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A resource-based view on enablers of supplier integration: evidence from China

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Abstract

Purpose – The purpose of this paper is to investigate the effects of human resource (HR) and manufacturing plant information technology (MP-IT) resource on companies' internal integration capabilities and how these resources/capabilities influence supplier integration.
Design/methodology/approach – Using data collected from 604 Chinese manufacturers, the authors empirically test the effects of different types of resources/capabilities on supplier integration.
Findings – The results show that HR has both direct and indirect effects on supplier integration through their effects on internal integration capabilities. MP-IT resource only has significant indirect effects on supplier integration through internal integration capabilities. The results also indicate that HR is more important than MP-IT resource in improving internal integration capabilities and supplier integration.
Originality/value – This study empirically investigates enablers of supplier integration in China, contributing to supply chain integration literature and practices.

Keywords China, Resource-based view, Human resource, Supplier integration, Internal integration, Manufacturing plant information technology
Paper type Research paper

1. Introduction

In recent years, there are hot debates on whether resource-advantage (R-A) theory or resource-based view (RBV) is an appropriate grounding theory for supply chain management (Barney, 2012; Hunt and Davis, 2008, 2012; Priem and Swink, 2012). Whatever the conclusions, purchasing function or supply chain management can be a source of sustained competitive advantages (Kim, 2009; Parmigiani *et al.*, 2011; Rajaguru and Matanda, 2013; Tracey *et al.*, 2005). According to these arguments, supplier integration, as a capability that has access to valuable resources from suppliers, could be a source of competitive advantages. Over the past two decades, the critical roles of supplier integration have been widely observed in companies (e.g. Zara, Dell, and Toyota) and empirically verified by researchers (Huo, 2012; Liu *et al.*, 2013; Wong *et al.*, 2011). For example, in a recent study, Ellram *et al.* (2013) suggested that the

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rivalry in factor market should be emphasized due to that companies increasingly rely on their suppliers to obtain competitive advantages. In the emerging economy like China, the issues of labor turnover and product quality strengthen the critical role of local suppliers in the global supply chain (Jiang *et al.*, 2009).

As an important manufacturing center of the world and representative of the emerging economy, China has received more and more attentions from academicians and practitioners. In particular, Chinese manufacturers are more involved into the global supply chains and their capabilities in supply chain integration will have a significant influence on their counterparts around the world. However, the theoretical understanding of supply chain integration and its enablers is limited in the emerging economy, especially in China (Liu *et al.*, 2013). Furthermore, although Chinese manufacturers can provide a valid context to develop and test the conceptual framework about supply chain management (Chen *et al.*, 2009), China's special cultural and developing institutional environment make the manufacturers have different behaviors from their counterparts in Western developed countries, which requires more rigorous studies to provide valuable theoretical and managerial implications to supply chain integration literature.

Although the rapid development of Chinese companies, many foreign companies have difficulties in strategically collaborating with Chinese suppliers (Wilkinson *et al.*, 2005). For example, in the automotive industry, the collaborative capability of Chinese suppliers is limited (Lockström *et al.*, 2010). Furthermore, Chinese suppliers greatly influence the competitiveness of global buyers in term of cost, quality, delivery, flexibility, and innovation. Therefore, it is interesting and important to understand what factors are helpful to facilitate supplier integration in China.

Previous studies of supplier integration identify relational, environmental, intra- and inter-organizational factors that enable supplier integration (Koufteros *et al.*, 2007; Min and Mentzer, 2004; Paulraj and Chen, 2007a; Vijayasarathy, 2010b; Zhao *et al.*, 2008). For example, inter-organizational relationship-specific factors such as trust and power can improve supplier integration (Yeung *et al.*, 2009). However, given that supplier integration is a significant source of competitive advantages, it is also critical to understand the impact of firm-specific resources and capabilities. Although it has been conceptually proposed that organizational resources/capabilities are antecedents of supply chain integration (Shub and Stonebraker, 2009), few empirical studies investigated the effect of firm-specific resources/capabilities on supplier integration. Therefore, the main purpose of this study is to empirically test the relationship between firm-specific resources/capabilities and supplier integration using data collected from Chinese manufacturers.

To understand how firm-specific resources/capabilities influence supplier integration, we use the theory lenses of RBV and socio-technical systems theory to identify the enablers of supplier integration. Internal resources/capabilities have been recognized as important enablers of supply management practices (Paulraj, 2011). For example, Zhao *et al.* (2011) found that internal integration capability is an important enabler of supplier integration. Following the similar logic, Huo (2012) found that internal integration, as a dynamic capability, can improve supplier integration. Therefore, in this study, we identify internal integration as one important capability that can facilitate supplier integration.

Furthermore, based on RBV and socio-technical systems theory, we identify two important firm-specific resources, human resource (HR) and manufacturing plant information technology (MP-IT) resources, which lead to supplier integration. There are

two major reasons to select HR and MP-IT resource in this study. First, Westrup and Liu (2008) argued that the use of technology is related to the national origins and found that China provides a useful setting to explore such a relationship. Thus, the investigation of the use of MP-IT in China and its influence on supplier integration can provide valuable implications to the application of socio-technical systems theory in supply chain management in China. Moreover, the effectiveness of technical system significantly relies on an adaptive social system (Kull *et al.*, 2013). Thus, considering that Chinese culture emphasizes the formal and informal human relations, interactions and behaviors, HR is another important driver of supplier integration for Chinese manufacturers. In addition, with the rapid globalization, the exploration of HR management (HRM) in the emerging economy is imperative so as to highlight its context-specific nature and effectiveness (Budhwar and Debrah, 2009). For example, Cooke (2005) found that the increasing economic liberalization due to globalization changes the way and the pattern of implementing HRM in China. Second, with the increasing labor and material costs in China, the effective management of HR and MP-IT is imperative for Chinese manufacturers to achieve competitive advantages. Thus, investigating HR and MP-IT is interesting and important and would give light on the contextual understanding on the enablers of supplier integration.

This study aims to address two research questions:

RQ1. How do HRs and MP-IT influence internal integration?

RQ2. How do HRs, MP-IT, internal integration influence supplier integration?

Through testing the conceptual model about relationships among these three firm-specific resources and capability and their effects on supplier integration based on data collected in China, this study has several contributions to the literature and practices. First, this study contributes to the antecedents of supplier integration literature. Second, this study contributes to the application of socio-technical systems theory in supply chain management. Third, the study contributes to our understanding on supplier integration literature and practices in China.

This paper is organized as follows. First, we review relevant literature on firm-specific resources/capabilities and propose a model about their effects on supplier integration. We then discuss research methodology and statistical analyses, after which we present the analytical results and discuss their theoretical and managerial implications. Finally, we present our conclusions, research limitations, and suggestions for future research.

2. Theoretical foundations and proposed hypotheses

2.1 Theoretical background and conceptual model

RBV explains how a company uses its firm-specific resources/capabilities, which are based on the internal strengths and weaknesses of the company, to gain sustained competitive advantages (Wernerfelt, 1984). These firm-specific resources/capabilities are distributed heterogeneously among companies, and are difficult to imitate and transfer (Peteraf, 1993). Thus, RBV demonstrates that the differences of competitive advantages among different companies are owing to their different resources and capabilities. In today's competitive environment, considering supply chain resources, only internal resources/capabilities are not sufficient to ensure competitive advantages. A company's internal resources/capabilities can enhance its ability to acquire and exploit external resources/capabilities (Lai *et al.*, 2012). Therefore, it is important

to investigate how firm-specific resources/capabilities enable a company to integrate supply chain partners, and to understand what types of internal resources/capabilities effectively facilitate the integration of external resources/capabilities in the supply chain context. Most previous studies of the enablers of supplier integration mainly focus on the relational, environmental, and inter-organizational antecedents (e.g. Vijayasarathy, 2010a). One exception is a case study that identifies suppliers' characteristics and capability as two enablers of supplier integration (Lockström *et al.*, 2010). However, it is still not clear whether the firm-specific resources/capabilities are effective in enabling supplier integration.

HR and MP-IT resource, as soft and hard resources, respectively, are two important firm-specific resources that can help companies to gain competitive advantages (Jones and Brown, 2002; Véronneau and Cimon, 2007). The socio-technical systems theory proposes that companies comprise both social and technical subsystems (Pasmore, 1988). The former consists of people who work with one another, whereas the latter includes equipment and technologies. HR and MP-IT resource are equivalent to the social and technical categories of a company's systems, respectively.

In this study, HR is represented by employee skill and employee participation. Employee skill refers to employees' knowledge and skills improvement through empowerment, cross-training, and learning (Li *et al.*, 2002). Employee participation refers to the involvement of the employee in problem solving and continuous improvement (Cua *et al.*, 2001). According to MacDuffie (1995), It is suggested that HR is useful when employees have and apply their skills, and when employees are encouraged to participate in decision making and collaborations. According to Cappelli (2012), HR is the human capital embedded in the workforce. It is classified as the people-dependent intangible resource (Fernández *et al.*, 2000). Valuable knowledge and personal relations are nurtured by years of effort and are not easy to imitate or replace. For example, an employee's knowledge of a particular supplier's products is referred to as "know-how," which may be tacit rather than explicit, and thus may not be easy to explain to others. Thus, consistent with RBV, employee skill and participation can create knowledge and are socially complex, which build advantages and inhibit transfer (Teece and Al-Aali, 2011).

Employee skill and participation belong to the important composition of the high involvement HR system (Batt, 2002). In this study, employee skill and participation are of particular interest in the Chinese context. First, in the competitive Chinese labor market, Chinese companies have great difficulties in attracting and retaining skilled employees (Cooke, 2005). It is very important to train and cultivate employees with firm-specific skills to achieve competitive advantages (Lepak and Snell, 1999). This is also a defensive method to boost employees' organizational commitment (Qiao *et al.*, 2009). Second, employee participation is relatively weak in Chinese companies because high power distance culture inhibits the involvement and sharing information of employees (Chow and Liu, 2009). Although Chinese employees are not accustomed to active participation, it is argued that employee participation is consistent with the philosophy of Confucianism and is expected to improve competitive advantages to the maximum extent (Warner, 2009).

MP-IT resource refers to the extent to which information technology including the technical and managerial applications of computer hardware and software are used in accomplishing development tasks and controlling production systems (Peng *et al.*, 2011). MP-IT resource helps Chinese manufacturers develop more complex competitive strategies with low cost and differentiation (Lei *et al.*, 1996). MP-IT resource is helpful in

reducing coordination costs, overhead costs, and operational complexities, and save time, money, and human capital (Bharadwaj, 2000; Subramani, 2004). As physical resources, the tangible elements of MP-IT resource, such as the software or systems, are easier to obtain than HR such as "know-how" or trust. For example, companies can easily purchase the hardware and the software of MP-IT resource in the market. In contrast, the intangible elements of MP-IT resource, such as the implementation of enterprise resource planning (ERP) systems, are difficult to imitate, especially if they are complex systems designed to integrate business processes (Boyer *et al.*, 1997). This type of MP-IT resource, which is complex if it is properly integrated with business processes, is hard to imitate and replace and is therefore valuable. Instead of the static resource perspective, the deployment of MP-IT is valuable, rare, imperfectly imitable, and non-substitutable (Fawcett *et al.*, 2011).

Internal integration refers to the degree to which a firm structures its own organizational strategies, practices and processes into collaborative, synchronized processes, in order to fulfill its customers' requirements and efficiently interact with its suppliers (Flynn *et al.*, 2010a, b). Internal integration is also defined as cross-functional integration (Foerstl *et al.*, 2013; Frankel and Mollenkopf, 2015; Hart and Service, 1993; Kusunoki and Numagami, 1998; Nakata and Im, 2010; Sherman *et al.*, 2000; Troy *et al.*, 2008). Internal integration plays an important role in improving competitive advantage (Antonio *et al.*, 2009; Yasumoto and Fujimoto, 2005), operational performance (Brettel *et al.*, 2011; Gomes *et al.*, 2003; Jayaram and Xu, 2013; Lee *et al.*, 2007; Liu *et al.*, 2012; Swink and Schoenherr, 2015) and financial performance (Flynn *et al.*, 2010a; Foerstl *et al.*, 2013).

From the capability-building perspective, capabilities reside in organizational memory and organizational routines (Peng *et al.*, 2008). Different from firm-specific resources, firm-specific capabilities are related to the coordination, optimization, learning, and transformation of business processes (Harreld *et al.*, 2007). Internal integration capabilities are important firm-specific capabilities in resource integration and transformation, which are fundamental capabilities for supply chain management (Wu *et al.*, 2006). Internal integration capabilities are a company's differentiated routines with multi-functional coordination and optimization (Verona, 1999; Wu *et al.*, 2010). They are capabilities to integrate different systems, flows, processes, and procedures (Verona, 1999; Weigelt, 2009). Therefore, HRs, MP-IT, and internal integration are firm-specific resources and capabilities.

Supplier integration, which is a sub-dimension of supply chain integration, can be defined as the degree to which a manufacturer cooperates with its key suppliers to fulfill its customers' requirements by shaping inter-organizational structures, strategies, and practices into collaborative and synchronized processes (Flynn *et al.*, 2010b). Supplier integration involves core competencies that are related to collaboration with critical suppliers (Flynn *et al.*, 2010b), such as strategic alliances, information sharing, and process coordination, in order to jointly resolve problems and facilitate operations (Zhao *et al.*, 2008). Through close integration with key suppliers, a manufacturer can leverage the resources/capabilities of its suppliers and reconfigure both parties' resources/capabilities to achieve better competitive advantages. In this study, we propose that firm-specific resources/capabilities enable companies to use supplier integration to access the resources/capabilities of their supply chain partners.

From the perspective of organizational capability (Huo, 2012), both internal integration and external integration are supply chain capabilities (Shore and Venkatachalam, 2003; Soosay *et al.*, 2008; Vanpoucke *et al.*, 2014; Zacharia *et al.*, 2009, 2011). While internal

integration is internally oriented capability, supplier integration is externally oriented capability. Compared with internal integration capability that may be relatively easy to manage within companies, external integration capability may be relatively difficult to achieve because external capabilities are mainly driven by resources of external supply chain partners that are not fully controlled by focal companies. Therefore, we need to examine the relationship between internal and external integration to find out the mechanism from internal to external supply chain capabilities.

We conducted a comprehensive literature review to identify antecedents of supplier integration (Table AI). Previous studies investigated the antecedents from various perspectives, such as external and internal environment, relational resources, IT resources, HRs, internal integration and other resources. Among them, some studies examined the combined resources, such as HRs and other resources (e.g. collaboration capability, internal support, IT), internal integration and other resources (e.g. relational resources, product strategies, external environments). For these resources, relational resources are mainly conducted by people, which are consistent with HRs. Therefore, HRs, IT, and internal integration are three major drivers of supplier integration. Among these three major drivers, Xu *et al.* (2014) examined the impact of HRs and IT on supplier integration, and Zhao *et al.* (2011) examined the impact of relational resources and internal integration on supplier integration. However, there is no study investigating the joint effect of HRs, IT, and internal integration on supplier integration. Therefore, in this study, we will cover this gap through examining the role of these three major resources in improving supplier integration. This study will identify the mechanism from internal firm-specific resources and capabilities to external supply chain capabilities.

2.2 Research hypotheses

2.2.1 Effects of firm-specific resources on capabilities. Employee skill and participation are HRM practices that focus on knowledge creation and combination of the employees. Subramaniam and Youndt (2005) suggested that the knowledge embedded in the mind of employees or social interactions of employees are critical resources of the company. From the perspective of organizational learning, they represent employees' knowledge and skill (Nonaka, 1994). HRM studies also supported its importance for human capital enhancement (Chen and Huang, 2009; Sundbo, 1999; Youndt *et al.*, 1996). Although there is lack of direct evidence, several studies have indicated the importance of HR for internal integration. For example, Snell and Dean (1992) found a positive relationship between staffing in quality and just-in-time inventory control. Hitt *et al.* (1993) also suggested that cross-functional appointments/training and multi-functional teams promote interfunctional integration.

The two components of HR, employee skill and participation, are proposed as key determinants of internal integration capability in this study. There are two reasons. First, internal integration needs efficient communication among employees. However, it may not be easy to exchange information due to functional fences. The training and learning throughout the company provide an effective platform for employees to exchange their information and ideas, which breaks down the wall between functions. A teamwork culture in problem-solving is also helpful for cultivating good relationships among employees that are beneficial for internal integration.

Second, the efficient communication depends on the common language used by employees from different functions. Employee skill represents companies' efforts in disseminating and developing new knowledge of employees through training, self-

learning, and multi-skill development. For example, multi-skill training provides a common understanding on the knowledge and information from different functions. Such knowledge can be very useful by providing a common language to employees. Employee participation fosters a kind of autonomy and interdisciplinarity that are important for knowledge transfer and creation among employees from different functions. Thus, data or information could be easily shared between functions based on common knowledge and language among employees (Cohen and Levinthal, 1990). Therefore, we propose:

H1. HR is positively related to internal integration capability.

MP-IT resource is closely embedded into different internal processes, such as manufacturing, planning, and product development. Competitive differentiation can be achieved through the way that MP-IT is used in such processes (Fawcett *et al.*, 2011). Many studies have shown that information technology is an important determinant of companies' internal integration. For example, Pagell (2004) suggested that information technology tools are necessary for integration of operations, purchasing and logistics. Park and Kusiak (2005) proposed that ERP systems resolve the fragmentation of information and help a company achieve process integration.

Internal integration requires the supports of MP-IT resource according to two reasons. First, MP-IT is mostly used to synchronize and automate manufacturing, planning, and product development processes in the company (Banker *et al.*, 2006). For example, ERP systems are deployed in the planning process, which facilitates the track and the control of ordering information throughout the company (Vollmann *et al.*, 1997). The application of computer-aided design (CAD), computer-aided manufacturing (CAM), and computer-aided process planning (CAPP) can help product and process design by building synchronized and automated processes (Liker *et al.*, 1998), which benefits data integration among different functions within a company in a timely manner.

Second, MP-IT resource provides a standard digital interface for integrating different functions, which strengthens the transparent and seamless exchange of data within the company (Boyer *et al.*, 1997; Diáz *et al.*, 2003). Digitalized processes with standardized interfaces are enabled by information technology. Data integration among different functions can be built into the MP-IT infrastructure that secures the consistency and standardized interface of data. Through these information technology infrastructures, information is easily transferred to other functions and communications among functions are greatly improved. Therefore, we propose:

H2. MP-IT resource is positively related to internal integration capability.

2.2.2 Effect of firm-specific resources on supplier integration. Companies have to overcome internal constraints to build supplier integration, which is lack of investigation in previous studies (Kull *et al.*, 2013). Companies need knowledge and tools to deal with upstream uncertainties. In establishing strategic relationships with suppliers, companies should have a deeper understanding of their suppliers (McAfee *et al.*, 2002). Such knowledge is often tacit and held by the employees, such as the person who contacts with suppliers. HRM activities, such as trusting and empowering employees and extensive employee motivation and training, enhance the retention of qualified employees (Huselid, 1995), which is useful for building long-term relationships with suppliers. The personal relationships that a company's employees develop with their suppliers' employees are difficult to transfer to other suppliers' employees, which benefits buyer-supplier relationships (Carey *et al.*, 2011).

Furthermore, employees having multi-skills are helpful in communicating with suppliers, improving processes together, and sharing information. As suggested by Cohen and Levinthal (1990), multi-skilled employees are needed for successful assimilation of external information and knowledge. The multi-skilled employees ensure the common background of knowledge of their counterparts in the supplier side and facilitate the dissemination and the assimilation of supplier information throughout the company. In our one executive interview, one R&D manager who previously worked in the production line has good knowledge of how the supplied materials influence their production process and cost structure of the products. With this experience, he pays great efforts in collaborating with the suppliers to reduce costs. This observation is consistent with the arguments of Kull *et al.* (2013) that the changing role of boundary spanner is an obstacle for suppler integration. Involving employees in problem solving and informing them quality information could also help employees have good knowledge of the supplied materials. Employees from suppliers are frequently involved in the problem-solving team of the company, which enables them to improve processes together (Koufteros *et al.*, 2005). Therefore, we propose:

H3. HR is positively related to supplier integration.

Investment in MP-IT is one of the major concerns when developing supplier integration capabilities because MP-IT enhances the flow of product information (Flynn and Flynn, 1999). MP-IT, as a quick-connect electronic interface, helps companies to facilitate information sharing and processing. MP-IT is widely applied in different processes, such as manufacturing, planning, and product development. In the manufacturing process, MP-IT is mostly used to synchronize and automate production processes on the shop floor (Banker *et al.*, 2006). The application of CAD, CAM, and CAPP can help the process of product design by building a common language (Liker *et al.*, 1998), making redesigning easier, and reusing old data promptly. Such functions help firms eliminate the non-value added activities, increase information processing flow, remove the information island and effectively link supplier information to the supply chain without any congestion (Lee, 2004; Min and Galle, 1999). Furthermore, MP-IT systems, such as ERP, contribute to better supplier integration through information sharing and dissemination (Sanders, 2005). Further, MP-IT can facilitate the supply chain integration through leveraging the human and social factors embedded in the collaboration and communication between supply chain partners (Paulraj and Chen, 2007a, b). Therefore, we propose:

H4. MP-IT resources are positively related to supplier integration.

2.2.3 Effects of firm-specific capability on supplier integration. RBV states that resources or capabilities can bring competitive advantages. Internal integration capability, as a dynamic organizational capability, can leverage other resources and capabilities for companies to achieve competitive advantages. Some literature argued that appropriate firm-specific capabilities are needed for establishing, maintaining, and monitoring portfolios or networks of business relationships (Wagner and Boutellier, 2002). Internal integration capability can be helpful in organizing internal resources for external collaboration (Zhao *et al.*, 2011). A company's internal integration capability is reflected in its integrative organizational structures, synchronized processes, collaborative routines, and values. A high level of internal communication and coordination among different functions could facilitate a high level of external supplier integration. For example, real-time information sharing and data integration among

different functions make it easier for the purchasing function to work with suppliers closely. With internal integration capability, companies can learn to work together with supply chain partners easily (Zhao *et al.*, 2011). Therefore, we propose:

H5. Internal integration capability is positively related to supplier integration.

Figure 1 illustrates the proposed relationships among firm-specific resources, capabilities, and supplier integration.

3. Research methodology

3.1 Questionnaire design

3.1.1 Dependent variable. The measures for supplier integration were adapted from extant literature (Flynn *et al.*, 2010b; Narasimhan and Kim, 2002) (Table AII). Respondents were asked to indicate the extent to which their company implements supplier integration practices using a 7-point Likert scale (1 = "not at all"; 7 = "extensively).

3.1.2 Independent variables. Based on previous studies (Ahire *et al.*, 1996; Cua *et al.*, 2001), HR is measured by assessing the level of implementation of HRM practices, and MP-IT resource is measured by assessing the level of MP-IT implementation in a company (Boyer *et al.*, 1997; Diáz *et al.*, 2003). As suggested by Shah and Ward (2003), the HRM practices used in Ahire *et al.* (1996), Cua *et al.* (2001) and Rungtusanatham *et al.* (2005) can be considered as the lower level practices of shop-floor employees, however, this study aims to measure the HRM practices in the whole company. Furthermore, during the interview and pilot tests before the administration of the survey, the interviewees (supply chain managers or general managers) stated that those items are too narrow to be used to evaluate the situation of HRM of the whole company. Thus, we adapted from extant literature and merged some lower level practices into higher level practices. Furthermore, Boyer and Pagell (2000) suggested that the lower level variables can be eliminated when using the higher level constructs. Thus, we combine those items used in previous literature into higher level items without missing important information. Similarly, the lower level items for MP-IT are also combined to form the higher level items in this study. We asked the respondents to

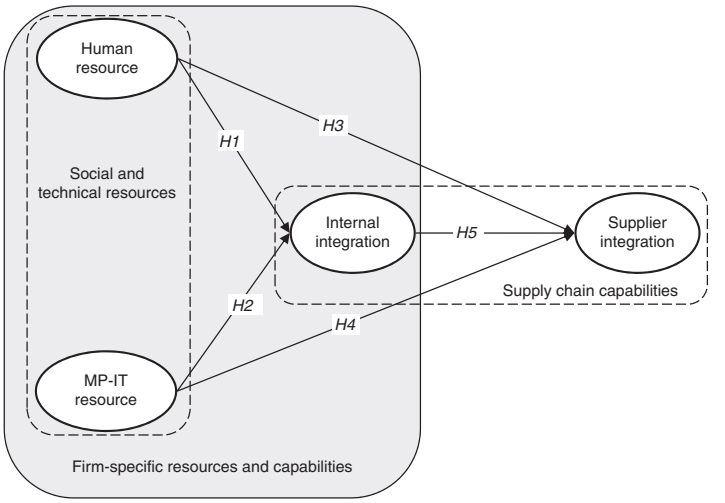


Figure 1.
Conceptual model

indicate the extent to which their companies use specific HRM practices and MP-IT systems, which are used as proxies for HR and MP-IT resource of the company, using a seven-point Likert scale (1 = "not at all"; 7 = "extensively").

Theoretically and practically, the two dimensions of HR, employee skill and employee participation, are highly correlated. On the one hand, employee skill makes employees capable to participate in operations of the company. On the other hand, employee participation helps employees to learn from each other and get the cross-training. Practically, many companies train employees to participate in various processes and the participation rewards the employees with cross-function skills. Methodologically, to use a second-order construct can make the model parsimonious. Therefore, we use the second-order construct for HR with two first-order constructs including employee skill and participation in this study.

3.1.3 Intervening variable. Capability is intangible in nature (Conner and Prahalad, 1996) and thus difficult to measure directly (Wu *et al.*, 2010). However, it is agreed that capability resides in routines (Wu *et al.*, 2010), and can be measured by routines from an operational perspective (Peng *et al.*, 2008). Internal integration capability is measured by the level of cross-functional integration of data, processes, and systems. Borrowing from Narasimhan and Kim (2002), we used four items to capture the routines that companies used to derive cross-functional knowledge and to cultivate integrative capabilities. We asked the respondents to indicate the extent to which their companies have certain routine-based activities, which are used as proxies for internal integration capability, using a seven-point Likert scale (1 = "not at all"; 7 = "extensively).

3.1.4 Control variables. Because companies with different sizes may have different resources and capabilities, we use company size as one control variable in the model. We measured company size using the number of employee. Similarly, companies in different industries may also have different resources and capabilities, therefore, we include industry as another control variable. Because there were twelve industries, we combined several highly related small industries to form big industries. Then, we measured food and beverage, electronic and transportation equipment, machinery, chemicals and petroleum using dummy variables with the basic group of textile and garments which is very popular in China.

To ensure the reliability of the questionnaire, the English version of the questionnaire was first developed and reviewed, and then translated into Chinese by knowledgeable professors of operations management. The Chinese version was then translated back into English by different professors. The back-translated English version was then checked against the original English version. Some Chinese questions were reworded to better reflect the original meaning of the questions in English. The Chinese version of the questionnaire was pilot-tested in more than 40 manufacturing companies in China. The data collected from the pilot tests were also used to check the face validity of the measures.

3.2 Data collection

A postal survey was used to collect the data. The research unit is the manufacturing company. Chinese manufacturers play an increasingly important role in global supply chains. Companies from developed countries increasingly source from China or outsource their manufacturing functions to China. When foreign companies source or relocate their plants in China, a key issue is how to manage their suppliers. They find that infrastructure and cultural issues can make supplier integration difficult (Han *et al.*, 2002; Li, 2007; Zhao *et al.*, 2008; Zhao *et al.*, 2011).

The key respondents were supply chain managers, operations managers, or general managers who had the knowledge to answer questions about operations management of their company and its major supply chain. The survey was conducted in 2005.

As China is a very large country, we used three representative and rapidly developing cities as target sampling areas: Shanghai, Guangzhou, and Beijing. The database of the Ebuywww Company, which provides professional business research services in China, formed our sampling pool. As suggested by Li *et al.* (2005), we excluded companies with less than 100 employees, as they are seldom involved in sophisticated supply chain management activities, finally, 9,764 companies meet this criterion.

To improve the response rate, we adopted the approach suggested by Frohlich (2002). First, the companies were called to solicit their participation, and the best informants were identified. Research assistants made telephone calls to the selected companies to introduce the study and to identify a key informant within the company who was able to answer the questionnaire. We randomly selected 3,187 manufacturing companies from the database and sent questionnaires to the 2,724 companies with correct contact information. After two rounds of reminders, 614 companies completed and returned the questionnaires, representing a response rate of about 22.5 percent. After screening, we determined that ten of the 614 questionnaires had not been completed properly and were removed from further analyses. Then, we used 604 responses for our subsequent analyses. Table I shows the industry distribution of the respondents.

Following the advice of Malhotra and Grover (1998), we compare the industry distributions of the respondent companies and the total population. The results in Table I show that the industry distribution of the respondents is close to that of companies in the total population. A χ^2 test (1.17) indicates no significant difference between the distribution of respondents and that of the overall population ($p > 0.05$), suggesting that our sample is not biased toward any particular industry. Following the procedure suggested by Armstrong and Overton (1977), we compare the demographic variables and key constructs of the first and last quartiles of the responses. This comparison reveals no significant differences between the two quartiles, thus suggesting that non-response bias was not an issue.

We use Harman's single-factor test to examine the possibility of common method bias (Podsakoff *et al.*, 2003). The results show eight factors and the variance explained by the first factor is about 20 percent. We conclude that no single-factor or general factor explain the major variances. Therefore, common method bias is not an issue in this study.

Before we do further analyses, we replace missing values with means, check and find no outliers and no multicollinearity, and find that the statistical power is near

Table I.
Industry distribution of respondents

Industries	Respondents (%)	Population (%)
Food and beverage	10.10	8.66
Electronic and communication equipment	8.79	8.38
Transportation equipment	8.63	8.79
Textile and garments	33.22	33.37
Electrical equipment	8.38	10.93
Machinery	16.12	17.74
Chemicals and petroleum	7.17	6.97
Plastic and latex	5.37	5.16
Total	100	100

to 1.0. Multivariate normality (Raykov and Marcoulides, 2000) is verified using univariate Q-Q plots.

3.3 Psychometric tests

The internal consistency or reliability of the scales is assessed using Cronbach's α. Table II indicates that all Cronbach's α values are above 0.70 and acceptable.

Next, we test the construct validity of the measurement instruments. Convergent and discriminant validity are assessed using confirmatory factor analysis (CFA). To check the convergent validity, each item is linked to its corresponding construct, and the covariances among all constructs are freely estimated. The model fit indices are $\chi^2 = 389.97$, df = 177, RMSEA = 0.045, Standardized RMR = 0.058, CFI = 0.98, and NNFI = 0.98, which exceed the threshold values recommended by Hu and Bentler (1999). In addition, all factor loadings except one item are greater than 0.50 and all *t*-values are greater than 2.0. These results indicate that convergent validity is ensured.

Discriminant validity is assessed by building a constrained CFA model for every possible pair of constructs, in which the correlations between the paired constructs are fixed to 1.0. This is compared with the original unconstrained model, in which the correlations among constructs are freely estimated. A significant difference between the χ^2 statistics of the constrained and unconstrained models indicates high discriminant validity. In this study, all 15 χ^2 differences are significant at the 0.001 level, indicating that discriminant validity is ensured.

4. Results

Table III shows the means, standard deviations, and inter-correlations of HR and MP-IT resource, internal integration capability, and supplier integration. Table IV shows the measurement model.

Construct	Number of questions	Cronbach's α
Human resource	2	0.682[a]
Employee skill	3	0.780
Employee participation	3	0.770
MP-IT resource	3	0.937
Internal integration	4	0.851
Supplier integration	4	0.790

Note: [a]Pearson correlation coefficient

Table II. Reliability analysis

	Human resource	MP-IT resource	Internal integration	Supplier integration
Human resource	1.00			
MP-IT resource	0.30*	1.00		
Internal integration	0.64*	0.34*	1.00	
Supplier integration	0.63*	0.28*	0.59*	1.00
Mean	5.18	4.52	5.03	4.50
SD	0.876	1.638	0.973	0.921

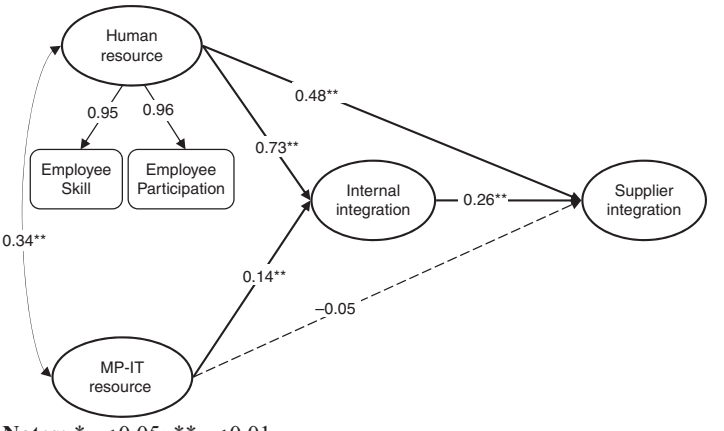
Note: *Correlation is significant at the 0.01 level

Table III. Correlations, means, and standard deviations

Construct Measures	Loading	Composite reliability	Average variance extracted
MP-IT resource		0.94	0.84
MP-IT1	0.87		
MP-IT2	0.98		
MP-IT3	0.90		
Human resource		0.96	0.91
Employee skill	0.95	0.80	0.58
HRS1	0.73		
HRS2	0.79		
HRS3	0.76		
Employee participation	0.96	0.81	0.58
HRP1	0.80		
HRP2	0.73		
HRP3	0.76		
Internal integration		0.86	0.61
IC1	0.78		
IC2	0.81		
IC3	0.80		
IC4	0.74		
Supplier integration		0.81	0.51
SI1	0.70		
SI2	0.76		
SI3	0.71		
SI4	0.69		

Table IV.
Measurement model

The hypothesized model in Figure 1 is tested using structural equation modeling (SEM) with the maximum likelihood estimation method, using LISREL 8.54 software. The corresponding fit indices are $\chi^2 = 406.27$, df = 183, RMSEA = 0.046, Standardized RMR = 0.058, CFI = 0.98, NNFI = 0.98, which are acceptable (Hu and Bentler, 1999). Out of the five tested relationships in the conceptual model, four are supported at the 0.05 significance level (Figure 2). No control variable has a significant impact on supplier integration at the 0.05 significance level. The major findings are discussed in the following section.



Notes: *$p < 0.05$; **$p < 0.01$

Figure 2.
Structural equation model

The results of the SEM are presented in Figure 2. The results generally support the overall argument of this study: firm-specific resources and capabilities are key enablers of supplier integration. HR resources have both a direct and an indirect effect on supplier integration. MP-IT resources have only an indirect effect on supplier integration. Firm-specific capability, as an intermediary, connects firm-specific resources and supplier integration.

5. Discussion and managerial implications

5.1 Improving capabilities through investment in firm-specific resources

Our findings show that companies need HR to develop internal integration capabilities, which are consistent with those of previous studies and our observations. The organization-wide HR can help companies to form an atmosphere to commit to the companies and respond to requirements of different functions (Huo *et al.*, 2014). As suggested by Cohen and Levinthal (1990), multi-skilled employees are necessary to facilitate internal communications because the employees provide enough knowledge overlap among the employees from different functions. Thus, multi-skill employees with extensive training can integrate systems, adapt to environments, and leverage resources and capabilities of different functions (Zhao *et al.*, 2011) . Furthermore, employee participation facilitates the communication through the involvement and information sharing among employees from different functions, which in turn improve the efficiency and the effectiveness of internal integration. As suggested by Cua *et al.* (2001), as a common practice, the HRM should be built into the complex system to bring manufacturing advantages for companies. Based on our observation of a manufacturing company in China before our survey, we find that a R&D manager with extensive knowledge of manufacturing processes and material purchasing can facilitate internal resource configuration. The manager has considerable work experience in the company, and his expertise helps him to coordinate product design, process design, and supply chain design in the dynamic environment. This observation further confirmed the role of HRs in facilitating internal integration.

In addition to HR, we find that MP-IT is also an important resource for companies that are developing internal integration capabilities, corroborating findings of extant literature (Luo *et al.*, 2012; Ramirez *et al.*, 2010). The application of MP-IT systems has a significant impact on internal integration because it can improve firm's information processing capability, which in turn can shorten decision time, broaden the scope of the available databases, formalize the information flow within the company, and facilitate group decision making (Galbraith, 1977). Thus, effective MP-IT systems provide an infrastructure or a platform for information communication for the whole company so that different functions can work seamlessly, which reduces task complexities raised by the integration activities. In particular, the product design and manufacturing systems, such as CAD, CAM, CIM, can facilitate the elicitation and the translation of customer demand into the manufacturing process (Berman, 2002). The production planning systems, such as ERP and MRP II, are used to plan and track the materials and products throughout the company, which link different functions including purchasing, design, manufacturing, marketing and service, etc. (Vollmann *et al.*, 1997). Furthermore, MP-IT systems improve the capabilities of organizational memory and knowledge absorption, which facilitate the integrated learning within the company (Cohen and Levinthal, 1990). Thus, MP-IT is an important resource for companies to pursue internal integration.

As aforementioned, both HR and MP-IT are important resources for internal integration capability. However, our findings also show that the impact of HR on internal integration is higher than that of MP-IT. This finding is similar to that of McCarthy-Byrne and Mentzer (2011) that argued that the people element contributes more heavily to supply chain infrastructure than the technology element. Although MP-IT systems facilitate information sharing and communication among different functions, final users of information and decision makers should be people. Thus, successful internal integration would rely more on HR, as noted by Kettinger *et al.* (1994) that "most of the information in organizations – and most of the information people really care about – isn't on computers. Managers prefer to get information from people; people add value to raw information by interpreting and adding context." Moreover, in the Chinese context, the human issue is more important for manufacturing companies than that for their counterparts in the western countries. Without efficient HR, the role of technologies cannot be fully developed. Thus, our results advance our understanding on different roles of people and technologies in operations management. Kull *et al.* (2013) posited that the social association or behavioral issues are critical in the development of supplier integration and cannot be replaced by technologies. Our findings also provide some evidence for their argument that HR seems more powerful than MP-IT in building integration capabilities.

This study contributes to RBV through classifying resources as HR and MP-IT resources and finding their different roles in improving capabilities. RBV states that rare, valuable, inimitable and irreplaceable resources can bring competitive advantages. Our study complements this statement through the finding that heterogeneous resources have different roles in gaining competitive advantages. For example, some intangible implicit resources (e.g. HR) are more powerful than tangible explicit resources (e.g. MP-IT resources) in achieving sustained competitive advantages. Our findings that both HR and MP-IT resources can improve internal integration capabilities directly are also consistent with the philosophy of socio-technical system theory. This means that companies that only focus on either social or technical resources cannot achieve the best competitive advantages.

5.2 Improving supplier integration through firm-specific resources/capabilities

Supplier integration requires a company to work collaboratively with its suppliers to continuously improve products and processes. This means that tasks performed by the supplier must be seamlessly integrated with those by the company. The synchronization and standardization of structures, strategies, and practices are important to create a seamless process between the company and its suppliers. A company with a high level of internal integration capability would be able to integrate with its suppliers, because extant internal collaboration and information sharing among different functions would enable the company to coordinate different activities with its external partners. This finding is consistent with those of Huo (2012), Huo *et al.* (2014) and Zhao *et al.* (2011).

Our findings also show that HR has both direct and indirect effects on supplier integration, whereas MP-IT resource has only an indirect effect on supplier integration through internal integration capabilities. This suggests that HR may be the basic requirement for supplier integration (Lockström *et al.*, 2010). People are a key factor in deploying external resources and activities. Our results show that HR plays a more important role than technologies in building and maintaining relationships with external supply chain partners for Chinese companies. For example, *guanxi* (relationship), a well-established and widely accepted concept in studies on inter-organizational relationships in

China, is considered as a more valuable way to build relationships with a company's suppliers in most cases. Thus, trust and empowerment can give employees more flexibility to develop relationships with their suppliers. Furthermore, from the perspective of organizational learning, the multi-skill background of a company's "gatekeeper" (an employee or team that has interactions with external organizations, such as sales person or purchasing person) would facilitate communication and knowledge sharing with external partners (Cohen and Levinthal, 1990), which improve supplier integration. This finding further shows that HR is more powerful than MP-IT resource in gaining competitive advantages, contributing to the theory and practices of RBV.

MP-IT resources have no direct effect on supplier integration, perhaps because MP-IT resources are only required for supplier integration after HR resources are already in place. Some companies have good MP-IT infrastructures connecting internal departments, but this is only a sufficient condition rather than a necessary condition for external supplier integration. Thus, MP-IT resources have an indirect effect on supplier integration by supporting firm-specific capabilities. Companies seeking to improve supplier integration need to pay more attention to HR than to MP-IT resources. If there are no resource constraints, companies should accumulate both human and MP-IT resources and develop internal integration capabilities to achieve the best supplier integration. Furthermore, our findings also show that MP-IT resource contributes to supplier integration through internal integration indirectly. The major reason is that MP-IT resource consists of shop-floor information systems that facilitate information sharing and communication among different functions within a company, but they are not capable of linking external partners, which requires inter-organizational IT systems such as EDI, collaborative forecasting system, etc.

Various previous studies examined the consequences of supply chain integration (e.g. Flynn *et al.*, 2010b; Frohlich and Westbrook, 2001), while relatively few studies investigated antecedents of supply chain integration (Zhao *et al.*, 2011). This study is one of the first examining enablers of supplier integration from the perspective of both resources and capabilities, echoing to Zhao *et al.*'s (2008, 2011) calling for more studies on drivers of supply chain integration. Our findings contribute to supply chain integration literature by identifying two important resources and exploring their antecedent impacts on integration. MP-IT and HR have significantly impacts on supplier integration, although the impact of MP-IT on supplier integration is fully mediated by internal integration. It means that supplier integration requires both "hard" and "soft" resources in the company. Furthermore, our study finds that heterogeneous resources have different roles in improving supplier integration. For example, some intangible implicit resources (e.g. HR) are more powerful than tangible explicit resources (e.g. hardware of MP-IT resource). This means that although supplier and internal integration are more technological oriented in operations management literature, the behavioral issues related to HRM such as communication, empowerment and learning are more important and need future investigations.

In the emerging market (e.g. China), companies are usually weak in infrastructures, legal systems, advanced technologies, etc., while they are relatively strong in slack resources of labors and lands, etc. Therefore, companies usually rely on the low cost strategy to gain competitive advantages. In this way, companies can leverage HR to enhance integration capabilities of internal functions. Furthermore, in the emerging market that is lack of well-established institutional systems, companies need to keep in mind that supplier integration may be influenced by the capability of their employees to maintain relationships with external partners, which is highlighted as behavioral

constrains by Kull *et al.* (2013) . These companies are also learning from their supply chain partners in developed markets to adopt MP-IT resource to help different functions to integrate with each other. However, the role of MP-IT resource in improving integration is smaller than that of HR in the emerging market. Furthermore, companies in emerging markets are usually weak in external integration with supply chain partners because external integration needs more resources. Thus, it is a viable strategy to first build internal integration capabilities and second supplier integration.

Although our findings are based on data collected from Chinese manufacturers, they are helpful for companies' decision makers in other countries. First, the resource-capability-integration paradigm is globally applicable. The three firm-specific resources and capabilities are basic elements of all companies. It is useful for managers to understand the roles of these elements in building supplier integration. Second, managers should understand that different resources have different roles in building internal integration capabilities, which lead to supplier integration. HR is more important than MP-IT resource for building supplier integration. Third, resource constraints are a reality for nearly all companies. Managers should pay attention to which resources they should invest in. Finally, it is notable that in other countries than China, especially in developed Western countries, HR may not be as important for improving integration capabilities as that in China (Zhao *et al.*, 2011). Therefore, managers from other countries should apply this finding cautiously.

6. Conclusions

This study contributes to the literature and practices in several ways. First of all, this study empirically tests the effects of three different firm-specific resources/capabilities on supplier integration. Based on RBV, this study provides a comprehensive framework of the relationships among HR and MP-IT resource, internal integration capabilities, and supplier integration, contributing to the antecedents of supplier integration literature. Second, this study examines the joint effect of HRs and IT on internal and supplier integration, enhancing our understanding on socio-technical systems theory in supply chain management. Third, the study extends supplier integration research to a Chinese context. Given the increasing importance of Chinese companies in global supply chains, our findings will have great practical implications for managers in Western multinational companies, because China's competitive environment requires a specific implementation of internal resources and capabilities to build supplier integration. Practically, our findings provide insights into the management of internal and external resources and capabilities.

Several limitations in our study suggest potential directions for future research. First, we only investigate the application of limited MP-IT systems. Future studies could investigate more MP-IT resources, especially newly created MP-IT systems and networks, such as cloud systems, virtual communities, etc. Second, we consider HR and MP-IT resource as integration enablers in the model but don't measure the alignment between these two resources. Future studies can identify the role of such an alignment in supply chain integration from the perspective of socio-technical systems theory. Third, different industries may have different resources and capabilities, and different levels of supplier integration, but our study does not identify the difference of them. Future studies can explore the differences of resources, capabilities and their effects on supplier integration. Finally, the data used in this study were collected from only one developing country, China. Our findings should be cautiously used by decision makers from other countries. Future studies can collect data from other countries and compare resource-capability-integration models in developing and developed countries.

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Appendix

Table AI.
Summary of major studies on antecedents of supplier integration

Perspectives	Studies	Dimensions of SCI	Antecedents
External and internal environments	Wong and Boon-itt (2008)	Internal integration, Customer integration, Supplier integration	Environmental uncertainty, Institutional norms
	Huo *et al.* (2013)	Supplier integration	Institutional pressure (normative, mimetic and coercive pressure)
	Zhao *et al.* (2013)	Supplier integration, Internal integration, Customer integration	Supply delivery risk, Demand variability risk
	Seo *et al.* (2014)	Supplier integration, Internal integration, Customer integration	Innovativeness
	Cao *et al.* (2015)	Supplier integration, Internal integration, Customer integration	Organizational culture (development, group, rational, hierarchical culture)
	Zsidisin *et al.* (2015)	Supplier integration	Supply market scanning, Internal communication climate
Relational resources	Frohlich and Westbrook (2002)	Demand integration Supply integration	Relational efficiency (new markets, anticipated performance), Bandwagon
	Petersen *et al.* (2008)	Supplier integration	Buyer dependence on supplier, Socialization processes
	Yeung *et al.* (2009)	Supplier integration Internal integration	Trust, Coercive power
	Vijayasarathy (2010b)	Supply integration	Dependence asymmetry, Trust, Commitment, Mutual dependence
	Zhang and Huo (2013)	Supplier integration, Customer integration	Dependence, Trust
	Ellström (2015)	Supplier integration	Retailer format, Trust
IT resources	Hill and Scudder (2002)	Supplier integration, Customer integration	EDI
	Devaraj *et al.* (2007)	Product information integration (supplier integration, customer integration)	E-business capabilities (customers, purchasing, collaboration)
	Parker *et al.* (2008)	Supplier integration (Timing of integration, extent of integration)	Technological newness, Buyer/supplier relationship, Strategic importance of the supplied item
Combined human and other resources	Eltantawy *et al.* (2009)	Supplier integration	Strategic supply management skills, Supply management function perceived status
	Lockström *et al.* (2010)	Supplier integration	Buyer leadership effectiveness, Supplier collaboration readiness, Collaborative supplier capabilities
	Lockström and Lei (2013)	Supplier integration (financial, operational, and strategic supplier integration)	Internal support, Buyer leadership effectiveness, Supplier top management support, Collaborative supplier capabilities, Continuous supplier development, Quality mindset

(*continued*)

Perspectives	Studies	Dimensions of SCI	Antecedents
	Xu *et al.* (2014)	Supplier integration, Customer integration	Top management support, IT
Combined internal integration and other resources	Zhao *et al.* (2011)	Customer integration, Supplier integration	Internal integration, Relationship commitment
	Horn *et al.* (2014)	Supplier integration	Internal and external social capital (cognitive, structural, relational capital), Internal integration
	Lau (2014)	Supplier integration (supplier involvement, information sharing, product co-development)	Product newness, Product modularity, Internal coordination, Environmental certainty
Others	Koufteros *et al.* (2007)	Supplier integration	Embeddedness with suppliers, Supply base rationalization, Supplier selection
	Droge *et al.* (2012)	Supplier integration, Customer integration	Product modularity, Process modularity
	Koufteros *et al.* (2012)	Supplier integration (supplier partnerships, supplier development)	Supplier selection (based on NPD, quality, cost capabilities)
	Kull *et al.* (2013)	Supplier integration	Environmental system, Social system, Technical system
	Zhao *et al.* (2014)	Black-box supplier integration	Strategic importance of the task, Complexity of the task

Table AI.

Item	Source
MP-IT resource	
MP-IT1: Applies computer technology in product design (e.g. CAD, CAE, CAPP)	Boyer *et al.* (1997) and Diáz *et al.* (2003)
MP-IT2: Applies computer/information technology in the manufacturing process (e.g. CAM, CIM, FMS, CNC)	Boyer *et al.* (1997) and Diáz *et al.* (2003)
MP-IT3: Applies computer/information technology in manufacturing planning and control (e.g. MRP II, ERP)	Boyer *et al.* (1997) and Diáz *et al.* (2003)
Human resource	
Employee skill	
HRS1: Provides ongoing training and learning for people	Li *et al.* (2002)
HRS2: Trusts and empowers the people in the organization	Curkovic *et al.* (2000)
HRS3: Develops multi-skilled workers	Li *et al.* (2002) and Ahmad and Schroeder (2003)
Employee participation	
HRP1: Employees work in problem-solving teams	Cua *et al.* (2001)
HRP2: Encourages continuous improvement	Cua *et al.* (2001)
HRP3: Employees are informed of quality control and performance	Cua *et al.* (2001)
Internal integration	
IC1: Data integration among internal functions	Narasimhan and Kim (2002)
IC2: Enterprise application integration among internal functions	Narasimhan and Kim (2002)
IC3: Integrative inventory management	Narasimhan and Kim (2002)
IC4: Real-time integration and connection among all of the internal functions from raw material management through to production, shipping, and sales	Narasimhan and Kim (2002)
Supplier integration	
SI1: Establishes strategic partnerships with suppliers	Narasimhan and Kim (2002) and Flynn *et al.* (2010a, b)
SI2: Works with suppliers to improve inter-organizational processes with suppliers	Flynn *et al.* (2010a, b)
SI3: Creates links with suppliers through information technology	Narasimhan and Kim (2002) and Flynn *et al.* (2010a, b)
SI4: Shares information with suppliers	Chen and Paulraj (2004) and Flynn *et al.* (2010a, b)

Table AII.
Survey instrument

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