSs and supply chain practices.

An SCS describes how a firm can gain competitive advantages through its supply chain capabilities, such as cost efficiency, response speed and flexibility (Qi et al., 2011). Prior literature has classified SCSs into two generic categories: lean and agile (Fisher, 1997; Yusuf et al., 2004). While a lean SCS efficiently streamlines the whole supply chain, an agile SCS focuses on the reconfiguration of a supply chain in response to uncertain and dynamic environments (Naylor et al., 1999). The use of new technologies, such as radio frequency identification (RFID), and new management techniques such as postponement, could mitigate internal OSs' conflicts in achieving SCSs (Kwok and Wu, 2009). Hilletofth (2009) also argued that a differentiated SCS required the combination of different supply, manufacturing, and distribution strategies based on the observations in two cases. A recent work by Morita et al. (2015) empirically tested the alignment of SCS and product characteristics and how this alignment should be conducted. As we know, the link between SCS and SCI has not been established and tested in the literature. Therefore, an integrated framework connecting OS, SCS, and SCI will benefit the OS literature from the SCM perspective.

2.2. The effect of OSs on SCSs

When developing an OS, firms should identify their customers’ needs for different products and translate them into either order winners to differentiate themselves from competitors or order qualifiers to bring themselves to the market. Based on the order winner and qualifier classifications, firms are required to build operational infrastructures and capabilities accordingly, such as supply chain development and management infrastructures and capabilities. Thus, following an OS, the development of an appropriate SCS is necessary. Kim et al. (2014) suggested an integrated process of strategy formation, indicating the roles of OS in forming SCS.

Organizational capability theory provides an effective theory lens for relationships among OSs, SCSs, SCI and performance. Organizational capability can be defined as the “ability to perform repeatedly a productive task which relates either directly or indirectly to a firm's capacity for creating value through effecting the transformation of inputs into outputs” (Grant, 1996, p. 377). It is a firm's intended or realized competitive performance or operational strengths in operations management (Peng et al., 2008). Among various organizational capabilities, one major capability is dynamic capability that refers to the ability to integrate, build, structure, and reconfigure internal and external competencies to meet requirements of changing environments to generate multiple sustained competitive capabilities simultaneously in dynamic, unstable, or volatile environments (Peng et al., 2008; Teece et al., 1997). Both operations and supply chain strategies are dynamic capabilities because they can help firms to repeatedly conduct productive tasks which relate to the transformation of inputs into outputs.

From the perspective of organizational capability, when a firm has a high level of absorptive capability to understand OSs, the firm will be more likely to learn from external partners and understand their businesses to facilitate the implementation of SCSs. As indicated by organizational capability theory, internal OS capabilities can directly improve external SCS capabilities, because they can use internal OS resources as a base to develop external SCS resources. In details, internal OS capabilities (e.g. low cost, high quality) are positively related to external SCS capabilities, because the OS culture and atmosphere based on low cost or high quality of the internal operations of the firms can spread from within the firm to the outside and to the whole supply chain. From a cumulative capability perspective, internal OS capabilities, which focus on a firm's internal operations management, are the base from which external SCS capabilities can be developed, which focus on a firm's external operations management. This is also consistent with the shift from the management of a sole firm to the management of a supply chain. In conclusion, OS capabilities are positively related to SCS capabilities.

A lean supply chain follows the tenet of lean thinking that emphasises waste and interruption reductions when providing a flow of goods, services and technologies from suppliers to customers. Thus, the 'lean thinking' and subsequent lean supply chains adopt various management techniques and practices such as JIT, Kanban and TQM to reduce overall costs, enhance product quality, and shorten delivery times (Ardalan and Diaz, 2012). Such objectives of the lean supply chains are aligned with the OSs of firms that have order winners on cost, quality or delivery. However, while the lean paradigm is better for higher and predictable demands in a stable environment, it is inefficient in a volatile marketplace (Katayama and Bennett, 1996). The increasing flexibility of the changing demands and production necessary to meet the requirements of a dynamic environment could benefit the leanness strategy. Therefore, we propose the following hypotheses.

Hypothesis 1a/b/c/d. The degree of emphasis on OSs in terms of cost/quality/delivery/flexibility is positively related to the extent to which lean SCSs are used.

Goldman et al. (1995, p. 4) describe agility as 'a comprehensive response to the business challenges of profiting from rapidly changing, continually fragmenting, global markets for high-quality, high-performance, customer configured goods and services'. Thus, agility is mainly enabled by flexible processes in a product supply chain framework (Stavrulaki and Davis, 2010). High-quality products, speedy and reliable delivery and flexibility are keys for manufacturers to provide customised products to customers in a timely way and to gain competitive advantages in an increasingly volatile market.

Although the current OS trend reflects the importance of flexibility, contrary to the leanness that focuses on efficiency (Stavrulaki and Davis, 2010), the implementation of an agile supply chain implicates the risks of increasing product design and production costs (Simchi-Levi et al., 2011). As highlighted by Naylor et al. (1999), whereas agility focuses more on flexibility and does not make the elimination of all wastes a prerequisite, leanness focuses on the elimination of all non-value activities. Moreover, a firm that selects low cost as an OS is likely to reduce the production cost through the economy of scale, which can also be realized through agile SCS. Therefore, we propose the following hypotheses.

Hypothesis 2a/b/c/d. The degree of emphasis on an OS in terms of cost/quality/delivery/flexibility is positively related to the extent to which an agile SCS is used.

2.3. The effect of SCSs on SCI

SCI can be defined as the degree to which a function or organization strategically collaborates with internal functions or external supply chain members to manage the intra- and inter-organizational processes necessary to achieve effective and efficient flows of products, services, information, money and decisions with the objective of providing maximum value to the customer (Zhao et al., 2008). Internal and external integration are two major dimensions of SCI and play different roles. Whereas the former argues that the departments within a firm should function as part of an integrated process, the latter emphasises the importance of establishing a close relationship with external supply chain partners. Internal integration refers to the degree to which a manufacturer structures its own organizational strategies, practices and processes into collaborative, synchronized processes, in order to fulfill its customers' requirements and efficiently interact with its suppliers (Flynn et al., 2010). In contrast, external integration refers to the degree to which a manufacturer partners with its external partners to structure inter-organizational strategies, practices and processes into collaborative, synchronized processes (Flynn et al., 2010).

SCI can be viewed as organizational capabilities (Huo, 2012). According to organizational capability theory, SCS capabilities can be transferred to supply chain integrative capabilities. The vision of supply chains defined by SCSs can facilitate firms to develop communication, process coordination, and joint planning among functions and external supply chain partners. The learning capabilities formed in the development of SCS can also help firms to build integrative relationships among functions and supply chain partners.

The key to lean SCM is to provide a flow of goods, services and technologies from suppliers to customers without creating waste (Jasti and Kodali, 2015). This means that the competitive focus of a lean supply chain is to reduce cost. Therefore, it is imperative for leanness to organise a highly efficient and integrated production and logistics process through which manufacturers can increase productivity and reduce process-related costs to produce high-volume products. Such a high volume of production processes requires high efficiency through automation and real-time information sharing within an organization. Therefore, we propose the following hypothesis:

Hypothesis 3a. The degree of emphasis on a lean SCS is positively related to the extent to which internal integration is adopted.

Lean manufacturers should maintain good relationships with their suppliers to ensure the availability of raw materials in order to make SCI work successfully (Qrunfleh and Tarafdar, 2013). Thus, the successful implementation of lean supply chains is more likely to produce a cooperative supplier relationship and a high degree of information sharing (Choi and Wu, 2009). Jacobs and Chase (2011) also emphasise that a long and rigid relationship with a small set of suppliers is one of the major characteristics of a lean supply chain. A lean supply chain also requires intensive communication with customers, which offers opportunities to improve the accuracy of the demand information exchanged, thereby reducing inventory obsolescence. Therefore, we propose the following hypothesis:

Hypothesis 3b. The degree of emphasis on a lean SCS is positively related to the extent to which external integration is adopted.

An agile supply chain emphasises market sensitivity and a quick response to the customer. To provide these elements, it should increase its process and functional integration through the use of advanced manufacturing and information technology (Gunasekaran and Yusuf, 2002). Moreover, agile supply chains could quickly transfer customers' demand to all functions within the manufacturer to facilitate real-time connections through information technologies and systems and process coordination among different functions (Roh et al., 2014). Firms with an agile SCS can flexibly strengthen the control of physical transformation processes and other logistics activities (Cachon and Fisher, 2000). Agile supply chains also push all internal functions to work together to meet changing customer requirements. Firms with an agile SCS are also capable in the formation of teams to effectively resolve conflicts, problems, and mistakes (Qrunfleh and Tarafdar, 2014). Therefore, we propose the following hypothesis:

Hypothesis 4a. The degree of emphasis on an agile SCS is positively related to the extent to which internal integration is adopted.

Agility aims at providing products first, fastest and best (Kisperska-Moron and De Haan, 2011). For example, the agile supply chain requires collaborative communication with customers to provide high value-added products. Unlike the lean supply chain, which is often criticized due to the provision of various products without considering customer requirements, the agile supply chain pays more attention to customer integration and leveraging customer-side information (Qrunfleh and Tarafdar, 2013). An agile supply chain is also determined by the consistent, on-time receipt of the correct number and type of parts from multiple suppliers (Ahmad and Schroeder, 2001). Mutual information sharing with suppliers is required for manufacturers to be responsive. To summarize, agile supply chains push firms to integrate with external partners to generate opportunities to leverage the intelligence embedded in collaborative processes and enable firms to create values and detect demand changes quickly. Therefore, we propose the following hypothesis:

Hypothesis 4b. The degree of emphasis on an agile SCS is positively related to the extent to which external integration is adopted.

2.4. The effect of SCI on financial performance

According to organizational capability theory, supply chain integrative capabilities are drivers of firm performance (e.g. Huo, 2012). Verona (1999) proposed that both internal and external integrative capabilities improve process efficiency and product effectiveness. However, Verona (1999) did not empirically test these relationships. Extensive literature has found roles of SCI in achieving financial performance (e.g. Wong et al., 2017, Demeter et al., 2016, Flynn et al., 2010; Kim, 2009).

Internal integration can improve financial performance. Stank et al. (2001) identified internal integration as the most important differentiator of firm performance, and many other studies found the relationship between internal integration and financial performance. For example, Swink et al. (2007) found that strategy integration and product-process integration influence financial performance. Similarly, external integration can also influence financial performance. Frohlich and Westbrook (2001), Schoenherr and Swink (2012) and Zailani and Rajagopal (2005) found that firms with the widest degree of arcs of integration achieve the highest level of performance. Das et al. (2006) and Narasimhan and Kim (2002) also found that supplier integration improves financial performance. The impact of customer integration on financial performance is inconsistent. While some studies (e.g. Flynn et al., 2010) failed to find a significant relationship between customer integration and financial performance, others studies (e.g. Koufteros et al., 2005; Narasimhan and Kim, 2002) found positive effects of customer integration on financial performance. Furthermore, Droge et al. (2004) found that supplier and customer integration can enhance market share and financial performance. We propose that internal and external integration contribute to manufacturers' financial performance, leading to the following hypotheses.

Hypothesis 5. Internal integration is positively related to financial performance.

Hypothesis 6. External integration is positively related to financial performance.

Because time and scale of economy may influence strategies and activities of firms, we include firm age and firm size as control variables in the conceptual model. Fig. 1 shows the conceptual model with proposed hypotheses, which are tested in the following sections.

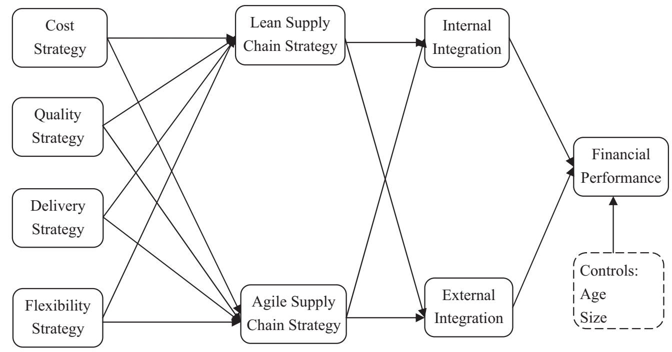

Fig. 1. Proposed model and hypotheses.

3. Research methodology and analyses

3.1. Questionnaire design

The constructs and measurements of this study are shown in Appendix A. Our questionnaire adopted the most commonly used OS measures related to cost, quality, delivery and flexibility (e.g., Ward and Duray, 2000; Ward et al., 1995). Respondents were asked to indicate the importance of their operational priorities according to the four constructs on a 7-point Likert scale with 1 ('most unimportant') and 7 ('most important'). We used three items including low production cost, productivity, and capacity utilization to measure cost strategy, three items including new product introduction, change product mix and line to measure flexibility strategy, three items including durable product, conformance quality, and reliable product to measure quality strategy, and two items including delivery schedule and time to measure delivery strategy. The measures are also tested by Zhao et al. (2006) and Quesada et al. (2008).

The SCS measurement items were extracted from a variety of sources including Katayama and Bennett (1999), Christopher (2000), Mason-Jones et al. (2000), Heikkila (2002) and Yusuf et al. (2004). Respondents were asked to indicate the extent to which they agreed the supply chains of their firms' major product/product mixes had certain characteristics on a 7-point Likert scale with 1 ('strongly disagree') and 7 ('strongly agree'). We used five items including structure change, flexible partnership, customization, flexible supply, and response to changes to measure agile SCS, and four items including waste reduction, low cost-supplier selection, small supplier number, and predictable production to measure lean SCS. The measure of SCS has been validated in Qi et al. (2009) and Qi et al. (2011).

The SCI measures were adapted from the literature (Chen and Paulraj, 2004; Narasimhan and Kim, 2002; Stank et al., 2001). Respondents were asked to indicate the extent of their SCI practices on a 7-point Likert scale with 1 ('not at all') and 7 ('extensively'). We used four items including integrative systems, data integration, inventory integration, and flow integration to measure internal integration, and ten items including partnership, information sharing, and process coordination with supplier and customers to measure external integration. The SCI measures appear in the recent studies (Huo et al., 2014a).

The financial performance items were based on De Toni and Tonchia (2001) and Vickery et al. (2003). Respondents were asked to indicate their performance in certain areas relative to their competitors on a 7-point Likert scale with 1 ('much worse') and 7 ('much better'). We used six items including ROI, ROS, and market sharing to measure financial performance.

To ensure the reliability of the questionnaire, we pilot tested it in more than 40 Chinese manufacturing firms. We discussed survey questions face-to-face with managers after they filled out the questionnaire and clarified the meaning of the questions with them. Based on their feedback, we modified, added or deleted questions, making

Table 1
Respondent profile.

A. Job title	Percent (%)	B. Years with the firm	Percent (%)
General manager	13.9	< 5	46.7
Production and operations manager	40.5	5–9	28.3
SCM and logistics manager	0.7	10–14	13.2
Purchasing and supply manager	0.5	15–19	6.0
Factory director	16.1	≥20	5.8
General manager assistant	9.6	Total	100
Chief financial officer	2.8		
Marketing manager	6.5		
Research and development manager	4.5		
Others	4.9		
Total	100		

them more understandable and relevant to practices in China. The data collected from the pilot tests were also used to check the face validity of the measures.

3.2. Data collection

In this study, a mail survey was used to collect the required data. The supply chain, operations and general managers in manufacturing firms were selected as key respondents. Table 1 shows that our respondents are capable of answering questions about OSs, SCSs, SCI, and financial performance. Similar to previous SCM studies in China (e.g. Zhao et al., 2011; Flynn et al., 2010), we used only one key informant to answer all questions in order to reduce the time and costs of data collection.

Geographically, China is a large country and it is very difficult to obtain samples from all parts of China. Therefore, we chose three representative cities from economically advanced areas in China: Beijing, Shanghai, and Guangzhou. Shanghai represents the Yangtze River Delta, which has China's highest GDP per capita. Guangzhou represents the Pearl River Delta, which has China's second highest GDP per capita. Both are located in eastern and southern China, which has the highest degree of marketization and economic reform. Beijing represents the Bohai Sea Economic area and reflects an average level of economic reform and marketization. All these three cities represent important industrial regions with a broad variety of manufacturing activities. Other areas of China have a low level of economic reform and marketization and are less likely to have advanced SCM activities. We used a database provided by Beijing Ebuywww Info Co. Ltd in our sampling. Founded in August 2000, Ebuywww provides a high-quality list of Chinese firms with information of key informants. The source of firm information is based on a close relationship between Ebuywww and various business journals, the government statistical bureaus, and various industrial societies. The data provided by Ebuywww are used by numerous large multinational firms to identify and assess potential suppliers in China. Following the suggestion of Li et al. (2005), we excluded the firms with fewer than 100 employees because they were seldom involved in sophisticated SCM activities. Among our sample targets, 9764 firms met this criterion.

Our research assistants reached out to 3187 manufacturing firms selected randomly from the database. However, only 2724 firms had correct contact information. In the end, 614 completed questionnaires were received, representing a response rate of about 22.5%. After screening the completed questionnaires, we removed 10 that had not been completed properly and used 604 responses in subsequent analyses (about 200 samples in each city of Beijing, Shanghai, and Guangzhou).

We evaluate non-response bias by comparing the industry distributions of the respondent firms with the population (Malhotra and Grover, 1998). Table 2 shows that percentages of the respondents are close to those of firms in the population in most industries. A chi-square test (χ^2=1.17) indicates no significant difference between the respondent distribution and the overall population ($p > 0.05$), suggesting that our sample was not biased towards any particular industry. We also compare early and late responses on physical assets, annual sales and number of employees with the *t*-test and find no significant difference, indicating that a non-response bias does not appear to be a major concern in this study.

Since we used one informant to answer all questions, potential common method bias is checked (Craighead et al., 2011). Appropriate arrangements of questionnaire items can reduce respondents' consistent motive to a certain extent to decrease the common method bias (Podsakoff et al., 2003; Podsakoff and Organ, 1986). In the questionnaire design stage, we adopted different instructions for different scales, and the adjacent variables in the conceptual model were put in distinct sections. The items comprising the scales of OSs, SCSs, SCI and performance are not similar in content, and the constructs are measured through 2–10 items. Furthermore, respondents are familiar with the constructs because they have been in a relatively senior position with responsibility for SCM for many years. Harman's one-factor (or single-factor) test of common method bias was performed (Sanchez and Brock, 1996). The model fit indices of χ^2 (740)=5398.63, NNFI=0.89, CFI=0.90 and n=0.13 are unacceptable and significantly worse than those of the measurement model. This suggests that a single-factor model is not acceptable, and thus that any potential

Table 2
Industry distribution of respondents and population.

Industries	Respondents	Population
Food and beverage	10.3%	8.7%
Electronic, electrical and communication equipment	19.7	19.3
Machinery and transportation equipment	24.8	26.5
Textile and garment	32.9	33.4
Plastic, latex, chemicals and petroleum	12.3	12.2
Total	100%	100%

Table 3
Correlations, means, standard deviations and reliability.

	Lean	Agile	CS	QS	DS	FS	II	EI	FP
Lean	1								
Agile	0.29*	1							
Cost strategy (CS)	0.59*	0.25*	1						
Quality strategy (QS)	0.48*	0.29*	0.47*	1					
Delivery strategy (DS)	0.57*	0.31*	0.59*	0.54*	1				
Flexibility strategy (FS)	0.38*	0.52*	0.39*	0.43*	0.50*	1			
Internal integration (II)	0.41*	0.40*	0.46*	0.47*	0.45*	0.48*	1		
External integration (EI)	0.57*	0.46*	0.53*	0.53*	0.52*	0.48*	0.68*	1	
Financial performance (FP)	0.24*	0.26*	0.30*	0.33*	0.28*	0.31*	0.48*	0.36*	1
Mean	5.29	4.87	5.45	5.66	5.80	5.34	5.03	5.09	4.64
S.D.	0.897	0.847	1.061	0.931	0.930	0.943	0.973	0.834	0.902
Cronbach's alpha	0.768	0.737	0.826	0.783	0.578[a]	0.779	0.851	0.889	0.896

* Correlation is significant at the 0.01 level.
[a] Correlation coefficient between two items.

common method bias is small. To further test common method bias, one measurement model including only the traits and one including a method factor in addition to the traits were tested (Widaman, 1985; Paulraj et al., 2008; Podsakoff et al., 2003; Williams et al., 1989). The results of the method factor model marginally improved model fit (RMSEA by 0.01, NNFI by 0.01, CFI by 0.00), with the common method factor accounting for only 1.9% of the total variance. The path coefficients of the trait factors and their significance were similar between the two models, suggesting that they were robust, despite the inclusion of a method factor (Paulraj et al., 2008). In summary, we can conclude that common method variance bias is not an issue in this study.

3.3. Psychometric tests

We use a principal component exploratory factor analysis (EFA) with varimax rotation to detect the underlying dimensions. Next, we use CFA to test construct validity, including convergent and discriminant validity. In the first step, items in the measurement model are deleted if their factor loadings are smaller than 0.50. In the second step, another EFA is done to assess unidimensionality (Appendix A). Table 3 shows the correlations, means, standard deviations, and reliability of the constructs. All Cronbach's alpha values are above 0.70 and hence acceptable. The significant and high correlation (0.58) between two items of delivery strategy ensures the reliability of the construct. Furthermore, all composite reliability values are higher than 0.70 (0.71–0.90). Therefore, reliability is achieved.

The model fit indices of CFA are $\chi^2(704)=1831.78$, RMSEA=0.056, CFI=0.97 and NNFI=0.98, which are acceptable. In addition, all factor loadings are greater than 0.50 (0.51–0.89) with *t*-values greater than 2.0 (Appendix A). Most of average variance extracted (AVE) values of the constructs are high than 0.50. Though several items have relatively low factor loadings, which lead to a relatively low AVE, we still keep

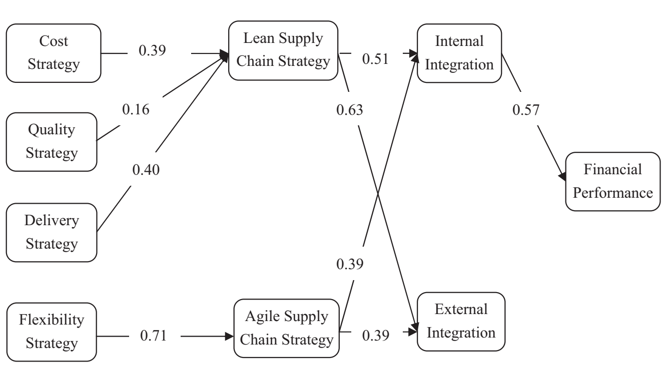

Fig. 2. Estimated SEM model.

these items because they are very important for the concept of the constructs (Flynn et al., 2010). The results indicate that convergent validity is ensured. We assess discriminant validity by building a constrained CFA model for every possible pair of constructs, in which the correlations between the paired constructs are fixed at 1.0. This is compared with the original unconstrained model, in which the correlations among the constructs are freely estimated. The significant difference in Chi-square statistics between the constrained and unconstrained models indicates a high discriminant validity (Fornell and Larcker, 1981). In this study, all 36 differences of χ^2 are significant at the 0.01 level, indicating that discriminant validity is ensured. Furthermore, except for the AVE value (0.44) of external integration and its squared correlation (0.46) with internal integration that is correlated with external integration conceptually (Zhao et al., 2011), the AVE value for each construct is greater than the squared correlation between that construct and other constructs as suggested by Fornell and Larcker (1981), providing further evidence of discriminant validity.

3.4. SEM model and hypotheses testing

We use structural equation modelling (SEM) to estimate the relationships among the constructs. We use a two-step model building approach, where the measurement model is tested prior to testing the structural model (Anderson and Gerbing, 1988).

The proposed model in Fig. 1 is tested by SEM with the maximum likelihood estimation method using the LISREL 8.54 software. Fig. 2 shows the standardized coefficients for the paths that are significant at the 0.05 level. The model fit indices are $\chi^2(790)=2066.54$, RMSEA=0.056, CFI=0.97 and NNFI=0.97, which are acceptable. Based on the significant coefficients of paths in Fig. 2, H1a~H1c, H2d, H3a, H3b, H4a, H4b, and H5 are supported, while H1d, H2a-c, and H6 are not supported. In addition, we statistically test the difference of the effects of lean and agile SCSs on external integration and find that lean SCSs are more effective than agile SCSs at improving external integration ($\Delta\chi^2=6.53$, $p < 0.05$). We also tested the relationships for different industries and results show that firms in different industries have different relationships among the variables (Table 4).

4. Results and discussion

4.1. The role of OSs in supply chain design

Our results show a clear-cut difference of companies' OSs in influencing supply chain design. More specifically, OSs related to cost, quality and delivery are positively related to lean SCSs. While flexibility is significantly related to agile SCSs. This finding is consistent with lean system arguments that lean supply chain aims to achieve the objectives

Table 4
Regression analyses across industries.

Independent variable	Dependent variable	
	Lean SCS	Agile SCS
Age	0.13[a], −0.01[b], 0.09[c], 0.10[d], 0.10[e], 0.08[f]	0.03, −0.01, 0.11, 0.09, −0.17, 0.06
Size	0.04, −0.17[*], 0.01, 0.00, −0.05, −0.03	0.16, 0.00, 0.12, −0.17[**], 0.11, 0.00
Cost strategy	0.26[*], 0.36[**], 0.25[**], 0.47[**], 0.28[*], 0.36[**]	−0.27, 0.14, 0.11, 0.02, 0.13, 0.03
Quality strategy	0.29[*], 0.16, 0.20[*], 0.19[**], 0.15, 0.16[**]	0.18, 0.11, −0.09, 0.04, 0.13, 0.05
Delivery strategy	0.41[**], 0.03, 0.17, 0.23[**], 0.31[**], 0.25[**]	−0.06, −0.18, −0.05, 0.25[**], −0.11, 0.02
Flexibility strategy	−0.19, 0.13, 0.19[*], −0.02, 0.09, 0.04	0.31[*], 0.41[**], 0.57[**], 0.39[**], 0.63[**], 0.47[**]
Adjusted R^2	0.46, 0.34, 0.42, 0.54, 0.38, 0.44	0.08, 0.16, 0.31, 0.32, 0.48, 0.27
F	8.89[**] 11.35[**], 18.80[**], 39.36[**], 8.34[**], 79.15[**]	1.83, 4.82[**], 12.14[**], 16.84[**], 11.99[**], 36.82[**]
	Internal integration	External integration
Age	−0.20, −0.22[**], −0.14[*], 0.00, 0.30[**], −0.05	−0.01, −0.12, −0.12[*], −0.03, 0.01, −0.07[*]
Size	−0.06, 0.06, 0.08, 0.02, −0.17, 0.04	−0.02, 0.11, 0.15[*], 0.03, 0.06, 0.10[**]
Lean SCS	0.62[**], 0.32[**], 0.37[**], 0.21[**], 0.11, 0.32[**]	0.63[**], 0.48[**], 0.46[**], 0.47[**], 0.42[**], 0.48[**]
Agile SCS	0.20, 0.27[**], 0.36[**], 0.34[**], 0.52[**], 0.32[**]	0.23[*], 0.29[**], 0.37[**], 0.29[**], 0.48[**], 0.33[**]
Adjusted R^2	0.34, 0.29, 0.35, 0.19, 0.34, 0.26	0.35, 0.41, 0.49, 0.39, 0.53, 0.44
F	8.31[**], 12.94[**], 20.94[**], 12.73[**], 10.12[**], 54.17[**]	8.63[**], 21.61[**], 36.08[**], 32.57[**], 21.31[**], 119.64[**]
	Financial performance	
Age	−0.07, −0.13, −0.11, −0.07, −0.26[*], −0.10[**]	
Size	0.01, 0.09, 0.04, 0.12, 0.23, 0.08[*]	
Internal integration	0.43[**], 0.45[**], 0.41[**], 0.46[**], 0.55[**], 0.45[**]	
External integration	0.25, 0.11, 0.05, −0.05, 0.00, 0.04	
Adjusted R^2	0.33, 0.33, 0.20, 0.19, 0.27, 0.25	
F	8.02[**], 15.25[**], 10.14[**], 12.37[**], 7.51[**], 49.76[**]	

[a] Food and beverage;
[b] Electronic, electrical and communication equipment;
[c] Machinery and transportation equipment;
[d] Textile and garment;
[e] Plastic, latex, chemicals and petroleum;
[f] All industries;
[*] $p < 0.05$;
[**] $p < 0.01$

of cost, quality, and delivery (Koskinen, 2009). Although quality and delivery should be order qualifiers for lean supply chain (Mason-Jones et al., 2000), they still act as order winners in emerging economy because of their importance for achieving lean production (Agus and Hajinoor, 2012; Panizzolo et al., 2012). The relationship between flexibility and agile SCSs is also expected because "agile supply chains must be flexible, and hence robust, to changes or disturbances and will in fact exploit the capability to competitive advantage. In contrast, lean systems aim to minimise internal and external variation as much as possible" (Naim and Gosling, 2011, p. 343). This also provides an explanation why flexibility is not significantly related to lean SCS in this study.

We find that cost strategy is not related to agile SCSs. The reason may be that, an agile supply chain is inappropriate in a low cost situation. The order winner of an agile supply chain should be the service level and its order qualifier should be cost (Mason-Jones et al., 2000). Manufacturers whose competitive focus is immediate availability at low cost should implement a lean supply chain, while those whose competitive focus is unique design should implement an agile supply chain (Stavrulaki and Davis, 2010). Thus, manufacturers with a lower-cost OS should increase their use of a lean supply chain but not an agile supply chain.

Inconsistent with our expectation, OSs in terms of quality and delivery have insignificant effects on agile SCSs. There may be two possible reasons for the insignificant relationship between quality and agile SCSs. First, the major focus of an agile SCS is to provide a premium level of customer service in terms of responsiveness and mastering market turbulence (Van Hoek et al., 2001). Performance quality is considered a qualifier in an agile SCS (Naylor et al., 1999). On top of this, an agile SCS can be built upon 'lean thinking' (Van Hoek et al., 2001). If a firm's major target is to provide high quality, it should consider the lean paradigm as its first priority but not the counterpart. Thus, there is consistent with Mason-Jones et al. (2000)'s propositions of match between supply chain design and market requirements. Second, agile supply chain is more difficult to manage than lean supply chain in achieving quality strategy. It is not easy to keep quality when there is always changing demands or design. The deficiency of legal systems in China makes the situation worse because supply chain partners may have opportunistic behaviour and sacrifice the quality standards when responding to changes in a hurry. For example, one of the 'crime culprits' of Mattel's recall crisis in 2007 was the feckless change in paint supplier by a major Chinese offshoring firm, which exemplifies the poor regulatory regime in China. Therefore, a firm with quality as its OS should implement a lean SCS instead of agile SCS.

Past literature suggests that delivery should be an order winner for agile supply chain if there is a match between supply chain design and market requirements (Mason-Jones et al., 2000). To our surprise, there is no significant association between delivery strategy and agile SCSs. This finding is consistent with a recent study that suggests a movement of delivery strategy from order winner to order qualifier in current competitive environment (Roh et al., 2014). Thus, this may be the possible reason that the configuration between supply chain design and market requirement changes with the fast development of economy. The insignificant relationship between delivery and agile SCSs may also be due to firms' inefficient logistics capability. A delivery-related OS requires firms to deliver their products to customers quickly and on time. While an agile SCS emphasises a flexible network structure and relationships among supply chain partners, which requires firms should rely heavily on the premium logistics performance. Nevertheless, the manufacturing industry of China is under fast development but the logistics infrastructure of China cannot catch up the increased economic activities. Firms' logistics performance is neither satisfactory nor competitive due to the inertia of state-owned enterprises and government, laggard transportation regulations, relatively low logistics-outsourcing rates, and low logistics integration (Zhou et al., 2008). Thus, in China, firms with delivery-related OSs should make lean SCSs but not agile SCSs their first priority.

Our findings suggest that a Chinese firm determined to provide highly flexible products with low costs, high quality and/or short-delivery advantages should implement both lean and agile SCSs accordingly. This finding supports the use of leagile supply chains, identified in studies by Qi et al. (2009), Naylor et al. (1999), and among others. The leagile supply chain is a hybrid paradigm in which leanness and agility are implemented in upstream and downstream supply chains, respectively (Mason-Jones et al., 2000). Leagility, seen as the evolution from the lean paradigm to the agile paradigm, can provide a comparable service level at an acceptable cost and is more popular in reality than either pure leanness or pure agility (Kisperska-Moron and De Haan, 2011). Our pattern of alignment between OS and SCS provides empirical evidences for this evolution.

4.2. SCSs and SCI

Our findings show that no matter which SCS is used by a firm, the SCI practices are important for the firm. A lean SCS interestingly focuses slightly more on external integration than internal integration. Such an external-oriented structure follows the requirements of a lean supply chain for outside partners' capabilities in terms of supplier development, quality of the source, information sharing and JIT delivery/purchase (Van Hoek et al., 2001; Yusuf et al., 2004).

We find that an agile SCS requires similar levels of both internal and external integration. Such a structure is very similar to the balanced supply chain in Flynn et al. (2010), which finds that both internal and external integration are important for firms to achieve the best performance. An agile SCS emphasises a quick response and personalisation. It requires the synchronisation of internal activities across different functions and responsiveness to the changes. Thus, compared with lean SCSs, agile SCSs pay more attention to the balance throughout the process flow in the supply chain.

Another finding is that the need of external integration in an agile supply chain is lower than that in a lean supply chain. The first reason may be the novelty and difficulties of Chinese manufacturers to implement agile SCSs together with supply chain partners. Our field observations show that the dynamic structure of the supply chain required by agile SCSs is implemented through the building of flexible *Guanxi* among supply chain partners in China. Compared with the investment in integration, *Guanxi* is more efficient at making firms flexible when they are faced with market turbulence. In the emerging economy of China, the informal control mechanisms, such as *Guanxi,* play more important role than formal control mechanisms, such as integration (Park and Luo, 2001). Thus, firms with agile SCSs are inclined to pay less attention to external integration. This finding is also consistent with previous findings and traditional wisdoms. An agile supply chain should be flexible and focus on effectiveness and rapid reconfiguration (Naylor et al., 1999). Thus, contrary to a lean supply chain, an agile supply chain requires a short-term and flexible relationship with suppliers to reconfigure the supply chain structure and grasp fleeting market opportunities. Stavrulaki and Davis (2010) also find that an agile supply chain should emphasise a flexible logistics process and manufacturers with an agile SCS should explore various supplier and logistics network options to ensure rapid response to customised demand and supply chain disruptions due to uncertainties. In the flexible supply chain structure, the focal firm should not commit ample resources to building a rigid relationship with their partners from the perspective of transaction cost economics (Williamson, 2008), which contradicts with the requirements of high level external integration. In other words, an agile supply chain does not encourage firms to invest too much in external integration, which leads to a "lock-in" situation for all supply chain partners. Furthermore, in an agile supply chain, the major norms are changes, and the costs for firms in such a supply chain to share real-time changing information and coordinate changing activities are very high.

4.3. SCI and financial performance

As we expected, internal integration is positively related to financial performance. Contrary to our expectation, there is no significant relationship between external integration and financial performance, perhaps because that relationship is mediated or moderated by other variables (Huo, 2012; Vickery et al., 2003; Yu et al., 2013). For example, Huo (2012) finds that external supplier and customer integration indirectly influences financial performance through supplier- and customer-oriented operational performance. Vickery et al. (2003) find that supply chain integration enhances financial performance through customer service. Yu et al. (2013) indicate that customer integration improve financial performance through the mediating effect of customer satisfaction. Zhao et al. (2015) provide another reason for this finding that the effect of supplier and customer integration on financial performance is nonlinear. Another reason may be that external integration needs various investments, such as information technologies, human resources, time, and money, which offset financial benefits of external integration (Das et al., 2006). Chan et al. (2010) indicate that customer involvement shifts more power from the focal company to its customers and brings more workload for the focal company. As a Chinese finding, the nonsignificant relationship between external integration and financial performance is also consistent with those of Flynn et al. (2010). One possible reason is that firms in China rely on *Guanxi* to link with supply chain partners rather than formal external integration for financial performance. Another possible reason may be that technologies and management skills in a developing country like China are relatively too weak to enhance financial performance greatly. Our findings enrich the SCI-performance literature and deepen our understanding of the SCI-performance relationship, especially in an emerging market like China.

5. Theoretical and managerial implications

Through an extensive literature review, Naim and Gosling (2011) found that most studies on SCSs have been conceptual, and therefore case studies and large-scale empirical studies are required in this field. Our study answers this call and investigates China's SCSs using a large-scale survey. Our study contributes to the SCM literature by extending the prior studies on the effects of product characteristics on SCS and extends the literature on the relationship between SCSs and other firm strategies. Our findings show that, in addition to business (e.g. Qi et al., 2011) and corporate strategies, OSs are accurate and appropriate SCS antecedents. Our findings validate the important alignment between SCS development and the determination of order winners and qualifiers. Furthermore, our large-scale survey of Chinese manufacturers contributes to our knowledge of OSs in developing countries. The cost advantages of Chinese manufacturers are manifested in their SCM and operations management, enhancing our understanding of OSs, SCSs and SCI practices of firms in emerging economies like China.

Our findings on SCSs and SCI contribute to the SCM theories. We find that SCSs can be achieved through SCI, leading to competitive advantages. This study supports the strategy- conduct-performance framework and provides a procedure for managers to achieve competitive advantages by aligning their strategies and practices. Previous studies have called for more research on SCI antecedents (Zhao et al., 2008, 2011), and this study echoes this call and covers the gap between strategy and integration practices in supply chains. Our findings also supplement the explorative case studies of Hilletofth (2009) by providing large-sample empirical evidence for how internal and external integration are used to achieve SCSs and OSs. Managerially, our findings suggest that firms with different SCSs should develop both internal and external SCI capabilities, but the priorities are different.

For example, firms in a lean supply chain should integrate with external partners first, then integrate among internal functions, whereas firms in an agile supply chain should develop a balanced supply chain with equal emphasis on internal and external integration.

In conclusion, this study extends the theory of organizational capability from a sole firm context to a supply chain context. Few previous organizational capability studies investigated relationships among different types of organizational capabilities, thus we know little about the development mechanism regarding different kinds of organizational capabilities. This study shows that OS and SCS capabilities are the base of SCI capabilities, shedding light on the "black box" of organizational capabilities. External integrative capabilities are crucial for firms to achieve financial performance. Through effective management of operations and supply chain capabilities, firms are more likely to acquire and absorb knowledge quickly and effectively, which leads to competitive advantages.

The managerial implications of these results are that a successful firm should develop a clear and appropriate OS according to the determination of order qualifiers and winners from customers. For a firm that selects low-cost, high-quality and/or short delivery as its competitive priorities, a lean SCS is the better choice. In contrast, for a firm that selects high flexibility as its competitive priority, an agile SCS is the best choice. In details, managers need to develop lean supply chains to achieve the operations objective of cost, quality, and delivery, in contrast, to develop agile supply chains to achieve the operations objective of flexibility. In addition, managers should work together to design OSs and SCSs and pay attention to how they are linked. If a SCS is not consistent with an OS, the firms have divergent objectives and should spend extensive resources on coordinating the strategies, thereby increasing the coordination costs and reducing the efficiency of the operations (Koskinen and Hilmola, 2008). In details, managers need to evaluate their OSs before they form their SCSs. If a firm only focuses on cost strategy, a lean SCS is enough for the firm to pursue low cost OS. When the firm also has cumulated quality and delivery strategies, the lean SCS is still useful for the firm to achieve the operations objectives. However, if the firm moves to pursue flexibility strategy, the firm needs to cumulate their lean SCS to leagile SCS. The finding about cumulated OSs and SCSs and their relationships can help managers to learn and cultivate their OSs and SCSs and match them in an effective way. More importantly, inconsistent SCSs and OSs may push firms to develop organizational cultures that are inconsistent with those of their supply chain partners, leading to the disruption of the supply chains.

In order to achieve better financial performance in emerging economies like China, managers should focus more on internal integration than on external integration. In order to focus on internal integration, a lean SCS is better for Chinese manufacturing firms. Similarly, in order to focus on lean SCS, managers should pay attention to OSs in terms of cost, quality, and delivery. These paths provide directions for managers to pursue super financial performance.

6. Limitations and future directions

Although this study makes significant contributions to the literature and practices, it has several limitations. First, OSs are not context free and may vary from country to country if their competitive environments are different (Frohlich and Dixon, 2001). Therefore, it should be acknowledged that the findings in this study may not be easily generalizable to other countries. Our model can be extended and explored in different areas, especially in different emerging markets that face various transitions in the environment. Kisperska-Moron and De Haan (2011) explore a Polish distributor's change in SCSs and highlight the importance of the effect of institutional and market transition. Soni and Kodali (2012) test the reliability and validity of SCS constructs in India. However, studies like these have been rare. More rigorous studies, especially cross-cultural studies on SCSs, are imperative. Second, this study uses a cross-sectional design. It may be interesting for future research to examine the coevolution of OSs, SCSs and SCI. Naim and Gosling (2011) identify the on-going debate around the differences and similarities among various SCSs and encourage the use of longitudinal study and action research to clarify this debate. Third, we only examine SCI from the perspective of firm boundaries. Future studies can explore additional aspects of SCI from more perspectives, such as information sharing and process coordination (Huo et al., 2013). Finally, while we use only two items to measure delivery, future studies could use additional items.

Appendix A. Items and scales

See Tables A1– A5.

Table A1
EFA of supply chain strategy.

	Agile SCS	Lean SCS
Our supply chain structure often changes in order to cope with volatile market	**0.779**	0.005
Our supply chain need to maintain a short and flexible relationship with a large number of suppliers	**0.731**	0.143
Our supply chain provides customer with personalized products	**0.715**	−0.039
Our supply chain selects the suppliers based on their performance on flexibility and responsiveness	**0.668**	0.201
It is necessary for our supply chain to maintain a higher capacity buffer to response to volatile market	**0.546**	0.262
Our supply chain always faces the volatile customer demand*	**NA**	NA
Our supply chain reduces any kind of waste as much as possible	0.188	**0.778**
Our supply chain selects the suppliers based on their performance on cost and quality	0.170	**0.770**
Our supply chain needs to maintain a long and rigid relationship with a small number of suppliers	0.083	**0.738**
Our supply chain supplies predictable products	0.005	**0.738**
Our supply chain structure seldom changes*	NA	**NA**
Our supply chain reduces costs through mass production*	NA	**NA**
Eigenvalue	2.467	2.417
Total variance explained	54.277%	

* Dropped from the final construct due to the low factor loading (below 0.50)

Table A2
EFA of operations strategy.

	Cost strategy	Flexibility strategy	Quality strategy	Delivery strategy
Manufacture the product at lower cost	**0.826**	0.201	−0.066	0.160
Manufacture product with high productivity	**0.795**	0.097	0.288	0.211
Ability to increase the capacity utilization	**0.785**	0.138	0.343	0.225
Ability to rapidly introduce new product to market	0.086	**0.829**	0.152	0.187
Ability to rapidly change product mix	0.186	**0.827**	0.099	0.030
Ability to provide broad product line	0.130	**0.707**	0.200	0.266
Provide highly durable product	0.039	0.233	**0.858**	−0.021
Provide product with high conformance quality	0.306	0.137	**0.729**	0.279
Provide highly reliable product	0.178	0.108	**0.699**	0.421
Ability to meet the delivery schedule	0.226	0.171	0.311	**0.793**
Ability to provide short delivery time	0.348	0.316	0.088	**0.725**
Eigenvalue	2.288	2.154	2.140	1.636
Total variance explained	74.708%			

Table A3
EFA of supply chain integration.

	External integration	Internal integration
Establishing strategic partnership with suppliers	**0.741**	0.142
Sharing information with suppliers	**0.695**	0.218
Working with suppliers to improve inter-organizational processes with suppliers	**0.688**	0.253
Establishing strategic partnership with customers	**0.660**	0.326
Working with customers to improve inter-organizational processes with customers	**0.645**	0.359
Long-term relationship with suppliers	**0.624**	0.238
Creating linkage with suppliers through information technology	**0.614**	0.338
Collecting customer feedbacks for quality improvement	**0.613**	0.187
Creating linkage with customers through information technology	**0.551**	0.418
Sharing information with customers	**0.536**	0.395
Enterprise application integration among internal functions	0.286	**0.801**
Integrative inventory management	0.292	**0.786**
Data integration among internal functions	0.264	**0.785**
Real-time integration and connection among all internal functions from raw material management through production, shipping, and sales	0.259	**0.737**
Eigenvalue	4.395	3.323
Total variance explained	55.129%	

Table A4
EFA of financial performance.

	Financial performance
Return on investment (ROI)	**0.853**
Growth in ROI	**0.852**
Growth in ROS	**0.839**
Return on sale (ROS)	**0.808**
Growth in market share	**0.781**
Market share	**0.737**
Eigenvalue	3.964
Total variance explained	66.061%

Table A5
CFA results.

	Standardized factor loading	T-value
Lean SCS		
Our supply chain supplies predictable products	0.56	–
Our supply chain reduces any kind of waste as much as possible	0.70	12.32
Our supply chain need to maintain a long and rigid relationship with a small number of suppliers	0.64	11.66
Our supply chain selects the suppliers based on their performance on cost and quality	0.77	12.97
Agile SCS		
It is necessary for our supply chain to maintain a higher capacity buffer to response to volatile market	0.51	–
Our supply chain provides customer with personalized products	0.57	9.60
Our supply chain selects the suppliers based on their performance on flexibility and responsiveness	0.61	9.97
Our supply chain need to maintain a short and flexible relationship with a large number of suppliers	0.65	10.31
Our supply chain structure often changes in order to cope with volatile market	0.68	10.48
Cost strategy		
Manufacture the product at lower cost	0.64	–
Manufacture product with high productivity	0.82	16.44
Ability to increase the capacity utilization	0.89	17.11
Quality strategy		
Provide product with high conformance quality	0.82	–
Provide highly durable product	0.64	15.27
Provide highly reliable product	0.76	18.38
Delivery strategy		
Ability to meet the delivery schedule	0.79	–
Ability to provide short delivery time	0.73	17.06
Flexibility strategy		
Ability to provide broad product line	0.72	–
Ability to rapidly introduce new product to market	0.78	16.29
Ability to rapidly change product mix	0.71	15.22
Internal integration		
Data integration among internal functions	0.76	–
Enterprise application integration among internal functions	0.80	19.36
Integrative inventory management	0.79	19.28
Real-time integration and connection among all internal functions from raw material management through production, shipping, and sales	0.73	17.52
External integration		
Collecting customer feedbacks for quality improvement	0.60	–
Long-term relationship with suppliers	0.63	12.70
Establishing strategic partnership with suppliers	0.66	13.17
Working with suppliers to improve inter-organizational processes with suppliers	0.67	13.27
Creating linkage with suppliers through information technology	0.66	13.16
Sharing information with suppliers	0.67	13.37
Establishing strategic partnership with customers	0.71	13.84
Working with customers to improve inter-organizational processes with customers	0.71	13.90
Creating linkage with customers through information technology	0.66	13.15
Sharing information with customers	0.63	12.71
Financial performance		
Return on Investment	0.82	–
Return on Sale	0.77	20.90
Market share	0.67	17.56
Growth in ROI	0.82	23.06
Growth in ROS	0.81	22.58
Growth in market share	0.73	19.62

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