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Antecedents to Supplier Integration in China: A Quantitative Study

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ABSTRACT

The aim of this paper is to identify antecedents to supplier integration in China. A deductive approach was deployed by building on a qualitative pre-study and various strands of SCM literature. All in all, 14 hypotheses were derived and subsequently tested by drawing on an empirical sample collected from 88 manufacturing firms operating in China. The data was then analyzed using partial least squares (PLS) analysis. The results indicated that supplier integration was positively influenced by collaborative supplier capabilities, continuous supplier development, and supplier quality mindset. These in turn proved to be sequentially influenced by supplier top management support, buyer-side leadership effectiveness and internal support.

Keywords: supplier integration, China, collaborative relationship

1. Introduction

Without doubt, China has become the most important supplier market in the world over the last decades. The high political stability, comparatively low economic uncertainty, and low comparative price levels have all contributed to attractiveness of the country (Eltschinger, 2007; Qu & Brocklehurst, 2003). At the same time, the degree of outsourcing in most industries has increased over time, leading to an increased dependency on supplier's for value creation (Quesada, Syamil, & Doll, 2006; Tiemann, Scholz, & Thies, 2000; Wagner, Bode, & Koziol, 2008). Besides freeing up resources, reducing assets on the balance sheet and creating a more flexible and agile organization, product complexity today makes it virtually impossible for individual firms to possess all the technical expertise and capabilities needed to develop and produce products and services (Binder, Gust, & Clegg, 2007; Wagner et al., 2008; Wolters & Schuller, 1997). In order to avoid excessive transaction costs when outsourcing business activities, companies nowadays try to get the best from both worlds by creating "a virtually integrated enterprise" (Browne & Zhang, 1999) where relatively independent parts of the value chain can work in sync. In the quest for synchronization of business processes, supplier integration has become a critical element. In order to better tap into the Chinese supplier base, companies increasingly try to integrate more domestic suppliers into their global supply chains.

However, both anecdotal and empirical evidence (Lockström, Schadel, Harrison, Moser, & Malhotra, 2010; Murray, Kotabe, & Zhou, 2004; Pyke, Robb, & Farley, 2000; Wilkinson, Eberhardt, & Millington, 2005) indicate that many foreign companies in China are experiencing difficulties in sourcing strategic supplies from domestic suppliers and in forming long-term partnerships with them. In China, these difficulties seem to be more frequent in

industries that are characterized by high requirements on quality, delivery and intellectual property protection (Holweg, Luo, & Oliver, 2005; X. Zhang & Chen, 2006).

The goal of this paper is to test and validate existing theory on supplier integration within the specific context of the Chinese business environment by analyzing empirical data gathered through a quantitative research methodology. More in-depth, the paper aims at answering the following research questions:

- How can buyers and suppliers operating in China collaborate more effectively?
- What are the antecedents to supplier integration in a Chinese business context?
- How do buyer- and supplier-related factors interplay as antecedents?

2. Literature Review

This paper adheres to several existing theories relative to *supplier integration* (SI) and *supply chain integration* (SCI) (Bowersox, Closs, & Stank, 1999; Malhotra, Saeed, & Jayaram, 2008).

2.1. Definitions of central terms

SCI is defined by Bowersox et al., (1999) as the simultaneous orchestration of four critical flows: product/service, market accommodation, information, and cash within and across companies. For this paper, SI is defined as a subset of SCI specifically focusing on the upstream part of the supply chain. Moreover, SI is defined as a practice that links externally performed work of the supplier into a seamless congruency with internal work processes (Bowersox et al., 1999). The unit of analysis in this paper is represented by collaborative buyer-supplier relationships, within which supplier integration is manifested and observed. *Strategic relationships* are formed as a function of the business impact of the commodity to be sourced and the level of complexity of the supply market. These are guided by the level of mutual investments of the buyer and the supplier in the relationship (Bensaou & Venkatraman,

1995). Although the majority of strategic relationships are also managed in a rather collaborative manner, the term *collaborative relationship* has a slightly different meaning. In this case, it is defined by the intensity of a buyer-supplier relationship characterized by the level of interaction and bilateral involvement between the buyer and supplier (P. K. Humphreys, Shiu, & Chan, 2004), and by the quality of those interactions (Cohen & Roussel, 2004).

2.2. Problem definition and motivation of research

Many industries today are characterized by a high degree of value added by suppliers in manufacturing (Quesada et al., 2006; Tiemann et al., 2000; Wagner et al., 2008), which strongly suggests the implementation of collaborative approaches (Goffin, Lemke, & Szwajkowski, 2006; Paulraj & Chen, 2007; Takeishi, 2001; C. Zhang, Henke, & Griffith, 2009). In many industries, key suppliers have taken on an increasing level of responsibility for developing and producing components rather than simply making predesigned parts (K. J. Petersen, Handfield, & Ragatz, 2004; Pil & Holweg, 2004; Quesada et al., 2006). As a consequence, the purchasing function in a company has become increasingly strategic and capable of generating competitive advantage through effective supplier management (Möller & Törrönen, 2003; Narasimhan & Das, 2001; Ulaga, 2003; Watts, Kim, & Hahn, 1995).

Furthermore, earlier research has shown that factors such as cost, quality, and innovation are determined very early in the product development phase (Binder et al., 2007; Zirpoli & Caputo, 2002). A high degree of collaboration during the product development phase is needed in order to manage complexity which in turn affects quality, cost, innovativeness, and product variety (Takeishi, 2001; Tang & Qian, 2007). Furthermore, a common rule of thumb suggests that 80 percent of product costs are locked in during the first

20 percent of the product life cycle (Buchta, Eul, & Schulte-Croonenberg, 2007). As a result, companies manufacturing complex products in particular (e.g. automotive, airplane, electronics) have deployed joint product development (Binder et al., 2007; Hsuan, 1999; Quesada et al., 2006) and joint production planning activities with suppliers (Bennett & O'Kane, 2006; Doran, 2003; Holweg & Pil, 2007) as a means to increase the competitiveness of their own companies as well as that of the whole supply chain networks within which they exist.

Collaborative production planning processes with suppliers lead to reduced inventory, capacity costs and shortened lead times (Doran, 2003; Parker, Zsidisin, & Ragatz, 2008; Tu, Vonderembse, Ragu-Nathan, & Ragu-Nathan, 2004). Furthermore, as a shift from make-to-stock to make-to-order strategies can be recognized in many industries such as automotive (Gunasekaran, 2004), synchronized production processes across the supply chain have shown to deliver high efficiency and operational performance (Bennett & O'Kane, 2006; Doran, 2004; Reichhart & Holweg, 2007). In order to facilitate these concepts, the material flow must be anticipated by a flow of highly accurate, timely, and reliable planning information (Cachon & Fisher, 2000; Krajewski & Wei, 2001; Stefansson, 2002). Finally, as more and more product parts are developed by suppliers independently or jointly between the buyer and supplier, the involvement of suppliers in this area is of high importance (Wagner et al., 2008). Put simply, supplier integration is a way for companies to reduce production cost and increased flexibility through outsourcing, while reducing transaction costs through stronger supply chain relationships – in other words, minimizing the trade-off between transaction costs vis-à-vis production costs as stipulated by transaction cost theory (Coase, 1937; Williamson, 1975, 1979, 1985).

As of today, researches on supplier integration have mostly been of descriptive nature in a Western context (Paulraj, Lado, & Chen, 2008). Hence, this research has failed to explain how to drive supplier integration, especially in Confucian countries like China where relationships play a pivotal role (Lee & Humphreys, 2007; Yeung, Selen, Zhang, & Huo, 2009). Although most prior researches have been conducted through empirical data based on case studies or surveys, the topic still largely remains unexplored or is not supported by reliable empirical evidence (Goffin et al., 2006). In sum, research on supplier integration in the Chinese automotive industry is relatively scarce. An overview of existing related literature is shown in Table 1. Hence, this motivates the development of a novel framework that can capture idiosyncratic aspects of China, without overly relying on existing theories.

Table 1. Overview of relation-related studies on SCM in China (Lockström et al., 2010).

| Authors | Focus of study/contribution | Theoretical perspective | Industry focus | Applied methodology |
|-------------------------|---|---|-----------------------|----------------------------|
| Cai and Yang (2008) | Cooperative norms as a critical governance mechanism. Authors emphasize the importance of informal relationships in China. | Resource dependence theory/transaction cost economics | Several | Survey |
| Pyke et al. (2000) | Investigation of level SCM among Chinese companies of different ownership. Chinese companies more advanced than expected, but still lagging behind. Ownership of company to be irrelevant. | Supply chain management | Several | Survey |
| Robb et al. (2008) | Investigation of supply chain/operations practice and operational/financial performance in China. Labor productivity reported to be low. Business performance to be mediated by SCM capabilities. | Supply chain management | Furniture | Survey |
| Zhao et al. (2008) | Normative relationship commitment to have a greater impact on customer integration than instrumental relationship commitment in China. | Transaction cost theory and social exchange theory | Several | Survey |
| Eberhardt et al. (2004) | Investigation of forces in localization in China. Besides confirming external factors, study identifies internal ones as well. | N/A | Several | Case study |
| Fang (2001) | Culture as a driver to inter-firm adaptation in business relationships. | Relationship theory of the industrial marketing and | Shipbuilding | Case study |

| | | purchasing group (IMP) | | |
|----------------------|--|------------------------|----------------------|--|
| Li et al. (2003) | Pervasion of quality practices in China. Poor quality performance of state-owned enterprises to be attributed to attitude and structures of the era of the planned economy and Chinese cultural aspects in general. Leadership to be important to implement TQM. | Quality literature | Several | Survey |
| Pun et al. (2000) | Relationship between cultural aspects and implementation of TQM investigated. Recommend to develop a culture specific management system that interweaves TQM practices in China. | Quality literature | Several | Case study |
| Jenner et al. (1998) | Relationship between cultural aspects and implementation of TQM investigated. Chinese culture to impede implementation of modern management techniques such as TQM. | Quality literature | Mostly manufacturing | Case study |
| Holweg et al. (2005) | Analysis of the current capabilities and challenge of automotive suppliers in China. Lack of process management skills and engineering capabilities of domestic suppliers identified. | N/A | Automotive | Benchmarking methodology of cooperative supplier performance/Case study interviews |
| Martinsson (1996) | Relationship between cultural aspects and implementation of radical re-engineering processes. Chinese culture to impede implementation of new ways how work is done. | Organizational theory | N/A | Literature review |
| Chen & Lu (1998) | Chinese approach to quality transformation. Resistance to quality transformation can be stubborn. Reasons may be a mismatch of organizational cultures. | Quality literature | Electronics | Case study |

Cai and Yang (2008), Robb and Xie (2008), Pyke et al. (2000), Zhao et al. (2008), Lockström et al. (2010) are some examples of studies that have focused on supply chain related topics in China in the past.

3. Conceptual Framework and Hypotheses

The research model in this paper is based on several existing theories relating to *supply chain integration* (SCI) of which SI is defined as a subset belonging to the upstream part with respect to a focal firm. As discussed earlier, SI can be derived from the concept of supply

chain integration (Bowersox et al., 1999; Malhotra et al., 2008; Zaheer & Venkatraman, 1995). In analogy to Möller and Törrönen (2003), buyer-supplier relationships affect the *efficiency* function, i.e. the efficacious use of current resources and the *effectiveness* function, i.e. a buyer's and supplier's ability to collaboratively invent and produce solutions that provide more value to customer than existing offers. In this paper, a taxonomy similar to earlier studies by Malhotra et al. (2008) and Bowersox (1999), comprising operational, strategic, and financial integration was adopted after deployment of a pre-study to examine the applicability in China.

Operational Integration (OI) is the linkage of systems and operational interfaces (Bowersox et al., 1999) and relates to what Möller and Törrönen (2003) call the core value of a product, i.e. the transaction-oriented production and delivery of products and services, process excellence and short-term flexibility. OI has a short-term focus and captures day-to-day business activities such as information sharing. Activities related to OI interlink with the collaborative production planning processes through the exchange of accurate, relevant and timely information (Wilson & Viosky, 1997). Its importance has been acknowledged in earlier studies, with improvements in long-term cost, delivery and quality (Cousins & Menguc, 2006; Das, Narasimhan, & Talluri, 2006; Lawson, Tyler, & Cousins, 2006; Paulraj & Chen, 2007).

Strategic Integration (SI) implies strategic alignment of value creation processes with supply chain partners and to collaborate with them at a strategic level (Bowersox et al., 1999). In order to elaborate this definition in the context of this paper, SI is defined as joint activities in the field of product development, supply chain network and capacity planning, but also the ability of the buyer and supplier to share new ideas and facilitate innovations leading to solutions that provide more value to the customer than existing ones (Malhotra et al., 2008; Moser, 2007; Teece, Pisano, & Shuen, 1997).

Financial Integration (FI) is defined as the extent to which buyers and suppliers jointly invest into common projects (Malhotra et al., 2008). It is argued that by these investments into relationship-specific assets, a higher level of commitment can be achieved (Stank, Keller, & Closs, 2001). According to some researchers, commitment is usually manifested as the investment into relationship specific assets (Dyer & Sing, 1998; Morgan & Hunt, 1994; Zhao et al., 2008).

3.1. Development of hypotheses

With an increasing focus on core competencies and outsourcing, current trends across industries require collaboration and coordination of activities across the supply chain (Salvador, Forza, & Rungtusanatham, 2002). The complexity of processes caused by these trends may not be apparent at glance, but may have severe consequences such as product recalls (Bates, Holweg, Lewis, & Oliver, 2007) unless taken seriously at an early stage of the product life cycle (Holweg & Pil, 2007). In order to cope with these challenges, a high degree of coordination between the OEMs and its first- and second-tier suppliers is of paramount importance (Bennett & O'Kane, 2006; Fawcett, Osterhaus, Magnan, Brau, & McCarter, 2003). Besides the production and the production planning processes, the product development process can be distinguished as a basic form of collaborative relationships between a manufacturers and their suppliers (Takeishi, 2001).

In a qualitative study preceding this research, interviewees were asked to elaborate on factors that facilitate and drive supplier integration (Lockström et al., 2010). It turned out that the key drivers behind the extent to which SI can take place hinges on three key factors, namely 1) a set of supplier capabilities that enables interaction and collaboration between the buyer and the supplier, 2) continuous supplier development activities that build and make

capabilities sustainable, and 3) quality mindset, which serves as a “organizational DNA” through which supplier integration is institutionalized. This is also in line with earlier research, which has stressed the importance of capabilities as a source of competitive advantage (Teece & Pisano, 1998; Teece et al., 1997). Some of those capabilities are relation-dependent, i.e. their existence hinge upon the governance of two individual organizations working as dyads (Dyer & Sing, 1998), which in the case of this research are represented by buyers and suppliers. The ability of suppliers to take on responsibility for product development activities has proven to be prerequisite from buyers in order to drive collaboration (Bidault, Despres, & Butler, 1998). Having said that, it is proposed that supplier-specific capabilities influence the extent to which suppliers can become integrated with buyers. Consequently, we propose the following set of hypotheses:

H1a. The level of operational supplier integration is positively influenced by the level of collaborative supplier capabilities.

H1b. The level of financial supplier integration is positively influenced by the level of collaborative supplier capabilities.

H1c. The level of strategic supplier integration is positively influenced by the level of collaborative supplier capabilities.

Furthermore, another category that emerged from the pre-study was Continuous Supplier Development (Lockström et al., 2010), where cross-functional teams consisting of buyers, logistics experts, quality engineers, and production managers were sent to the facilities

of key suppliers to improve production processes and train staff and management. The importance of supplier development activities has been widely acknowledged in earlier literature (Modi & Mabert, 2007; Watts et al., 1995) as a means for transferring knowledge from the buyer to the supplier. However, the idiosyncratic feature of supplier development as was discovered during the pre-study is the necessity of continuity of such activities (Lockström et al., 2010). Among most of the investigated companies, supplier performance turned out to become volatile and drift away from pre-defined target levels as soon as the supplier development activities were stopped. There are various explanations to this, such as failure to establish a quality mindset, lack of clearly defined processes, lack of performance management systems, and high staff turnover rates (Lockström et al., 2010). Based on this finding, the following set of hypotheses was defined:

H2a. The level of operational supplier integration is positively influenced by the level of continuous supplier development.

H2b. The level of financial supplier integration is positively influenced by the level of continuous supplier development.

H2c. The level of strategic supplier integration is positively influenced by the level of continuous supplier development.

Next, the pre-study unanimously revealed that quality mindset of suppliers was a key driver of supplier integration (Lockström et al., 2010). Such a mindset were manifested in the perceived importance of quality, zero tolerance for defects, paying attention to details in

operations, continuous improvement philosophy, and an acknowledged importance of the customer. According to Kenny (1994) and Gabris et al. (2000), mindset is represented as organizational values which collectively drive personal commitment, loyalty, teamwork and behavior. The importance of mindset as a driver of quality has been acknowledged in earlier studies (Deming, 1982; Kanji & Moura, 2001). The lack of quality mindset has been frequently been pointed out as a common challenge to sourcing in China, and is often a reason why collaborative supplier relationships cannot be sustained on a long term. With this in mind, the following set of hypotheses is defined:

H3a. The level of operational supplier integration is positively influenced by the level of supplier quality mindset.

H3b. The level of financial supplier integration is positively influenced by the level of supplier quality mindset.

H3c. The level of strategic supplier integration is positively influenced by the level of supplier quality mindset.

Another driver that emerged from the pre-study was top management support. The importance of this factor has also been frequently stressed in literature from the past. For example, Dale and Cooper (2000), Deming (1982), and Kanji et al. (2001) have shown that leadership is essential for setting the vision/mission, organizational culture and strategy. Obviously, top management of the supplier's organization is responsible for effective leadership to materialize. Among the respondents of the pre-study, top management support

was stated as needed for building and nurturing buyer-supplier relationships; it was found that without it, it is difficult to build and nurture the same kind of thinking throughout the organization (Lockström et al., 2010). The pre-study revealed that top management of the suppliers also can help creating congruence of strategic goals and with customers in terms of strategic alignment, capacity allocation and organizational interfaces (Hartley & Choi, 1996; Lockström et al., 2010). Put simply, it is proposed that the top management of suppliers is ultimately responsible for the integration with their customers, by having capabilities, organizational development and organizational culture as key levers. As a result, the following set of hypotheses is proposed:

H4a. The level of collaborative supplier capabilities is positively influenced by the level of supplier top management support.

H4b. The level of continuous supplier development is positively influenced by the level of supplier top management support.

H4c. The level of supplier quality mindset is positively influenced by the level of supplier top management support.

Another aspect that emerged out of the pre-study was the role of leadership (Lockström et al., 2010). Most leadership research has primarily focused on “influencing a group of people to achieve a common goal” within one’s own organization (Northouse, 1997, p. 3) by virtue of formal power and authority (French & Raven, 1959). The relevant aspect in the pre-study proved to be the organizational leadership behaviors towards the supplier organizations.

This is in line with the discussion by Kanja et al. (2001, p. 709), who states that leadership is “the simultaneous performance of leaders in the roles of establishing and sharing the values, developing and communicating the vision, mission, selecting and implementing a strategy, and managing other operational key issues.” It seemed that leaders in the buyer organizations who had managed to facilitate a high degree of supplier integration had taken a systematic approach. They not only focused their efforts on single functions, but also targeted the senior management among their own suppliers and actively worked at a very personal level to convince these managers to adopt their own values, beliefs, etc (Lockström et al., 2010). They also convinced them to make strategic adaptations and to invest in new machinery/equipment, etc., in line with the strategic orientation of their own companies. This is also confirmed by earlier research such as which stresses the need for socialization processes (K.J. Petersen, Handfield, Lawson, & Cousins, 2008), and alignment (P. Humphreys, Li, & Chan, 2004) to drive supplier integration. Although Modi and Mabert (2007, p. 48) claims that “An organization’s top management is aware of its current and future business needs”, this is not always the case in China, where many suppliers often take a rather myopic view of their companies instead of a holistic supply chain perspective (Lockström et al., 2010). The novelty in this context is the characteristics of *inter-organizational leadership*, meaning leadership exerted across firm boundaries, and not only within one’s own organization which is the traditional case. Having said that, we proposed the following hypothesis:

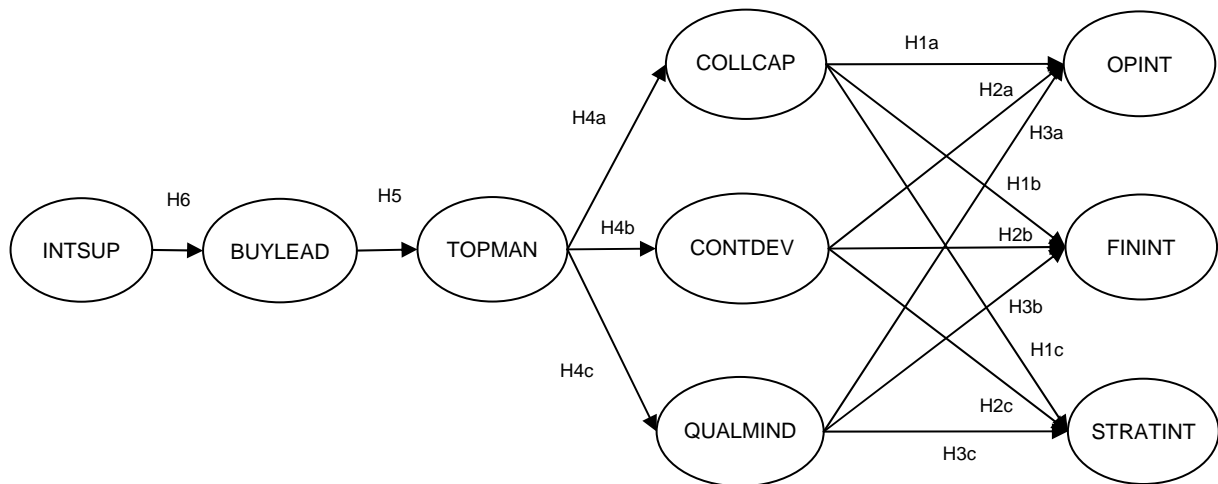
H5. The level of supplier top management support is positively influenced by the level of buyer leadership effectiveness.

The data revealed that the challenges concerning supplier integration in the Chinese automotive industry are not only related to the suppliers themselves, but also to internal constraints of the buyers (Lockström et al., 2010). Such challenges were manifested by a lack of cross-cultural management skills of expatriate managers, and skepticism of the headquarters towards domestic suppliers. As one of the interviewees said: “Managing headquarter expectations is many times more difficult than managing Chinese suppliers” (Lockström et al., 2010, p. 13). An interesting and prevalent internal challenge was identified as unrealistic headquarter expectations. This resulted in frustration by the headquarters over the perceived under-achievement of local supply managers. Large buying organizations also seemed to have a harder time adapting to local conditions, leading to overdependence on the headquarters (Lockström et al., 2010). Obviously, without internal support, it becomes very difficult for the local purchasing organization in China to create the necessary adaptation of strategies, processes and organizations to effectively integrate suppliers. These findings have been acknowledged in earlier studies (W. Li, Humphreys, Chan, & Kumaraswamy, 2003), where internal managerial support was identified as a key driver. Considering the discussion above, the following final hypothesis is defined:

H6. The level of buyer leadership effectiveness is positively influenced by the level of internal support.

The conceptual framework formed by the collection of hypotheses is shown in Figure 1.

Figure 1. Conceptual framework with hypotheses.



4. Data Collection

In order to validate the model indicated in Figure 1, quantitative empirical data was collected through an online survey. The sample domain for the study comprised purchasing managers, general managers, quality assurance managers and supplier quality engineers at business unit level of large-sized companies operating in China. The pre-study showed that these groups are typically directly involved in managing strategic supplier relationships in China. Hence, these informant groups were deemed most suitable for inclusion in the study, thus minimizing the risk for key-informant bias (Kumar, Stern, & Anderson, 1993). The qualifying criterion for participation was annual revenues exceeding US\$5 bn.

A contact database consisting of 923 entries with characteristics as mentioned above served as the sample domain. An invitation letter to participate in the survey was sent via e-mail to the contacts in this database where the respondents could access the online survey via a hyperlink. For native Chinese speakers, a Chinese version was also prepared and sent in order to overcome potential language barriers. Out of the total number of contacts, 382 invitations bounced back. The reason to the large number of invalid contacts was the fact that

the database had been built up in-house during a time period of four years. Due to the dynamics of the Chinese business environment with an average job turnover rate of 15.9% in 2009, the extent of invalid database entries was anticipated (Xu, 2010).

A total number of 102 questionnaires were filled out, implying an initial response rate of 22 percent. Out of these, 42 questionnaires were only partially filled out. 18 were still deemed useful though, resulting in a total number of 78 useable questionnaires. Two weeks after the first invitation letter mail-out, non-respondents were approached via telephone and requested to participate in the survey. In order to ensure adequate information collection, the phone calls were carried out by two researchers involved in the project along with a native Chinese-speaking research assistant to support calls to the Chinese contacts. A total number of 80 phone calls were successfully made, yielding another 20 completed questionnaires. 10 of these were again only partially filled out, making the remaining 10 useable.

Hence, 88 usable questionnaires were finally obtained, implying an effective response rate of 15.6 percent, which is slightly lower compared to those of mail surveys but poses no problem as sometimes have been pointed out in literature (Fitti, 1979; Massey, Barker, & Hsuing, 1981). This is also in line with trends in empirical research studies (Banker, Bardhan, Chang, & Lin, 2006; Ray, Muhanna, & Barney, 2001), even more so in China where domestic companies are usually very secretive about disclosing any kind of business-related information. The sample represented a wide range of industries, distributed as depicted in

Table 2. The industries correspond to SIC codes 07, 17, 28, 34, 35, 36, 37, 47, 48 and 55. For this study, only manufacturing industries were included, deliberately focusing on those where joint product development activities take place, such as machinery and automotive.

Table 2. Industry representation.

| Industry | # companies | Percentage |
|-----------------|--------------------|-------------------|
| Agriculture | 2 | 2.3 |
| Machinery | 12 | 13.6 |
| Energy | 8 | 9.1 |
| Construction | 5 | 5.7 |
| Transportation | 30 | 34.1 |
| Electronics | 8 | 9.1 |
| Chemical | 4 | 4.5 |
| Communications | 9 | 10.2 |
| Others | 10 | 11.4 |
| Total | 88 | 100 |

About 16 percent of the completed interviews came through the follow-up call; this differentiation was used to detect possible non-response bias. To test for this, a modified procedure suggested by Armstrong and Overton (1977) was applied. First-time questionnaires were compared to the follow-up call respondent group on three nominal variables, namely comparative return on assets, sales growth and market share. The assumption of this analysis was that follow-up call respondents shared similar characteristics and response biases with non-respondents. A chi-square test indicated that no significant differences existed between first-round online respondents and follow-up call respondents for the variables comparative return on assets ($\chi^2_{5df} = 5.709, p = 0.336$), sales growth ($\chi^2_{5df} = 2.571, p = 0.766$) or industry ($\chi^2_{5df} = 7.006, p = 0.220$). Thus, there was no evidence of obvious response bias in the sample. Although more stringent non-response bias tests exist (Mentzer & Flint, 1997), the one applied for this particular study was deemed sufficient.

5. Analysis and Results

In this section, the analysis of the empirical data collection and corresponding results is elaborated. The analysis procedure was divided into two steps. First, the measurement model was assessed, followed by testing of the structural model itself.

5.1. Measurement Model

For this study, an approach suggested by Jarvis (2003) was deployed. In case of ambiguity, existing theory, previously defined constructs and the pre-study were used to determine the optimal operationalization of the constructs (Hulland, 1999; Chin and Gopal, 1995; Barclay et al., 1995). As the constructs measure attitudes and beliefs of respondents, the constructs should ideally be operationalized using reflective items (Coltman et al., 2007). In other words, the constructs are considered as overarching latent variables where construct items share a common theme and hence co-vary.

Table 3. Definitions of latent variables and corresponding construct items.

| Latent Variable Name (Abbreviated Code) | Item Code | Item Scale Measurement |
|---|-----------|--|
| Buyer Leadership Effectiveness (BUYLEAD) | BL1 | We actively communicate with our strategic suppliers. |
| | BL2 | We treat our key suppliers as partners. |
| | BL3 | We encourage and involve our key suppliers in teamwork activities. |
| | BL4 | We get authority to make critical sourcing-related decisions. |
| | BL5 | We give our key suppliers autonomy and stimulate innovative thinking. |
| | BL6 | We encourage continuous improvement among our key suppliers. |
| Supplier Top Management Support (TOPMAN) | TMS1 | Top management of our key suppliers supports the efforts to build a strong relationship with us. |
| | TMS2 | Top management of our key suppliers has formal long-term plans aiming at improving supply chain efficiency. |
| | TMS3 | Top management of our key suppliers holds regular meeting with us to discuss critical issues. |
| | TMS4 | Top management of our key suppliers supports changes in their organization to strengthen our relationship with them. |
| Quality Mindset (QUALMIND) | QM1 | Our suppliers encourage problem solving at shop floor level. |
| | QM2 | Our suppliers have clearly defined process and are able to measure performance. |
| | QM3 | Our suppliers continuously try to improve processes to meet our needs. |
| | QM4 | Our suppliers see continuous improvement as part of their organizational goals. |
| | QM5 | Our suppliers have formal quality objectives and relevant quality polices. |
| Collaborative Supplier Capabilities (COLLCAP) | CSC1 | Our suppliers are able to develop and execute business and operations plans based on our needs. |
| | CSC2 | Our suppliers are capable carrying out product development projects based on our specifications. |
| | CSC3 | Our suppliers are capable of identifying and leveraging new innovations from our supply chain partners. |
| | CSC4 | Our suppliers are able to engage in joint product development projects. |
| | CSC5 | Our suppliers are able to communicate effectively and proactively with us. |
| Internal Support (INTSUP) | IS1 | We have a clearly defined strategy for our China sourcing activities. |
| | IS2 | We have a clear communication line between our HQ, local office and suppliers. |

| | | |
|---|------|--|
| | IS3 | Our company has a positive attitude toward Chinese suppliers. |
| Continuous Supplier Development (CONTDEV) | CSD1 | We frequently provide key suppliers with technological support. |
| | CSD2 | We have assigned support staff to our suppliers' facilities. |
| | CSD3 | We conduct formal training of our suppliers on a regular basis. |
| Financial Supplier Integration (FININT) | FI1 | Our company shares R&D costs with key suppliers. |
| | FI2 | Our company helps suppliers finance capital equipment. |
| | FI3 | Our company has invested in suppliers' equity. |
| Operational Supplier Integration (OPINT) | OI1 | Our company has implemented real-time information exchange with key suppliers. |
| | OI2 | Our company has implemented interlocking mechanisms (e.g. JIT, kanban) with key suppliers. |
| Strategic Supplier Integration (STRATINT) | SI1 | We have defined joint strategic objectives with key suppliers. |
| | SI2 | We work jointly with suppliers to identify and capture new market opportunities. |
| | SI3 | We often share new ideas and best practices with our key suppliers. |

In order to verify convergent validity, a factor analysis was performed. The results show that all items loaded strongly onto their respective constructs, hence providing strong evidence of convergent validity (Table 4). The resulting constructs were then used for PLS modeling.

Table 4. Factor analysis results.

| Construct Item | Factor | | | | | | | | |
|----------------|-------------|-------------|-------------|-------------|-------|-------|-------|-------|-------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| BL3 | .777 | .066 | .040 | .238 | .325 | .084 | .127 | .114 | .034 |
| BL6 | .758 | .033 | .180 | -.077 | .150 | .162 | .239 | .238 | .217 |
| BL4 | .727 | -.011 | .118 | .002 | .261 | .073 | .173 | .160 | .112 |
| BL5 | .669 | .176 | .165 | .072 | .210 | .367 | .159 | .066 | .217 |
| BL1 | .596 | .028 | -.170 | .366 | .383 | .132 | .033 | .121 | .154 |
| BL2 | .505 | .111 | -.034 | .325 | .494 | .198 | .131 | .129 | .033 |
| CSC2 | .044 | .868 | .219 | .090 | .170 | .063 | .078 | .012 | .169 |
| CSC3 | .027 | .759 | .289 | .116 | .184 | .096 | .248 | .048 | .189 |
| CSC1 | .088 | .711 | .104 | .117 | .203 | .159 | .278 | .051 | .187 |
| CSC5 | .126 | .657 | .197 | .249 | -.101 | .179 | .178 | .062 | .227 |
| CSC4 | -.070 | .540 | .183 | .262 | .148 | -.092 | .463 | .003 | .023 |
| QM3 | .091 | .192 | .767 | .115 | -.036 | .102 | -.029 | .259 | .169 |
| QM4 | .069 | .284 | .718 | .081 | .048 | -.081 | .183 | .083 | .232 |
| QM5 | .020 | .078 | .602 | .266 | .124 | .176 | .245 | -.040 | -.058 |
| QM1 | .105 | .333 | .598 | .149 | .156 | .421 | .003 | -.024 | -.047 |
| QM2 | .047 | .137 | .566 | .242 | .045 | .224 | .300 | -.062 | .263 |
| TMS1 | .106 | .072 | .126 | .768 | .272 | .100 | .051 | .135 | .238 |
| TMS3 | .019 | .220 | .335 | .683 | .089 | .157 | .278 | .318 | .060 |
| TMS4 | .055 | .211 | .175 | .668 | .031 | .141 | .177 | .223 | .232 |
| TMS2 | .145 | .217 | .328 | .557 | .046 | .059 | .291 | .136 | .356 |

| | | | | | | | | | |
|------|-------|-------|-------|-------|-------------|-------------|-------------|-------------|-------------|
| IC1 | .176 | .088 | .197 | .163 | .797 | .071 | .119 | .230 | .143 |
| IC2 | .296 | .143 | .133 | -.071 | .707 | .025 | .126 | .270 | .219 |
| IC3 | .254 | .135 | -.104 | .151 | .671 | .098 | .217 | .080 | .136 |
| FI2 | .119 | .039 | .042 | .000 | .191 | .817 | .260 | .241 | .072 |
| FI1 | .176 | .016 | .105 | .165 | .103 | .693 | -.031 | .176 | .162 |
| FI3 | .030 | .085 | .089 | .067 | -.082 | .518 | .184 | .000 | .226 |
| SI3 | .310 | .121 | .003 | .011 | .138 | .111 | .761 | .202 | .344 |
| SI2 | .121 | .236 | .181 | .224 | .199 | .376 | .587 | .091 | .162 |
| SI1 | .144 | .214 | .134 | .172 | .167 | .328 | .388 | .243 | .299 |
| CSD2 | -.020 | -.022 | -.005 | -.035 | .152 | .008 | .028 | .822 | .335 |
| CSD1 | .197 | -.005 | .030 | .351 | .162 | .073 | .141 | .686 | -.025 |
| CSD3 | .118 | .024 | .052 | .129 | .085 | .191 | .085 | .599 | -.012 |
| OI1 | .103 | .146 | .090 | .153 | .107 | .151 | .093 | .041 | .775 |
| OI2 | .058 | .109 | .028 | .140 | .199 | .161 | .279 | .191 | .605 |

Extraction Method: Principal Axis Factoring. Rotation Method: Equamax with Kaiser Normalization.
a. Rotation converged in 15 iterations.

Next, reliability was assessed by calculating Cronbach's alpha and Fornell and Larcker's (1981) measure of internal consistency for each construct. As can be seen in Table 5, all the corresponding values were well above the threshold of 0.70 as recommended by Nunnally (1978). In order to verify convergent validity, assessment of factor loadings (>0.36) and statistical significance of construct item loadings are recommended (Falk and Miller, 1992). Furthermore, average variance extracted (AVE), should also exceed the threshold value of 0.50 (Barclay et al., 1995). As can be seen in Table 5, all these criteria are met and exceeded with a good margin.

Table 5. Measurement model specification.

| Construct Name | Construct Items | Factor Loadings | t-values | AVE (R^2) | Cronbach's Alpha | Composite Reliability |
|----------------|-----------------|-----------------|----------|-----------------|------------------|-----------------------|
| BUYLEAD | BL1 | 0.83 | 22.6 | 70.7% (0.42) | 0.917 | 0.93 |
| | BL2 | 0.84 | 20.7 | | | |
| | BL3 | 0.90 | 32.4 | | | |
| | BL4 | 0.81 | 9.31 | | | |
| | BL5 | 0.83 | 19.2 | | | |
| | BL6 | 0.83 | 11.8 | | | |
| TOPMAN | TMS1 | 0.85 | 18.0 | 77.6% (0.48) | 0.903 | 0.90 |
| | TMS2 | 0.88 | 35.3 | | | |
| | TMS3 | 0.91 | 56.8 | | | |
| | TMS4 | 0.87 | 29.8 | | | |
| QUALMIND | QM14 | 0.79 | 18.4 | 68.3% (0.42) | 0.876 | 0.90 |
| | QM4 | 0.80 | 24.1 | | | |
| | QM7 | 0.82 | 19.7 | | | |

| | | | | | | |
|----------|------|------|------|-----------------|-------|------|
| | QM8 | 0.76 | 13.6 | | | |
| | QM9 | 0.81 | 20.2 | | | |
| COLLCAP | CSC1 | 0.88 | 32.4 | 69.0% (0.20) | 0.908 | 0.87 |
| | CSC2 | 0.91 | 38.6 | | | |
| | CSC3 | 0.91 | 70.6 | | | |
| | CSC4 | 0.76 | 10.2 | | | |
| | CSC7 | 0.82 | 18.7 | | | |
| INTSUP | IS1 | 0.87 | 40.8 | 70.6% (N/A) | 0.876 | 0.92 |
| | IS2 | 0.87 | 43.1 | | | |
| | IS3 | 0.77 | 27.9 | | | |
| CONTDEV | CSD1 | 0.90 | 27.5 | 69.4% (0.10) | 0.780 | 0.93 |
| | CSD3 | 0.79 | 11.0 | | | |
| | CSD4 | 0.79 | 11.1 | | | |
| FININT | F11 | 0.83 | 7.33 | 70.9% (0.13) | 0.792 | 0.87 |
| | F12 | 0.87 | 9.64 | | | |
| | F13 | 0.80 | 6.44 | | | |
| OPINT | OI2 | 0.91 | 20.7 | 82.6% (0.11) | 0.790 | 0.90 |
| | OI3 | 0.90 | 32.4 | | | |
| STRATINT | SI1 | 0.86 | 22.3 | 76.2% (0.16) | 0.842 | 0.93 |
| | SI2 | 0.91 | 17.4 | | | |
| | SI3 | 0.85 | 22.6 | | | |

As a next step, discriminate validity was examined by comparing the square root of latent variable AVE with latent variable correlations. The correlation matrix shows that the square root of AVE is larger than the off-diagonal values, which is an indicator of discriminate validity (Hulland, 1999).

Table 6. Latent variable correlation matrix.

| No. | Construct | Mean | σ | \sqrt{AVE} | 1. | 2. | 3. | 4. | 5. | 6. | 7. | 8. | 9. |
|-----|-----------|------|----------|--------------|------|------|------|------|------|------|------|------|------|
| 1. | BUYLEAD | 3.61 | 0.87 | 0.84 | 1.00 | | | | | | | | |
| 2. | COLLCAP | 3.67 | 0.91 | 0.86 | 0.39 | 1.00 | | | | | | | |
| 3. | CONTDEV | 3.29 | 0.99 | 0.83 | 0.32 | 0.17 | 1.00 | | | | | | |
| 4. | FININT | 2.84 | 1.19 | 0.84 | 0.43 | 0.33 | 0.28 | 1.00 | | | | | |
| 5. | INTSUP | 3.64 | 0.90 | 0.84 | 0.65 | 0.41 | 0.37 | 0.31 | 1.00 | | | | |
| 6. | OPINT | 3.34 | 1.08 | 0.91 | 0.39 | 0.33 | 0.42 | 0.37 | 0.39 | 1.00 | | | |
| 7. | QUALMIND | 3.22 | 0.90 | 0.83 | 0.31 | 0.19 | 0.57 | 0.35 | 0.29 | 0.35 | 1.00 | | |
| 8. | STRATINT | 3.22 | 1.01 | 0.87 | 0.55 | 0.39 | 0.56 | 0.54 | 0.51 | 0.57 | 0.47 | 1.00 | |
| 9. | TOPMAN | 3.43 | 0.92 | 0.88 | 0.43 | 0.43 | 0.55 | 0.37 | 0.40 | 0.47 | 0.57 | 0.56 | 1.00 |

5.2. Structural Model

The structural model was evaluated by using the software SmartPLS 10.0 (Ringle, 2006).

Partial least squares regression is advantageous since it does not require normally distributed

data, it is stable against multicollinearity, and performs well under circumstances where the number of indicator variables is large in comparison with the sample size (Abdi, 2003). Being a components-based structural equations modeling technique, PLS is similar to regression, but simultaneously models the structural paths (i.e., theoretical relationships among latent variables) and measurement paths (i.e., relationships between a latent variable and its indicators). Rather than assume equal weights for all indicators of a scale, the PLS algorithm allows each indicator to vary in how much it contributes to the composite score of the latent variable. Thus indicators with weaker relationships to related indicators and the latent construct are given lower weightings. In this sense, PLS is preferable to techniques such as regression which assume error free measurement (Lohmöller 1989; Wold 1982, 1985, 1989).

In terms of minimum sample size, an approach suggested by Cohen (1998) was applied. It implies calculating the minimum sample size for each construct in isolation, by considering their respective squared multiple correlations (R^2) and the corresponding number of paths leading to each one of them. By selecting a desired significance level of 0.05 and a desired statistical power level of 0.8, the minimum sample size is given by the largest of this set of numbers generated. In retrospect, the minimum sample size turned out to be 35, which is well accomplished with an actual sample size of 88 in this case.

In order to evaluate the path coefficients, bootstrapping technique with one hundred resamples was used. The results showed that 25.0 percent of the variance in OPINT was collectively explained by COLLCAP, CONTDEV and QUALMIND. However, the paths from COLLCAP and QUALMIND were insignificant. Hence, hypotheses H1a and H1c were rejected whereas H2b was accepted, whose path coefficient was 0.30. Elimination of the paths corresponding to the rejected hypotheses showed that CONTDEV alone accounted for 8 percent of the variance in OPINT.

For the latent variable FININT, 21.1 percent of its variance was explained by COLLCAP, CONTDEV and QUALMIND. The path from CONTDEV proved insignificant, whereas the other two were significant. As a result, hypotheses H2a and H2c were accepted whereas H2b was rejected. The two significant path coefficients were both 0.27. Elimination of the path leading from CONTDEV did not affect the variance explained in the construct.

In terms of the latent variable STRATINT, 43.3 percent of its variance was explained by COLLCAP, CONTDEV and QUALMIND. However, the path leading from QUALMIND proved insignificant and was thus eliminated from the model. Doing so only decreased the amount of variance explained to 40.8 percent. In sum, hypotheses H3a and H3b were accepted whereas H3c was rejected, where the two significant path coefficients were 0.28 and 0.41, respectively.

The latent variables COLLCAP, CONTDEV and QUALMIND proved to be positively influenced by TOPMAN, with corresponding amounts of variance explained at 20.1, 29.7 and 32.6 percent, respectively. All three paths were significant at the 0.1 percent level, and the corresponding path coefficients were 0.44, 0.54 and 0.57, respectively. Consequently, H4a, H4b and H4c were all accepted.

The latent variable TOPMAN proved to be significantly and positively influenced by BUYLEAD at the 0.1 percent level, with a path coefficient of 0.43, and 18.9 percent of variance explained. BUYLEAD in turn proved to be positively affected by INTSUP at the 0.1 percent level, with a path coefficient of 0.65 and 42 percent variance explained. A summary of the hypothesis testing is shown in Table 7.

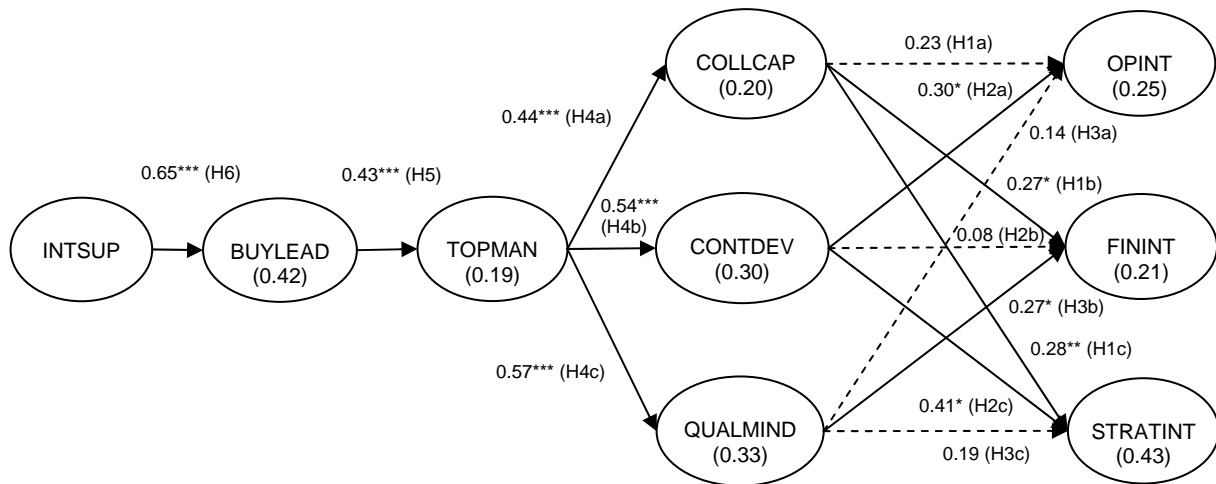
Table 7. Path coefficients of structural model.

| Hypothesis | Path | Path Coefficient | Standard Error | t-value |
|------------|---------------------|------------------|----------------|---------|
| H1a | COLLCAP → OPINT | 0.23 | 0.16 | 1.50 |
| H1b | COLLCAP → FININT | 0.27 | 0.11 | 2.40* |
| H1c | COLLCAP → STRATINT | 0.28 | 0.09 | 3.29** |
| H2a | CONTDEV → OPINT | 0.30 | 0.14 | 2.13* |
| H2b | CONTDEV → FININT | 0.08 | 0.13 | 0.60 |
| H2c | CONTDEV → STRATINT | 0.41 | 0.10 | 4.08*** |
| H3a | QUALMIND → OPINT | 0.14 | 0.11 | 1.29 |
| H3b | QUALMIND → FININT | 0.27 | 0.11 | 2.53* |
| H3c | QUALMIND → STRATINT | 0.19 | 0.12 | 1.63 |
| H4a | TOPMAN → COLLCAP | 0.44 | 0.11 | 4.13*** |
| H4b | TOPMAN → CONTSDEV | 0.54 | 0.08 | 6.52*** |
| H4c | TOPMAN → QUALMIND | 0.57 | 0.10 | 5.84*** |
| H5 | BUYLEAD → TOPMAN | 0.43 | 0.11 | 4.12*** |
| H6 | INTSUP → BUYLEAD | 0.65 | 0.09 | 7.64*** |

* Significant at the 0.05 level. ** Significant at the 0.01 level. *** Significant at the 0.001 level

In sum, ten out of the fourteen hypotheses postulated were accepted. With this in mind, the overall validity of the model can be considered satisfactory. A graphic illustration of the structural model can be seen in Figure 2.

Figure 2. Structural model with path coefficients, construct variance explained and significance levels.



* Significant at the 0.05 level. ** Significant at the 0.01 level. *** Significant at the 0.001 level. --- Insignificant path.

6. Conclusions

Supplier integration has become increasingly important as a means to reduce product life cycle costs, improve quality and improve time-to-market. In this section, contributions to theory and implications for managers are discussed.

6.1. Theoretical contributions

This study examined antecedents to supplier integration in the Chinese industry. The results from the study support the hypothesized causal linkages in terms of internal support, buyer leadership, supplier top management support, continuous supplier development, quality mindset and collaborative supplier capabilities. The results were in line with expectations to a large extent, where ten out of fourteen hypotheses were confirmed. The causal linkages that were rejected were between H1a (collaborative supplier capabilities → operational integration), H2b (continuous supplier development → financial integration), H3a (supplier quality mindset → operational integration), and H3c (supplier quality mindset → strategic integration). One can speculate to the reasons for the rejection of these hypotheses, but the most plausible ones are as follows.

For H1a, collaborative supplier capabilities have been conceptualized and operationalized as very strategic and high-level in terms of project management capabilities, communication capabilities, ability to exploit innovations from supply chain partners etc. As a consequence, it is not likely that they translate directly into operational performance improvements, but rather do this via mediation.

For H2b, it is also clear that continuous supplier development activities focus on rather short-term performance improvements, such as implementation of TQM principles, factory layout optimization etc., by dispatching supplier quality engineers from the buyers, a fact that

has become clear already during the pre-study. Although it makes sense to hypothesize that such operational improvement measures could translate into higher-level financial integration, this turned out to not be the case. This can be explained especially if senior management of the supplier is not directly involved in such improvement activities, hence an “organizational separation” between operations and strategy exist on such an instance.

Concerning H3a and H3c, again, it is clear that quality mindset refer to rather high-level aspects, such as performance measurement, policy adoption etc. As a result, it appears that these factors do not directly influence operational or strategic integration. The fact that H3b was supported (supplier quality mindset → financial integration) can be interpreted as an enabling factor for buyer firms to dare to integrate financially with their suppliers in terms of provision of financing, acquisition of equity stakes etc.

6.2. Managerial implications

As discussed above, companies continue to focus on core competencies and outsource non-strategic business activities. As a result, the dependency on suppliers for creation of customer value and competitive advantage has accordingly increased to an equal extent. This has become an even more strategic topic as companies today strive to reduce their supplier bases, consolidate spend, and develop relationships with preferred suppliers. Moreover, as a shift has taken place in purchasing from cost-orientation to value-orientation, companies nowadays leverage suppliers in order to tap into their innovative capabilities for joint product development.

Despite the widespread adoption of supplier integration approaches in the West, there are several idiosyncratic challenges in China, most notably the need for continuity of supplier development activities, and the support from corporate headquarters, as local purchasing

teams cannot do this in isolation. Put simply, the local purchasing organization (in China) serves as a bridge and extended arm of the global purchasing organization, by providing relevant expertise in terms of know-how, language and cultural understanding. As can be seen from the study results, it is also clear that the collective organizational leadership play a key role in creating alignment between the buyer organization and the suppliers in terms of operations, strategy and financial investments.

In sum, the overall conclusion from a practitioner's perspective is that management must work in tandem with operations to make supplier integration happen. And leadership is not a concept solely exerted within one's own organization, but clearly across firm boundaries. Only in this way supplier integration can drive transparency across the supply chain and facilitate an optimal balance between production costs vis-à-vis transaction costs, ultimately reducing total costs.

6.3. Limitations of the Study and Suggestions for Future Research

This is a cross-sectional study whereby the results only provide a static picture of the current situation. Thus, it fails to capture the dynamic nature of the supply markets in emerging economies such as China. In addition to cross-sectional studies, a longitudinal study could strengthen the arguments about causality. Secondly, due to the relatively small sample size, it was not possible to make cross-industry comparisons. However, this opens up a window of opportunity for future research in order to detect industry-specific differences and similarities. Thirdly, the specific context of the Chinese industry might limit the generalization of the conceptual framework for other geographical areas. However, this study is a critical step in developing such conceptual frameworks for large and fast growing economies and industry sectors.

7. References

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