Structuring Supplier Involvement in New Product Development: A China–U.S. Study

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ABSTRACT
Buying and supplying organizations rely on each other for developing better products in an efficient manner, which explains the popularity of involving suppliers in new product development (NPD). However, such involvement is not always successful, partially due to the challenges of structuring a buyer–supplier team to manage joint dependence and dependence asymmetry. This study adopts an organizational dependence view to examine how three types of intergroup structures—administrative (formalization and centralization), task (task interdependence), and physical (colocation)—influence project performance and buyer learning in NPD projects. Furthermore, adopting a contingency theory perspective, we study whether the national context moderates the effects of intergroup structures on project outcomes. We adopt a two-group structural equation modeling approach to test hypotheses with survey responses from a sample of NPD projects in the United States (US) and China. Results show different ways in which intergroup structures influence project performance and buyer learning in the two culturally, economically, and institutionally distinct countries. We discuss the implications of these new findings and present directions for future research. [Submitted: May 8, 2014. Revised: July 28, 2015. Accepted: August 20, 2015.]

Subject Areas: Contingency Theory, Intergroup Structure, New Product Development, Organizational Dependence, Performance, and Supplier Involvement.

INTRODUCTION
Original equipment manufacturers are increasingly involving suppliers in new product development (NPD) projects (Yan & Dooley, 2014). These suppliers provide innovative technologies to create novel designs and share process capability information to improve design and manufacturability of the product (Swink, 1999).
Despite of the potential contributions from suppliers, joint buyer–supplier NPD projects are not always successful (Yan & Dooley, 2013). Supplier involvement in buyers’ NPD may actually lead to “rigidities, inflexibilities, and coordination issues that can affect performance negatively” (Das, Narasimhan, & Talluri, 2006, p. 569). To explain failures of buyer–supplier joint NPD projects, the literature has focused on factors related with (i) supplier involvement strategy (e.g., timing, design responsibility, and supplier selection), (ii) the quality and quantity of buyer–supplier interactions (e.g., communication intensity, collaboration quality), (iii) characteristics of the task environment (e.g., product complexity, technological novelty), and (iv) buyer–supplier relationship (e.g., previous collaboration experience, idiosyncratic investment) (Hartley, Zirger, & Kamath, 1997; Walter, 2003; Van Echtelt, Wynstra, Van Weele, & Duysters, 2008; Wagner, 2012; Yan & Dooley, 2013, 2014; Stock, 2014). However, relatively less attention has been paid to the organizational structure of a buyer–supplier project team. This is surprising because the organizational structure of a project team is such a key project success factor that defines how activities such as task allocation, coordination, and supervision are directed toward the achievement of project goals, all of which could influence outcomes of a buyer–supplier NPD team (Pugh, 1990; Olson, Walker, & Ruekert, 1995; Stewart & Barrick, 2000).

Among studies that examine the organizational structure of an NPD team, there exist three gaps that limit our understanding of supplier involvement in a buyer NPD project. First, the majority of the studies focus on effects of organizational structure on immediate project performance, such as project completion time, development cost, and product quality, with limited attention to longer term collaboration outcomes, such as learning, or the acquisition of knowledge that could be used in future innovations (Olson et al., 1995). However, a structure that contributes to the accomplishment of project tasks might limit learning opportunities between the buyer and supplier groups due to a myopic focus on short-term project goals (Sobrero & Roberts, 2001). Given such possible trade-off between short-term task-oriented and long-term learning-enhancing outcomes, it is important to know how to structure an NPD project team so that both types of outcomes can be enhanced. To fill this gap, we consider two different types of project outcomes: project performance and buyer learning. Project performance refers to the extent to which resources are fully utilized on productive design activities so that the project team could meet time, budget, and product quality goals (Yan & Dooley, 2013), while buyer learning refers to the extent to which buyer members acquire new knowledge from supplier members that can be used for future projects (Sobrero & Roberts, 2001).

Second, most studies examine the organizational structure in an intraorganizational team, where all members come from the same organization. However, a buyer–supplier NPD team is an interorganizational team, which is more challenging to structure and could result in potential conflicts in the collaboration process due to the existence of the firm boundary that separates the buyer and supplier groups (Li & Hambrick, 2005). The firm boundary creates integration challenges by increasing intergroup differentiation and creating information asymmetry (Srinivasan & Brush, 2006; Richey, Roath, Whipple, & Fawcett, 2010). An organizational structure that works well for managing an intraorganizational team...
might fail to integrate the buyer and supplier groups in a buyer–supplier NPD team. Therefore, it is critical to study performance implications of organizational structure, which governs interactions among multiple subgroups, in an interorganizational project context. To fill this gap, we choose a buyer–supplier NPD team setting to study performance implications of organizational structure. To highlight the existence of two formal groups in a buyer–supplier NPD team and our focus on interactions between the buyer and supplier groups, we use the terms intergroup structure and organizational structure interchangeably.

Finally, and most importantly, most studies examine organizational structure of project teams in a single country. Therefore, we do not know whether the effects of an organizational structure are contingent on the national context. This gap is important to be filled because NPD projects of leading organizations are being undertaken all over the world. According to the organizational structure literature, we have valid reasons to believe that the cultural, economic, and institutional environment within a country could influence the effectiveness of organizational structures (Damanpour, 1991; Farh, Hackett, & Liang, 2007; Kull & Wacker, 2010). To fill this gap, this study uses a two-country survey sample to test how performance implications of intergroup structural factors vary in two distinctively different national contexts—China and the United States (US)—differentiated by national culture, economic ideology, and institutional practices. National culture characterizes the underlying societal principles that give order and direction to activities (Hofstede, 2001). Economic ideology is the “workplace philosophy” that pervades the business environment within a country (Ralston, Holt, Terpstra, & Kai-Cheng, 1997). Institutional practices relate to the political, economic, and contractual behavior patterns that regulate societal interactions (Busenitz, Gomez, & Spencer, 2000). Altogether, these three dimensions lead members to behave differently, sometimes in ways that support an intergroup structure and at other times acting as constraints (Newman & Nollen, 1996). We adopt a contingency theory perspective (Van de Ven & Drazin, 1984; Newman & Nollen, 1996) to examine how the fit between the national context and the intergroup structure could explain differences in performance implications of intergroup structures. By doing so, this study responds to the call for a closer examination of the influence of China’s unique national environments on successful NPD (Zhao, Flynn, & Roth, 2007).

In sum, the key research question answered in this study is: In a buyer–supplier joint NPD project, how do China and the US differ on effects of the intergroup structure on project performance and buyer learning? To answer this question, we build upon the organizational structure and NPD project management literature to focus on three dimensions of an intergroup structure: administrative, task, and physical (Aiken & Hage, 1968; Pugh, Hickson, Hinings, & Turner, 1968; Campion, Medsker, & Higgs, 1993; Sivadas & Dwyer, 2000; Stewart & Barrick, 2000). We chose to focus on these organizational factors because they have been shown to be relevant for studying task allocation, coordination, and supervision in a multigroup team setting (Gupta & Wilemon, 1988; Barclay, 1991; Schmidt, Montoya-Weiss, & Massey, 2001; Hoegl, Weinkauf, & Gemuenden, 2004; Polzer, Crisp, Jarvenpaa, & Kim, 2006). Formalization and centralization are considered as elements of the administrative structure for governing decision-making processes.
(Miller, Droge, & Toulouse, 1988; Sivadas & Dwyer, 2000), task interdependence characterizes the task structure (Pugh et al., 1968), and colocation captures the physical structure (Kahn & McDonough, 1997).

**LITERATURE REVIEW**

In this section, we reviewed the interorganizational NPD literature to show (i) what we already know and what the opportunities are for new knowledge development, (ii) what gaps in the literature does this study specifically address, and (iii) why we need an integrated theoretical framework that combines an interorganizational dependence view with contingency theory to develop our research hypotheses.

The interorganizational NPD literature has primarily adopted either a relational view or organizational learning perspective to study interorganizational collaboration in NPD. The relational view suggests a firm’s critical resources may span firm boundaries and may be embedded in interfirm resources and routines (Dyer & Singh, 1998). The literature has used the relational view to explain why certain interorganizational innovation communities or alliances perform better by focusing on the characteristics of interorganizational structural and relational ties (Yli-Renko, Autio, & Sapienza, 2001; Capello & Faggian, 2005; Ettlie & Pavlou, 2006; Hervas-Oliver & Albors-Garrigos, 2009; Dahlander & Frederiksenn, 2012). From this literature stream, we learn that the structural aspects of the interorganizational collective, such as network configurations, governance structure, geographic distribution, IT support, and resource complementarity, significantly influence the joint innovation outputs (Rowley, Behrens, & Krackhardt, 2000; Sarkar, Echambadi, Cavusgil, & Aulakh, 2001; Srinivasan & Brush, 2006; Bercovitz & Feldman, 2007; Phelps, 2010). However, most of this stream of work focuses on the performance of the joint project, with little attention to other types of gains of individual participants (Wagner, Eggert, & Lindemann, 2010). Our study fills this gap by studying how intergroup structure influences not only project performance, but also buyer learning, a form of long-term gain obtained by the buying firm from buyer–supplier collaboration.

The literature adopting the theoretical lens of organizational learning examines factors that influence knowledge flows among organizational units (Lane & Lubatkin, 1998; Sarin & McDermott, 2003; Dhanaraj, Lyles, Steensma, & Tihanyi, 2004; Giuliani & Bell, 2005; Wagner & Buko, 2005; Azadegan, Dooley, Carter, & Carter, 2008) as well as performance implications of various types of organizational learning (Hult, 1998; Hult, Hurley, Giunipero, & Nichols, 2000; Peng, Mu, & Di Benedetto, 2013). Studies emphasize that the structural arrangements among partners influence the quantity and quality of interpartner knowledge flows (Ahuja, 2000; Kim & Inkpen, 2005; Broekel & Hartog, 2013). However, the focus of these studies has primarily been on learning outcomes with somewhat limited attention to the performance of immediate tasks. Yet, given the resource constraints faced by organizations and the need for balancing long-term learning and short-term task performance, a joint consideration of these performance outcomes within the context of interorganizational NPD projects is needed (Van Aken & Weggeman, 2000). By considering both buyer learning and project performance in a buyer–supplier NPD project, our study fills this gap in the literature.
Although pertinent to our research objective, neither the relational view nor the organizational learning literature alone is enough to answer the research questions considered within this study. The relational view does not adequately explain how intergroup structure affects learning of individual partners in a collaboration process, while the organizational learning literature does not emphasize enough on the efficiency aspect of the collaboration process. Gulati and Sytch (2007) propose an organizational dependence view that considers salient aspects of the relational view and organization learning to present an integrated perspective. The organizational dependence view argues that joint dependence, that is, the sum of actors’ dependencies on each other, and dependence asymmetry, that is, the difference in firms’ dependencies on each other in the project, differ in their performance implications in a dyadic relationship (Gulati & Sytch, 2007). This organizational dependence view has been adopted by the interorganizational innovation literature to show how mutual dependence drives technology collaboration (Davis & Eisenhardt, 2011) and how one party’s dependence on its collaborators influences its investments in the collaboration and ultimately its capability of exploiting external resources (Lavie & Drori, 2012; Inemek & Matthyssens, 2013).

Differentiating joint dependence from dependence asymmetry helps us explain why a certain intergroup structure influences project performance and buyer learning differentially in the same national context. When involving suppliers in NPD projects, buyers face the tension between the need for accessing supplier resources and the misappropriation of resources by suppliers (Katila, Rosenberger, & Eisenhardt, 2008; Jean, Kim, & Sinkovics, 2012). From an organizational dependence perspective, appropriately structuring the buyer–supplier team reduces this tension by increasing joint dependence and managing the uncertainty associated with dependence asymmetry, to ensure collaboration success (Gulati & Sytch, 2007).

Because Gulati and Sytch’s study do not explicitly study the role of the national context, we also need to resort to the contingency theory literature, especially those cross-country studies that allude to the fact that interorganizational interactions are influenced by the underlying national environment (Newman & Nollen, 1996; Hofstede, 2001; Gelfand, Bhawuk, Nishii, & Bechtold, 2004). This contingency view has been adopted by the innovation literature to study how the impact of organizational structures on innovation performance is contingent on environmental factors (Tidd, 2001), organization type and scope (Damanpour, 1991), corporate culture (Deshpandé, Farley, & Webster, 1993), technological context (Lee & Miller, 1996), institutional environment (Luder, 1992), and the national context (Lundvall, 2010). In fact, Lundvall (2010) argues that the national context should be viewed in terms of its broader definition encompassing “[a]ll parts and aspects of the economic structure and the institutional setup affecting learning as well as searching and exploring . . .” (p. 13). Comparing NPD projects in the US and China allows us to shed insights into the distinct ways in which these factors, which are subsumed in the national context, influence performance implications of intergroup structures in buyer–supplier NPD collaborations.
RESEARCH MODEL AND HYPOTHESES

In this section, we start with cultural, economic, and institutional differences between China and the US. Then we develop hypotheses about how various structural factors differentially influence project performance and buyer learning owing to such national differences.

China–U.S. Cultural, Economic, and Institutional Differences

In concert with recent assertions (Lundvall, 2010), we consider a broader notion of national context that subsumes national culture, economic ideology, and institutional environment. National culture is the collective programming of the mind distinguishing the members of one country from others (Hofstede, 2001). To focus on cultural tenets that differentiate China and the US, we consider those aspects that are consistent in the two major national culture studies: the seminal model developed by Geert Hofstede (Hofstede, 2001) and the GLOBE study (House, Hanges, Javidan, Dorfman, & Gupta, 2004). Specifically, the two studies agree that (i) China emphasizes more on collectivism and the US more on individualism; and (ii) China has a higher power distance index score than that of the US. Collectivism refers to the extent to which a country values institutional practices that encourage and reward collective actions (House et al., 2004). Power distance refers to the extent to which people expect power to be concentrated at higher levels within an organization (Carl, Gupta, & Javidan, 2004).

Economic ideology refers to a country’s perspective on the way an economy should run and to what end (Kalt & Zupan, 1984). China’s dominant economic ideology is socialism, while the US’s is capitalism (Ralston et al., 1997). In a socialistic society, the economy is managed by social ownership over the means of production and cooperative management of the allocation of resources. In contrast, a capitalistic country operates an economic system where the means of production are largely privately owned and operated for profit (Schumpeter, 1942).

Institutionally, China distinguishes itself most from the US on the extent of reliance on informal, rather than formal, institutions to govern business transactions (Li, Xie, Teo, & Peng, 2010). For instance, China is a country widely believed to be lacking in legal commitment to the use of formal contracts (Peng & Heath, 1996). Instead, business relationships and transactions are strongly influenced by informal institutions, such as Guanxi, or interpersonal relationships, which act as substitutes of formal institutional support (Xin & Pearce, 1996).

An Organizational Dependence View of Intergroup Structure in Buyer–Supplier NPD

From an organizational dependence view, interorganizational collaboration is a tactic that organizations use to stabilize the flow of valued resources possessed by other organizations (Emerson, 1962; Pfeffer & Nowak, 1976; Gulati & Sytch, 2007). Involving critical resource providers in joint actions reduces performance uncertainty by increasing joint dependence (Gulati & Sytch, 2007; Hillman, Withers, & Collins, 2009). Higher levels of joint dependence, operating through a logic of embeddedness, result in increased joint action, higher trust between partners, and a more advantageous information exchange in the dyad (Gulati & Sytch,
However, collaborating partners do not necessarily rely on each other to the same extent. Unequal dependence could cause power imbalances that are likely to be detrimental for the weaker partner (Emerson, 1962; Pfeffer & Nowak, 1976). Assuming the simultaneous and homogeneous existence of joint dependence and dependence asymmetry, to ensure successful collaboration, an organizational dependence view suggests that a buyer–supplier NPD team needs to be appropriately structured to increase buyer–supplier joint dependence, while effectively managing the uncertainty associated with dependence asymmetry.

The administrative structure, characterized by formalization and centralization, influences the capability of the joint NPD team in managing the uncertainty emanating from dependence asymmetry, which affects the efficiency of the collaboration process (Bensaou & Venkatraman, 1995). At the same time, the administrative structure also influences the extent to which joint dependence helps with encouraging buyer–supplier interactions, which ultimately influences buyer learning (Huber, 1991). The task and physical structures, indicated by task interdependence and colocation, also influence the level of joint dependence in a buyer–supplier NPD team, thereby influencing project performance and buyer learning differently (Sobrero & Roberts, 2001). We adopt this organizational dependence view to explain how the four structural dimensions differentially influence project performance and buyer learning.

### Administrative structure: Formalization

Ruekert and Walker (1987) define formalization as the “degree to which rules or standard procedures are used to govern the interaction between individuals” (p. 6). Formalized processes, such as documented rules, detailed procedures, contract books, sign-off forms, and phase/gate review systems, help in clarifying, regulating, and integrating intergroup interactions. This is crucial for integrating buyer and supplier activities in an efficient manner, especially in the situations of dependence asymmetry (Miller, 1987). Given asymmetric dependence between the buyer and supplier groups, the more powerful group is less motivated to support the other group. A formal intergroup structure avoids such uncooperative situations by clarifying role assignments and task procedures. By using structured processes to plan and execute activities, a formalized intergroup structure reduces relational uncertainties emanating from power imbalances between the buyer and supplier groups (Rosenthal, 1992). In addition, formalization regulates the content and timing of intergroup interactions, which prevents delayed responses or low-quality communication caused by dependence asymmetry. In essence, formalized intergroup interactions integrate the two group’s work activities by orienting the interactions toward achieving project goals, which encourage team members to focus on exchanging task-related information and solving project-relevant problems (Moenaert & Souder, 1996). As a result, a formalized intergroup structure enhances project performance due to the reduced uncertainty resulting from asymmetric dependence between the buyer and supplier groups (Gulati & Sytch, 2007).

Although formalization enhances project performance by reducing uncertainty resulting from dependence asymmetry, it could hurt buyer learning by over-controlling the joint dependence between buyer and supplier members in an NPD
project. Buyer–supplier joint dependence enhances buyer learning by forcing the two groups to interact intensively, which creates greater learning opportunities (Wagner & Buko, 2005). However, formalized structures limit such intergroup interactions, which inhibit problem-solving and exploratory learning (Brockman & Morgan, 2003). predefined communication protocols limit buyer learning by constraining the quantity and quality of information exchanged between buyer and supplier team members. Formalized rules and procedures discourage exploratory learning by constraining variation seeking behavior (Jansen, Van Den Bosch, & Volberda, 2006). A formalized intergroup structure limits social interactions, which prevents the buyer group from acquiring novel ideas from the supplier group (Yli-Renko et al., 2001).

How do China and the US differ in terms of formalization?

A formal intergroup structure does not fit well with China’s collectivistic culture, socialistic ideology, and informal institutional environment. A collectivistic culture emphasizes the interdependence of every human being (Gelfand et al., 2004). Similarly, a socialistic ideology values social ownership over the means of production and cooperative management throughout the economy (Ralston et al., 1997). Both the cultural and economic aspects of China’s national context imply the importance of interpersonal relationships, or Guanxi, in governing business activities (Tsang, 1998). This is consistent with China’s informal institutional environment that lacks formal regulations. In such a national context, a formal intergroup structure won’t be appreciated and followed by project members who rely on their interpersonal relationships to plan and execute project activities (Xin & Pearce, 1996). As a result, project members are less motivated to truly adopt and implement formal rules and procedures to the full extent. Hence, in China, the efficiency benefits of a formal structure won’t be fully realized, while the damaging effect of formalization on learning will be reduced, due to the superficial adherence to formal procedures and rules (Newman & Nollen, 1996). In contrast, in individualistic societies, such as in the US, the ties between individuals are very loose and everybody is supposed to look after his/her own self-interest (Gelfand et al., 2004). Rather than relying on interpersonal relationships, people in individualistic societies usually rely on formal institutions, such as legal and economic regulations to govern business transactions. The capitalistic nature of the U.S. society further strengthens the role of formal institutions, such as objective laws, in ensuring equal individual rights. All together, the national context of the US fits well with the rationale of a formal intergroup structure, which suggests the greater benefit of a formal structure on project performance and a less negative effect of formalization on buyer learning. Accordingly, we hypothesize:

**H1a:** In buyer–supplier joint NPD projects, the size of the positive effect of intergroup formalization on project performance is greater in the US as compared to that in China.

**H1b:** In buyer–supplier joint NPD projects, the size of the negative effect of intergroup formalization on buyer learning is smaller in the US as compared to that in China.
Administrative structure: Centralization

Centralization relates to the concentration of decision-making authority within project teams (John & Martin, 1984). Centralization creates a bureaucratic and nonparticipatory environment, which is detrimental for managing uncertainty resulting from buyer-supplier dependence asymmetry (Eisenhardt & Tabrizi, 1995). A centralized intergroup structure discourages active participation of subordinates in project planning and decision making, which creates opportunities for the powerful group to misappropriate value. Centralization increases the power imbalance by reducing cognitive, psychological, and affective bonding between buyer and supplier members, which further encourages opportunistic behaviors (John & Martin, 1984). Furthermore, a centralized administrative structure discourages buyer and supplier members from timely horizontal communication due to the focus on vertical communication between subordinates and supervisors. A centralized structure further increases task uncertainty by inhibiting an efficient usage of resources and experience for the project (Sivadas & Dwyer, 2000). In addition, centralized intergroup structures discourage project members from making their own decisions without permission from supervisors. Consequently, the speed and quality of information exchanged between the two groups suffer, which limits buyer learning by reducing buyer-supplier joint dependence. In sum, a centralized intergroup structure aggravates the uncertainty resulting from buyer-supplier dependence asymmetry, which makes it challenging to integrate buyer and supplier activities in an efficient manner. Similarly, centralization limits the level of joint dependence between buyer and supplier members, which inhibits buyer learning.

How do China and the US differ in terms of centralization?

A centralized intergroup structure is congruent with China’s power distant culture, socialistic ideology, and informal institutional environment. In national cultures that have higher values of power distance, people are more comfortable with power being concentrated at higher levels within an organization (Carl et al., 2004). In China, the hierarchical structures are accepted as a way of life and are considered to provide social responsibility and stability (Carl et al., 2004). A lack of power centralization in NPD project is likely to be viewed with fear, distrust, and disrespect. Furthermore, managers encouraging participation and autonomy could be perceived as being weak and incompetent (Newman & Nollen, 1996). In addition, China’s socialistic ideology relies on centralized control of means of production, which is also congruent with a centralized intergroup structure (Rojek, 1989). Finally, a lack of formal legal and economic institutions in China makes interpersonal relationships, or Guanxi, critical in governing business transactions (Xin & Pearce, 1996). Among the many Guanxi that a Chinese needs to maintain, an immediate supervisor is the most important one due to its immediate impact on job security and wealth growth. As a result, Chinese are more likely to strictly obey commands from the supervisor than Americans. This means a centralized intergroup structure is more congruent with China’s informal institutional environment. In contrast, the US has a low-power distance culture, which promotes independent decisions irrespective of hierarchical levels (Nakata & Sivakumar, 1996). In addition, studies have shown that among similar organizations, those in the US have less centralized
organizational structures than in China due to the US’s capitalistic ideology (Hall, Jiang, Loscocco, & Allen, 1993). Finally, the US has a more formalized institutional environment, where people rely on formal rules and regulations rather than commands from supervisors. As a result, centralized control from the top will be less influential in guiding behaviors in the US than in China. Altogether, the inherent discomfort of working in a centralized structure in the US will demotivate NPD project team member to effectively engage in intergroup collaboration, thereby exacerbating the negative impact of centralization on project outcomes (Hansen & Wernerfelt, 1989; Denison & Mishra, 1995). Accordingly, we hypothesize that:

\( H2a: \) In buyer–supplier joint NPD projects, the size of the negative effect of intergroup centralization on project performance is smaller in China as compared to that in the US.

\( H2b: \) In buyer–supplier joint NPD projects, the size of the negative effect of intergroup centralization on buyer learning is smaller in China as compared to that in the US.

**Task structure: Task interdependence**

Task interdependence refers to the “degree to which an individual’s task performance depends upon the efforts or skills of others” (Wageman & Baker, 1997, p. 141). Two tasks are interdependent if the value generated from performing each is different when the other task is performed versus when it is not (Puranam, Raveendran, & Knudsen, 2012). An interdependent task structure increases the joint dependence between the buyer and supplier groups. To appropriately manage such joint dependence, the buyer and supplier groups need to actively engage in information exchange and mutual adaptation to avoid task failures. However, such intergroup interactions consume time and money and could impact project performance adversely. An interdependent task structure increases the possibilities of coordination failure, which can manifest in the form of delays, misunderstanding, and synchronization issues (Weick, 1993). In the context of buyer–supplier NPD projects such coordination issues could adversely impact project performance. That is probably why the NPD literature has been long advocating the efficiency benefits of product modularity since a modular product structure results in a lower level of task interdependence (Sanchez & Mahoney, 1996).

Through increasing buyer–supplier joint dependence, an interdependent task structure results in joint actions, trust and fine-grained information transfer (Uzzi, 1997). Such enhanced relational embeddedness creates a fertile environment for buyer learning. An interdependent task structure creates a need for buyer–supplier information exchanges when each tries to determine its optimal actions (Wageman, 1995). With high task interdependence, project members have to seek and provide feedback about project activities and task performance. As a result, buyer members have a better understanding of supplier resources, knowledge, and skills. Recognizing their dependence upon the members from the buyer firm, supplier team members are also more motivated to share their knowledge to enhance task performance (Emerson, 1976). Buyer learning is therefore enhanced in an
interdependent task structure due to intensified information, resource, and knowledge exchange between buyer and supplier members.

**How do China and the US differ in terms of task interdependence?**

An interdependent task structure fits well with China’s collectivistic culture, socialistic ideology, and informal institutional environment. In a collectivistic culture, members of the society display a high level of interdependence (Hofstede, 2001). Individuals view each other as interdependent, which leads to a high value placed on interpersonal relationships and reciprocity of social exchanges (Park & Luo, 2001). Such a collectivistic environment fits well with an interdependent task structure, where buyer and supplier groups are expected to collaborate to realize synergy and avoid discord (Bachrach, Powell, Collins, & Richey, 2006). In addition, the socialistic ideology emphasizes that the benefits of the society as a whole outweighs individual gains. Such a view fits well with an interdependent task structure, where successful task planning and execution rely on prioritizing project goals over group gains. Finally, in China, the reliance on informal institutions, such as Guanxi, as well as on trust and behavioral norms to govern economic activities motivate people to consider long-term impacts of their behavior, which is conducive for an interdependent task environment. The congruence of an interdependent task structure with China’s national context increases its effectiveness in facilitating buyer learning while dampening its harm on project performance. China’s collectivistic, socialistic, and informal national context reduce the salience of organizational boundaries in a buyer–supplier NPD team (Brewer & Chen, 2007), which encourages buyer and supplier groups to view each other as an integral part of the project team (Tsui & Farh, 1997). In contrast, the U.S.’s individualistic culture emphasizes independence, which goes against an interdependent task environment. In addition, the U.S.’s capitalistic ideology values individual gains, which contradicts the need to collaborate in an interdependent task context. Finally, the U.S.’s reliance on formal institutions, rather than interpersonal relationships, to guide individual behaviors reduces the need for interpersonal collaboration. As a result, the effectiveness of task interdependence in boosting project performance and enhancing buyer learning is greater in China, as compared to the US (Puranam et al., 2012). Accordingly, we hypothesize that:

**H3a:** In buyer–supplier joint NPD projects, the size of the negative effect of intergroup task interdependence on project performance is smaller in China as compared to that in the US.

**H3b:** In buyer–supplier joint NPD projects, the size of the positive effect of intergroup task interdependence on buyer learning is greater in China as compared to that in the US.

**Physical structure: Colocation**

Colocating buyer and supplier members helps enhance the quality of communication and resource exchanges through increasing buyer–supplier joint dependence (Uzzi, 1997). Studies have found that colocation enhances communication flows among project members (Keller & Holland, 1983). Colocating buyer and supplier
members allows the right amount and type of information to be exchanged among appropriate project members, which enables conflicts to be timely identified and synergies to be effectively realized. As a result, project progresses in a more efficient manner due to less rework. Along the same line, improved communication flows allow buyer members to observe supplier activities and obtain supplier feedback, both of which enhance buyer learning. In addition, colocation also aids in equitable allocation and timely exchanges of resources among buyer and supplier teams. Such equitable resource allocation allows the optimal task strategy to be chosen, which contributes to project performance. In geographically dispersed teams, in contrast, it is more likely that the resources are distributed disproportionately to the team whose leaders have better access to resource decision makers (McDonough, Kahn, & Barczaka, 2001). Finally, colocation creates opportunities for serendipitous solution generation via informal contacts among intergroup project members (Swink, Talluri, & Pandejpong, 2006). Buyer and supplier members could use all five senses to seek task solutions, rather than being limited by electronic media of communication. Colocation allows buyer–supplier interactions to happen beyond normal project hours, that is, during breaks when people are more relaxed. Accordingly, creative solutions are more likely to be found in an efficient fashion and buyer learning is more likely to occur.

**How do China and the US differ in terms of colocation?**

China’s national context also augments the benefits of colocation in buyer–supplier joint NPD projects. In a collectivistic culture, people value social interdependence and relational harmony (Schwartz, 1994). Informal socialization and face-to-face communications are ways people in collectivistic culture tend to strengthen interpersonal relationships and align task goals (Xie, Song, & Stringfellow, 2003). Physically colocating buyer and supplier groups facilitates such interactions as it makes it easier to exchange opinions and clarify expectations (Petersen, Handfield, & Ragatz, 2003). Similarly, the socialistic ideology emphasizes social cohesion and relational harmony, which is best maintained when buyer and supplier groups are colocated. In contrast, in an individualistic culture, such as the US, people are not used to interacting intensively with each other for accomplishing tasks. With their individualistic mindsets, buyer team members in the US are less likely to view supplier members as an integral part of the project team due to the existence of formal organizational boundaries, even when the two groups are colocated. In addition, colocation enhances the social influence of project members on each other, which is against the U.S.’s reliance on formal institutions, rather than interpersonal relationships, to govern business activities (Latané, Liu, Nowak, Bonevento, & Zheng, 1995). Altogether, in China’s national context, buyer and supplier members are more motivated to fully realize the value of colocation by timely exchanging high-quality information and actively building a collaborative atmosphere. Accordingly, we hypothesize that:

**H4a:** In buyer–supplier joint NPD, the size of the positive effect of intergroup colocation on project performance is greater in China as compared to that in the US.
H4b: In buyer–supplier joint NPD, the size of the positive effect of intergroup colocation on buyer learning is greater in China as compared to that in the US.

The overall conceptual model is presented in Figure 1.

DATA COLLECTION AND MEASURES

Data Collection

Survey responses from original equipment manufacturers (buyers) are used to test the hypotheses. The initial set of respondents comes from a commercial list provider who provided contact information of 2,045 U.S.-based company managers. Among this initial set, 2,000 have e-mail addresses and 45 have mail addresses. The initial set of respondents in China was extracted from member listings of manufacturer associations with a sample size of 580, all of which provided physical mailing addresses. Job titles and industries are used to screen respondents. Specifically, we limit the initial set of respondents to those that have responsibilities in the areas of engineering, manufacturing, product development, project management, or purchasing, which have been shown to be relevant for NPD projects (Takeishi, 2001). We limit industries to those that manufacture physical and discrete products and avoid service and software companies due to their significantly different innovation inputs, processes, and outputs (Ettlie & Rosenthal, 2011).

To ensure that we receive inputs from informed respondents, we asked the respondents to evaluate the extent to which they were knowledgeable in answering the survey questions and retained only those responses that indicated "above average" or "very knowledgeable." To make sure that the projects in each country involved buying and supplier firms from the same country we asked respondents to specify the headquarters of buying and supplier firms. Only those samples that meet the criterion of single-country collaboration were kept (i.e., in the U.S. sample, both buying and supplier firms have their headquarters in the US and in the China sample both buying and supplier firms have their headquarters in China).

To control for single respondent and common method biases, we surveyed two project members from each buying firm. The first respondent was asked to select a recent NPD instance (i.e., finished within the past three years) in which an external supplier collaborated with its business unit for the design of a new product. This respondent provided information regarding the two dependent variables: project performance and buyer learning, and seven control variables: firm size, industry, supplier involvement timing, product complexity, technological novelty, coordination experience, and idiosyncratic investments. This respondent then provided the contact information of one key project member who actively participated in the project. The second respondent was asked to provide information on the four independent variables: formalization, centralization, task interdependence, and colocation, and two control variables: complementary capabilities and task relevant expertise. To ensure content invariance between the English and Chinese surveys, one translator translated the English version of the survey into Chinese.
Figure 1: Intergroup structure, project performance, and buyer learning: SEM results of China–U.S. differences.

Note: 1. For the same path between the two countries, ++/−−− suggests a statistically significant difference on the size of the same path between the two countries.
2. A solid line suggests a statistically significant path, while a dashed line suggests an insignificant path.
3. A +/− sign suggests a statistically positive/negative relationship.
Then another bilingual translator translated the Chinese version back into English. A third person checked for inconsistency between the original English survey and the translated English survey to correct for any problem in the translation.

To ensure all the survey items are appropriately worded, we adopted a two-stage scale validation approach, which involved pretesting and then testing (Malhotra & Grover, 1998). We asked both academic researchers and practitioners from various target industry groups to evaluate each item in terms of concept and instruction clarity, lack of ambiguity, flow, and ease of use. The pretesting procedures led to some minor rewording and reordering of questions. For instance, one of the items measuring task interdependence was originally worded as “people in other organizations outside Job Service Division,” which was revised into “people from one firm have to depend on people from the other firm” to better fit the buyer–supplier NPD context.

We adopted both electronic and hard-copy mailing approach for data collection. We hosted a two-part survey on Survey Monkey (www.surveymonkey.com). The overall response rate for completed pairs of Part I and II surveys are 16.23%. Specifically, 186 completed surveys were collected online from the US out of 2,000, indicating a response rate of 9.3%; 28 completed surveys were collected in mails out of 45 from the US, indicating a response rate of 62.2%; 212 completed survey were collected in mails out of 580 from China, indicating a response rate of 36.6%. The response rates in each subsample as well as the demographics of the US and the China samples are presented in the Supporting Information. It shows that the sample covers 16 industries and involves firms with different sizes, thus enhancing the external generalizability of results from this study. Table 1 in the Supporting Information shows details about responses collected from each country using each method. Table 2 in the Supporting Information shows industry demographics of the final sample.

**Scale Development and Data Validation**

All the constructs are measured using existing scales. Centralization is measured using the scale developed by Hage and Aiken (1970). The respondents were asked to assess how the buyer and supplier groups made decisions during the project by using five items. Formalization is measured on a scale used in Tatikonda and Montoya-Weiss (2001). Task interdependence between the buyer and supplier groups is assessed with three items developed by Van de Ven and Ferry (1980). Colocation is assessed by the proportion of supplier members who were conveniently located near buyer members during the collaboration (four categories were used: none, less than half, more than half, and all) (Yan & Dooley, 2013). Project performance is assessed by adopting the approach used in Swink and Calantone (2004) with 10 items. Each item is a product of goal aggressiveness and the extent to which each goal is achieved. Buyer learning is assessed using two items developed in Sobrero and Roberts (2001).

We control for effects of nine variables on project performance and buyer learning. To account for project-specific factors, we control for the effects of product complexity and technological novelty since they have been shown to affect project success rates (Tatikonda & Rosenthal, 2000). We operationalize product
complexity by adapting items from Griffin (1997) and Swink (1999) that capture three dimensions of a complex product system: the number of components, the degree to which these components vary, and the level of design interdependence. We use six items adapted from Tatikonda and Rosenthal (2000) to operationalize technological novelty, with three focusing on product technology and the remaining three focusing on process technology. In addition, we include as a control variable complementary capabilities, another important factor that influences collaboration outcomes (Brown & Eisenhardt, 1995; Yan & Dooley, 2014). It refers to the degree to which partners are able to “fill out, or complete, each other’s performance by supplying distinct capabilities, knowledge, and resources” (Jap, 1999, p. 465). It is measured by adapting a scale used in Jap (1999). The timing of supplier involvement has been shown to affect NPD project outcomes (Ragatz, Handfield, & Scannell, 1997). Thus, we included supplier involvement timing in the model. Finally, we control the effects of task-relevant expertise of project members from the two companies on collaboration outcomes.

On a firm level, companies of different sizes may differ in their project management capabilities, collaboration competences, and innovation potentials, all of which may affect performances of NPD projects. Thus, we control for potential effects of the manufacturers’ firm size, measured by two items: the number of employees (log) and sales (log). On an interfirm level, the outcomes of a joint NPD project are influenced by the nature of interfirm buyer–supplier relationship (Primo & Amundson, 2002). Accordingly, we control for the effects of two interfirm relational factors (coordination efforts and idiosyncratic investments) on project performance and buyer learning (Jap, 1999).

Performance of NPD projects can also be influenced by industry-wide factors, such as R&D intensities, infrastructure, demand patterns, and manufacturing processes. We control for industry effects by using industry NAICS codes reported in Part I of the survey. As the samples in some sectors were small, we grouped the 16 registered categories into six clusters using the first two digits of NAICS codes: nonmetallic products (3.7%), metal, machinery, and transportation products (17.3%), computers (29.4%), electronics (16.4%), medical equipment (16.4%), and others (19.6%). We created five binary dummy variables and selected “others” as the reference category. Survey items, factor loadings, t-values and reliabilities, and their supporting literature are shown in Table 3 in the Supporting Information. Before testing invariance of structural paths across the two samples, measurement invariance must be tested (Rungtusanatham, Ng, Zhao, & Lee, 2008). All the scales exhibit enough convergent and discriminant validity. Nonresponse and single-respondent biases do not appear to be major concerns of this study. Table 1 shows detailed results of all the data validation tests and Table 2 provides means, standard deviations, and correlations.

ANALYSIS AND RESULTS

Two-Group Structural Equation Modeling (SEM)

In order to control for measurement errors, we adopted the two-group SEM approach to test whether effects of the four structural factors on project performance
Table 1: Data validation tests and results.

<table>
<thead>
<tr>
<th>Validation Tests</th>
<th>Statistical Methods</th>
<th>Results</th>
</tr>
</thead>
</table>
| Measurement invariance    | Two-group SEM (Little, 1997; Arbuckle & Wothke, 1999; Byrne, 2001). A test of configural invariance is a test of a “weak factorial invariance” null hypothesis (Horn & McArdle, 1992) in which the same pattern of fixed and free factor loadings is specified for each group. A test of metric invariance (or equal loadings), after configural invariance has been confirmed, is that loadings for like items are invariance across populations. A test of factor variance invariance is to test whether factor variances are invariant across populations. A test of full invariance, after metric invariance has been established, is a test that error variances are invariant across populations. | Configural invariance: RMSEA = 0.054, NNFI = 0.93, CFI = 0.94, Chi-square (2123) = 3484.39  
Metric invariance: Chi-square (36) = 39.92, p-value = .30, RMSEA = 0.054, NNFI = 0.93, CFI = 0.94  
Factor variance invariance: Chi-square (12) = 33.6, p-value < .001, RMSEA = 0.054, NNFI = 0.93, CFI = 0.94  
Full invariance: Chi-square (48) = 199.9, p-value < .001, RMSEA = 0.056, NNFI = 0.92, CFI = 0.92 |
| Unidimensionality         | A CFA model with all the 13 latent constructs is tested in the two subsamples (Garver & Mentzer, 1999). | China: Chi-square (1001) = 1777.47, RMSEA = 0.061, SRMR = 0.069, NNFI = 0.093, CFI = 0.94, IFI = 0.94;  
US: Chi-square (1001) = 1425.52, RMSEA = 0.045, SRMR = 0.059, NNFI = 0.94, CFI = 0.95, IFI = 0.95 |
### Table 1: Continued

<table>
<thead>
<tr>
<th>Validation Tests</th>
<th>Statistical Methods</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discriminant validity</td>
<td>Chi-square difference tests comparing two models for each of the 66 pairs of the 12 multi-item latent constructs: In the first CFA model, the correlation between the constructs is free to vary. In the second, the correlation is fixed to a perfect correlation (1.0) (O’Leary-Kelly &amp; Vokurka, 1998; Garver &amp; Mentzer, 1999). Significant chi-square difference tests suggest discriminant validity. A Bonferroni corrected <em>p</em>-value.000657 is used since we are performing a number of repeated tests (Byrne, 1994; Kroes &amp; Ghosh 2010).</td>
<td>All the 66 pairs of chi-square difference tests turned out to be significant (<em>p</em>-value &lt; .00078), indicating discriminant validity.</td>
</tr>
<tr>
<td>Reliability</td>
<td>To test reliability, we used both the traditional reliability measures, such as Cronbach’s Alpha, Spearman Brown (unequal-length), and Guttman Split-Half, and SEM construct reliability measures, such as construct reliability and variance extracted (Garver &amp; Mentzer, 1999).</td>
<td>All the constructs’ Cronbach’s Alpha are higher than 0.80 (most are higher than .85), indicating reliable scales (Dunn, Seaker, &amp; Waller, 1994; Garver &amp; Mentzer, 1999). In addition, all the scales have Spearman Brown coefficients higher than 0.70 and Guttman Split-Half scores higher than 0.60. All the constructs have SEM construct reliability scores higher than 0.70 and variance extraction scores higher than 0.50, indicating acceptable reliability levels (Garver &amp; Mentzer, 1999).</td>
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Table 1: Continued

<table>
<thead>
<tr>
<th>Validation Tests</th>
<th>Statistical Methods</th>
<th>Results</th>
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<tr>
<td>Nonresponse bias</td>
<td>Two procedures were used to test for the presence of nonresponse bias using two methods. First, we compared results from the first and the last 30 survey responses on all the items composing the 12 multi-item latent constructs (Lambert &amp; Harrington, 1990). Second, we conducted $t$-tests on the 2010 sales figures and on number of employees between a random sample of 100 respondents and 100 nonrespondents from our population pool.</td>
<td>No significant differences between the two groups are identified. To understand nonrespondents, we made phone calls to 100 randomly selected nonrespondents (50 in the US and 50 in China). It is noted that 55% of firms did not recently undertake NPD projects that actively involved external suppliers in the development process. For the remaining 45 firms, we do not find significant differences between them and the 426 firms in the sample on firm sales and size.</td>
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<tr>
<td>Common method bias</td>
<td>We attempted to minimize common method bias through separating the respondents answering dependent variables from those evaluating independent variables. In addition, we employed two data collection methods, online and mail surveys, to minimize the bias associated with one data collection method (Podsakoff et al., 2003). Harman’s Single Factor Test is employed to examine for common method bias.</td>
<td>Common method bias is not found to be a major concern of this study.</td>
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Table 2: Descriptive statistics.

|                      | Mean | S.D  | 1  | 2  | 3  | 4  | 5  | 6  | 7  | 8  | 9  | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
|----------------------|------|------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| Formalization       | 3.34 | 0.89 | 1.00 |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Centralization      | 3.36 | 1.00 |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
|                      | 2.63 | 1.14 |    | .18** |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
|                      | 2.10 | 0.96 |    |   | .04 |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Task interdependence | 3.64 | 1.02 |    | .19** | .11 |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
|                      | 3.98 | 0.81 |    |   | .00 |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Colocation           | 3.66 | 1.26 |    | .19** |    | .04 |    | .20** |    |    |    |    |    |    |    |    |    |    |    |    |
|                      | 4.32 | 1.00 |    |   | −.01 |    | .04 |    | .01 |    |    |    |    |    |    |    |    |    |    |    |
| Project performance  | 10.63| 4.65 |    | .25** |    | −.15** | .12 | .31** |    |    |    |    |    |    |    |    |    |    |    |
|                      | 13.55| 4.85 |    | .27** |    | −.02 |    | .07 |    |    |    |    |    |    |    |    |    |    |    |
| Buyer learning       | 3.63 | 1.06 |    | −.19** |    | −.02 |    | .26** |    | .20** |    | 0.03 |    |    |    |    |    |    |    |
|                      | 3.73 | 1.11 |    | .05 | −.36** |    | .16** | .04 |    |    |    |    |    |    |    |    |    |    |
| Supplier involvement | 2.25 | 0.72 |    | .01 |    | .03 |    | .04 |    | −.04 |    | −.04 |    |    |    |    |    |    |
| timing               | 2.28 | 0.72 |    | .00 |    | .01 |    | .04 |    | .04 |    | −.02 |    | .09 |    |    |    |    |
| Task relevant expertise | 3.88 | 0.97 |    | .27** |    | .06 |    | .41** |    | .19** |    | .34** |    | .22** |    | .11 |    |    |
|                      | 4.05 | 0.70 |    | .19** |    | −.25** | .09 | −.12 |    | .26** |    | .15 |    | .02 |    |    |
| Product complexity   | 3.20 | 1.06 |    | .06 |    | .11 |    | −.10 |    | .04 |    | −.05 |    | .08 |    | .00 |    | −.14** |    |    |
|                      | 2.99 | 0.99 |    | .08 |    | .13 |    | .01 |    | −.04 |    | .11 |    | .12 |    | .00 |    | .03 |    |

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**Note:** *p < .05, **p < .01.
Sample size (US) = 214, Sample size (China) = 212.
Italic numbers represent the China sample, while bolded numbers represent the U.S. sample.
and buyer learning differ significantly between China and the US (Koufteros & Marcoulides, 2006). According to our measurement invariance test, the two samples are invariant on factor structures and loadings. So we constrain factor structure and loadings to be invariant between the two groups in the measurement model. Then we establish a baseline model, where none of the path coefficients among constructs is constrained to be equal across groups. Next, the structural coefficient of interest is constrained to be equal across the two samples in a more constrained model. Finally, a chi-square difference test between the baseline and more restrictive models is conducted to determine whether a structural coefficient is invariant across the samples. A significant chi-square difference test suggests a deterioration of the model and the null hypothesis that the coefficient is equal is rejected. Thus if the standardized regression coefficient in one sample is greater than the one in the other sample, then we could safely say the difference is statistically significant. A nonsignificant chi-square difference test is consistent with model invariance; that is, the parameter examined is not statistically significantly different across groups.

**Hypotheses Testing Results**

Table 3 presents the two-group SEM analysis results, which are used to test hypotheses H1–H4. The fit statistics shows that the two-group SEM model with all the structural path coefficients freely estimated fits the data well. The Chi-square statistics is 4360.26 with degrees of freedom of 2816. Root Mean Square Error of Approximation (RMSEA) is 0.048, non-normed fit index (NNFI) is 0.92, comparative fit index (CFI) is 0.93, and incremental fit index (IFI) is 0.93. The group goodness of fit indices also shows that the China and the U.S. samples fit their respective group model well.

From Table 3, we found the four structural factors to considerably differ in terms of their performance implications within the China and the U.S. samples, which offer initial evidence to support our comparative hypotheses. For instance, we found that formalization helps with project performance only in the US ($\beta = 0.75$, $p$-value < .05), while it hurts buyer learning only in China ($\beta = -0.36$, $p$-value < .001). Similarly, a centralized intergroup structure hurts project performance only in China ($\beta = -1.23$, $p$-value < .01), while it hurts buyer learning only in the US ($\beta = -0.57$, $p$-value < .001). Colocation helps with project performance and buyer learning only in China (project performance: $\beta = 0.85$, $p$-value < .01; buyer learning: $\beta = 0.13$, $p$-value < .01) but not in the US. Task interdependence is the only one structural factor that shows similar effects in the two countries. Specifically, in both countries, it helps in enhancing buyer learning (China: $\beta = 0.22$, $p$-value < .01; US: $\beta = 0.22$, $p$-value < .05), while it does not significantly influence project performance.

To test whether the difference in path coefficients we observed from Table 3 are statistically significant, we conduct chi-square difference tests. Table 4 presents the results, which are used to test hypotheses H1–H4. As shown, there are five paths that are statistically different between China and the US, four of which are as expected: from formalization to buyer learning, from centralization to buyer learning, from colocation to project performance and from colocation to buyer learning, which lend support to hypotheses H1b, H2b, H4a, and H4b. One
Table 3: Two-group SEM results

<table>
<thead>
<tr>
<th>Variables</th>
<th>Project Performance</th>
<th>Buyer Learning</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>China</td>
<td>US</td>
</tr>
<tr>
<td><strong>Control variables</strong></td>
<td></td>
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</tr>
<tr>
<td>Task relevant expertise</td>
<td>1.44* (0.70)</td>
<td>1.86* (0.83)</td>
</tr>
<tr>
<td>Supplier involvement timing</td>
<td>−1.28* (0.53)</td>
<td>−0.92 (0.56)</td>
</tr>
<tr>
<td>Complementary capabilities</td>
<td>0.14 (0.86)</td>
<td>0.58 (0.96)</td>
</tr>
<tr>
<td>Technological novelty</td>
<td>−1.29 (0.82)</td>
<td>0.98 (0.79)</td>
</tr>
<tr>
<td>Product complexity</td>
<td>0.20 (0.44)</td>
<td>0.21 (0.63)</td>
</tr>
<tr>
<td>Firm size</td>
<td>−0.10 (0.13)</td>
<td>−0.06 (0.12)</td>
</tr>
<tr>
<td>Coordination experience</td>
<td>0.89 (0.65)</td>
<td>1.34 (0.72)</td>
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<tr>
<td>Idiosyncratic investments</td>
<td>0.59 (0.55)</td>
<td>−0.36 (0.55)</td>
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<tr>
<td>Nonmetallic products industry</td>
<td>−1.55 (2.71)</td>
<td>−0.51 (2.07)</td>
</tr>
<tr>
<td>Metal, machinery, &amp; transportation industry</td>
<td>−2.25 (1.00)</td>
<td>0.64 (1.28)</td>
</tr>
<tr>
<td>Computer industry</td>
<td>−0.00 (1.07)</td>
<td>0.94 (1.06)</td>
</tr>
<tr>
<td>Electronics industry</td>
<td>0.44 (1.11)</td>
<td>−2.02 (1.22)</td>
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<tr>
<td>Medical equipment industry</td>
<td>0.96 (1.37)</td>
<td>−1.43 (1.32)</td>
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Table 3: Continued

<table>
<thead>
<tr>
<th>Variables</th>
<th>Project Performance</th>
<th></th>
<th>Buyer Learning</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>China</td>
<td>US</td>
<td>China</td>
<td>US</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Independent variables</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Formalization</td>
<td>0.44 (0.45)</td>
<td>0.75* (0.38)</td>
<td>−0.36*** (0.09)</td>
<td>−0.03 (0.07)</td>
</tr>
<tr>
<td>Centralization</td>
<td>−1.23** (0.39)</td>
<td>0.55 (0.56)</td>
<td>0.01 (0.07)</td>
<td>−0.57*** (0.10)</td>
</tr>
<tr>
<td>Task interdependence</td>
<td>−0.20 (0.46)</td>
<td>−0.36 (0.55)</td>
<td>0.22** (0.09)</td>
<td>0.22* (0.10)</td>
</tr>
<tr>
<td>Colocation</td>
<td>0.85** (0.28)</td>
<td>0.53 (0.37)</td>
<td>0.13** (0.05)</td>
<td>−0.04 (0.07)</td>
</tr>
<tr>
<td>$R^2$</td>
<td>.27</td>
<td>.28</td>
<td></td>
<td>.30</td>
</tr>
<tr>
<td>Group goodness-of-fit indices</td>
<td>SRMR: 0.082</td>
<td>SRMR: 0.069</td>
<td>SRMR: 0.082</td>
<td>SRMR: 0.069</td>
</tr>
<tr>
<td></td>
<td>GFI: 0.72</td>
<td>GFI: 0.76</td>
<td>GFI: 0.72</td>
<td>GFI: 0.76</td>
</tr>
<tr>
<td>Global goodness-of-fit indices</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Chi-square (2,816) = 4360.26</td>
<td>RMSEA: 0.048</td>
<td>p-VALUE (RMSEA &lt; 0.05) = .82</td>
<td>NNFI: 0.92; CFI: 0.93; IFI: 0.93</td>
</tr>
</tbody>
</table>

Note: All the numbers are unstandardized path coefficients with their respective standard errors in the bracket.
*p < .05, **p < .01, ***p < .001.
N(US) = 214, N(China) = 212.
<table>
<thead>
<tr>
<th>Hypotheses</th>
<th>Path Coefficients in China and the US</th>
<th>Chi-Square Statistics</th>
<th>p-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>H1a: ++ in the US</td>
<td>Formalization → project performance (PP) China: 0.44 US: 0.75*</td>
<td>$\chi^2 (1) = 0.26$</td>
<td>.61</td>
</tr>
<tr>
<td>H1b: −− in China</td>
<td>Formalization → buyer learning (BL) China: −0.36*** US: −0.03</td>
<td>$\chi^2 (1) = 9.01$</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>H2a: −− in the US</td>
<td>Centralization → PP China: −1.23* US: 0.55</td>
<td>$\chi^2 (1) = 6.49$</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>H2b: −− in the US</td>
<td>Centralization → BL China: 0.01 US: −0.57***</td>
<td>$\chi^2 (1) = 20.71$</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>H3a: − in the US</td>
<td>Task interdependence → PP China: −0.20 US: −0.36</td>
<td>$\chi^2 (1) = 0.05$</td>
<td>.82</td>
</tr>
<tr>
<td>H3b: ++ in China</td>
<td>Task interdependence → BL China: 0.22** US: 0.22*</td>
<td>$\chi^2 (1) = 0.00$</td>
<td>1</td>
</tr>
<tr>
<td>H4a: ++ in China</td>
<td>Colocation → PP China: 0.85** US: 0.53</td>
<td>$\chi^2 (1) = 3.05$</td>
<td>.08</td>
</tr>
<tr>
<td>H4b: ++ in China</td>
<td>Colocation → BL China: 0.13** US: −0.04</td>
<td>$\chi^2 (1) = 3.89$</td>
<td>.048</td>
</tr>
</tbody>
</table>
significant difference between the two samples is in the opposite direction: cen-
tralization has a significantly more negative effect on project performance in China
than the US, which rejects H2a. The other three insignificant chi-square tests show
a lack of evidence to support H1a, H3a, and H3b.

Robustness Check

*Replace survey responses for firm size with archival data*

Regression results could be biased by the inaccuracy of firm size data provided by
respondents. To test the robustness of results, we replaced 187 survey responses
(132 in the US and 55 in China) for firm size (number of employees) by the
2010 archival data obtained from COMPSTAT and reran all the analysis. All
the hypothesis-testing results stay the same, which supports the robustness of the
results for the accuracy of the reported firm size data.

*Different ways of creating industry dummies*

Hypothesis-testing results could also be biased by the ways we create industry
dummies. Thus we consider an alternative way of creating industry dummies,
that is, four groups created by classifying the industries based on the clock-speed
as defined by Fine (1998). Faster clock-speed industries were those with shorter
product life cycles, like personal computers, semiconductor, etc. Both types of
industry dummies generate consistent results as those in the main analysis. Thus
we conclude that the results shown in Table 4 are robust to how we create industry
dummies.

DISCUSSION AND CONCLUSION

*Theoretical Implications*

Our results show the importance of taking a national contingent view when study-
ing the performance implications of intergroup structures in NPD projects. We
found both similarities and differences between the two countries regarding how
intergroup structural factors impact project performance and buyer learning. The
effects of task interdependence, compared to those of other structural factors,
seem to be least country contingent. All other structural factors differ significantly
in influencing project performance and/or buyer learning between China and the
US. Specifically, the results from our study show that colocation enhances buyer
learning only in China and not in the US. This emphasizes the importance of
considering the congruence of China's national context, which values collective
behavior, with the opportunities presented by colocation, when studying how colo-
cation influences project outcomes. Similarly, we found that formalization inhibits
buyer learning in China but not in the US. The rules and procedures within a
formalized structure of NPD projects constrain the natural tendencies of engaging
in informal knowledge exchange among Chinese team members. Because formal
rules and procedures are the way of professional life in the US, the constraining
effects on buyer learning are not significant. Among the four structural factors
examined, centralization differs most between China and the US in its perform-
ance implications. Due to its congruence with China's power distant culture,
socialistic ideology, and informal institutional environment, a centralized structure hurts buyer learning more in the US than in China. However, contradictory to our hypothesis, centralization is found to hurt project performance more in China than in the US. This unexpected result might suggest the importance of considering the types of project goals when examining the effects of centralization. For more task-oriented goals, such as project performance, the comfort of working in a centralized intergroup structure (in China’s case) might amplify the damaging effect of centralization due to a lack of urgency to correct the counterproductive mechanisms. This could endanger the accomplishment of immediate tasks and thereby hurt project performance.

In summary, these significant differences between the two countries show that the national context, as a multidimensional variable, could significantly influence performance implications of intergroup structure in interorganizational NPD projects. These impacts could result due to different reasons, such as culture, ideology, and institutions, which present challenges in terms of measuring the exact intervening variables (Siggelkow & Rivkin, 2009). Data from the US and China allows us to consider these facets to be subsumed within the national context and examine how various factors, together, might create contextual limits (or opportunities) for structuring interorganizational NPD projects. The context-dependent relationship of intergroup structure with project performance and buyer learning lends credence to the equifinality argument (Gresov & Drazin, 1997). Specifically, there are multiple ways in which structural elements can impact project performance and buyer learning and, depending on the underlying context, different structural arrangements can provide various pathways to improve NPD project performance.

By considering both project performance and buyer learning, our study highlights the multifaceted performance implications of intergroup structures in interorganizational NPD projects. The results point to distinct ways in which the same intergroup structure could differentially or similarly impact project performance and buyer learning in NPD projects. For instance, colocation helps with both project performance and buyer learning in China, which shows the possibility of simultaneously improving both aspects of performance. In contrast, formalization helps with project performance in the US while hurting buyer learning in China, which shows a trade-off relationship between the two types of performance. For buyer learning, we witness a stronger contingent role played by the country context. In contrast, the effect of intergroup structure on project performance is more universal and less country-dependent. These results suggest the importance of simultaneously considering multiple types of performance when studying project structures in interorganizational innovation.

Our results show support to the relevancy of an organizational dependence view for differentiating performance implications of various intergroup structural dimensions in interorganizational project teams. By reducing uncertainty emanating from dependence asymmetry, formalization helps in creating an efficient NPD process in both countries. By increasing joint dependence, task interdependence facilitates buyer learning and colocation increases project performance in both countries. Overall, our results suggest that project success relies on a higher level of joint dependence with a prudent context-specific management of
dependence asymmetry. These results lay a foundation for future studies that adopt an organizational dependence view to study effects of joint dependence and dependence asymmetry in interorganizational collaboration.

Unlike the other three dimensions, task interdependence relates to the value gained by performing two tasks together as compared to the value received when they are done independently (Puranam et al., 2012). Previous literature has argued that task interdependence enhances cooperation by intensifying interactions and increasing perceived mutual dependence (Wageman, 1995). With high task interdependence, individuals perceive others as closely coupled partners rather than independent or competing entities. Such perceived mutual dependence encourages the emergence of collaborative behaviors and norms, such as open communication, autonomous adaptation, mutual respect, trust, and reciprocity (Dyer & Singh, 1998). Our results confirm these findings and further show that one benefit of task interdependence is enhanced buyer learning. We also found that an interdependent task structure does not necessarily mean a less efficient and effective process, given the insignificant effects of task interdependence on project performance. Overall, our results suggest a more positive view about structuring a task interdependent structure to organize multigroup project teams.

Managerial Insights
This study helps project managers understand how intergroup structural factors distinctively influence NPD project outcomes. Specifically, we show that formalized rules and procedures improve project performance. However, managers need to recognize the adverse impact of formalization on buyer learning in certain national contexts. Hence, a balanced approach that incorporates some degree of informality in project management should work best for improving multiple goals simultaneously. Managers need to formalize intergroup interactions by specifying roles and rules, while leaving enough room for members to explore innovative ideas.

In NPD projects, managers often rely on an interdependent task structure with the hope that it fosters learning and instills a sense of team spirit. Our study supports the use of interdependent task structure in NPD projects. It enables utilizing complementary capabilities of the supplier. By jointly performing a task with the supplier, the buyer learns new innovation possibilities that could be part of subsequent NPD projects. The negative effect of task interdependence on project performance was not confirmed in our study, which further supports the benefits of an interdependent task structure. Buyer and supplier members can be colocated and be guided by formal rules and procedures when working in an interdependent task structure. In certain national contexts, spatial proximity not only enhances efficiency but also creates opportunities for buyer learning. Our findings show that centralized structures are detrimental in NPD projects for either project performance or buyer learning, depending on the underlying cultural, social, and institutional contexts. So managers need to be cautioned when relying on a hierarchical administrative structure to manage an interorganizational NPD team.
Results of this study point to the importance of considering the national context, as a contingency factor, when organizing an interorganizational team. Our focus on the US and China is relevant in providing important insights to practicing managers since these two countries play important roles in emerging global product development initiatives. The findings from our study have direct implications for project managers in charge of interorganizational NPD teams in these two countries. Our results also present some directions for managers engaged in interorganizational NPD projects conducted in other countries to structure NPD teams to better fit the underlying cultural contexts.

Limitations and Future Research

While every effort was undertaken to ensure a rigorous examination of the research questions considered in this study, there are few limitations that are worth noting. First, survey responses are only collected from buyers. Using buyers’ responses as the sole source relies on the assumption that buyers have major responsibility in structuring the interfim NPD. Thus, they have better knowledge in evaluating the collaboration structure, process, and outcomes. Collecting information from the buyer and supplier firms would be preferable to enhance the validity and reliability in measuring latent constructs. However, constraints associated with collecting reasonable sample size for dyadic buyer-supplier pairs make it difficult to undertake a robust and rigorous statistical analysis, as was accomplished in this study.

Second, only two countries are sampled in this study, limiting the generalizability of the findings to other national contexts. However, limiting the sample to just two countries also allows us to gain significant statistical power in testing relationships among constructs in each country. The contingency role of country is examined from a cultural, economic, and institutional perspective without directly testing the influences of the interactions between national culture, economic ideology, and institutional values and interorganizational structures on collaboration outcomes. Future studies can extend this stream of research by considering a larger number of countries and by using measures that directly assess national culture, economic ideology, and institutional environment. Also it should be interesting to study how cultural, economic, and institutional differences between buyer and supplier team members influence project outcomes through affecting the way the two groups interact. In this study, we only consider the main effects of different structural elements on NPD collaboration outcomes. However, these structural elements might also interact and influence collaboration outcomes. Future studies could examine the effect of interactions among different structural factors on various NPD project outcomes.

Finally, buyer learning is assessed by only two items, which could limit the conceptual richness and empirical quality of the construct. Although we adopt the two-item scale from Sobrero and Roberts (2001)’s seminal work and all the reliability/validity indexes of the scale are satisfactory, the scale could still be improved in many ways. For instance, future studies could add items that differentiate the types of knowledge learned, assess the quality of the knowledge, and so on. Overall, examination of various structural antecedents, contingent factors,
mediating variables, and performance outcomes within the purview of intergroup NPD projects presents bountiful opportunities for future research inquiries.

SUPPORTING INFORMATION

Additional supporting information may be found in the online version of this article at the publisher’s website:

Table S1: Data collection statistics:
Table S2: Sample Demographics:
Table S3: Measurements of the constructs

REFERENCES


**Anand Nair** (PhD, Michigan State University) is an Associate Professor of supply chain management at the Broad College of Business, Michigan State University. His current research interests are in the areas of administrative innovations, networks, operations strategy, and technological innovation. His methodological orientation for research includes empirical analysis using econometric and psychometric methods, computational experiments using complexity theory and complex adaptive systems approach, Monte Carlo simulations, data envelopment analysis, and mathematical modeling. He holds the Certified Fellow in Production and Inventory Management (CFPIM) designation from the Association for Operations Management (APICS) and the Certified Quality Engineer (CQE) designation from the American Society of Quality (ASQ). He has served as the Track Chair for Manufacturing Operations Management as well as Strategic Sourcing and Supply Management for the Decision Sciences Institute annual meetings. He serves as an associate editor for the *Journal of Operations Management* and *Decision Sciences*. 