Research article

# Interorganizational cooperation and supplier performance in high-technology supply chains

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ABSTRACT

Never in history have global supply-chain relationships in high-tech electronics firms been more sophisticated, complicated, and almost always tied in some major aspect to China. This research examines how interorganizational (IO) cooperation impacts performance and what role relationship learning and information technology (IT) integration play in the value-creation process for Chinese suppliers in business-to-business (B2B) supply chains. We examine this issue using data collected from face-to-face interviews with supply chain managers and executives from 1,004 Chinese high-tech electronic component suppliers. The results strongly support the hypothesis that IO cooperation improves a supplier's performance regarding both its major customer and overall marketplace. Relationship learning and IT integration are important mediating variables that drive performance. The strongest effect in our study was the influence of IO cooperation on relationship learning. A unique aspect of this study is that it focuses on a large sample of a specific supplier type—high-tech Chinese suppliers. This, combined with the fact that the sampled companies were involved in manufacturing 13 different product groups, greatly increases the generalizability of the results.

## 1. Introduction

In practice, multinational corporations (MNCs) are intensifying their engagement through more extensive monitoring and collaborative practices to increase the value added by the supply chain and speeding up time to market. For example, MNCs such as Giorgio Armani, S. Oliver, H&M, and IKEA are sending their international design teams to their suppliers' factories for extended periods of time to speed up the design-to-market process (Hultman et al., 2012; Kang et al., 2018). The strategy of increasing collaboration with suppliers strengthens innovativeness, responsiveness, and profitability—all of which are critical for the long-term sustainability of the MNCs' global supply chains (Grekova et al., 2016; Fossas-Olalla et al., 2015; Strebinger and Treiblmaier, 2004).

Prior research has focused on optimizing supply chain (SC) performance by contracting for the sharing of information, such as collaborative forecasting; coordination of multiple suppliers via monitoring routines; encouraging downstream buyer cooperation; and optimizing various cost factors of location, inventory management, and distribution (Aviv, 2001; Inderfurth et al., 2013; Jayaram et al., 2011; Kurtulus et al.,

2012; Tarafdar and Qrunfleh, 2017). Although these studies predict how performance can be improved by optimizing various factors, a comprehensive understanding of how supplier involvement, monitoring, and collaborative commitment—which we term *interorganizational* (IO) *cooperation*—works in these settings is still limited due to the absence of empirical work. This nascent state of the literature has in part led to a call by Fisher (2007) to strengthen the empirical base of operations management. In their literature overview of a related concept—*SC integration*—Van der Vaart and van Donk (2008) find that most surveys report a positive relationship between SC integration and performance, but the authors question whether the nature of this relationship is well understood. To date, the vast majority of studies analyze data from Western companies and apply a Western perspective (Treiblmaier et al., 2020). Given that China is now involved in the high-tech electronics components supply chain more than any other country in the world there is a need for research that investigates the nature of SC relationships from an Asian perspective. Additionally, the concerns for how MNCs engage in IO cooperation with emerging-market suppliers are explicitly evaluated in our study.

Ongoing relationship learning and information technology (IT) integration between suppliers and buyers have been identified as crucial determinants of successful collaboration and sustainable performance. Researchers have identified a range of factors that impact successful relationship learning, such as the frequency of meetings and interactions and the effectiveness of IO communication, long-term commitment, top-management support, a buyer's trust in its supplier, formal and social control structures, the level of cooperation, initiatives to increase logistics responsiveness and knowledge exchange, and the use of common resources (Bhatti, 2019; Humphreys et al., 2004; Iyer et al., 2014; Jean et al., 2010; Osborn and Nault, 2012). In addition, researchers have recognized IT integration as an important driver of performance (Boyer et al., 2005; Ralston et al., 2015; Lai et al., 2016; Ward and Zhou, 2006). The interdependent nature of SC management necessitates the use of IT integration to facilitate the sharing of information so that organizations can minimize the costs associated with capacity coordination and production planning (Aydinliyim and Vairaktarakis, 2010). However, in one of the few studies have examined both the interplay of relationship learning and IT integration Tan et al. (2010) argue that SC relational alignment—which they measured by asking about the suppliers' volume flexibility and ability to improve customer satisfaction—influences a company's performance more strongly than, for example, information alignment.

Given these aspects of successful customer-supplier relationships, the purpose of our research is to investigate how IO cooperation—measured by the level of supplier involvement, customer monitoring, and collaborative commitment with their largest customer—impacts supplier performance. Our specific research question for our context is as follows:

**RQ**. How does IO cooperation influence supplier performance in the context of China's high-tech hardware components industry?

Furthermore, we empirically assess whether the influence of IO cooperation on supplier performance is mediated by relationship learning and IT integration. Specifically, we focus on China's high-tech industry, which provides an ideal setting because of its global importance and the unique way business relationships are fostered in China (Kang et al., 2018). Namely, we test our model by using a sample of 1,004 Chinese electronic component suppliers.

### 1.1. Research contribution and impact

Our empirical results show that in China's high-tech industry, a company's level of IO cooperation is a major determinant of its performance with its major buyer and the market in general. One especially interesting finding is that the strong positive effect of IO cooperation on (a) supplier performance for customer and (b) supplier market performance is partly mediated by relationship learning and IT integration. We thus infer that synergies arise for an organization from simultaneously implementing an adequate infrastructure and building a business network. The strongest effect in our study was the influence of IO cooperation on relationship learning, which confirms preexisting literature that highlights the strong connection of cooperation and the subsequent emergence of personal networks.

Our model further indicates that researchers must not only include IO cooperation as an important antecedent in any study that strives to explain and predict performance; instead, researchers must measure cooperation in three dimensions to take into account how supplier involvement, customer monitoring, and collaborative commitment together constitute cooperation. Namely, IO cooperation is determined by these three dimensions, and we used a formative measurement to account for this conceptualization. We discuss these and other important implications for research, practice, and theory in the discussion section.

### 1.2. Structure of the manuscript

Going forward, this paper is structured as follows: In Section 2, we briefly elaborate on the theoretical background, namely relationship marketing theory (RMT) and social exchange theory (SET) and introduce IO cooperation as a formative construct. In Section 3, we develop our hypotheses and introduce a comprehensive model. In Section 4, we discuss the methodology, namely, our sample, the measurement model and the process of data collection. We present the results in Section 5, which are followed by a discussion including theoretical and managerial implications (Section 6), as well as important conclusions and limitations (Section 7).

## 2. Theoretical background

High-tech industries have complex and dynamic international SCs (Akkermans and Van Wassenhove, 2018; Gao et al., 2008; Isaksson et al. (2016); Gaimon and Morton, 2005); this industry is distinguished from the low-tech environment in that high-tech alliances are formed to manage the complexity and multidimensionality of shared information, whereas the primary purpose of a low-tech alliance is to enhance efficiency. For example, in a study of 167 high-tech manufacturing companies, Patel (2011) describes the high-tech setting as a dynamic environment that creates early organizational imprints of the flexibility necessary for responding to this unique environment. Ellram (1992) studies the roles of trust and collaboration in the SCs of high-tech industries, such as pharmaceuticals, chemicals, energy, computers, semiconductors, and telecommunications, concluding that high-tech industries have the highest tendency to establish buyer-supplier alliances because of the complexity and multidimensionality of the information shared. Furthermore, Ellram (1992) study shows that mutual commitment contributed more to the success of SC collaboration and carried more weight than formal agreements.

Several prominent studies argue that the task interdependence associated with the complexity of high-tech alliances is associated with partnership control practices such as contractual contingency planning, performance target setting, operational reviews, information sharing, supplier support, and joint problem solving (Dekker et al., 2013). Relatedly, Dekker et al. (2014) find that greater task interdependency is associated with an increase in boundary-spanner interactions and greater information sharing about partnership activities and performance. Given this collective evidence, we thus propose that suppliers involved in high-tech partnerships that exchange technologically complex components will likely have a greater need for IO cooperation to navigate such interdependencies.

### 2.1. Relationship marketing theory and social exchange theory

Our investigation into the effects of IO cooperation on performance and its various antecedents and consequences touches upon several socioeconomic theories concerning the underlying mechanisms and structures of the complex relationship between buyers and suppliers. Regarding the relationships between human actors—which, in our case is the interaction between suppliers and buyers—the RMT provides a conceptual underpinning (Lewin and Johnston, 1997). Rooted in various disciplines and research streams, such as business marketing, services marketing, and marketing channels, as well as database marketing and direct marketing (Berry, 1983; Hunt et al., 2006; Möller and Halinen, 2000; Rather and Sharma, 2019), the RMT represents a major stream in current marketing research and is mainly focused on attracting, maintaining, and enhancing customer relationships (Berry, 1983). Among other phenomena, RMT research strives to explain why companies and consumers enter into relationships with other companies and consumers and why some efforts at relationship building turn out to be more successful than others (Hunt et al., 2006). The RMT is composed of two types

of relationship theories: (1) market based (i.e., consumer-oriented) and (2) network-based (i.e., interorganizationally oriented) (Möller and Halinen, 2000). In the context of the present study, the latter type is relevant. The implication of applying the RMT to a high-tech SC context is that network-based RMT involves more managerial levels and complexity in the interactions between SC partners.

A second theory that focuses on the rational behavior of human actors is SET (Chan et al., 2008; Reimann and Ketchen, 2017). SET explains human actors' motivations—beyond the obvious economic benefits—to share and exchange information. SET also explains social behavior in economic undertakings, stating that such behavior is contingent upon receiving rewarding reactions from others (Blau, 1964). SET is used to analyze exchange mechanisms in relationships within social contexts; the proponents of SET consider interaction processes between parties to be at the core of social exchange relationships, in which each participant's behavior is influential and evokes responses from the other. Analogously, the outcome of each exchange-relationship participant's behavior is influenced by the responsive behaviors of others (Anderson and Narus, 1984). In an SC context, Wu et al. (2014) find that SET "guides interactional behaviors for the expectation of a reward from partners" (p. 122), and the authors name trust, reciprocity, and power as the antecedents to collaboration. Similarly, Tanskanen (2015) highlights the importance of "playing the relationship game" smartly in buyer-supplier relationships. SET has been previously applied to illustrate ways of avoiding lock-in situations in buyer-supplier relationships (Narasimhan et al., 2009).

We combine the RMT and SET to investigate how IO cooperation enhances performance via (1) relationship learning and (2) IT integration. Given this background, we summarize the proposed theoretical model as follows: *Relationship learning,* which is defined as a cooperative "process of improving future behavior in a relationship" through joint teams and communication (Selnes and Sallis, 2003, p. 80), is affected by IO cooperation and impacts a supplier's performance regarding its major buyers and the overall market. Similarly, *IT integration* acts as a mediating variable between IO cooperation and customer and market performance. Relationship learning is operationalized as an outcome of IO cooperation and is a driver of performance, whereas IT integration functions as an enabling technology. Our SC performance model allows us to test simultaneously for direct and mediating relationships and to detect spurious relationships. The remainder of this section proposes the hypotheses for the model.

## 2.2. IO cooperation as a formative multidimensional construct

Researchers have examined two main types of control mechanisms in the interorganizational context. First, supplier performance measurement and monitoring are important formal control mechanisms in B2B relationships, which customers use to guide supplier evaluations and give feedback as well as to make purchase order allocation and ongoing contract renewal decisions (Chaddad and Rodriguez-Alcalá, 2010; Jayaraman et al., 2013). Second, customers use informal control mechanisms—such as supplier involvement in decision making, informational sharing, and joint problem-solving—to enhance supplier confidence in the customer's honesty and benevolence (Zhou et al., 2008). Informal controls are processes that attempt to improve the understanding, interactions, and involvement between the parties. They include collaborative practices that transmit common values, beliefs, and philosophy within the clan and help to minimize information asymmetry and to absorb misunderstandings among the parties, which diminishes opportunistic tendencies and enhances coordination efforts (Krause et al., 2007).[1] In so doing, informal control mechanisms help to build trust in

the customer and strengthen relational norms and beliefs about the future of the relationship (Mesquita and Brush, 2008).

Based on the premise that using a combination of formal and informal control mechanisms in managing the interorganizational relationship is likely to be more effective, researchers have sought to understand whether such mechanisms act as complementary or substitutive forces (Poppo and Zenger, 2002; Wuyts and Geyskens, 2005) that influence partner behavior, such as in curtailing opportunism and focusing their efforts to achieve efficient coordination outcomes (Gundlach and Cannon, 2010). Another set of scholars has sought to reconcile these divergent views by arguing that the effectiveness of control depends on the mechanisms involved, their joint use and contextual factors in their deployment (Jayaraman et al., 2013; Liu et al., 2009; Zhou and Xu, 2012). Echoing this view, we model these control mechanisms as a formative multidimensional construct (IO Cooperation) with three dimensions: (1) supplier involvement, (2) monitoring, and (3) collaborative commitment. *Supplier involvement* captures the personal aspects of doing business, such as the extent to which the customer involves the supplier in collaborative activities (Jean et al., 2014). The second dimension of IO cooperation—*monitoring*—captures formalized communication and supervision activities that are often institutionalized (Ittner et al., 1999). Monitoring is recognized as an important part of maintaining effective buyer-supplier links, especially with the increasing need for transparency in the sustainable supply chain (Short et al., 2016; Talluri and Sarkis, 2002). Cousins et al. (2008) stress that monitoring does not correspond with the close supervision of supplier performance, but rather, it is the process of the buyer and supplier's socializing that is critical to success.

Finally, to capture the activities related to proactive communication and the sharing of important information, both of which require a certain level of trust and relationship commitment, we include *collaborative commitment* as the third dimension of IO cooperation. *Collaborative commitment* captures the extent of supplier integration in terms of both the supplier and major customer's commitment to the exchange of information on operations and sales, respectively (Flynn et al., 2010). This is, in part, a function of the purpose in the relationship (Ramanathan and Gunasekaran, 2014); a narrow scope of purpose might encompass such things as simply providing feedback on reliable deliveries, whereas a broad scope might include more advanced feedback such as improving key processes, developing new products, and developing new markets. It follows that the more ambitious the collaborative commitment is in a relationship, the more reason there is to exchange information and learn how relationship performance can be improved. Overall, *IO cooperation* is a similar construct to *SC integration,* which is defined as the degree to which a supplier can partner with key customers to structure its IO practices, procedures, and behavior into collaborative, synchronized, and manageable processes that fulfill customer requirements (Stank et al., 2001).

## 3. Hypothesis development

### 3.1. The mediating role of relationship learning

Companies engage in relationship learning activities to better understand each other's needs and respond accordingly (Kim and Chai, 2017). Such activities have naturally increased in importance with global SC sustainability efforts (Gosling et al., 2016; Oelze et al., 2016). This is congruous with the basic propositions of SET, which postulates that relationships form because business partners provide reciprocal benefits to each other over time (Gouldner, 1960). As has long been recognized by marketing managers, relationship learning between organizations is key to successful performance (Vieira et al., 2014), and this concept has received much attention in supply chain research (Blome et al., 2014; Brito et al., 2014; Cao and Zhang, 2011; Wadhwa et al., 2010a). By sharing information about products, systems, competencies, and needs,

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[1] Authors have also referred to the informal control construct as *informal socialization* (Lawson et al., 2009; Cousins et al., 2006), *socialization mechanisms* (Cousins and Menguc, 2006) and *supplier (direct) involvement* (Lau, 2014; Kosmol et al., 2018; Krause et al., 2007).

both suppliers and buyers can improve their competitive positions and increase their mutual attractiveness (Tanskanen and Aminoff, 2015).

To foster the development of RMT, Hunt et al. (2006) ask the question of why firms and consumers enter into relationships with each other. We expect that increased IO cooperation necessitates relationship learning activities. Companies gain a better understanding of the value their partners seek; for example, both the buyer and supplier will develop inter-functional organizational solutions (e.g., joint teams) to coordinate their exchanges, thereby strengthening their relationship. Ou et al. (2010) identified process management as an important mediator between supplier management and supplier performance. They argued that effective supplier management improved operational performance not only through reductions in inventory, waste, and safety stocks, but also showed that effective supplier management enhances cooperation between buyers and suppliers by allowing supplier involvement and participation in both the design and production processes. Similarly, involvement and participation in joint meetings enhance relationship learning, or the acquisition of knowledge that can be used in future innovation (Ding et al., 2014; Ge et al., 2014; Arthanari et al., 2015; Yan and Nair, 2016).

For the supplier, relationship learning provides a chance to promote its capabilities and responsiveness to gain business over the long term. For example, a supplier has the chance not only to learn from its partner (the buyer) but also to respond proactively to design issues during product development and production and to supply issues through corrective action requests. In this way, relationship learning allows a supplier to build trust with its buyer and to communicate and show its commitment to that partner, which helps increase the buyer and supplier's overall relational capital (Jean et al., 2010). Thus, we hypothesize the following:

**H1**. IO cooperation improves relationship learning.

One of the key elements of the RMT is that beneficial business outcomes are a result of the close links between suppliers and buyers, which has been empirically confirmed (Cheung et al., 2010). Johnson (1999), for example, finds that the strategic integration of a supplier's relationship enhances a company's financial performance. Johnson emphasizes that intercompany relationships "do reach a point where the intercompany partnership becomes a strategic asset to the participant companies" (p. 13). Similarly, Luo (1997) reveals that relationship-based business variables have significant, positive influences on foreign-invested enterprises' financial and market performances. Thus, companies must constantly strive to build relationships with their partners, and they do so by continuously learning about their partners' reciprocal expectations and needs.

We can expect a supplier's relationship learning to enhance its performance, with its learning acting as a timely feedback mechanism. For example, through relationship learning activities, suppliers gain greater insights from their respective customers (i.e., buyers) into the critical performance areas they must achieve (Knight, 2002). This improved understanding and awareness of critical performance areas will likely translate into more proactive and targeted behaviors on the part of the supplier to meet its customer's needs, improving the supplier's overall performance in the following ways: First, suppliers can use what they learn to set up performance feedback mechanisms that provide them with timely feedback about production quality problems before their customers receive and complain about poor-quality deliveries; second, relationship learning allows a supplier to focus its resources on areas its customer deems critical, thus increasing overall efficiency by eliminating the possibility that the supplier would spend resources in other ways.

According to SET, in a business environment, relationships are not "ends" in themselves, but rather, they serve to improve the performance of the participating companies (Sungu et al., 2019). Drawing on SET, Relationship stability, a buyer's trust in its supplier, relational capital, and commitment all have a significant influence on the market performance of companies in SC alliances (Christopher, 2017; Yang, 2009).

These findings are corroborated by Lambert and Enz (2012), who measure the financial outcomes of two companies that implemented cross-functional teams to enhance their business-to-business (B2B) relationships. They conclude that cross-functional involvement was a key driver of financial performance for the two participating companies. Finally, a cross-national SC study shows that relationship learning indeed enhances the value and performance of both suppliers and buyers (Cheung et al., 2010). Given the increased promise of synergistic outcomes from relationship learning, we propose the following:

**H2**. Relationship learning improves suppliers' performance for their main customer.

**H3**. Relationship learning improves suppliers' overall market performance.

### 3.2. The mediating role of IT integration

IO coordination, such as coordinated production schedules, necessitates information-sharing capabilities. Implementing IT systems to increase these capabilities has become a pressing priority for many vertically integrated companies (Aydinliyim and Vairaktarakis, 2010). Therefore, efficient data exchange and communication within and between organizations needs a coordinated IT infrastructure (de Mattos and Barbin Laurindo, 2015). From a SET perspective, integrated IT systems provide the infrastructure necessary for social exchange, which we argue enables the benefits of IO cooperation to be realized (Gefen and Ridings, 2002). With recent advances in information and communication technologies, organizations over time can efficiently integrate business processes with their SC partners, establishing ongoing relationships. SC management technologies (e.g., electronic data interchange, electronic data access, barcodes, RFID, artificial intelligence, Internet of Things, real-time supply-chain agents, real-time big-data analytics, Distributed Ledger Technology (DLT), Blockchain) support the integration and coordination of SC information and enable manufacturers to engage in timely information sharing and collaboration with their upstream suppliers and downstream buyers (Chae et al., 2014; Devaraj et al., 2007; Huo et al., 2014; Li and Gao, 2008; Treiblmaier, 2018; Zhao et al., 2011).

Several studies support this assertion. Bayraktar et al. (2009) stress that these technologies, which they call "enablers," are essential for improving the link between SC management practices and operational performance. Suppliers' relationship-specific investments have been found to encourage the sharing of their product and process innovation ideas with their customers (Wagner and Bode, 2014), and this supports the view that technology enables business relationships (Gibson and Edwards, 2005). The myriad of opportunities that IT presents occasionally lead to over-optimistic expectations about what benefits integrated IT can provide a company. Research has shown that "IT-savvy" companies need to develop IT infrastructures that are carefully aligned with their operating models (Weill and Ross, 2009), strategies, and structures (Strebinger and Treiblmaier, 2004). When this alignment is properly implemented, companies can expect numerous benefits. Sinkovics et al. (2011) demonstrate how IT integration using B2B IT infrastructures helps multinational enterprises enhance local suppliers' responsiveness. Of course, the integration impediments caused by technological differences between businesses' IT applications remain major problems that often lead to fundamental challenges in joint planning and collaborative transportation, despite the use of state-of-the-art IT (Buijs and Wortmann, 2014). In the present context, Zhao et al. (2011) show that in China, strong internal IT integration is a necessary condition to realize the benefits of external IT integration—a critical component of IO cooperation. Finally, Lai et al. (2016) also show in a China context that this IT integration must reflect a deep assimilation throughout an organization and its supply chain—as opposed to mere "adoption"—in order to reap the potential benefits. Thus, we posit that the following hypothesis:

**H4**.   IO cooperation positively influences IT integration.

Following the tenets of SET, we argue that IT integration acts as a mediator between IO cooperation and performance. Namely, cooperation leads to better IT integration, which, in turn, fosters performance. We focus explicitly on the *enabling role* of IT, whose effect on company performance is controversial (Mitra, 2005). The results showing the relationship between IT implementation (in the broadest sense) and its hypothesized benefits to performance have long been mixed (Bardhan et al., 2007a, 2007b) and are often fraught with caveats. Boone and Ganeshan (2001) show that IT can contribute to significant productivity gains when integrated into the production process but not when used solely to collect information. In a study of 518 manufacturing plant managers, Maiga et al. (2014) find that IT integration and cost-control systems do not exert substantial *independent* effects on financial performance, but the interaction of such systems turns out to be beneficial. Swafford et al. (2008) report that the IT integration and competitive business performance relationship is mediated by SC flexibility and agility. Bardhan et al. (2007b) examine how specific types of IT are better aligned with certain types of project characteristics, showing that the fit between IT use and the environment is directly associated with project performance and indirectly with project competence. A study by He et al. (2014) indicates that a SC that integrates the supplier has a positive, direct effect on product performance.

Finally, Wu and Katok (2006) demonstrate that enhanced SC performance through relationship learning requires communication between partners. Currently, this communication is incomplete without IT integration. Broadly speaking, the positive effects of IT integration can be subsumed into two major categories: (1) timely feedback and (2) improved resource efficiency. Both have been shown to strengthen the relationships between organizations, in turn, fostering IO exchange in general (Katsamakas, 2007; Medlin, 2006). Given the above juxtaposed to the fact that the high-tech industry is more likely to benefit from IT integration (Saksena, 2009), we propose the following:

**H5**.   IT integration improves a supplier's performance regarding its major buyer.

**H6**.   IT integration improves a supplier's market performance.

### 3.3. IO cooperation and performance

Finding the antecedents to a company's successful performance remains one of the most pressing, yet vexing, tasks for researchers. Among others, prior research has focused on optimizing performance by contracting for the sharing of information such as in collaborative forecasting, variability amplification, quality flexibility contracts, SC integration, the coordination of multiple suppliers or multiple units within the buyer, supply networks, and downstream buyer cooperation (Ataseven and Nair, 2017; Aviv, 2001; Balakrishnan et al., 2004; Chen and Paulraj, 2004; Jayaram et al., 2011; Li and Atkins, 2002; Wadhwa et al., 2010b).

Highlighting the important role boundary spanners play within cross-cultural international cooperative ventures, Luo (2001) concludes that personal attachment influences return on investment (ROI) and process performance; the author differentiates between three different levels of attachment—individual, organizational, and environmental—all of which turn out to have significant effects on company performance. Cousins and Menguc (2006) focus on the relationship between SC integration and performance, finding that the former has a marked impact on suppliers' communication performances but not on their operational performances, improvements of which consist of cost, time to market, lead-time reductions, and quality improvements. Chang et al. (2016) identify a positive effect of SC integration on firms' financial performance, whereas earlier, Yeung et al. (2005) find that the impact of quality management on performance is context dependent. In their study of the Chinese electronics industry, they identify process management

and customer focus as crucial antecedents. Using data from the financial services industry, Field and Meile (2008) show that better supplier involvement correlates with greater buyer satisfaction with the suppliers' overall performance. Interestingly, their research shows that partnering components (e.g., cooperation) are more important to buyers than operational components (e.g., feedback). Related studies have found that collaborative planning has an important influence on SC performance and indirectly on a company's financial performance (Petersen et al., 2005). To account for the complexity of buyer-supplier relationships, Paulraj and Chen (2005) examine three essential B2B activities: supply base reduction, communication, and long-term relationship building, and conclude that IO communication has a significant influence on quality performance, while long-term relationships do not.

Regarding SC integration, a similar construct to IO cooperation, Flynn et al. (2010) confirms that SC integration is related to both operational and business performance. In a study of 120 manufacturing companies, Devaraj et al. (2007) find that the relationship between e-business technologies and company performance is mediated by buyer and supplier integration. Supplier integration is shown to enhance the cost, quality, flexibility, and delivery performance. Similarly, Lee et al. (2007) posit that SC integration is the best strategy available to suppliers for achieving reliable SC performance. Given these findings and the importance placed on cooperation in China (Gu et al., 2008), we propose the following:

**H7**.   IO cooperation improves supplier performance regarding its major buyer.

To improve the study's clarity and conciseness, we first explicitly asked our study's interviewees about their relationships with their *major* buyers. In line with the literature on the RMT, we hypothesize that a better performance with a company's major buyer has a positive effect on a company's overall market performance. This hypothesis can be directly derived from the fundamental premises of B2B relationship marketing, which assumes that improving the service level of a company's (business) customers leads to better overall market performance (Ellis, 2010; Luu et al. (2018); Palmatier et al., 2006; Rajput et al., 2018; Streukens et al., 2011). Thus, we hypothesize the following:

**H8**.   A supplier's performance regarding its major buyer improves that supplier's market performance.

Figure 1 summarizes all eight hypotheses and shows our final model; it combines crucial elements from the RMT and SET. The importance of the relationships can be found in H1, H2, and H3, which hypothesize that IO cooperation is an important antecedent of relationship learning, IT integration, and performance. This is in line with Hunt et al. (2006), who identify several relational factors and indicators for marketing success. The application of SET can be found in the reciprocal relations in the combinations of H1/H2, H1/H3, H4/H5, and H4/H6. In all four cases, we hypothesize that increased IO cooperation triggers an increase in performance that is mediated by relationship learning or IT integration. Namely, each increase in cooperation triggers a positive response that can be either a more sophisticated infrastructure for communication or better relationships. This has a positive reciprocal effect on the performance of the company that made the first move to improve cooperation.

## 4. Methodology

### 4.1. Data and samples

Our study involved an interview survey of supplier B2B customer relationship managers. Thus, our sample comprises 1,004 electronic component suppliers, ranging in size from nine to 60,000 employees. The distribution, according to 13 different component types, is shown in Table 1.

In response to criticisms in the literature (Van der Stede et al., 2005) regarding "who" completed the mail survey or who was interviewed, the
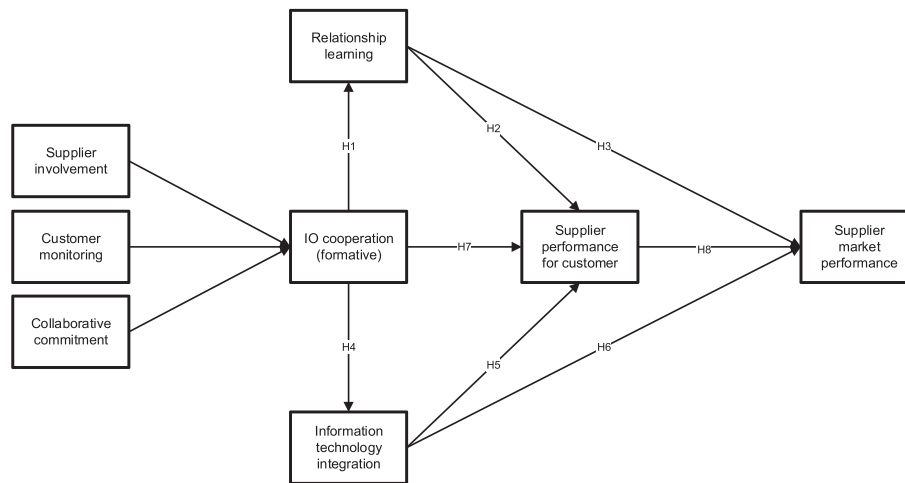
**Figure 1.** Supply chain performance model.

**Table 1.** Sample product group distribution and interviewee position categories.

| Industry Group Name | No. of Companies | % of Sample |
|---|---|---|
| Connector | 150 | 14.94% |
| Passive components | 146 | 14.54% |
| Generic components | 107 | 10.66% |
| Materials | 85 | 8.47% |
| Printed circuit boards (PCBs) | 81 | 8.07% |
| Light-emitting diodes (LEDs) | 76 | 7.57% |
| Transformers | 69 | 6.87% |
| Optronics | 68 | 6.77% |
| Battery and power | 60 | 5.98% |
| Integrated circuits (ICs) | 53 | 5.28% |
| Touch panels | 50 | 4.98% |
| Switches | 44 | 4.38% |
| Speakers | 15 | 1.49% |
| | 1,004 | 100% |
| Position Category | No. | % of Sample |
| Sales manager/director/engineer | 291 | 28.99% |
| Business department manager | 197 | 19.62% |
| General manager and vice general manager | 142 | 14.14% |
| Salesman/representative/supervisor | 133 | 13.25% |
| Account/asset/purchasing/project director | 78 | 7.77% |
| Foreign/overseas sales | 75 | 7.47% |
| Market department manager | 70 | 6.97% |
| CEO/President | 18 | 1.79% |
| | 1004 | 100.00% |

interviewee vetting process was carried out personally by the first author. Because we focused on the supplier's relationship with its major downstream customer, the target interviewee was the customer relationship manager. We used an intensely personal approach to ensure that the key customer relationship manager in each supplier selected for the interview was knowledgeable about the collaborative practices of their largest manufacturing customer. To execute this ideal, the first author attended 29 B2B trade shows and went on factory visits over a two-year period to personally meet with and approve each interviewee before beginning an interview. A total of 988 interviews were conducted in Chinese and 16 were conducted in English (see Table 1 for the sample interviewees). Each interview lasted for one hour on average. We followed the steps pioneered by Bloom and Van Reenen (2007) in their large-scale interview study of over 3,000 managers. The sample population consisted of all the component companies invited to interview in each expo, and

among the short-listed potential interviewees, there was over a 70% take-up rate for the request to be interviewed by the first author. Crucially, this study was approved by the Human Research Ethics Committee for Non-Clinical Faculties at The University of Hong Kong, reference number EA190109 on January 21, 2009, in support of the associated peer-reviewed research grant: Hong Kong GRF Fund (No.12503515).

### 4.2. Variable measures and scale development

Table 2 details the measurement items used in our survey. Given the extensive commitment of the interview process, the survey had a large range of measures, enabling the exploration of different research questions that focused on specific outcomes such as the following: (i) What are the determinants of supplier performance measurement alignment? (ii) What is the influence of geographical distance on customer governance behavior? These questions are explored in other working papers that aim to contribute to the accounting and international business literature. The specific variable measures taken from the interview survey all related to the collaborative and communicative activities of the suppliers' largest customers, the focus of our study. Validated scales were taken from the literature and modified for our context following the procedures recommended in the literature, as needed. All items were carefully pretested and checked for content validity ex-ante. The modifications were informed by a pilot study of the purchasing managers of six large brand-name manufacturers and the sales managers of 11 of their suppliers (Wieland et al., 2017).

The survey items measuring *relationship learning* were taken from Jean et al. (2010); this construct is intended to measure communication and information exchange between individuals but can capture personal exchanges as well as the quality of relationships. By contrast, the survey's *IT integration* measurement assesses technological dimensions—that is, the virtual connections between suppliers and their major buyers. It not only covers general aspects of connectivity (i.e., the use of network technologies such as e-mails, virtual-network connections, file sharing) but also focuses on the level of computerization and sharing of information via quick ordering systems. These survey items were adapted from Narasimhan and Kim (2002) and Kim (2009), who investigate company integration in SCs and the impact of SC integration on firm performance, respectively.

The most complex construct in our study, *IO cooperation*, examines three different dimensions: supplier involvement, customer monitoring, and collaborative commitment. The supplier involvement dimension measures the importance of the role that the supplier plays in various areas of the buyer's value chain (Song et al., 2011; Song and Di

**Table 2.** Measurement details for survey.

| Latent Construct/Scaling | Items | Label |
|---|---|---|
| **Relationship learning;** adapted from Chen et al. (2009); Jean et al. (2010); Selnes and Sallis (2003)<br>7-point scale: strongly disagree/agree | rel_learn_1 | It is common to establish joint teams to solve operational problems in the relationship. |
| | rel_learn_2 | It is common to establish joint teams to analyze and discuss strategic issues. |
| | rel_learn_3 | The problem-solving atmosphere in the relationship is cooperative. |
| | rel_learn_4 | We have a lot of face-to-face communication in this relationship. |
| **IT integration**<br>IT_int_1 adapted from Narasimhan and Kim (2002)<br>IT_int_2 and IT_int_3 were from Kim (2009)<br>7-point scale: to a very little/large extent | IT_int_1 | How linked is your company with the major customer through information networks (e-mails, virtual-network connections, file sharing)? |
| | IT_int_2 | How computerized is the ordering process for your major customer (e.g., do you have an online ordering system)? |
| | IT_int_3 | To what extent has your company established a quick ordering system with your major customer? |
| **Interorganizational cooperation: Supplier involvement;** adapted from Ittner et al. (1999)<br>Items 1–4<br>5-point scale: not at all/primary;<br>Item 5<br>5-point scale: never vs. always/almost always;<br>Item 6<br>5-point scale: no role/central role;<br>Item 7<br>5-point scale: not at all/fully | io_co_rel_1 | How important are you to the customer in its acquisition of product technology, (i.e., technology incorporated into the design of the product or services delivered to the customer)? |
| | io_co_rel_2 | How important are you to the customer's acquisition of manufacturing-process technology (i.e., technology incorporated into the design of the process through which your products and services are produced)? |
| | io_co_involv_3 | How important are you in the speeding up your customer's new-product development? |
| | io_co_involv_4 | How important are your suggestions to your customer's development of new products/services? |
| | io_co_involv_5 | How often do you play a prominent role in identifying your customer's new product/service opportunities? |
| | io_co_involv_6 | What is your company's role in developing your customer's strategic plans, either formally or informally? |
| | io_co_involv_7 | How well does your company understand your customer's strategic plans? |
| **Interorganizational cooperation: Monitoring**<br>Adapted from Ittner et al. (1999)<br>7-point scale: never/daily | io_co_mon_1 | How frequently does your major customer supervise or monitor your company? |
| | io_co_mon_2 | How frequently are supplier employees trained? |
| | io_co_mon_3 | How often do your company's and your major customer's senior executives typically meet per year? |
| | io_co_mon_4 | At the lower levels (for example, in R&D at one company and manufacturing at another), how frequently does communication take place (by any means)? |
| **Interorganizational cooperation: Collaborative commitment**; adapted from Flynn et al. (2010);<br>Item 1<br>5-point scale: never/daily;<br>Items 2 and 3<br>5-point scale: very low/high importance;<br>Item 4<br>5-point scale: (if YES) daily/annually (reverse coding) | io_co_cc_1 | How often does your company's major customer provide it with production-planning forecasts (including updates)? |
| | io_co_cc_2 | Your major customer believes it is important for your company to communicate problems before it detects them. |
| | io_co_cc_3 | Your major customer feels it is important that your company proactively communicates schedule changes and changes to product or process specifications. |
| | io_co_cc_4 | Does your major customer explicitly share its performance data with you? |
| **Supplier performance with major buyer;** from (Humphreys et al., 2004)<br>7-point scale: no/significant improvement | su_cust_perf_1 | Percentage of orders meeting design specifications. |
| | su_cust_perf_2 | Percentage of orders meeting quality requirements. |
| | su_cust_perf_3 | Percentage of on-time deliveries. |
| | su_cust_perf_4 | Cost management of purchased parts. |
| | su_cust_perf_5 | Average investment in purchased-parts inventory. |
| | su_cust_perf_6 | Lead time for special/rush orders. |
| | su_cust_perf_7 | Time required for supplier to take a new item from development into production. |
| **Supplier market performance;** adapted from (Flynn et al., 2010; Kim, 2009)<br>7-point scale: no/significant improvement | su_mark_perf_1 | Sales growth over past three years. |
| | su_mark_perf_2 | Increased market share. |
| | su_mark_perf_3 | Increased profitability (i.e., profit ratio). |
| | su_mark_perf_4 | Creation of new products/product enhancements (past three years). |

Benedetto, 2008). We used the seven-item instrument developed by Ittner et al. (1999). The second dimension (customer monitoring) measures the frequency of on-site customer monitoring practices, such as training and supervision. We used the four monitoring items reported by Ittner et al. (1999). Both supplier involvement and customer monitoring scales were adapted from the study by Ittner et al. (1999). After pretesting, these dimensions were modified to match the specific goals of our study. The third dimension, collaborative commitment, was based on the supplier- and customer-integration measurement items from Flynn et al. (2010). We used four items that were adapted and best suited for the present study's cooperation domain based on pretests and expert opinions gained through the pilot study.

The items measuring *supplier performance* regarding major buyers were taken from Humphreys et al. (2004), who surveyed companies in Hong Kong to examine the role of supplier development. Finally, the four measurement items for supplier market performance were based on two studies in the literature that carefully researched *market performance:* that of Kim (2009) and Flynn et al. (2010). They were also based on pretests and expert opinions gained through the pilot study.

### 4.3. Data quality assurance and collection

Several steps were taken to ensure high-quality data were collected. All interviews were screened by the first author in person at the expo or

factory site, thus allowing for cross-checking with other company materials (e.g., brochures, product displays, buyer brand logos). All interviewers received special training and were required to carefully audit and review at least five interviews with another experienced interviewer before conducting their own interviews. Each interview was supervised by one researcher to ensure the interview team followed the correct protocol, such as following the correct order of questions and double-checking with interviewees for all responses that exhibited potential common response bias (e.g., three or more responses on the same level of the Likert-type scale).

Before testing our model, several analyses were run with the interviewer as a fixed effect. These analyses were designed to test for inconsistent interpretations of categorical responses and standardizations of the scoring system, and they did not yield any significant effects. Therefore, we concluded that our survey and interview protocols suffered no significant distortions because of our interviewers.

Our target group consisted of sales managers, who can offer the greatest insight into suppliers' relationships and interactions with their largest buyers. Before each interview, the potential candidate was screened for knowledge of the company's relationship with its largest buyer. The survey's topic and goal were explained, and it was made clear that most of the questions focused on the suppliers' interactions with their largest buyers. During each interview, the interviewers closely adhered to a checklist to ensure consistency during follow-ups on particular response patterns. Additionally, detailed information on the interview process (e.g., date and expo or factory location) and type of manager (e.g., gender, seniority, and confidence level) were collected and used to reduce residual variation. Four to six weeks after completing each interview, a follow-up call was made, during which a research team member rechecked select questions in each section of the interview to assess response consistency and reliability.

Given that our topic is subject to social desirability bias and that most of our data are based on self-reported survey answers, we incorporated several design choices to lessen the chance of common method bias (CMB) and to increase the likelihood of data quality (Bagozzi, 2011; Lowry et al., 2016; MacKenzie and Podsakoff, 2012; Podsakoff et al., 2003). To do so, all company representatives were interviewed by a team of interviewers who filled out the responses on behalf of their respective interviewees. Open-ended questions, control variables, and single-item measures were also interspersed with measures of more complex constructs based on multiple items. We also used measures with different scaling and anchors. Finally, our survey also included several control questions that were theoretically unrelated to our topic to serve as marker variables to demonstrate that common method bias did not threaten our data. In the case of inconsistent responses, the interviewees were asked to double-check their answers and discuss them on the spot. These controls were used within and between different sections of the survey. Consequently, these efforts dramatically decreased the possibility of CMB occurring and greatly increased data quality. This is further empirically confirmed in multiple ways the next section.

## 5. Results

Except where noted, all model analyses were conducted with partial least square (PLS) regression using SmartPLS version 2.0 (Ringle et al., 2005) because PLS is more appropriate than covariance-based SEM for preliminary model building, is more robust for the analyses of less-normalized industry data, and better handles complex data (e.g., large datasets, datasets with second-order factors, datasets with formative measurement)—which best describes the present study's data (Chin et al., 2003; Fornell and Larcker, 1981; Peng and Lai, 2012). By contrast, CB-SEM is more appropriate than PLS when testing highly developed, known models with highly normalized data (Chin et al., 2003; Peng and Lai, 2012).

Our work was in accordance with that of Peng and Lai (2012), who explains how to apply PLS to operations management research. We also

leveraged additional guidelines for applying PLS to management research, as established and demonstrated by Gefen and Straub (2005), Cenfetelli and Bassellier (2009), and Lowry and Gaskin (2014). We conducted an extensive pre-analysis and data validation according to the latest standards for the following four reasons: (1) to establish the factorial validity of our measures through convergent and discriminant validity; (2) to establish that multicollinearity was not a problem with any of our measures; (3) to check for common method bias using the marker-variable approach; and (4) to establish strong reliability.

### 5.1. Details on factorial validity

Factorial validity is formed by establishing both *convergent validity* and *discriminant validity*, two highly interrelated concepts that must coexist. To establish the factorial validity of our latent constructs, we used two widely accepted techniques to determine convergent validity and two widely accepted techniques to determine discriminant validity. First, we examined our outer-model loadings, summarized in Table 3. Convergent validity can be established when the outer-model loadings' *t*-values are significant; all items in the present study's outer-model loadings were highly significant. To double-check our results, we correlated our latent-variable scores against their indicators as a form of factor loading, then examined the indicator loadings and cross-loadings to establish convergent validity, as proposed by Gefen and Straub (2005) and demonstrated in Lowry and Gaskin (2014). This analysis is summarized in Table 4. Although this approach is typically used to establish discriminant validity, convergent validity, and discriminant validity are interdependent and help establish each other (Straub et al., 2004). Thus, convergent validity is also established when each loading for a latent variable is substantially higher than those for other latent variables—and this was true for the present study's data in every case.

Similarly, we also used two approaches to establish discriminant validity, as described in Gefen and Straub (2005) and demonstrated more recently in Lowry and Gaskin (2014). First, as with convergent validity, we examined our study's factor loadings, but this time, we did so to ensure no significant overlap existed between our constructs. Again, see Table 4, which illustrates the strong discriminant validity our method showed.

Second, we compared the square roots of the average variance-extracted (AVE) scores with the latent variables' correlations. The standard here is that the AVE scores' square roots for any given construct (latent variable) should be higher than any of the correlations involving that construct (Fornell and Larcker, 1981; Staples et al., 1999). The numbers are shown in the diagonal for constructs (bolded and underlined) in the measurement model of Table 5. Strong discriminant validity was shown for all sub-constructs. Importantly, interorganizational cooperation is a second-order factor composed of three first-order, reflective constructs that we validated separately: (1) shared measures, (2) operational monitoring, and (3) relationship strength.

### 5.2. Establishing lack of mono-method bias

Moreover, our research was designed a priori so that common method bias (aka mono-method bias) would not likely result from our study—as per the leading literature on the subject (Bagozzi, 2011; MacKenzie and Podsakoff, 2012; Podsakoff et al., 2003). However, we still tested for common method bias to establish that it was unlikely to be a negative factor in our analysis' remaining data.

The most important point concerning common method bias is that, if it exists, the constructs of a model will be highly correlated with each other. Thus, we simply examined a correlation matrix of our study's constructs and determined whether any of the correlations were above 0.90; if they had been, it would have been sufficient evidence that common method bias might have existed (Pavlou et al., 2007). These correlations are presented in the measurement-model statistics in Table 5, and as shown, all are significantly below the 0.90 threshold.

**Table 3.** Outer model weights to establish convergent validity.

| Latent Construct | Items | Outer weight | t-values |
|---|---|---|---|
| Relationship learning | rel_learn_1 | 0.652 | 12.66*** |
| | rel_learn_2 | 0.770 | 26.30*** |
| | rel_learn_3 | 0.576 | 9.99*** |
| | rel_learn_4 | 0.707 | 19.44*** |
| IT integration | IT_int_1 | 0.623 | 10.73*** |
| | IT_int_2 | 0.789 | 21.58*** |
| | IT_int_3 | 0.777 | 21.10*** |
| Interorganizational cooperation: Supplier involvement | io_co_involv_1 | 0.643 | 18.94*** |
| | io_co_involv_2 | 0.630 | 20.74*** |
| | io_co_involv_3 | 0.723 | 36.24*** |
| | io_co_involv_4 | 0.730 | 34.51*** |
| | io_co_involv_5 | 0.719 | 37.12*** |
| | io_co_involv_6 | 0.669 | 25.17*** |
| | io_co_involv_7 | 0.611 | 21.38*** |
| Interorganizational cooperation: Monitoring | io_co_mon_1 | 0.691 | 15.91*** |
| | io_co_mon_2 | 0.550 | 9.10*** |
| | io_co_mon_3 | 0.728 | 18.02*** |
| | io_co_mon_4 | 0.509 | 7.73*** |
| Interorganizational cooperation: Collaborative commitment | io_co_cc_1 | 0.503 | 6.411*** |
| | io_co_cc_2 | 0.628 | 9.50*** |
| | io_co_cc_3 | 0.739 | 15.10*** |
| | io_co_cc_4 | 0.751 | 7.73*** |
| Supplier performance with major buyer | su_cust_perf_1 | 0.694 | 26.36*** |
| | su_cust_perf_2 | 0.705 | 27.76*** |
| | su_cust_perf_3 | 0.726 | 28.12*** |
| | su_cust_perf_4 | 0.623 | 22.14*** |
| | su_cust_perf_5 | 0.689 | 28.67*** |
| | su_cust_perf_6 | 0.696 | 28.89*** |
| | su_cust_perf_7 | 0.631 | 21.55*** |
| Supplier market performance | su_mark_perf_1 | 0.767 | 34.63*** |
| | su_mark_perf_2 | 0.795 | 34.46*** |
| | su_mark_perf_3 | 0.749 | 26.85*** |
| | su_mark_perf_4 | 0.527 | 4.49*** |

$*p < 0.05$, $**p < 0.01$, $***p < 0.001$, n/s = not significant.

However, as an additional check, we also used various control variables as marker variables to see whether any of these were highly correlated with our DVs, and again, this was not the case. Consequently, we have no reason to believe common method bias is a factor in our study.

### 5.3. Reliabilities

All of our reflective sub-constructs exhibited high levels of reliability. *Reliability* refers to the degree to which a scale yields consistent and stable measures through time (Straub, 1989). To establish reliability, PLS computes a composite reliability score as part of its integrated model analysis. This score is a more accurate measurement of reliability than Cronbach's alpha because it does not assume loadings or error terms must exist for the items to be equal. The computed composite-reliability values are summarized in Table 6 and indicate strong reliability.

### 5.4. Checking for multicollinearity

Another major concern with SEM, especially with PLS path modeling, is its potential for multicollinearity. To check for this, we adhered to the latest validation standards with all our construct items, regressing each item against an arbitrary DV of the first cooperation dimension: integration. These results are depicted in Table 7. The highest VIF score was 2.699, which is far below the current standards for reflective constructs

($<5.0$) (Cenfetelli and Bassellier, 2009; Peng and Lai, 2012). We thus concluded that our model does not suffer from multicollinearity.

### 5.5. Final analysis results

Our final path modeling results are summarized in Figure 2 and detailed in Table 8. Most of our hypothesized relationships were supported, which we address in the final part of this section.

Effect sizes of the results. Following Peng and Lai (2012) guidelines for operations management researchers using PLS, we provide a post hoc analysis to assess our model's effect sizes, statistical power, and Stone-Geisser blindfold. The effect sizes cannot be estimated from SEM beta coefficients; instead, a conservative approach is used to use Pearson's *r* among the supported paths. Table 9 summarizes this analysis and indicates that all the supported relationships have medium-to-large effect sizes.

**Statistical power**: Regarding statistical power, our large sample size of 1,000 companies far exceeds the minimum guidelines for PLS—a minimum sample size of at least ten times the most complex relationship in a given model (Peng and Lai, 2012). A more conservative approach is to follow CB-SEM guidelines, which require a minimum of 10 samples per item (Westland, 2010). Our model, including the control variables, has 38 indicators and hence would require a minimum sample size of 380, making our actual sample size more than twice the size of the required minimum. Finally, we used a more conservative approach in calculating the sample size for SEM by following Westland (2010), who considers the number of latent variables (10), the number of indicators (38), the minimum effect for observation, and an alpha significance of .05 and a power of .80. This calculation indicates that the minimum sample size for our ratio of indicators to latent variables is 112, yet to produce a minimum 0.15 level of Cohen's $f$, a sample size of 797 would be required.

**Predictive relevance of our model**: Regarding the Stone-Geisser blindfold, we calculated the Stone-Geisser ($Q^2$) test of predictive relevance, which tests whether a model can predict data points that are explicitly excluded: "If $Q^2 > 0$, then the model is viewed as having predictive relevance" (Peng and Lai, 2012, p. 473). In every case for the present study, $Q^2$ was greater than 0.

## 6. Discussion

In this paper, we present the findings from a study focusing on China's technology industry using a sample consisting of 1,004 high-tech companies. Our research goal was to examine how IO cooperation, directly and indirectly, impacts performance and what role IT integration and relationship learning play in the value-creation process for suppliers in B2B supply chains. We hypothesized a positive effect of IO cooperation on relationship learning and IT integration, both of which were corroborated. Furthermore, we identified IO cooperation and IT integration as important antecedents for supplier performance for the customer, while relationship learning turned out to have no such effect. Finally, Relationship learning, supplier performance for customer and IT integration all showed significant positive effects on supplier market performance.

### 6.1. Theoretical implications

In our study, we show that in China's high-tech industry, a company's level of IO cooperation is a major determinant of its performance with its major buyer and the market in general. We were able to reduce the influence of confounding variables, such as country of origin and type of business. Our sample selection method and our sample's size greatly increased the generalizability of our results.

One especially interesting finding of the present study is that the strong positive effect of IO cooperation on (a) supplier performance for customer and (b) supplier market performance is partly mediated by relationship learning and IT integration. Therefore, it can be inferred that

**Table 4.** Correlations of latent variable scores against indicators.

| Latent Construct Items | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
|---|---|---|---|---|---|---|---|
| rel_learn_1 | 0.652 | 0.072 | 0.193 | 0.052 | 0.100 | 0.094 | 0.060 |
| rel_learn_2 | 0.770 | 0.036 | 0.392 | 0.180 | 0.040 | 0.114 | 0.164 |
| rel_learn_3 | 0.576 | 0.099 | 0.131 | -0.023 | 0.073 | 0.069 | 0.057 |
| rel_learn_4 | 0.707 | 0.099 | 0.272 | 0.272 | 0.091 | 0.122 | 0.112 |
| IT_int_1 | 0.061 | 0.623 | 0.056 | -0.009 | 0.154 | 0.200 | 0.093 |
| IT_int_2 | 0.033 | 0.789 | 0.155 | 0.056 | 0.101 | 0.166 | 0.147 |
| IT_int_3 | 0.123 | 0.777 | 0.114 | 0.082 | 0.061 | 0.183 | 0.183 |
| io_co_involv_1 | 0.189 | 0.105 | 0.643 | 0.159 | 0.139 | 0.178 | 0.192 |
| io_co_involv_2 | 0.156 | 0.108 | 0.630 | 0.198 | 0.152 | 0.180 | 0.153 |
| io_co_involv_3 | 0.230 | 0.085 | 0.723 | 0.188 | 0.188 | 0.220 | 0.186 |
| io_co_involv_4 | 0.312 | 0.093 | 0.730 | 0.182 | 0.162 | 0.212 | 0.216 |
| io_co_involv_5 | 0.313 | 0.122 | 0.719 | 0.140 | 0.164 | 0.227 | 0.208 |
| io_co_involv_6 | 0.347 | 0.083 | 0.669 | 0.199 | 0.107 | 0.202 | 0.181 |
| io_co_involv_7 | 0.355 | 0.125 | 0.611 | 0.173 | 0.144 | 0.195 | 0.258 |
| io_co_mon_1 | 0.141 | 0.021 | 0.167 | 0.691 | 0.026 | 0.051 | 0.051 |
| io_co_mon_2 | 0.104 | 0.065 | 0.154 | 0.550 | 0.009 | 0.094 | 0.099 |
| io_co_mon_3 | 0.175 | 0.050 | 0.212 | 0.728 | 0.115 | 0.098 | 0.110 |
| io_co_mon_4 | 0.128 | 0.023 | 0.101 | 0.509 | 0.149 | 0.020 | -0.010 |
| io_co_cc_1 | 0.043 | 0.058 | 0.099 | 0.026 | 0.503 | 0.077 | 0.068 |
| io_co_cc_2 | 0.074 | 0.105 | 0.175 | 0.075 | 0.628 | 0.142 | 0.117 |
| io_co_cc_3 | 0.057 | 0.078 | 0.141 | 0.084 | 0.739 | 0.170 | 0.115 |
| io_co_cc_4 | 0.090 | 0.115 | 0.166 | 0.110 | 0.751 | 0.200 | 0.128 |
| su_cust_perf_1 | 0.119 | 0.128 | 0.182 | 0.088 | 0.135 | 0.694 | 0.332 |
| su_cust_perf_2 | 0.084 | 0.163 | 0.119 | 0.004 | 0.119 | 0.705 | 0.317 |
| su_cust_perf_3 | 0.073 | 0.204 | 0.160 | 0.062 | 0.196 | 0.726 | 0.256 |
| su_cust_perf_4 | 0.056 | 0.169 | 0.239 | 0.098 | 0.182 | 0.623 | 0.275 |
| su_cust_perf_5 | 0.098 | 0.142 | 0.258 | 0.103 | 0.148 | 0.689 | 0.327 |
| su_cust_perf_6 | 0.112 | 0.175 | 0.192 | 0.077 | 0.207 | 0.696 | 0.312 |
| su_cust_perf_7 | 0.172 | 0.194 | 0.254 | 0.077 | 0.113 | 0.631 | 0.290 |
| su_mark_perf_1 | 0.141 | 0.111 | 0.214 | 0.072 | 0.086 | 0.323 | 0.767 |
| su_mark_perf_2 | 0.114 | 0.144 | 0.200 | 0.086 | 0.159 | 0.345 | 0.795 |
| su_mark_perf_3 | 0.077 | 0.179 | 0.195 | 0.082 | 0.148 | 0.358 | 0.749 |
| su_mark_perf_4 | 0.148 | 0.126 | 0.252 | 0.068 | 0.068 | 0.233 | 0.527 |

(1) = Relationship learning; (2) = IT integration; (3) = Interorganizational cooperation: Supplier involvement; (4) = Interorganizational cooperation: Monitoring; (5) = Interorganizational cooperation: Collaborative commitment; (6) = Supplier performance with the major buyer; (7) = Supplier market performance.
Items shaded in grey indicate loadings over 0.500 on the associated latent construct.

**Table 5.** Measurement model statistics and AVEs.

| Latent Construct | Mean | SD | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
|---|---|---|---|---|---|---|---|---|---|
| Relationship learning (1) | 5.30 | 0.91 | **0.680** | | | | | | |
| IT integration (2) | 4.66 | 1.54 | 0.105 | **0.734** | | | | | |
| IO cooperation: Relations (3) | 3.35 | 0.67 | 0.382 | 0.156 | **0.677** | | | | |
| IO cooperation: Monitoring (4) | 2.53 | 0.88 | 0.201 | 0.062 | 0.252 | **0.626** | | | |
| IO cooperation: Integration (5) | 3.91 | 0.65 | 0.103 | 0.131 | 0.222 | 0.124 | **0.663** | | |
| Supplier performance regarding major buyer (6) | 4.81 | 1.03 | 0.147 | 0.238 | 0.298 | 0.103 | 0.227 | **0.681** | |
| Supplier market performance (7) | 4.16 | 1.26 | 0.162 | 0.198 | 0.305 | 0.096 | 0.160 | 0.439 | **0.717** |

Bolded and underlined entries down the diagonal indicate the square root of the AVEs.

synergies arise for an organization from simultaneously implementing an adequate infrastructure and building a business network. The strongest effect in our study was the influence of IO cooperation on relationship learning, which confirms preexisting literature that highlights the strong connection of cooperation and the subsequent emergence of personal networks.

Our model further indicates that researchers must not only include IO cooperation as an important antecedent in any study that strives to explain and predict performance; instead, researchers must measure cooperation in three dimensions to take into account how supplier involvement, customer monitoring, and collaborative commitment together constitute cooperation. In other words, IO cooperation is determined by these three dimensions, and we used a formative measurement to take this into account.

When it comes to the theory behind practice, our findings are in line with the basic RMT guidelines. IO cooperation fosters relationship learning and thus has a direct and indirect positive effect on supplier market performance. Interestingly, we found no such

**Table 6.** Reliability of this Study's Latent Constructs.

| Latent Construct | Reliability |
| --- | --- |
| IT integration | 0.776 |
| Relationship learning | 0.773 |
| IO cooperation: Relations | 0.855 |
| IO cooperation: Monitoring | 0.716 |
| IO cooperation: Integration | 0.754 |
| Supplier market performance | 0.806 |
| Supplier performance regarding major buyer | 0.858 |

**Table 7.** Collinearity statistics.

| Latent Construct Items | Item Label | Tolerance | VIF |
| --- | --- | --- | --- |
| Relationship learning 1 | rel_learn_1 | 0.698 | 1.432 |
| Relationship learning 2 | rel_learn_2 | 0.511 | 1.955 |
| Relationship learning 3 | rel_learn_3 | 0.635 | 1.574 |
| Relationship learning 4 | rel_learn_4 | 0.480 | 2.082 |
| IT integration 1 | IT_int_1 | 0.664 | 1.507 |
| IT integration 2 | IT_int_2 | 0.649 | 1.541 |
| IT integration 3 | IT_int_3 | 0.623 | 1.606 |
| Supplier involvement 1 | io_co_rel_1 | 0.685 | 1.460 |
| Supplier involvement 2 | io_co_rel_2 | 0.460 | 2.174 |
| Supplier involvement 3 | io_co_rel_3 | 0.486 | 2.056 |
| Supplier involvement 4 | io_co_rel_4 | 0.465 | 2.148 |
| Supplier involvement 5 | io_co_rel_5 | 0.370 | 2.699 |
| Supplier involvement 6 | io_co_rel_6 | 0.446 | 2.241 |
| Supplier involvement 7 | io_co_rel_7 | 0.467 | 2.141 |
| Monitoring 1 | io_co_mon_1 | 0.599 | 1.669 |
| Monitoring 2 | io_co_mon_2 | 0.631 | 1.584 |
| Monitoring 3 | io_co_mon_3 | 0.695 | 1.438 |
| Monitoring 4 | io_co_mon_4 | 0.783 | 1.277 |
| Collaborative commitment 1 | io_co_cc_1 | 0.773 | 1.294 |
| Collaborative commitment 2 | io_co_cc_2 | 0.708 | 1.413 |
| Collaborative commitment 3 | io_co_cc_3 | 0.641 | 1.560 |
| Collaborative commitment 4 | io_co_cc_4 | 0.543 | 1.841 |
| Supplier performance with major buyer 1 | su_cust_perf_1 | 0.492 | 2.031 |
| Supplier performance with major buyer 2 | su_cust_perf_2 | 0.520 | 1.921 |
| Supplier performance with major buyer 3 | su_cust_perf_3 | 0.578 | 1.731 |
| Supplier performance with major buyer 4 | su_cust_perf_4 | 0.677 | 1.476 |
| Supplier performance with major buyer 5 | su_cust_perf_5 | 0.562 | 1.780 |
| Supplier performance with major buyer 6 | su_cust_perf_6 | 0.568 | 1.761 |
| Supplier performance with major buyer 7 | su_cust_perf_7 | 0.582 | 1.717 |
| Supplier market performance 1 | su_mark_perf_1 | 0.518 | 1.929 |
| Supplier market performance 2 | su_mark_perf_2 | 0.547 | 1.829 |
| Supplier market performance 3 | su_mark_perf_3 | 0.536 | 1.867 |
| Supplier market performance 4 | su_mark_perf_4 | 0.499 | 2.003 |

mediated effect of IO cooperation on supplier performance for the customer dimension.

Moreover, our results also confirm and refine SET, which postulates the reciprocity of exchange relations. Notably, IO cooperation has a positive effect on IT integration (i.e., the integration of IT infrastructure and data exchange). Therefore, close collaboration necessitates the establishment of a solid technological infrastructure (Chae et al., 2014; Huo et al., 2014; Treiblmaier and Strebinger, 2008). This infrastructure, in turn, has a positive reciprocal effect on performance. Similarly, IO cooperation fosters relationship learning, which also has a positive reciprocal effect on supplier market performance. Furthermore, these effects confirm the findings by Li et al. (2009), who state that IT implementation (which is closely related to IT integration) does not directly

enhance the performance of the overall SC but rather has indirect benefits.

Regarding the methodological contributions, we closely adhered to recommendations by Peng and Lai (2012) on how to use PLS in operations management research. Additionally, we employed various techniques to avoid bias (e.g., common method bias) to check for multicollinearity and ensure the validity of our results. The Peng and Lai paper offers some guidance to other operations management researchers who are seeking to apply PLS to cases for which it is the method of choice (e.g., preliminary model building). Furthermore, we adapted existing scales from the literature and modified them for our research study, which will help other researchers who want to investigate related phenomena.

Examining our hypotheses, we find that IO cooperation is strongly associated with relationship learning (H1), which in turn impacts supplier market performance (H3). The H1 results highlight the important role of cooperation (Arthanari et al., 2015; Yan and Nair, 2016) and confirm the findings of Ou et al. (2010), who identified supplier management as an important driver of process management, and Prajogo and Olhager (2012), who showed that long-term relationships lead to improved communication between suppliers and their customers. Comparable to Bayraktar et al. (2009), who identified a positive relationship between SCM practices and performance, we found that relationship learning improves suppliers' overall market performance (H3). However, the hypothesized impact of relationship learning on supplier performance for customer (H2) was not significant.

Examining the individual hypotheses for IT integration, we find that this construct is strongly impacted by IO cooperation (H4) and in turn, impacts supplier performance for customer (H5) and supplier market performance (H6). This is consistent with the findings of Prajogo and Olhager (2012), who concluded that information technology and logistics integration had significant mediating effects on long-term supplier-buyer relations and the operational performances of buyers. Other studies have also reported similar findings. Our results for H5 and H6 are comparable with the findings of Bayraktar et al. (2009) who found a positive relationship between IS practices and operational performance.

Examining our hypotheses for IO cooperation, we find that IO cooperation strongly impacts supplier performance for the customer (H7). This is consistent with the findings of Chang et al. (2016), Sezen (2008), Li et al. (2009), and Ou et al. (2010), as well as those of Cao and Zhang (2011). Finally, we find that supplier performance for the customer is significantly associated with supplier market performance (H8). This builds on much of the above literature, which mainly focuses on buyer and supplier operational performances. Indeed, our findings show that when suppliers achieve a higher operational performance regarding their major buyers, their financial performance consequently improves.

Our findings on performance are also consistent with the few studies that have examined the performance implications of SC management practices for the supplier (e.g., Li et al., 2009; Flynn et al., 2010; Hernández-Espallardo et al., 2010). As such, our study builds on previous literature that examines supplying manufacturers and how they manage their relationships with their primary customers.

### 6.2. Managerial implications

For managers, the results of our study indicate that IO cooperation within a SC is essential for improving a supplier's performance regarding its major customer and within the overall marketplace. Interestingly, focusing on parts of the whole organizational system might not yield the expected results, as shown by the nonsignificant relationship between relationship learning and supplier performance for the customer.

The results of the present study demonstrate clearly that companies should improve their IO cooperation, and in turn, this will strongly improve performance—both the supplier's performance with its major customer and its overall market performance. To achieve this goal, strong
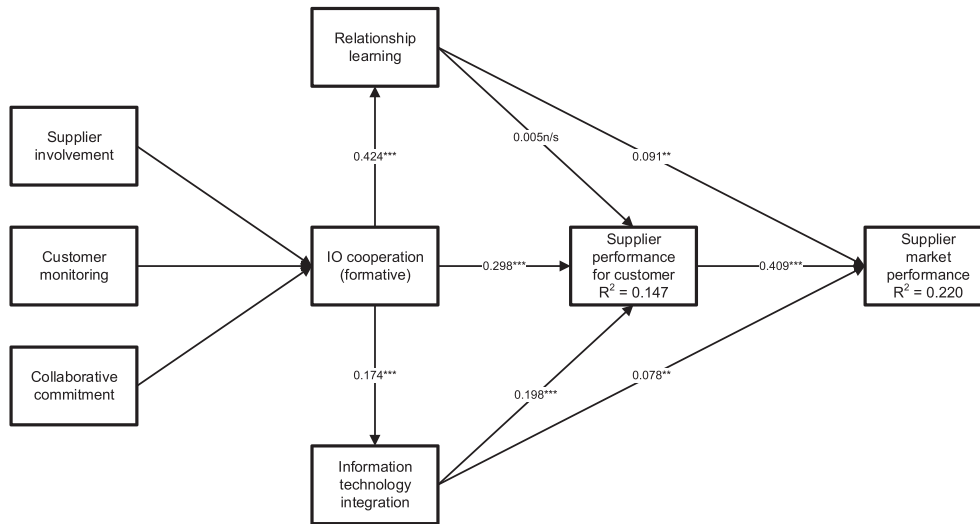
**Figure 2.** Model testing results.

**Table 8.** Results of exploratory structural equation model testing.

| Tested Path | β | *t*-value | Sig. |
|---|---|---|---|
| **Hypotheses** | | | |
| (H1) IO cooperation → Relationship learning | 0.424 | 16.231*** | Yes |
| (H2) Relationship learning → Supplier performance with major buyer | 0.005 | 0.230 (n/s) | No |
| (H3) Relationship learning → Supplier market performance | 0.091 | 3.136** | Yes |
| (H4) IO cooperation → IT integration | 0.174 | 5.107*** | Yes |
| (H5) IT integration → Supplier performance with major buyer | 0.198 | 8.599*** | Yes |
| (H6) IT integration → Supplier market performance | 0.078 | 2.544** | Yes |
| (H7) IO cooperation → Supplier performance with major buyer | 0.298 | 6.315*** | Yes |
| (H8) Supplier performance with major buyer → Supplier market performance | 0.409 | 14.692*** | Yes |
| **Control Variables** | | | |
| Buyer concentration → Supplier performance with major buyer | (-0.020) | 1.359 (n/s) | No |
| Size (no. employees) → Supplier performance with major buyer | (-0.015) | 0.572 (n/s) | No |
| Chinese ownership? → Supplier performance with major buyer | 0.007 | 0.651 (n/s) | No |
| Buyer concentration → Supplier market performance | 0.038 | 0.102 (n/s) | No |
| Size (no. employees) → Supplier market performance | 0.062 | 2.745** | Yes |
| Chinese ownership? → Supplier market performance | (-0.003) | 0.230 (n/s) | No |

*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$, n/s = not significant.

**Table 9.** Effect sizes of significant model paths.

| Tested Hypothesis | Calculated Pearson's *r* | Effect size interpretation* |
|---|---|---|
| (H1) IO cooperation → Relationship learning | 0.456 | Large |
| (H2) Relationship learning → Supplier market performance | 0.007 | Very small |
| (H4) IO cooperation → IT integration | 0.098 | Small |
| (H5) IT integration → Supplier performance with major buyer | 0.159 | Medium |
| (H6) IT integration → Supplier market performance | 0.262 | Medium–large |
| (H7) IO cooperation → Supplier performance with major buyer | 0.080 | Small |
| (H8) Supplier performance with major buyer → Supplier market performance | 0.421 | Large |

* Cohen (1988) indicates that in using Pearson's *r* for estimating effect size, the following magnitudes should be used: *small* ($\leq 0.10$), *medium* ($> 0.10$ and $< 0.30$), and *large* ($> 0.30$ and $< 0.50$).

relationships are an essential prerequisite, but the importance of sharing a common IT infrastructure must not be neglected. Managers should ensure that different types of information exchanges (ranging from e-mails and file sharing to online ordering systems) over integrated networks are possible (i.e., that the necessary enabling technologies are in place), but they must also make sure that this technology is actually

enhancing IO communications, which largely depend on personal relationships.

In our research, we have identified three important constituents of cooperation (i.e., supplier involvement, customer monitoring, and collaborative commitment), but several more may exist. Our operationalization for the cooperation construct provides interesting starting

points for managers on how to improve IO exchanges. Suppliers can take proactive steps toward understanding their customers' strategic plans and making suggestions for new product opportunities. Suppliers should also proactively seek regular, formal evaluations from their buyers to constructively improve their operations. These formal process systems can offset the negative impacts of random feedback triggered by specific underperformance events (e.g., delayed delivery and poor product quality), and which can lead to greater trust and reciprocity between partners over time.

## 7. Conclusions and limitations

In our study, we have shown that IO cooperation is an important antecedent of supplier performance for the customer and later within the general marketplace. From 2010 to 2012, we investigated the direct and mediating effects of *relationship learning* and *IT integration*. Our results indicate that relationship learning, and IT integration mediate the impact of IO cooperation on an organization's performance.

Additionally, we corroborate previous research indicating that cooperation has a positive influence on performance, highlighting the importance of correctly specifying the nature and direction of relationships between the drivers and enablers of cooperation and performance. For example, several studies have provided evidence to support the role of cooperation regarding the performance of a manufacturer in managing an upstream SC (e.g., Cao and Zhang, 2011; Ou et al., 2010; Tan et al., 2010). Our study expands on this by providing evidence to support the important role of cooperation regarding a manufacturer's performance in managing a downstream SC.

Nevertheless, relationship learning, and IT integration were shown to be important mediators of performance, which is vital information for researchers and practitioners alike. Indeed, our findings for relationship learning corroborate a great deal of previous research on the topic, which shows the value of relationship learning; for example, several previous studies have shown that a correlation exists between relationship learning and cooperation (e.g., Cai et al., 2010; Ou et al., 2010) and between relationship learning and performance (e.g., Hernández-Espallardo et al., 2010).

Given our focus on how suppliers' perceptions affect their relationships with their major customers, our IT integration construct closely mirrors the customer integration construct used in other SC management studies. Although some previous literature shows evidence of a positive relationship between customer integration and performance (Lee et al., 2007), other studies have not supported these findings (Devaraj et al., 2007; Wong et al., 2011). Thus, our results, which show cooperation's important mediating role, shed light on the lack of a direct correlation between customer integration and performance.

Although our study makes a significant contribution to the SCM literature and has important implications in practice, it does have some limitations, which present several opportunities for future research. First, although the data for the present study come from a diverse sample of 1,004 high-tech companies in China—thus guaranteeing a high level of external validity—care should be taken when imposing our findings on other countries and industries; naturally, future research should study our SC performance model in other contexts to validate or contradict is applicability elsewhere.

Second, with only five constructs, our model is parsimonious and open for further theory-driven expansions. We intentionally created our model this way so that we could avoid the possible adverse effects of model overfitting and could focus exclusively on the effects of relationship learning and IT integration. In doing so, however, we deliberately left out many constructs and subconstructs found in the literature that are frequently associated with establishing effective cooperation. Furthermore, our study uses a cross-sectional design that cannot capture cooperation and performance development over time.

Therefore, future research should focus on additional constructs and longitudinal studies.

## Declarations

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