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How does technological diversity in supplier network drive buyer innovation? Relational process and contingencies

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ABSTRACT

External networks provide important knowledge sources of innovation for firms. Drawing on social network theory, this study examines how technological diversity in supplier network influences a focal buyer firm's innovation. The results from a survey of 202 Chinese manufacturing firms and their supplier networks reveal that novel information sharing partially mediates the effect of technological diversity in supplier network on buyer firms' new product creativity. The positive effect of technological diversity is enhanced by buyer–supplier relational strength but inhibited by supplier network density; competitive intensity positively moderates this effect, and technological turbulence negatively moderates it. These findings provide novel insights into how buyer firms can use their supplier networks to enhance product innovation.

1. Introduction

Developing radically new products is vital for firms to create and sustain competitive advantage in the marketplace, a critical challenge in doing so is how to gain novel insights and creative ideas (Frohlich and Westbrook, 2001; Zhou and Li, 2012). Because rapid technological advances and volatile customer demand require knowledge and expertise beyond a firm's boundary, external networks such as supplier networks have become increasingly important wellsprings of new product development (NPD) (Phelps, 2010; Zaheer and Bell, 2005). Manufacturers often proactively involve upstream suppliers in NPD processes—for example, through the guest engineer mechanism, in which automakers involve technical personnel of suppliers and incorporate their knowledge into product design and innovation (Choi and Hong, 2002; Dyer, 1997). Moreover, consumer product manufacturers such as Procter & Gamble have obtained a significant proportion of new product ideas externally rather than relying on their own internal capabilities (Fawcett et al., 2012).

The supply chain management literature has long acknowledged the benefit of engaging suppliers in the NPD process. Previous research supports the value of such practices, including supplier selection (Choi and Hartley, 1996), early supplier involvement (Petersen et al., 2005), supply base management (Choi and Krause, 2006), and supplier integration (Wong et al., 2011), in fostering buyer performance. More recent developments further stress the importance of developing social capital between buyers and suppliers and show that embeddedness with suppliers promotes cooperation and enables buyer firms to better leverage supplier resources for their product innovation (Carey et al., 2011; Koufteros et al., 2007; Lawson et al., 2008; Villena et al., 2011). Although existing studies provide rich insights into how suppliers can contribute to a buyer firm's competitive advantage, most focus on the dyadic relationship between the buyer and its key supplier (Villena et al., 2011; Zhou et al., 2014) and limited attention has been paid to the broader supply chain network, which consists of multiple suppliers.

Social network theory suggests that a complete understanding of the impact of social networks requires a joint examination of network content such as technological diversity, network structure that reflects both buyer–supplier and supplier–supplier relationships, and the surrounding conditions of market environments (Gulati, 1995; Gulati et al., 2000; Phelps, 2010). *Technological diversity in supplier network* refers to the extent to which technologies owned by a buyer firm's suppliers differ from one another and from those of the focal buyer firm (Phelps, 2010; Rodan and Galunic, 2004). It provides rich access to novel knowledge elements and

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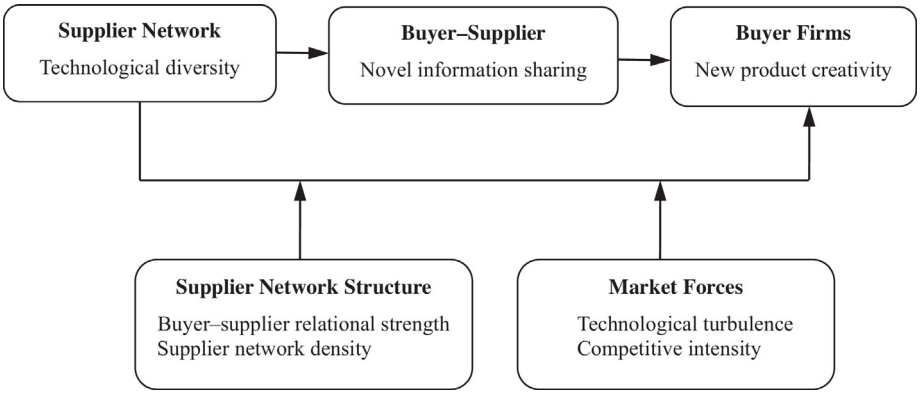

Fig. 1. Conceptual model.

expertise for buyer firms. Although technological diversity in supplier network has been identified as a key driver of buyer innovation in the literature, the process through which it affects buyers' NPD is still not well understood (Oke et al., 2008; Phelps, 2010; Terjesen et al., 2011). Furthermore, network structure and market forces represent critical contingent factors, as they can influence the extent to which technological diversity serves as a knowledge base and the motivation and efficiency of knowledge transfer between a focal buyer firm and its suppliers. Therefore, we focus on three major research questions: (1) how does technological diversity in supplier network affect the buyer's innovation? (2) What are the contingent effect of network structure for the relationship between technological diversity and buyer innovation? (3) How do market conditions moderate the effect of technological diversity on buyer innovation?

Building on social network theory, we examine the role of technological diversity in the supplier network on the buyer's new product (NP) creativity. *NP creativity* refers to the degree to which a new product differs from industry norms and competitive alternatives (Rindfleisch and Moorman, 2001). Creativity is a necessary condition for successful innovation: by providing meaningful differences from rivals, creativity leads to product differentiation and competitive advantage (Im and Workman, 2004; Song and Parry, 1997). Extending previous research, we argue that whereas technological diversity in supplier network has a *potential* value for buyer innovation, the actual impact is *achieved* when the buyer firm can detect and assimilate knowledge from the supplier network. Because technological knowledge is tacit in nature, information sharing between the buyer firm and its supplier network reflects a key relational process for successful knowledge assimilation. Therefore, we propose *novel information sharing* as a critical process through which technological diversity affects buyer NP creativity. Furthermore, we examine how the value of technological diversity is contingent on network structure and market forces. We depict the theoretical model in Fig. 1.

This study contributes to supply chain management literature in two important ways. First, we develop a more comprehensive theoretical model of how buyer firms benefit from technological diversity in supplier network through the process of novel information sharing. Thus, this study addresses the critical question of how technological diversity contributes to buyer product innovation. Second, few studies examine moderating effects of network structure and market forces (Phelps, 2010; Terjesen et al., 2011), so little is known about how variations in supplier networks and external environments affect the value of technological diversity for boosting successful NPD. We examine the moderating roles of *buyer–supplier relational strength* and *supplier network density* as key indicators of supplier network structure, as well as the moderating effects of two market forces, *technological turbulence* and *competitive intensity*. The findings provide a deeper understanding of the value of supplier network's technological diversity; they also help reveal the conditions in which buyer firms can enhance the value of technological diversity in supplier network.

2. Conceptual framework

2.1. Supplier network and product innovation

Product innovation involves a process in which knowledge-based assets contribute to firms' competitiveness (Anand et al., 2007; Zhou and Li, 2012). As a problem-solving process, NPD uncovers solutions to selected problems through organizational searches, during which firms create new knowledge by recombining existing elements or solutions into novel patterns, or reconfiguring the ways the elements are linked (Fleming, 2001; Phelps, 2010). Accordingly, NP creativity relies on firms' ability to think divergently, view things from different perspectives, and combine previously unrelated ideas and knowledge elements into something new and better (Fleming et al., 2007). Therefore, a critical determinant of NP creativity is whether a firm is able to access various knowledge elements, such as different technological components and the engineering know-how embedded in them (Schilling and Phelps, 2007). For example, in the Aerospace industry, the innovation process has been driven by expertise diversity of suppliers collectively; the supply chain has gradually transformed into a multi-voiced relationship of diverse firm capabilities, rather than a structure dominated by airframe manufacturers (Rose-Anderssen et al., 2008). As a result, technological diversity is vital for NP creativity because exposure to diverse knowledge is a precondition of successful recombination (Nickerson and Zenger, 2004).

Social network theory suggests that firms are interconnected with one another and embedded in various external social networks (Granovetter, 1985; Uzzi, 1996, 1997). Because a firm's own knowledge base alone may not be sufficient to obtain diversified knowledge, the firm must capture, interpret, and deploy knowledge resources from external networks (Laursen and Salter, 2006; Zhou and Li, 2012). Through interaction and interdependence, firms develop social capital, which functions as a social lubricant to prevent potential conflicts and enhance cooperation (Carey et al., 2011; Gulati et al., 2000; Koufteros et al., 2007; Lawson et al., 2008). Social capital provides an enduring source of knowledge advantage for firms by facilitating transactions, reducing uncertainties, and offering access to external resources and knowledge (Gulati, 1995). Firms therefore increasingly rely on external partners to access novel knowledge that is not available internally. The external network provides firms with access to diverse knowledge, especially when partners' knowledge bases are heterogeneous (Phelps, 2010; Rodan and Galunic, 2004).