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The impact of internal integration and relationship commitment on external integration☆

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ABSTRACT

Supply chain integration (SCI) among internal functions within a company, and external trading partners within a supply chain, has received increasing attention from academicians and practitioners in recent years. SCI consists of internal integration of different functions within a company and external integration with trading partners. While both supply chain internal and external integration have been studied extensively, our understanding of what influences SCI and the relationship between internal and external integration is still very limited. This paper argues that external integration with customers and suppliers is simultaneously influenced by internal integration and relationship commitment to customers and suppliers. Internal integration enables external integration because organizations must first develop internal integration capabilities through system-, data-, and process-integration, before they can engage in meaningful external integration. At the same time, before external integration can be successfully implemented, organizations must have a willingness to integrate with external supply chain partners, which is demonstrated by their relationship commitment.

We propose and test a model that specifies the relationship between internal integration, relationship commitment, and external integration, using data collected from manufacturing firms in China. The results show that internal integration and relationship commitment improve external integration independently, and their interactive effect on external integration is not significant. However, internal integration has a much greater impact on external integration than relationship commitment.

We also examine the model for companies with different ownerships, and the results indicate that for Chinese controlled companies where there is a strong collectivism culture and more reliance on "*Guanxi*" (relationship), relationship commitment has a significant impact on external integration with suppliers and customers. This is in stark contrast to foreign controlled companies, characterized by a more individualistic culture and more reliance on technological capabilities, where no significant relationship between relationship commitment and external integration could be found. The model is also tested across different industries and different regions in China, providing useful insights for Chinese companies in particular. This study makes significant contributions to the SCI literature by simultaneously studying the effects of internal integration and relationship commitment on external integration, and providing several future research directions.

1. Introduction

Supply chain integration (SCI) has received increasing attention among academicians and practitioners alike in recent years (Frohlich and Westbrook, 2001; Narasimhan and Kim, 2002; Vickery et al., 2003; Droge et al., 2004; Swink et al., 2005; Das et al., 2006; Swink et al., 2007; Zhao et al., 2008; Braunscheidel and Suresh, 2009; Flynn et al., 2010). SCI consists of the integration of internal functions, as well as the integration with customers and suppliers (Stank et al., 2001b). Despite the increasing research interests in SCI, our understanding of what influences SCI, and

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the relationships between internal and external integration, is still very limited. While some studies (e.g. Stevens, 1989, 1990) conceptually described the relationship between internal and external integration, there is limited empirical evidence on this relationship (Hillebrand and Biemans, 2003). Furthermore, findings about this relationship from previous studies were inconsistent. While some studies provided empirical evidence for the impact of internal integration on external integration in areas such as information sharing (Carr and Kaynak, 2007) and new product development (Koufteros et al., 2005), others postulated and tested a reverse relationship from external integration to internal integration from the perspective of external and internal collaboration (Salvador et al., 2001; Sanders and Premus, 2005; Sanders, 2007). In a recent study, Braunscheidel and Suresh (2009) found that internal integration has a positive influence on external integration which includes supplier and customer integration as two subdimensions. Therefore, there is a need for empirically testing the relationship between internal integration and external supplier and customer integration to improve our understanding of the mechanism of SCI. This will help practitioners focus their limited resources to either invest first in internal integration or external integration.

In order to achieve a high level of integration with suppliers and customers in the supply chain, the company should have the capability and willingness to integrate with external partners (Fawcett et al., 2007). While the capability of the company to integrate with its partners is reflected by the company's level of internal integration (break down functional silos, share information, and deploy cross-functional teams), the willingness to integrate relates to the company's relationship commitment to its partners. The literature has confirmed that trust and relationship commitment engender cooperation between trading partners (Morgan and Hunt, 1994; Lai et al., 2008). With relationship commitment, companies within a supply chain can establish long-term relationships with their partners and enhance the level of external integration. In a recent study, Zhao et al. (2008) found that relationship commitment to the customer significantly influenced the degree of customer integration. Although both internal integration (Stevens, 1989, 1990) and relationship commitment (Zhao et al., 2008) have been suggested to significantly influence external integration, this study will be one of the first to simultaneously examine the impacts of internal integration and relationship commitment on external integration in a supply chain. Furthermore, the willingness to integrate may enhance the effectiveness of internal integration on external integration. Similarly, internal integrative capability may also enlarge the role of relationship commitment in improving external integration. Therefore, we will also test the interactive effect of internal integration and relationship commitment on external integration.

We conduct this study using data collected from Chinese manufacturers. While China has become a global manufacturing center and plays a very important role in many global supply chains, very few studies on supply chain management have been conducted in China (Zhao et al., 2006, 2007). Furthermore, most studies on SCI and relationship management have been performed in the context of Western cultures (e.g. Droge et al., 2004; Germain and Iyer, 2006; Gimenez and Ventura, 2005; Koufteros et al., 2005; Morgan and Hunt, 1994) . There is a need for testing and validating theories of SCI and relationship management in different cultural settings (Huff and Kelley, 2003). The collectivism culture and emphasis on "Guanxi" (relationship) in China provide a fertile ground for testing and validating these theories developed in Western cultures. Furthermore, enterprises in China have different histories and varying cultures and management philosophies, depending on their ownerships (Delios et al., 2006). Ownership, as a form of control and governance, has significant implications for organizational control, risk sharing, resource allocation, bargaining power, and managerial decision making (Zhao and Luo, 2002). Different ownerships represent different cultures which may influence SCI and relationship commitment. For example, while Chinese state-owned, collectively owned, or privately owned companies are characterized by a high collective culture, joint ventures (JVs) and foreign-owned companies exhibit a more individualistic culture. In the collective culture, relationship commitment is deemed more important in maintaining relationships, as compared to that in an individualistic culture. As such, relationship commitment may play a more important role in achieving external integration in Chinese controlled companies in which the Chinese collectivism culture and "Guanxi" (relationship) dominate. In contrast, in foreign controlled companies, which have a more individualistic culture, relationship commitment may play a lesser role in improving external integration. While relationship commitment might have a greater effect on external integration in Chinese controlled companies, internal integration may play a more important role in pursuing external integration in foreign controlled companies, which may exhibit relatively more advanced information and manufacturing technologies. Besides ownership, we also examine the relationships between internal integration, relationship commitment, and external integration in different contexts of industries and regions.

This study addresses two major research questions: (1) How do internal integration and relationship commitment to customers and suppliers influence external integration with customers and suppliers? (2) What are the differences in the relationships between internal integration, relationship commitment and external integration for companies with different ownerships, in different industries and regions? This study will contribute to the SCI literature and practices in several ways. First, this study will provide empirical evidence of the effects of both internal integration and relationship commitment to customers and suppliers, on external integration with customers and suppliers. The empirical evidence will also demonstrate the relative importance of internal integration and relationship commitment in improving external integration. Second, this study will reveal the difference of the effects of internal integration and relationship commitment to customers and suppliers on external integration with customers and suppliers for companies with different ownerships, which is a proxy for culture. It will also indicate the differences between different regions and industries. Third, this study will provide managerial guidelines for practicing managers to decide how to devote their efforts and resources in different areas of SCI, and how to manage companies with different ownerships, in different industries and regions to achieve a higher level of external integration.

The remainder of the paper is organized as follows: First, the theoretical background and research hypotheses are described. Next, the research methodology is presented, followed by the presentation of the analyses and results. Subsequently, managerial implications are discussed. Finally, main conclusions are drawn, together with limitations of this study and suggestions for future research.

2. Theoretical background and research hypotheses

SCI refers to "the degree to which an organization strategically collaborates with its supply chain (SC) partners and manages intra- and inter-organization processes to achieve effective and efficient flows of products, services, information, money and decisions, with the objective of providing maximum value to its customers" (Zhao et al., 2008, p. 7). There are mainly two types of SCI: external integration and internal integration.

2.1. External integration

External integration refers to the degree to which a firm can partner with its key supply chain members (customers and suppliers) to structure their inter-organizational strategies, practices, procedures and behaviors into collaborative, synchronized and manageable processes in order to fulfill customer requirements (Chen and Paulraj, 2004; Stank et al., 2001b). External integration includes strategic alliance with suppliers and customers, in which the company builds strategic partnerships with its suppliers and customers and jointly develops strategies facing market opportunities (Narasimhan and Kim, 2002). Information sharing, synchronized planning, and working together with customers and suppliers to jointly resolve problems and facilitate operations are also important themes of external integration. External integration enables companies to form collaborative relationships with trading partners, and leverage their core competency while reducing transaction costs (Zhao et al., 2008).

According to Flynn et al. (2010), external integration is positively related to operational performance, given the positive relationship between internal integration and operational performance. External integration represents the higher level of supply chain management (Stevens, 1989, 1990; Flynn et al., 2010). The importance of external integration is also reflected by some influential SCI studies that only investigated external integration, but not internal integration (Frohlich and Westbrook, 2001; Petersen et al., 2005; Das et al., 2006; Devaraj et al., 2007).

2.2. Internal integration

Internal integration refers to the degree to which a firm can structure its organizational practices, procedures and behaviors into collaborative, synchronized and manageable processes in order to fulfill customer requirements (Cespedes, 1996; Chen and Paulraj, 2004; Kahn and Mentzer, 1996). Internal integration mainly involves data and information system integration through the use of enterprise resources planning (ERP), real-time searching of inventory and operating data, and integration of activities in different functional areas. Internal integration also involves cross-functional cooperation, or working together across different functions in process improvement or new product development. Internal integration recognizes that different functions within a firm should not act as functional silos, but instead as part of an integrated process.

Internal integration in essence refers to information sharing between internal functions, strategic cross-functional cooperation, and working together. Prior to supply chain management thinking, companies relied on internal integration to gain competitive advantage and company performance. For example, concurrent engineering (Swink, 1998; Koufteros et al., 2001; Tan and Vonderembse, 2006) and lean production systems (Shah and Ward, 2003; Narasimhan et al., 2006; Holweg, 2007; Shah and Ward, 2007) are consistent with the philosophy and practices of internal integration. Some studies only focused on internal integration, but not on external integration (O'Leary-Kelly and Flores, 2002; Pagell, 2004; Swink and Nair, 2007; Swink and Song, 2007), reflecting the importance of internal integration. According to the systems management perspective, every function (sub-system) in an organization (system) should be integrated for the organization to pursue excellent performance.

2.3. The impact of internal integration on external integration

Although there are inconsistent findings on the relationship between internal and external integration in the literature, we argue that internal integration should positively influence external integration from several perspectives. From the perspective of organizational capability, it is argued that when a company has a high level of internal communication and coordination capabilities, it will be more capable to achieve a high level of external integration. In particular, when a company has a high level of absorptive capability, defined as "the ability of a firm to recognize the value of new, external information, assimilate it, and apply it to commercial ends" (Cohen and Levinthal, 1990, p. 128) to disseminate, interpret, utilize, and evaluate new knowledge acquired from external suppliers and customers, the company will more likely learn from external partners and understand their business to facilitate external integration. As a result, internal integration represents an absorptive capability for learning from external partners (e.g. Hillebrand and Biemans, 2004; Lane et al., 2006), as well as an internal coordination capability for external coordination (Takeishi, 2001).

The influence of internal integration on external integration can also be elaborated on from three major aspects of SCI: information sharing, strategic cooperation or alliance, and working together. In the area of information sharing, it is less likely that a firm can share information and data with external trading partners if it does not have an ERP system to integrate data and share information among its internal units. Companies that already enjoy well-established internal systems and capabilities for integrating data and sharing information among their internal functional units can more readily add functional modules to link with external customers and suppliers. Actually, without internal integration, shared data with external partners may not be accurate and timely. For example, if the firm cannot perform real-time searching of inventory and operating data, neither can it share such data with its trading partners accurately in real time. If the firm does not have a good ERP system, which allows for cross-functional transparency of data for operational planning and control, data shared by trading partners are less likely to be fully utilized in the firm as well. Furthermore, information sharing within a firm is necessary to help internal functions within the company identify critical issues regarding suppliers (Bhatt, 2000; Crocitto and Youssef, 2003). For most companies, interactions with suppliers are mainly conducted by the purchasing function, while interactions with customers are usually conducted by the marketing function. Internal information sharing or coordination is helpful for understanding and closely cooperating with suppliers and customers. If there is no effective information sharing or coordination between internal functions, the company will be hard pushed to fully understand supplier or customer requirements. Stank et al. (2001b) found that internal information sharing between departments is related to external cooperation with partners. Recently, Carr and Kaynak (2007) found that information sharing within the company positively influences information sharing between companies. Ward and Zhou (2006) found that within-firm information technology (IT) integration and between-firm IT integration are positively correlated.

In the area of strategic cooperation or alliance, if people in different functional units within the firm do not interact with each other to make its objectives and practices consistent (Swink et al., 2005, 2007), it is less likely that the company can have a high degree of integration with its external suppliers or customers. Strategic alliance literature also suggested that internal integration (including communication, information sharing and cross-functional teamwork across internal functions within the company) is particularly important for establishing and maintaining the company's alliance with external customers and suppliers (Kanter, 1994). Kanter (1994, p. 107) further stated that, for strategic alliance, "companies with strong communications across functions and widely shared information [within the company] tend to have more productive external relationships [with customers and suppliers]."

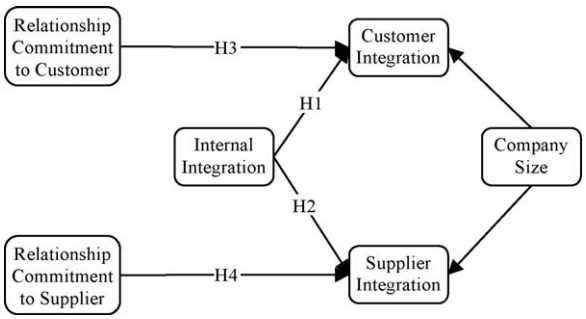

Fig. 1. Proposed model.

In the area of working together, if a firm lacks cross-functional integration, allowing for people to work within their own functional silos, processes within the firm will be fragmented and disconnected. Under such circumstances, the firm is less likely to plan well for its own activities, and hence is more likely to lack the capability to resolve potential conflicts, set up synchronized processes, and facilitate operations with its external trading partners. Effective internal teamwork may enhance the company's capability to communicate and solve problems with external partners. For example, cross-functional teams are commonly used to solve supplier quality problems (Kaynak, 2002). The coordination between engineering and purchasing functions helps the company solve problems with suppliers in the product development process (Takeishi, 2001). Koufteros et al. (2005) found that concurrent engineering, which is "the early involvement of a cross-functional team in a process to plan product design, process design, and manufacturing activities simultaneously" (p. 100) directly enhanced customer integration and supplier integration, in product development activities. Biemans (1991) also stated that, in order to be effective in external cooperation, organizations need well-functioning internal interfaces. From both perspectives of strategic alliance and working together, Gimenez and Ventura (2005) found that joint planning and working internally across logistics and production functions in companies are related to the companies' joint planning and working externally with supply chain partners. Therefore, we argue that a company performing well in internal integration will more likely integrate with external partners (Kanter, 1994).

Therefore, companies with a lower level of internal integration will less likely have adequate capability to integrate with external partners, whereas companies with a high level of internal integration are more likely, and in a better position, to integrate their processes with customers' or suppliers' processes. As such, we postulate that increased internal integration enables higher levels of customer and supplier integration (Fig. 1):

H1. Internal integration is positively related to customer integration.

H2. Internal integration is positively related to supplier integration.

2.4. The impact of relationship commitment on external integration

While companies with a higher level of internal integration may potentially have a greater capability to integrate with external partners, such higher level of external integration with suppliers and customers may not materialize unless the companies possess a willingness to integrate with their external partners (Fawcett et al., 2007). For example, some companies may not want to share information with their suppliers or customers, even when they have the information systems and the capabilities for information sharing. This is where relationship commitment comes in as another key enabler of external integration. Relationship commitment is the willingness of a party to maintain a relationship through the investment of financial, physical, or relationship-based resources (Morgan and Hunt, 1994; Zhao et al., 2008). In a supply chain, it is an attitude or willingness of a supply chain partner to develop and maintain a stable, long-lasting relationship (Anderson and Weitz, 1992; Moore, 1998). Relationship commitment increases the exchange partners' confidence in the effectiveness of future relational exchange, motivating the exchange partners to maintain the relationship. It also emphasizes shared values and long-term attachment within an inter-organizational relationship. As a result, relationship commitment ensures interactions between the partners. Morgan and Hunt (1994) empirically tested the relationship between relationship commitment and cooperation between trading partners. They found that, in the context of retailer and distributor relationships, relationship commitment positively influences acquiescence and cooperation, but inversely influences propensity to leave.

From the perspective of transaction cost theory, relationship commitment is an investment in transaction-specific assets which are difficult or impossible to re-deploy when the relationship is terminated (Heide, 1994). Williamson (1985) believed that reciprocal or joint commitment can lead to stable long-term relationships in which opportunistic behaviors are reduced. With relationship commitment, both partners in a transaction have a willingness to communicate and share information to understand each other so as to reduce opportunistic behaviors, which in turn leads to low transactions costs. As a result, if a company invests in a relationship with a partner, the company will more likely cooperate or integrate with that partner.

Because SCI is created by cooperative, mutually beneficial, partnerships with supply chain members (Wisner and Tan, 2000), relationship commitment as such plays a very important role in SCI. In order to have a higher degree of integration with the supplier or customer, there has to be information sharing, coordination, and synchronization of the processes between the manufacturer and the supplier or the customer. Beth et al. (2003) advocated that relationship commitment is a key enabler in achieving "supply chain integration". With relationship commitment, supply chain partners will become more intrinsically tied to established goals, and more willing to share information and integrate their business processes (Chen and Paulraj, 2004). They will also establish long-term relationships with their partners, and learn more about their customers' wants and needs, and tailor their product development and marketing strategies accordingly (Levitt, 1986). Zhao et al. (2008) found that relationship commitment to the customer improved customer integration directly, but they did not investigate the impact of relationship commitment to the supplier on supplier integration, or the impact of internal integration on external integration. Our study expands on this by examining the impact of relationship commitment of the manufacturer to customers and suppliers on external integration with both customers and suppliers. As such, we propose the following hypotheses:

H3. Relationship commitment to the customer is positively related to customer integration.

H4. Relationship commitment to the supplier is positively related to supplier integration.

2.5. The interactive effect of internal integration and relationship commitment on external integration

In addition to the independent effects of internal integration and relationship commitment on external integration proposed

in Hypotheses 1–4, internal integration and relationship commitment may also interact to influence external integration. On the one hand, with the help of relationship commitment, companies can take advantage of internal integration to achieve a higher level of external integration. For example, some companies have good information systems to share information with their supply chain partners. However, they may not have fully utilized the information sharing capabilities of the systems due to the lack of relationship commitment. Therefore, the degree of integration with the supply chain partner is lower than what it could be. As relationship commitment improves between the two partners, the stronger willingness to integrate with supply chain partners will push the company to a higher permission level for information sharing, which will allow them to fully utilize the information sharing capability to achieve a higher level of external integration. In this case, relationship commitment will enhance the effect of internal integration on external integration. On the other hand, when the company has a higher level of internal integration, the company will be more capable to take advantage of the willingness to integrate with its trading partners. For example, while the marketing function may have a high level of relationship commitment to customers, poor internal integration may hinder the cooperation of the marketing function with manufacturing and purchasing, which are needed to integrate with the customer to better meet customer's requirements. In contrast, when there is a high level of internal integration among different functions, the company will be able to take full advantage of increased relationship commitment in improving external integration. So, we propose the following hypotheses:

H5. The interaction of internal integration and relationship commitment to the customer is positively related to customer integration.

H6. The interaction of internal integration and relationship commitment to the supplier is positively related to supplier integration.

2.6. The impact of ownership

The ownership of Chinese companies mainly consists of collectively owned enterprises (COEs), state-owned enterprises (SOEs), privately owned enterprises (POEs), JVs, and foreign-owned enterprises (FOEs) (Jefferson et al., 2000; Peng, 2003; Tan, 2002). As a willingness to maintain the relationship, relationship commitment may have different impacts on the integration between supply chain partners across different ownerships. In particular, the role of relationship commitment in reducing uncertainty is expected to differ among different ownerships. Chinese controlled companies (COEs, SOEs, and POEs), in contrast to foreign controlled companies (JVs and FOEs), have a Chinese collectivism culture as the dominating company culture, which is characterized by Guanxi networks (Wong et al., 2005; Zhao et al., 2006). As Guanxi is the granting of preferential treatment to business partners in exchange for favors and obligations (Lee et al., 2001), it requires reciprocity, or the obligation to return a favor (Jiang and Prater, 2002). In a Guanxi network, in-group supply chain partners with a higher level of trust and relationship commitment will get preferential treatment (Arias, 1998; Farh et al., 1998; Tsui and Farh, 1997).

Peng and Heath (1996) suggested that, compared to common Western business practices, Chinese companies operating in the dynamic transitional economy are more likely to rely on network contacts and personal trust to minimize uncertainties in a rapidly changing environment. They state that "... in a volatile and uncertain environment, networks stabilize economic activities by having members engage in reciprocal, preferential, and mutually supportive action" (Peng and Heath, 1996, p. 514). For Chinese controlled companies, without relationship commitment in the Guanxi network, external integration will be very low, even though the capability to integrate may be in place. In contrast, most foreign controlled companies are more advanced in applying supply chain management practices and information technology, such as ERP systems. As a result, they rely more on the use of technology and advanced practices to integrate with their customers or suppliers. They often first integrate their own systems and processes internally, and subsequently try to influence their partners to integrate with their systems. So, we propose the following research hypotheses:

H7. The impact of relationship commitment to the customer on customer integration will be significant for Chinese controlled companies, but non-significant for foreign controlled companies.

H8. The impact of relationship commitment to the supplier on supplier integration will be significant for Chinese controlled companies, but non-significant for foreign controlled companies.

Considering the varying levels of operations strategy formulation and execution, available manufacturing technologies, and supply chain management experience across different ownerships, it is expected that internal integration may impact differently on external integration. Most Chinese controlled companies may exhibit lower levels of information system capabilities, and internal systems and process integration. In order to integrate with their customers and suppliers, they have to enhance their internal capabilities, causing internal integration to become an important enabler for external integration. Most foreign-owned companies often show a higher level of adoption of advanced information systems, manufacturing technologies and practices (such as TQM and JIT, etc.), and supply chain management practices due to the influence of the parent company. Sometimes, foreign controlled companies may transfer their information systems, processes, facilities, equipment, human resources, and management style directly from their home countries to China. They may also adopt the same inter-organizational information systems, process and other management practices. The pattern and evolution of SCI in foreign controlled companies, which are advanced in technologies and management experience, may differ from Chinese controlled companies, which lack in these aspects. So, we propose the following hypotheses:

H9. The impact of internal integration on customer integration will be different between Chinese controlled companies and foreign controlled companies.

H10. The impact of internal integration on supplier integration will be different between Chinese controlled companies and foreign controlled companies.

2.7. Control variable

Aside from the enablers of internal integration and relationship commitment, other factors, such as company size, may also influence external integration. Larger companies may have more resources for supply chain activities. As a result, they may achieve a higher level of external integration in comparison to small companies. However, empirical evidence for the relationships between SCI and company size were mixed (Frohlich and Westbrook, 2001; Pagell, 2004). Therefore, we included company size as a control variable in our model.

3. Research design and methodology

3.1. Questionnaire design

Based on the relevant supply chain management literature and theoretical framework described earlier, a survey instrument

was designed to measure relationship commitment and varying types of SCI. In addition, the questionnaire also included the demographic profile of the company such as industry, ownership, size and location. In this study, we conceptualized SCI as having three dimensions: internal integration, external integration with customers, and external integration with suppliers. We used two major dyadic relationships (manufacturer–major supplier, and manufacturer–major customer) to represent the relational horizon of relationship commitment of the manufacturing company in the supply chain.

There are several major reasons for taking this approach. First, relationship commitment and SCI across supply chains are very complicated. To concretely measure SCI and relationship commitment, we simplify a supply chain as a supplier–manufacturer–customer chain and measure the two dyads from the perspective of the manufacturer. Since the supplier and the customer may have different power over the manufacturer, the manufacturer may have different levels of relationship commitment and SCI with the supplier and the customers. Therefore, we need to measure relationship commitment and external integration with customers and suppliers, separately. Second, since the content of supplier integration is different from that of customer integration, we have to develop separate measures for supplier and customer integration. Third, in order to examine the effects of internal integration and relationship commitment on customer and supplier integration, we need to capture the content, degree of relationship commitment, and SCI with customers and suppliers, separately. As such, in our study, the relationship commitment to both customers and suppliers represents the relational horizon in the simplified supply chain. Likewise, internal integration, supplier integration, and customer integration reflect the overall level of SCI in the simplified supply chain. Furthermore, as a manufacturer may have many suppliers and customers, and the level of relationship commitment and SCI might be different for different customers and suppliers, we limited our questions on relationship commitment and external integration as they apply to the company's major customer and major supplier. The major customer is defined as the customer who buys the highest dollar value of the respondent's products. Likewise, the major supplier is defined as the supplier who supplies the respondent the highest dollar value of supplies among all suppliers.

The reasons for limiting our questions to the major customer and the major supplier in investigating relationship commitment and external integration are elaborated on next. First, the major customer and the major supplier are the most important supply chain partners for the respondent, and as such can be expected to have the highest degree of relationship commitment and SCI. Second, the single informant is more familiar with the major customer and the major supplier, and is more likely to provide accurate information on relationship commitment and external integration with that customer or supplier. Furthermore, focusing on the dyadic relationship with a major customer and a major supplier has been commonly used in supply chain relationship management and relationship marketing studies such as Fynes and Voss (2002), Fynes et al. (2005), Morgan and Hunt (1994) and Brown et al. (1995).

Both relationship commitment to the customer and relationship commitment to the supplier are measured by four items used by Morgan and Hunt (1994), using a 7-point Likert scale with "1" for "strongly disagree" and "7" for "strongly agree". These items were used in several later studies in the Operations Management area (e.g. Fynes and Voss, 2002; Fynes et al., 2005). Some other influential marketing studies used similar items to measure relationship commitment, such as Tax et al. (1998), Garbarino and Johnson (1999), and Brown et al. (2005). Hence, the selected items are deemed adequate in capturing the relationship commitment construct in a Chinese context after further validation by Chinese practitioners in the pilot-testing of the survey instrument.

Customer integration, supplier integration, and internal integration are measured by 11, 13, and 9 items, respectively. Some items from previous studies were modified and some new ones were added to operationalize these constructs. Of the 11 items of customer integration, nine items measure information sharing and cooperation, and were adopted from Narasimhan and Kim (2002), and Frohlich and Westbrook (2001). The remaining two items about customers' point of sales and forecasting information sharing are newly developed to enhance the measurement of customer integration. Of the 13 items of supplier integration, eight items were adopted from Narasimhan and Kim (2002) and Frohlich and Westbrook (2001) to measure information sharing and cooperation. Another four items are newly developed to capture the extent of information sharing in supplier integration. The last item is designed to measure cooperation. For the nine items of internal integration, the first six items were adopted from Narasimhan and Kim (2002) to measure data or information integration and process integration. The last three items are newly designed to capture cross-functional teams and full functional integration for this study, providing a deeper understanding of the content of internal integration. In all these SCI questions, a 7-point Likert scale was used with "1" for "not at all" and "7" for "extensively". Company size was measured by three items including number of employees, fixed assets, and total sales.

To ensure the reliability of the questionnaire, its English version was first developed and subsequently translated into Chinese by an operations management professor. The Chinese version was then translated back into English by another operations management professor. This translated English version was then checked against the original English version for any discrepancies, and adjustments were made to reflect the original meaning of the questions in English. The questionnaire was pilot tested using a sample of 15 companies before full scale launch of the survey. The researchers discussed the survey questions face-to-face with managers after they filled out the questionnaire and clarified the meaning of the questions with them. When there was any confusion, the wording of the questions was modified. The measurement items are shown in Appendix A.

3.2. Sampling and data collection

To test the proposed hypotheses, 4569 companies were randomly selected from five major cities in China representing the national economy of China (Zhao et al., 2006). These five cities are Chongqing, Tianjin, Guangzhou, Shanghai, and Hong Kong. Chongqing is a traditional industrial base in the central part of China, and at a relatively early stage of economic reform and market formation. Tianjin is an industrial base in Northern China, reflecting the "average" stage of economic reform and market formation in China. Guangzhou and Shanghai are in Southern and Eastern China, respectively, and have enjoyed a higher degree of economic reform. There are few SCI activities in other parts of mainland China because their economy is still developing. Hong Kong was chosen as being different from mainland China, as Hong Kong has a well-developed and established business structure.

The sampling frame of manufacturing firms in China consisted of the Yellow Pages of China Telecom in each of the four cities in mainland China, and the Directory of the Chinese Manufacturers Association in Hong Kong. These companies represented a wide variety of industries.

An issue confronted in this research dealt with how to collect reliable data concerning relationship management and process integration with internal functions, customers and suppliers within

the supply chain. Many studies used a single informant in studying relationship issues between different organizations (e.g., Hewett and Bearden, 2001), while some researchers have demonstrated the benefits of using multiple informants (e.g. Bruggen et al., 2002). After visiting 15 companies during the pilot-testing of the questionnaire, it was established that the best way forward was to get one key informant who is knowledgeable in supply chain management, and is familiar with internal processes, processes for purchasing and distribution, and customer and supplier relationship management. Such key informants included supply chain managers, CEO, presidents, senior executives, vice presidents, senior directors and senior managers. Selected companies were contacted by telephone to identify the name and contact information of the most suitable informants who were in charge of supply chain management, purchasing and marketing, sales, or operations. The best suited informant was then sent the questionnaire, along with a cover letter highlighting the objectives of the research and its potential contribution to the respondent. Follow-up telephone calls were made to improve the response rate, and respondents were contacted to clarify missing data in their responses. This resulted in 617 usable questionnaires from a total of 4569 contacted companies in 2004; of which 3126 were classified as manufacturers; yielding a usable response rate of 19.7%. A check of normality showed the data to be approximately normally distributed.

3.3. Respondent profile

Table 1 shows the profiles of respondent companies. A wide variety of industries are represented, with about 28% of the companies coming from the metal, mechanical and engineering industry sector, about 18% of the companies producing textiles or apparel, and 13% of the respondents representing electronics and electrical companies. Across the five selected cities, different industry sector concentrations emerge. About 36% of Hong Kong companies belong to textiles and apparel, in contrast to only about 4% in Chongqing. Likewise, about 9% of Hong Kong respondents are from metal, mechanical and engineering, as compared to 36% in Chongqing and 42% in Shanghai. Company size also varies widely, with over 32% of respondents showing annual sales of less than HK$5 million, and 15% showing an annual turnover of more than HK$100 million. Detailed information on the sample demographics is shown in Table 1.

3.4. Non-response bias, common method bias, and sampling bias

As in all empirical studies, non-response bias is a concern. Early and late (after four or more calls) responses on physical assets, annual sales, and number of employees were compared (Armstrong and Overton, 1977; cf. Handfield and Bechtel, 2002; Stank et al., 2001a), with the *t*-test showing no significant differences, indicating that non-response bias does not appear to be a major concern in this study.

Since we use one informant to answer the self-reported questionnaire in this study, potential common method bias is checked. Appropriate arrangements for the order of questionnaire items can reduce respondents' consistent motive to a certain extent so as to decrease the common method bias in self-reporting (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 relationship commitment and SCI are not similar in content, and the constructs are measured through 4–13 items. Furthermore, respondents are familiar with the constructs because they have been in a relatively senior position with responsibility for supply chain management for many years. Harman's one-factor (or single-factor) test of common method bias was performed on the variables of SCI and relationship commitment using exploratory factor analysis (EFA) (Hochwarter et al., 2004; Podsakoff and Organ, 1986; Podsakoff et al., 2003). The results show eight distinct factors with eigenvalues above or near 1.0, explaining 72.0% of total variance. The first factor explained 35.1% of the variance (not the majority of the total variance), which is acceptable for our study where constructs are correlated, both conceptually and empirically. To further assess common method bias, confirmatory factor analysis was applied to Harman's single-factor model (Sanchez and Brock, 1996). The model fit indices of $\chi^2(767) = 8092.83$, NNFI = 0.88, CFI = 0.89, RMSEA = 0.16 and SRMR = 0.13 were unacceptable and were significantly worse than those of the measurement model. This suggests that a single-factor model is not acceptable, thus any potential common method bias is small. As a third test of 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 (NFI by 0.00, NNFI by 0.01, CFI by 0.01), with the common method factor

Table 1
Company profiles.

Industry	Total (*N* = 617)	Hong Kong (*N* = 206)	Guangzhou (*N* = 104)	Chongqing (*N* = 104)	Shanghai (*N* = 100)	Tianjin (*N* = 103)
Arts and crafts	1.9%	0.5%	3.8%	4.8%	1.0%	1.0%
Building materials	5.0	1.9	6.7	8.7	7.0	3.9
Chemicals and petrochemicals	6.3	1.5	8.7	7.7	8.0	10.7
Electronics and electrical	13.1	13.6	9.6	11.5	11.0	19.4
Food, beverage and alcohol	4.9	5.8	5.8	4.8	1.0	5.8
Jewelry	0.5	1.0	0.0	0.0	0.0	1.0
Metal, mechanical and engineering	25.4	9.2	28.8	35.6	42.0	28.2
Pharmaceutical and medical	1.8	2.4	0.0	3.8	0.0	1.9
Publishing and printing	4.4	2.4	1.9	9.6	7.0	2.9
Rubber and plastics	6.6	9.2	2.9	2.9	8.0	7.8
Textiles and apparel	17.8	35.4	14.4	3.8	10.0	7.8
Toys	1.3	3.9	0.0	0.0	0.0	0.0
Wood and furniture	1.9	1.0	3.8	1.9	0.0	3.9

Sales	Total (*N* = 587)	Hong Kong (*N* = 176)	Guangzhou (*N* = 104)	Chongqing (*N* = 104)	Shanghai (*N* = 100)	Tianjin (*N* = 103)
<HK$5M	32.4%	9.1%	49.0%	33.7%	30.0%	56.3%
HK$5 to $10 M	14.1	9.1	18.3	12.5	16.0	18.4
HK$10 to $20 M	12.4	15.3	4.8	19.2	12.0	8.7
HK$20 to $50 M	15.8	22.2	12.5	16.3	15.0	8.6
HK$50 to $100 M	10.2	13.6	9.6	7.7	15.0	2.9
HK$100 M or more	15.0	30.7	5.8	10.6	12.0	4.9

Table 2
Reliability analysis.

Construct	Number of questions	Cronbach's alpha	CITC range of the underlying items
Internal integration	9	0.924	0.632–0.798
Customer integration	11	0.900	0.555–0.697
Supplier integration	13	0.944	0.580–0.834
Relationship commitment to the customer	4	0.902	0.729–0.813
Relationship commitment to the supplier	4	0.891	0.680–0.836

accounting for only 6.4% 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.

Since Fynes et al. (2005) identified potential limitations associated with the use of a major or focal customer and supplier, we performed additional analyses to safeguard against a possible sampling bias. First, we checked our samples to see whether there are major customers/suppliers. We found the mean percentage of sales to the major customer to equal 50% (with the 10th percentile at 15%), and the mean percentage of supplies from the major supplier to equal 52% (with the 10th percentile at 20%). These high values indicate that the responding companies do have a major customer and a major supplier. Second, to reduce the concern that there may not be a uniform perception of a major customer and supplier, we specifically indicate that the respondent should use "dollar value contributions" to identify the major customer and the major supplier, which is unambiguous.

3.5. Reliability and validity

A rigorous process was used to develop and validate the survey instrument, modeled on previous empirical studies (e.g. Chen and Paulraj, 2004; Garver and Mentzer, 1999; Min and Mentzer, 2004). Prior to data collection, content validity was supported by previous literature, executive interviews, and pilot tests. After the data collection, a series of analyses was performed to test the reliability and validity of the constructs.

First, the reliability of each construct was tested. Reliability is an assessment of the degree of consistency between multiple measurements of a variable (Hair et al., 1998). A strict process for scale development was conducted, particularly since the scales were being deployed in a very different national culture. We followed the two-step method used in Narasimhan and Jayaram (1998) to test construct reliability, employing EFA to ensure unidimensionality of the scales, followed by Cronbach's alpha for assessing construct reliability. EFA with principal components analysis was used for data reduction and for determining the main constructs measured by the items from different sources, including adaptations from previous studies or newly developed items. Varimax rotation with Kaiser normalization was used to clarify the factors (Loehlin, 1998). Three types of SCI, including internal integration, supplier integration and customer integration; and two types of relationship commitment, including relationship commitment to the supplier and relationship commitment to the customer, emerged. Measurement items all had strong loadings on the construct they were supposed to measure, and lower loadings on the constructs they were not supposed to measure, and the SCI and relationship commitment factors explained, respectively, 59.03% and 77.06% of the total variances, thereby demonstrating unidimensionality. The generally agreed lower limit for Cronbach's alpha is 0.60 (Flynn et al., 1990; Nunnally, 1994). Cronbach alpha values in Table 2 indicate that all constructs are reliable for this research (Nunnally, 1978). In addition, we used the corrected item-total correlation (CITC) reliability test (Kerlinger, 1986). Table 2 also shows that all CITC values were larger than 0.50, which is higher than the minimum acceptable value of 0.30. Based on the Cronbach's alpha values and CITC values, we conclude that the scales are reliable.

We also used CFA to further test unidimensionality and reliability. In order to balance SCI theories and Structural Equation Modeling (SEM) methods, the items with the largest 10 modification indices that can be explained theoretically are controlled in the model. The CFA factor loadings are shown in Appendix A. The average variance extracted (AVE) values for all constructs are higher than 0.50, except for customer integration (0.45). Though several items of customer integration have relatively low factor loadings, which lead to a relatively low AVE, we still keep these items because they are very important for the concept of customer integration (Flynn et al., 2010). According to Hu and Bentler (1999), our model fit indices (RMSEA = 0.072, 90% confidence interval for RMSEA = (0.070, 0.075), NNFI = 0.96, IFI = 0.97, CFI = 0.96, Standardized RMR = 0.067) are acceptable. In addition, other fit indices (Bentler and Bonett, 1980), such as $\chi^2 = 3215.68$ with degrees of freedom = 877, NFI = 0.95, RFI = 0.95, PNFI = 0.88, GFI = 0.79, AGFI = 0.76, PGFI = 0.70, are also acceptable. These model fit indices are also comparable to those of other SCI or operations management studies, such as Handley and Benton (2009), Koufteros et al. (2005), Koufteros et al. (2002), Shah and Goldstein (2006), and Shah and Ward (2007). This indicates that the model is acceptable and unidimensionality and reliability were further confirmed.

Next, discriminant validity and convergent validity were tested. Discriminant validity is the degree to which measures of different latent variables are unique, whereas convergent validity relates to the degree to which multiple methods of measuring a variable provide the same results (O'Leary-Kelly and Vokurka, 1998). O'Leary-Kelly and Vokurka (1998) also suggested that CFA is a more powerful tool for assessing convergent and discriminant validity,

Table 3
Correlations, means, and standard deviations.

	Rcc	Rcs	Ii	Ci	Si
Relationship commitment to the customer (Rcc)	1				
Relationship commitment to the supplier (Rcs)	0.51[a]	1			
Internal integration (Ii)	0.21[a]	0.20[a]	1		
Customer integration (Ci)	0.26[a]	0.21[a]	0.59[a]	1	
Supplier integration (Si)	0.11[a]	0.25[a]	0.52[a]	0.65[a]	1
Mean	6.16	5.62	4.05	4.26	3.51
S.D.	0.826	0.993	1.446	1.256	1.407

[a] Correlation is significant at the 0.01 level.

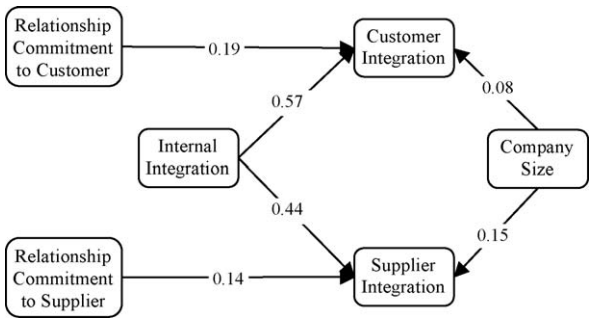

Fig. 2. Estimated structural equation model.

and requires fewer assumptions than the traditional Multitrait-Multimethod Matrix Method (MTMM). As such, CFA is used in our study to ascertain convergent and discriminant validity. In the model, each item is linked to its corresponding construct and the covariances among those constructs are freely estimated. In this study, the CFA model is acceptable. Furthermore, generally, a construct with either loadings of indicators of at least 0.50, a significant t-value ($t > 2.0$), or both, is considered to be convergent valid. For our model, all the factor loadings are greater than 0.50, and all t-values are greater than 2.0. Therefore, convergent validity is achieved.

In order to assess discriminant validity, a constrained CFA model is used for each possible pair of constructs in which the correlations among this pair of constructs are fixed to 1. This model is subsequently compared to the original unconstrained model, in which the correlations among constructs are freely estimated. A significant difference of the χ^2 statistics between the fixed and unconstrained models indicates high discriminant validity (Fornell and Larcker, 1981). In our study, all the differences of χ^2 between the fixed and unconstrained model were significant at the 0.05 level. As such, discriminant validity is ensured. Table 3 shows the mean, standard deviations of the major constructs and their correlations.

4. Analyses and results

SEM is used to estimate the relationships among different constructs and to test the four research hypotheses. SEM estimates were generated using LISREL 8.54 with the maximum likelihood estimation method. The goodness of fit indices for our model are $\chi^2 = 3345.78$ with degrees of freedom = 880, RMSEA = 0.073, 90% confidence interval for RMSEA = (0.070; 0.075), NNFI = 0.96, IFI = 0.96, CFI = 0.96, Standardized RMR = 0.095, NFI = 0.95, RFI = 0.96, PNFI = 0.88, GFI = 0.78, AGFI = 0.76, PGFI = 0.70. These indices are better than the commonly accepted threshold values (Hu and Bentler, 1999; Shah and Goldstein, 2006) and are comparable with those of other SCI models (e.g. Koufteros et al., 2002, 2005), and indicate that the model can be accepted for future discussion.

The results of hypotheses tests 1–4 using SEM are shown in Fig. 2 and Table 4. All four standardized coefficients are shown to be significant at the 0.05 level, suggesting support for hypotheses 1–4. Relationship commitment to the customer has a positive influence on customer integration, as does relationship commitment to the supplier have on supplier integration. Internal integration has a positive influence on both customer integration and supplier integration. We also found that company size has a positive impact on supplier and customer integration.

To further explore the relationships among relationship commitment, internal integration and external integration, we also tested the interactive effect of relationship commitment to customers and suppliers and internal integration, on external integration with customers and suppliers (Tables 5 and 6). However, no significant interactive effect was found, indicating that internal integration and relationship commitment influence external integration independently, and not interactively. As such, Hypotheses 5 and 6 were not supported. Furthermore, additional analyses also show that there are no significant mediating effects for the relationships between internal integration, relationship commitment and external integration.

Prior to testing Hypotheses 7–10, sample companies were classified according to their ownerships. SOEs and COEs are controlled

Table 4
Results of hypotheses 1–4 tests using SEM.

	Unstandardized coefficient	Standardized coefficient	t-value	Outcome
Internal integration → customer integration (H1)	0.53*	0.57*	9.32	Supported
Internal integration → supplier integration (H2)	0.42*	0.44*	8.31	Supported
RC to the customer → customer integration (H3)	0.31*	0.19*	4.91	Supported
RC to the supplier → supplier integration (H4)	0.21*	0.14*	3.67	Supported

* $p < 0.01$.

Table 5
Impact of internal integration, relationship commitment and their interaction on customer integration: OLS regression results[a].

Independent variable	Dependent variable: Customer integration			
	Model 1	Model 2	Model 3	Model 4
Constant	3.70 (.00)	2.07 (.00)	.85 (.01)	.83 (.01)
1. Size	**.20** (.00)	**.06** (.05)	**.07** (.02)	**.07** (.02)
2. Internal integration (II)		**.50** (.00)	**.47** (.00)	**.47** (.00)
3. Relationship commitment to customers (RCc)			**.21** (.00)	**.22** (.00)
4. II × RCc Interaction				.02 (.62)
R^2	.056	.358	.377	.377
F	36.22	171.16	123.44	92.53
d.f.	(1, 615)	(2, 614)	(3, 613)	(4, 612)
p-value	.000	.000	.000	.000
Change in R^2	–	.302	.019	.000
Change in F	–	**289.13**	**18.33**	.25
d.f.	–	(1, 614)	(1, 613)	(1, 612)
p-value (change)		.000	.000	.618

[a] p-values for each unstandardized parameter estimate are in parentheses. Significant parameter estimates and "change in F-value" ($p \leq 0.05$) are shown in bold.

Table 6
Impact of internal integration, relationship commitment and their interaction on supplier integration: OLS regression results[a].

Independent variable	Dependent variable: Supplier integration			
	Model 1	Model 2	Model 3	Model 4
Constant	2.85 (.00)	1.29 (.00)	.11 (.70)	.09 (.76)
1. Size	**.24** (.00)	**.10** (.00)	**.12** (.00)	**.12** (.00)
2. Internal integration (II)		**.48** (.00)	**.44** (.00)	**.43** (.00)
3. Relationship commitment to suppliers (RCs)			**.23** (.00)	**.24** (.00)
4. II × RCs Interaction				.05 (.15)
R^2	.062	.283	.308	.310
F	40.93	121.12	9.81	68.76
d.f.	(1, 615)	(2, 614)	(3, 613)	(4, 612)
p-value	.000	.000	.000	.000
Change in R^2	–	.221	.025	.002
Change in F	–	188.80	21.94	2.11
d.f.	–	(1, 614)	(1, 613)	(1, 612)
p-value (change)		.000	.000	.147

[a] p-values for each unstandardized parameter estimate are in parentheses. Significant parameter estimates and "change in F-value" ($p \leq 0.05$) are shown in bold.

by a state or local government or a working unit under the government. POEs are owned and managed by private Chinese individuals. These three ownerships represent Chinese controlled companies. JVs are jointly owned by Chinese and foreign investors, and are greatly influenced by foreign cultures. FOEs are wholly owned by foreign investors and are heavily influenced by foreign cultures. JVs and FOEs are foreign controlled companies. Since the ownership categorization in Hong Kong is markedly different from that in mainland China, Hong Kong companies are listed separately from other Chinese controlled SOEs, COEs or POEs. Hong Kong companies are usually influenced by a unique Hong Kong management culture, which is influenced by Chinese and foreign cultures. Therefore, the ownership was simplified into three major groups (Chinese controlled, foreign controlled, and Hong Kong controlled) according to their history and dominant management culture. SEM or the path analysis method could not be used to test Hypotheses 7–10 across the three ownership groups, due to the small sample sizes. As such, regression analyses were used to estimate the effects of internal integration and relationship commitment to customers/suppliers on customer/supplier integration. Table 7 shows the results of the regression analyses. The results for Hong Kong controlled companies are not reported in this table, as they are further analyzed in the regional analysis.

The results in Table 7 indicate that the impacts of relationship commitment to the customer on customer integration are different in companies with different ownerships. While relationship commitment to the customer/supplier has a significant positive impact on customer/supplier integration in Chinese controlled companies, it is not significant for foreign controlled companies. Therefore, these results support Hypotheses 7 and 8. It is interesting to point out that the impacts of internal integration on external integration are significant for both Chinese controlled companies and foreign controlled companies. As such, Hypothesis 9 and Hypothesis 10 are not supported. Considering that the relatively large sample size of Chinese controlled companies may influence the significance level of the results, we also randomly selected other samples of 70 Chinese controlled companies to run the regression models, yielding similar results to those of the original sample.

Companies in different industries may exhibit different approaches to external integration. We therefore tested the model for the three largest industries including metal, mechanical and engineering; electronics and electrical; and textiles and apparel. Because of the relatively small sample sizes we could not use SEM, and regression analysis was used instead, with results shown in Table 8. The results show that internal integration has a positive influence on external integration for the companies in all three industries. In contrast, only relationship commitment to the supplier in the metal, mechanical and engineering; and textile and apparel industries showed a positive impact on external integration. Likewise, relationship commitment to the customer showed a positive impact on external integration only in the electronics and electrical industry.

Furthermore, China is not a homogenous country and different regions have characteristics of their own, such as different sub-cultures, degree of development, political and economic climate, and the like. As such, the importance of internal integration and relationship commitment in improving external integration may be different across regions. We therefore also tested the conceptual model in different regions of China using regression analysis, with results shown in Table 9. The results show that inter-

Table 7
Impact of internal integration, relationship commitment and their interaction on external integration across ownerships: OLS regression results[a].

Independent variable	Dependent variable			
	Chinese controlled (N = 341)		Foreign controlled (N = 70)	
	Customer integration	Supplier integration	Customer integration	Supplier integration
Constant	.46 (.30)	−.52 (.17)	2.49 (.01)	.62 (.47)
1. Size	.07 (.11)	**.11** (.02)	.01 (.93)	.14 (.15)
2. Internal integration (II)	**.50** (.00)	**.48** (.00)	**.27** (.01)	**.30** (.01)
3. Relationship commitment (RC)	**.25** (.00)	**.31** (.00)	.13 (.38)	.24 (.13)
4. II × RC Interaction	.03 (.61)	.08 (.07)	**.25** (.05)	.07 (.52)
R^2	.415	.402	.282	.283
F	**59.58**	**56.45**	**6.37**	**6.41**
d.f.	(4, 336)	(4, 336)	(4, 65)	(4, 65)
p-value	.000	.016	.000	.000

[a] p-values for each unstandardized parameter estimate are in parentheses. Significant parameter estimates are shown in bold.

Table 8
Impact of internal integration, relationship commitment and their interaction on external integration across industries: OLS regression results[a].

Independent variable	Dependent variable					
	Metal, Mechanical and Engineering (N = 157)		Electronics and Electrical (N = 81)		Textiles and Apparel (N = 110)	
	Customer integration	Supplier integration	Customer integration	Supplier integration	Customer integration	Supplier integration
Constant	1.75 (.01)	.06 (.92)	−.61 (.56)	.31 (.72)	.60 (.33)	.12 (.85)
1. Size	.04 (.53)	.10 (.14)	.04 (.62)	.13 (.10)	**.12** (.03)	**.17** (.02)
2. Internal integration (II)	**.44** (.00)	**.35** (.00)	**.47** (.00)	**.51** (.00)	**.57** (.00)	**.40** (.00)
3. Relationship commitment (RC)	.10 (.40)	**.30** (.00)	**.48** (.00)	.15 (.25)	.18 (.08)	**.24** (.03)
4. II × RC Interaction	−.01 (.90)	.02 (.76)	−.11 (.40)	−.04 (.71)	.04 (.64)	.04 (.65)
R^2	.309	.270	.399	.412	0.519	.291
F	**17.00**	**14.09**	**12.60**	**13.31**	**28.36**	**10.79**
d.f.	(4, 152)	(4, 152)	(4, 76)	(4, 76)	(4, 105)	(4, 105)
p-value	.000	.000	.000	.000	.000	.000

[a] p-values for each unstandardized parameter estimate are in parentheses. Significant parameter estimates are shown in bold.

nal integration has a positive influence on external integration for companies across all five regions. Relationship commitment has significant impacts on both customer and supplier integration in Guangzhou. In Hong Kong and Shanghai, however, only relationship commitment to the customer shows a significant impact on customer integration, while only relationship commitment to the supplier has a positive impact on external integration in Chongqing and Tianjin. Overall, the results in Tables 8 and 9 show that internal integration has strong and significant impacts on external integration across regions and industries, but the effects of relationship commitment to customers/suppliers on integration with customers/suppliers depend on the type of industry and region.

5. Discussion and managerial implications

5.1. Improving external integration through internal integration or relationship commitment

Our study clearly shows, from both conceptual arguments and empirical evidence, that internal integration is an enabler for external customer and supplier integration, suggesting that an effective approach to enhance external integration is to pursue internal integration. This finding is partially supported by Braunscheidel and Suresh (2009), Carr and Kaynak (2007) and Koufteros et al. (2005).

In today's competitive environment, companies are forced to cooperate closely with their suppliers and customers to meet various challenges, such as requirements of low cost, high quality, better delivery, flexibility, customer service, innovation, and responding to a rapidly changing environment. Our findings indicate that companies need to progress from good internal practices and processes to effective management of external processes. For example, internal working team routines can evoke the participation of external supply chain partners. The joint planning of internal integration can be assimilated and learned by internal functions in order to establish cooperative plans with external supply chain partners. The internal trust and cooperative environment can be extended to involve external supply chain partners.

In comparison to internal integration, external integration represents a higher level of SCI and SCM capabilities. According to the stage theory of SCI as suggested by Stevens (1989, 1990), internal integration is a relatively low level of SCI, in which only the internal functions are integrated, while external integration is a relatively high level of SCI, in which also external supply chain partners are integrated. Flynn et al.'s study (Flynn et al., 2010) found that internal integration is the main enabler of business performance. Customer integration also significantly contributes to improvement in performance. However, supplier integration does not directly contribute to business performance, but enhances the positive effect of customer integration on business performance.

Our model also shows that relationship commitment significantly influences external integration, for both customer and supplier sides in a supply chain. This means that companies with a stronger relationship commitment to customers and suppliers are more likely to have a greater extent of customer and supplier integration. This finding is partially supported by earlier studies, such as Morgan and Hunt (1994), Chen and Paulraj (2004), and Zhao et al. (2008), who found that, with a higher level of relationship commitment, supply chain partners become integrated into their key customers' business processes and more closely tied to established goals.

Table 9
Impact of internal integration, relationship commitment and their interaction on external integration across regions: OLS regression results[a].

Independent variable	Dependent variable									
	Hong Kong (N = 206)		Guangzhou (N = 104)		Chongqing (N = 104)		Shanghai (N = 100)		Tianjin (N = 103)	
	Customer integration	Supplier integration	Customer integration	Supplier integration	Customer integration	Supplier integration	Customer integration	Supplier integration	Customer integration	Supplier integration
Constant	1.16 (.03)	.89(.12)	.25 (.70)	−.13 (.83)	.52 (.53)	-1.09 (.14)	0.91 (.20)	1.23 (.15)	1.51 (.17)	−.14 (.84)
1. Size	.05 (.32)	**.15** (.04)	−.02 (.76)	.11 (.18)	.08 (.29)	.10 (.24)	.08 (.23)	.08 (.26)	.20 (.07)	.14 (.24)
2. II	**.44** (.00)	**.37** (.00)	**.51** (.00)	**.36** (.00)	**.61** (.00)	**.62** (.00)	**.26** (.00)	**.29** (.00)	**.43** (.00)	**.47** (.00)
3. RC	**.20** (.02)	.11 (.22)	**.32** (.00)	**.29** (.01)	.15 (.29)	**.32** (.01)	**.35** (.00)	.19 (.16)	.11 (.53)	**.27** (.02)
4. II × RC	−.03 (.60)	.00 (1.00)	.02 (.80)	.04 (.57)	.03 (.78)	.13 (.14)	.03 (.67)	.17 (.14)	.06 (.60)	.06 (.41)
R^2	.341	.183	.493	.307	.512	.511	.254	.269	.357	.405
F	**26.03**	**11.23**	**24.06**	**10.96**	**25.93**	**25.87**	**8.10**	**8.72**	**13.63**	**16.65**
d.f.	(4, 201)	(4, 201)	(4, 99)	(4, 99)	(4, 99)	(4, 99)	(4, 95)	(4, 95)	(4, 98)	(4, 98)
p-value	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000

[a] p-values for each unstandardized parameter estimate are in parentheses. Significant parameter estimates are shown in bold.

Since SCI requires investment in time and other resources, partners must strongly commit to the relationship before conducting SCI activities. With a higher level of relationship commitment, customers or suppliers are more likely to cooperate with the manufacturer, thereby facilitating the external integration process. More specifically, strong relationship commitment will facilitate the trading process and reduce transaction costs directly. Stable supply chain relationships will help the supply chain achieve better supply chain performance, and hence benefit all supply chain partners.

Another very interesting finding is that the impact of internal integration on external integration is much stronger than that of relationship commitment, highlighting the importance of building effective internal integration capability. From an organizational learning perspective, the company will be more capable to learn from external partners and understand the partner's business to facilitate external integration when it shows a high level of absorptive capability to process new knowledge acquired from external suppliers or customers. Therefore, internal integration capability is the foundation for effective external integration. While relationship commitment indicates the willingness to integrate with external partners, effective external integration cannot be achieved if the company does not have the capability to engage in external integration as a result of a lack of internal integration. Therefore, relationship commitment cannot greatly enhance external integration without the support of internal integration. Many manufacturers fail to recognize the importance of internal efforts when pursuing external collaboration with their supply chain partners. This may stem from a belief that external cooperation with partners is only related to their external efforts, such as building and maintaining good relations with their partners. However, our findings indicate that companies must also greatly improve their internal systems and processes and achieve a higher degree of internal integration in order to achieve effective integration with their customers or suppliers.

Our analyses also indicated that there is no interactive effect of relationship commitment and internal integration on external integration. This means that internal integration and relationship commitment are two different approaches to external integration. Relationship commitment cannot improve the role of internal integration in improving external integration, and vice versa. Both methods are effective for managers to pursue a high level of external integration, and managers can work on either relationship commitment or internal integration when implementing external integration.

5.2. The approaches to external integration in different contexts

Internal integration is an important enabler for both customer and supplier integration for all companies across different ownerships. While neither relationship commitment to customers, nor to suppliers, exhibits any significant influence on external integration with either customers or suppliers for foreign controlled companies, relationship commitment to both customers and suppliers significantly influences external integration with customers or suppliers for Chinese controlled companies. This shows that relationship commitment is helpful in improving external integration in Chinese controlled companies, while its usefulness in enhancing external integration in foreign controlled companies cannot be demonstrated. This difference can be explained by the respective underlying dominant management cultures. As Chinese controlled companies are mainly controlled and managed by Chinese, they exhibit a predominant Chinese management culture. Due to high collectivism and emphasis on Guanxi in the Chinese management culture in regard to inter-organizational collaboration, relationship commitment to customers and suppliers plays a more important role. In contrast, foreign controlled companies are mainly controlled and managed by foreigners and hence exhibit a predominant Western management culture. These companies do not depend that much on Guanxi or relationships in conducting businesses, and hence relationship commitment plays a less important role in their efforts to enhance external integration with their supply chain partners. In fact, many foreign firms have a negative connotation of "Guanxi" in supply chain management, as it makes the selection of partners partially independent from market forces and the logic of merit. Therefore, relationship commitment may not be useful in fostering external integration in foreign-controlled firms.

In addition to culture and an emphasis on "Guanxi", one can also posit alternative explanations for the different roles that relationship commitment plays in improving external integration in Chinese-owned, vis-à-vis foreign-owned companies. For example, foreign-controlled companies often have better internal integration capabilities in comparison to their Chinese-controlled counterparts as a result of having implemented more advanced information systems and cross-functional management practices transferred from their parent companies. Foreign-controlled companies often use their internal integration capabilities to drive external integration with customers and suppliers, making internal integration the more important precursor for external integration, as compared to relationship commitment. Furthermore, many foreign-controlled plants in China may act as satellite production units for intermediate and/or export-oriented products or components. Such companies may have a particular approach to external integration with their mother companies or special supply chain partners, making relationship commitment less of an issue for SCI. The large geographical distance and the different time zones associated with foreign customers or suppliers may also hinder Guanxi from effectively influencing external integration. Moreover, in foreign-controlled companies, proprietary rules are generally emphasized to better protect intellectual property, especially in the context of China. In such cases, requirements of confidentiality would limit the relational propensity of foreign-controlled companies to use relationship commitment to pursue external integration. The former discussion indicates that more research is needed to further explain the differences in the roles that relationship commitment and internal integration play in enhancing external integration between foreign and Chinese controlled companies.

Our finding shows that internal integration is positively related to external supplier and customer integration across all three industries. In the metal, mechanical and engineering industry; and textiles and apparel industry, the impact of relationship commitment to the customer on customer integration is non-significant. Yet, the impact of relationship commitment to the supplier on supplier integration is significant. In contrast, in the electronics and electrical industry, the impact of relationship commitment to the supplier on supplier integration is non-significant. Yet again, the impact of relationship commitment to the customer on customer integration is significant. This may be explained by the fact that for electronics and electrical products, requirements of customers change frequently and product life cycles are very short, prompting manufacturers to design their products in close cooperation with customers. As a result, relationship commitment to the customer has a positive impact on customer integration. In contrast, metal, mechanical and engineering; and textile and apparel industries exhibit longer product life cycles with lesser customer involvement. This may explain why relationship commitment to the customer in these two industries is not important in improving customer integration. In terms of supplier integration, major suppliers of companies in the metal, mechanical and engineer-

ing; and textile and apparel industries may provide mainly raw materials, which are key in the value creation process. As such, manufacturers need to develop good relationships with their suppliers in order to facilitate integration with them. In contrast, major suppliers of companies in the electronics and electrical industry may provide mainly standardized components, which may be readily available from different providers in the market. As such, having close relationships with suppliers does not have a main impact on enhancing supplier integration. Further research is needed to provide detailed explanations for the differences in the importance of relationship commitment in different industries.

These findings provide significant implications for companies in different industries. For all companies studied, internal integration proved important in improving external integration. Yet, companies in different industries could selectively deploy relationship commitment for improving external integration, pending what relationship building (towards customers or suppliers) is called for. From our former discussion, companies in the metal, mechanical and engineering- or textiles and apparel industry should rely on internal integration in improving customer integration, and build supplier integration through supplier relationship commitment. On the other hand, companies in the electronics and electrical industry should depend more on internal integration to enhance supplier integration, and build customer integration through customer relationship commitment.

Aside from selective use of relationship commitment to enhance external integration across industry groups, our findings further demonstrate regional differences in China. For Hong Kong, Guangzhou and Shanghai companies, relationship commitment to the customer is important in enhancing customer integration, whereas companies located in Guangzhou, Chongqing and Tianjin call for relationship commitment to the supplier in improving supplier integration. This may be explained by the fact that Hong Kong, Guangzhou and Shanghai enjoy a relatively high economic development with fierce market competition, where close relationships with external supply chain partners play an important role in external integration. In contrast, Chongqing and Tianjin are characterized by more subdued economic development and a low marketization level, and customer relationship management is shown not to be of importance in building external SCI. Our finding also shows that all companies across the five regions of China should use internal integration to implement external integration. These initial results call for additional future research to gain more insights across regional differences in China.

6. Conclusions and future research

With the growing importance of relationship commitment and recognition of different types of SCI over the past decade, it is essential to improve our understanding of these constructs and their associated interrelationships. This research contributes to the literature by developing and empirically testing a relationship commitment—SCI model based on a sample of manufacturing firms in China. The model includes relationship commitment to both the customer and the supplier, and three types of SCI. Empirical evidence is presented for the enabling influences of internal integration and relationship commitment on external integration, simultaneously. This study also demonstrated the positive effects of relationship commitment on external integration in Chinese controlled companies, whereas such effects were statistically non-significant in foreign controlled companies. Furthermore, the impacts of relationship commitment on external integration were also found to be different across different industries and regions in China.

Findings from this study also provide some guidelines for managers to direct their management actions for achieving better external integration. In particular, better external integration may be achieved by first paying attention to internal integration, which proves much more important than relationship commitment. In addition, relationship commitment to customers or suppliers, which positively influences customer or supplier integration, is an additional enabler for enhancing external integration. However, companies with different ownerships may put different emphasis on relationship commitment in improving external integration with customers or suppliers. Also, companies across different industries or regions should be cautious when and where to deploy relationship commitment to the customer/supplier to enhance external customer/supplier integration.

While this study makes significant contributions towards the understanding of the relationship between internal integration, relationship commitment, and external integration, there are also some limitations and more opportunities for future research. First, while this study reveals that ownership as a proxy for culture does influence the role that relationship commitment plays in improving external integration, we did not measure culture directly. Furthermore, we only used data from China. To further explore the effects of culture on the relationships between internal integration, relationship commitment, and external integration, we need to collect data from multiple countries and measure the cultural values directly. Using data from multiple cultures, we will be able to investigate the effects of cultural values in the relationships between internal integration, relationship commitment, and external integration. Second, the difference in the role that internal integration and relationship commitment play in improving external integration can also be caused by other factors. While we provided some alternative explanations, further research is needed to test and validate these propositions. Third, this study also indicates some differences in the role that relationship commitment played in improving external integration across industries and regions. However, we were not able to fully explain these differences. Further research is needed to better understand such differences. Fourth, other factors that may influence SCI and relationship commitment, such as dependence, trust, use of power, etc. were not included in this study. Future studies should investigate how these factors influence relationship commitment and SCI. Fifth, like many other previous SCI studies, the measurement of SCI is mainly governed by an information systems and process management perspective. Future research may investigate SCI in a wider framework, including strategy management, quality management, production systems (e.g. lean and agile production), human resources management, technology management, financial management, and the like. Our study, as many previous studies, measured customer and supplier integration in a similar manner; future research may differentiate between both constructs to distinguish buy-side and sell-side integration. Furthermore, this study only took a manufacturer perspective, and future research could investigate the constructs and the relationships among them concurrently from a supplier, manufacturer, and customer perspective. Sixth, while this study only investigated a dyadic relationship with the major customer and the major supplier, future research may further examine the full relational horizon of the company and the corresponding external integration to better understand relationship commitment and SCI. Finally, this study used cross-sectional data. Future longitudinal studies could be conducted to investigate the evolution of internal integration, relationship commitment, external integration, and how they interact with each other in affecting business performance over time.

Appendix A. Construct measurement

	Factor loading	Mean	S.D.
Relationship commitment to the customer (AVE: 0.70)			
The relationship that our firm has with our major customer is something we are very committed to	0.86	6.05	0.973
The relationship that our firm has with my major customer is something our firm intends to maintain indefinitely	0.87	6.18	0.910
The relationship that our firm has with my major customer deserves our firm's maximum effort to maintain	0.83	6.10	0.990
It is very important for our organization to maintain the relationship with our major customer	0.77	6.31	0.876
Relationship commitment to the supplier (AVE: 0.69)			
The relationship that my firm has with my major supplier is something we are very committed to	0.89	5.51	1.168
The relationship that my firm has with my major supplier is something my firm intends to maintain indefinitely	0.90	5.67	1.131
The relationship that my firm has with my major supplier deserves our firm's maximum effort to maintain	0.77	5.35	1.266
It is very important for our organization to maintain the relationship with our major supplier	0.74	5.97	0.993
Internal integration (AVE: 0.56)			
Data integration among internal functions.	0.62	4.06	1.839
Enterprise application integration among internal functions	0.63	3.67	1.879
Integrative inventory management	0.73	3.74	1.956
Real-time searching of the level of inventory	0.74	4.21	1.869
Real-time searching of logistics-related operating data	0.74	4.05	1.821
The utilization of periodic interdepartmental meetings among internal functions	0.81	4.16	1.861
The use of cross-functional teams in process improvement	0.88	3.90	1.724
The use of cross-functional teams in new product development	0.84	4.01	1.848
Real-time integration and connection among all internal functions from raw material management through production, shipping, and sales	0.71	4.67	1.681
Customer integration (AVE: 0.45)			
The level of linkage with major customer through information network	0.54	4.00	1.982
The level of computerization for our major customer ordering	0.54	3.73	1.986
The level of sharing of market information from our major customer	0.72	3.91	1.788
The level of communication with our major customer	0.70	5.22	1.356
The establishment of quick ordering system with our major customer	0.68	4.67	1.750
Follow-up with our major customer for feedback	0.64	4.86	1.616
The frequency of periodical contacts with our major customer	0.68	5.07	1.467
Our major customer shares point of sales (POS) information with us	0.69	3.90	1.849
Our major customer shares demand forecast with us	0.71	4.04	1.829
We share our available inventory with our major customer	0.71	3.62	1.873
We share our production plan with our major customer	0.71	3.80	1.921
Supplier integration (AVE: 0.57)			
The level of information exchange with our major supplier through information network	0.57	3.48	1.901
The establishment of quick ordering system with our major supplier	0.55	4.18	1.865
The level of strategic partnership with our major supplier	0.65	4.18	1.841
Stable procurement through network with our major supplier	0.61	3.76	1.904
The participation level of our major supplier in the process of procurement and production.	0.75	3.37	1.764
The participation level of our major supplier in the design stage.	0.75	3.10	1.768
Our major supplier shares their production schedule with us.	0.88	3.26	1.782
Our major supplier shares their production capacity with us.	0.86	3.26	1.753
Our major supplier shares available inventory with us.	0.86	3.17	1.768
We share our production plan with our major supplier.	0.88	3.22	1.817
We share our demand forecast with our major supplier.	0.79	3.56	1.855
We share our inventory level with our major supplier.	0.83	3.17	1.789
We help our major supplier to improve their process to better meet our needs.	0.69	3.91	1.838

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