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**The Double-Edged Sword of Customer Participation on New Product Development
Performance: The Contingent Roles of Relational and Environmental Factors
(Forthcoming in *Industry and Innovation*)**

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Conflict of interest statement

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

The Double-Edged Effects of Customer Participation on New Product Development Performance: The Contingent Roles of Relational and Environmental Factors

Abstract

Although customer participation plays an increasingly important role in firm innovation, both its effects on new product development (NPD) performance in the B2B context and the underlying mechanisms remain unclear in the extant literature. Building on the boundary spanning theory, we investigate the double-edged effects of customer participation on NPD performance by explicating the mediating roles of knowledge sharing and customer–developer conflict. Based on a sample of 167 high-tech firms in China, our findings indicate that customer participation can improve NPD performance through knowledge sharing but decrease NPD performance by exacerbating the conflict between the developer firm and its customer. Furthermore, previous cooperation experience attenuates the effects of customer participation on knowledge sharing and customer–developer conflict, whereas technological turbulence strengthens the effect of customer participation on knowledge sharing. Our findings offer important implications for both innovation research and practice.

Keywords: customer participation; knowledge sharing; customer–developer conflict; new product development; previous cooperation experience; technological turbulence

Introduction

To survive and grow in increasingly competitive markets, firms need to innovate constantly and bring out new products (Fazlıođlu, Dalgıç, and Yereli 2019; Spescha and Woerter 2019; Svare, Gausdal, and Möllering 2020). In business-to-business (B2B) markets, firms can improve their innovation outcomes by leveraging customers' needs- and solution-related inputs, which has led numerous firms to involve customers in new product development (NPD) (Fang 2008; Najafi-Tavani et al. 2023). In the co-development process, the customer cooperates with the developer to understand product-related technical requirements, establish development goals, and develop and refine new products (Gruner and Homburg 2000; Najafi-Tavani et al. 2022).

Prior literature has paid considerable attention to the role that *customer participation*, which refers to the extent to which the customer is involved in a manufacturer's invention process through which new products are developed jointly (Fang 2008; Wang, Jin, and Zhou 2019), plays in generating innovation outcomes. A brief summary of representative empirical research on customer participation in the B2B context (please see Table 1) reveals, however, several research gaps. First, prior studies have discussed mainly its effects on various innovation performance outcomes (e.g., Lin et al. 2013; Yu 2017). While the majority of prior studies consider overall NPD performance (e.g., Najafi-Tavani et al. 2023; Zhang and Xiao 2020), some studies capture specific dimensions, such as product innovation capability (Zhang and Zhu 2019), new product innovativeness (Fang 2008), and new product speed (Fang 2008; Lin et al. 2013), which also have strong associations with overall NPD performance. The general theoretical understanding in the literature is that customer participation leads to innovation success, so a great many studies thus investigate the bright side of customer participation. Recently, a limited number of studies have touched on the dark side, but empirical studies have

yielded conflicting and inconsistent results regarding the impact of customer participation (Fang 2008; Najafi-Tavani et al. 2022). Some studies find that customer participation positively affects innovation outcomes (e.g., Fang, Palmatier, and Evans 2008; Zhang and Zhu 2019), while others find a negative (e.g., Knudsen 2007) or nonsignificant effect (e.g., Campbell and Cooper 1999). Prior studies have tended to explore the bright side or the dark side separately and thereby fail to construct a holistic framework for a unitary study. To extend this stream of research and resolve the inconsistent findings, we therefore need to integrate the positive and negative effects of customer participation in the NPD process and disentangle these effects from each other to evaluate the actual value of customer participation.

Insert Table 1 about here

Second, prior studies discuss mainly direct linkages with innovation performance outcomes, leaving the process mechanisms underexplored. Recent studies have gradually recognized that the implementation of customer participation may encounter substantial challenges, which are more complex than they initially appear (Hurtak, Kashyap, and Ehret 2022; Wang and Yu 2019). Several notable studies have examined the theoretical mechanisms underlying the relationship empirically. For example, Fang, Palmatier, and Evans (2008) examine the mediating role of information sharing, coordination effectiveness, and relationship-specific investment; Lin and Huang (2013) highlight inter-organizational relationships and Yu (2017) emphasizes knowledge integration. These studies mainly capture the bright side of customer participation, however, neglecting the dark side of the process mechanism and leaving the challenges underexplored. Examining the process through which the effects of customer participation are transmitted has been recognized as crucial in facilitating the theoretical advancement. Considering Najafi-Tavani

et al.'s (2022) call for explicit consideration of the underlying mechanisms, it is helpful to investigate *how* customer participation matters in shaping NPD performance.

Third, inconsistent results reported in prior studies also reveal the existence of the contingencies under which customer participation is more or less beneficial. Prior studies focus primarily on such contingent factors at the project level (Lin et al. 2013; Yu 2017) as well as the firm and customer levels (Fang 2008; Najafi-Tavani et al. 2023; Zhang and Xiao 2020). While the interaction process between the customer and the developer firm is embedded in their relations and external environments, few studies have examined how these factors shape the innovation consequences of customer participation.

To address these research gaps, we draw on the boundary spanning theory and the customer participation literature to examine *whether, how, and when* customer participation affects firm NPD performance. Since boundary spanning representatives from both firms in a B2B relationship exercise dual functions (Aldrich and Herker 1977; Fan and Stevenson 2019), we propose that customer participation serves as a “double-edged sword” for the innovation process: while the information processing function enhances the effect of customer participation on *knowledge sharing* between the customer and the developer firm, customer participation may also lead to *customer–developer conflict* because the external representation function tends to enable the boundary spanning actors to protect their own interests (Bai, Sheng, and Li 2016; Fang, Palmatier, and Evans 2008; Wang et al. 2020). We also investigate how relational and environmental factors moderate the effects of customer participation on knowledge sharing and customer–developer conflict, which in turn impacts NPD performance.

Empirical analyses of 167 high-tech firms in China support our propositions. This study contributes to the extant literature in several ways. First, we adopt the boundary spanning

perspective to explicate the theoretical mechanisms about how customer participation affects NPD performance. In this way we address the ambiguity of the underlying mechanisms and provide a foundation for future research aimed at improving joint innovation success (Fang, Palmatier, and Evans 2008; Yu 2017). Second, we take both positive and negative factors into consideration, drawing a complete picture of the relationship between customer participation and NPD performance. The combination of knowledge sharing and customer–developer conflict reflects a more evenly balanced view of the benefits and challenges posed by customer participation (Najafi-Tavani et al. 2022, 2023), thereby potentially reconciling the mixed findings reported in prior literature. Third, we broaden the boundary conditions about when customer participation is more or less effective. Our findings demonstrate that the effects of customer participation depend on relational factor as well as the external environment. In this regard, we answer the call for research on relevant boundary conditions and construct a thorough framework to comprehend the effectiveness of customer participation in driving innovation.

Theoretical Framework

Boundary spanning theory and customer participation

A developer firm can face a costly and slow process when seeking to catch up with emerging technologies and develop new products entirely or primarily with internal resources (Bernal, Carree, and Lokshin 2022; Bogers and Lhuillery 2011). In the B2B context, many firms are thus shifting from internal team-based collaboration to cross-boundary cooperation with partners, potentially deploying a cost- and time-efficient strategy for overcoming resource constraints (Eggers, Kraus, and Covin 2014; Stock 2006). Customer participation occurs when firms integrate their industrial customer firms into the innovation process (Fang 2008; Wang, Jin, and Zhou 2019). Customer participation encompasses the interchange of information across

organizational boundaries and joint problem-solving, wherein a customer and a developer collaborate to achieve the new product objective throughout the development process (Najafi-Tavani et al. 2023; Zhang and Zhu 2019). The industrial customer and the developer firm generally select several representatives to staff an informal unified project team for product development. When the customer engages in joint development, they may utilize various cues and feedback mechanisms, including face-to-face discussions, regular meetings, or online communication as they articulate market preferences to one another. To align these efforts with the overall goal of NPD, such a project team works synergistically and oversees each specific stage (e.g., conceptualization, design and planning, development, testing and validation, production and manufacturing) to ensure that the process runs smoothly (Lin and Huang 2013).

Customer participation aligns with the core assumption of the boundary spanning theory, which posits that firms lack the internal resources needed to address challenges and instead rely on their external relationships for critical resource inputs (Carlile 2002; Gimenez-Fernandez and Sandulli 2017; Leone, Petruzzelli, and Natalicchio 2022; Stock 2006). To achieve competitive advantage, organizations need to engage in a variety of boundary spanning activities (e.g., customer participation). Thus, the boundary spanning theory provides a theoretical explanation of how and when customer participation as a boundary spanning activity may influence organizational effectiveness (Aldrich and Herker 1977; Stock 2006). Customer participation involves mutual collaboration and boundary penetration between the developer firm and its customer firm. The customer and the developer rely on their boundary-spanning actors to ensure that social and economic exchanges are executed smoothly (Aldrich and Herker 1977; Fan and Stevenson 2019). The critical challenge is to manage the boundary with the customer to enhance the efficacy on NPD performance (Aldrich and Herker 1977; Stock 2006).

In the boundary spanning activities, the main actors need to exercise their dual functions effectively: engaging in information processing to facilitate inter-organizational exchange while acting as external representatives to safeguard each party's own interests (Aldrich and Herker 1977; Carlile 2004; Fan and Stevenson 2019; Huang et al. 2016; Luo 2007; Mäkelä et al. 2019). Information and knowledge make up the most significant flow between organizations. The information processing function involves selecting, transmitting, and interpreting information between two parties (Carlile 2004; Huang et al. 2016). We thus use *knowledge sharing*, which reflects the extent to which both parties actively exchange information pertaining to market demand, technical knowledge, product ideas, and other factors (Fang, Palmatier, and Evans 2008), to capture the outcome of this function. In particular, customer participation creates opportunities for both partners to pool their knowledge (Wang et al. 2017). As the extent of customer participation increases, close interactions across organizational boundaries increase as well, making it easier to share information and thus providing critical inputs for innovation activity (Gopal and Gosain 2010; Yu 2017). Through knowledge sharing, the developer firms can enhance their ability to create cutting-edge ideas and integrate relevant knowledge for innovation success (De Luca and Atuahene-Gima 2007; Zhou and Li 2012).

The external representation function enables boundary-spanning actors to maintain their power and identities, often creating strong 'in-group'/'out-group' barriers (Schotter et al. 2017). Identifying with their own firms may create difficulties when navigating these boundaries. The boundary spanning actors therefore need to respond to the requirements of both the customer and the developer firm (Edmondson et al. 2019; Hoppner, Mills, and Griffith 2021). As goals and priorities, domains of expertise, and capabilities differ between the customer and the developer firm (Oinonen et al. 2018), the boundary spanning actors are likely to encounter incompatible

expectations in the innovation process, which may lead to the *customer–developer conflict* (Schotter and Beamish 2011), that is, a state in which one party feels opposition to or infringement on its interests by the other party in the process of joint development (Bai, Sheng, and Li 2016; Wang et al. 2020). Accordingly, the tensions arising from such a conflict may undermine the competitive advantage brought by customer participation and negatively influence NPD performance. As such, we identify knowledge sharing and customer–developer conflict as two important boundary spanning factors caused by customer participation and may also influence NPD performance.

The contingencies

According to the boundary spanning theory, the boundary spanning actors do not exercise their functions and facilitate knowledge sharing and conflict development unambiguously to influence NPD performance (Minbaeva and Santangelo 2018). To assess the extent to which boundary spanners carry out their functions properly, we need to account for specific contexts that favor the emergence of these functions. The boundary spanning activities are embedded in the link between the boundary spanning organizations and the link between organizations and the external environment (Luo 2007; Schotter et al. 2017). That is, customer participation, as a boundary spanning activity, is likely influenced by firm–customer relationships and the external market environment, in that way determining the nature of boundary spanning actions and influencing the effectiveness of customer participation.

Regarding the link between the boundary spanning organizations, we consider *previous cooperation experience*, which reflects the degree to which such a relationship is embedded in their operations (Lioukas and Reuer 2015; Wang, Jin, and Zhou 2019). Previous cooperation experience establishes familiarity between boundary spanning partners and thus influences

information processing (Lioukas and Reuer 2015). Such an embedded relationship also facilitates the establishment of norms and trust between partners, thereby affecting conflict development during the boundary spanning activities (Espinosa et al. 2007; Wang, Jin, and Zhou 2019).

Furthermore, NPD requires a combination of customer-related information and technological knowledge. The interplay between market and technological factors is an important issue in NPD (Cui and Wu 2016). The effectiveness of customer participation depends on the technological aspect, which affects the utilization of customer information (Cui and Wu 2016; Wang and Yu 2019). We thus need to consider the technological environment when examining customer participation. *Technological turbulence*, one of the most important environmental factors, which has been widely discussed in prior innovation studies (e.g., Gao, Xie, and Zhou 2015), refers to the rate of technological change in a given industry (Cui and Wu 2016; Shu, Jin, and Zhou 2017). This factor makes an existing technological base obsolete and creates serious threats to boundary-spanning firms (Li et al. 2022; Stock 2006). Technological turbulence thus amplifies external challenges in the marketplace and helps boundary-spanning organizations prioritize their collective interests (Shu, Jin, and Zhou 2017). Regarding the link between organizations and the external environment, we thus consider the moderating effect of technological turbulence. Therefore, we develop a conceptual framework (see Figure 1) and examine *whether*, *how*, and *when* customer participation affects firms' NPD performance.

*****Insert Figure 1 here*****

Hypotheses

Customer participation, knowledge sharing, and NPD performance

We argue that customer participation serves as a bridge between a developer firm and a customer, thereby facilitating knowledge sharing. Involvement of industrial customers in the

firm's innovation activities would contribute to boundary integration, promoting interaction and the establishment of information-transfer channels (Foss, Laursen, and Pedersen 2011; Lin and Huang 2013). Such integration involves the creation of specialized collaborative teams comprising boundary spanning representatives from the two firms, and such teams would conduct regular discussions of product development. This heightened interaction enhances the partners' ability to identify valuable information and work effectively together (Cui and Wu 2017; Wang, Wang, and Mardani 2023). On the one hand, as "buyers" of a new product, industrial customers, through their participation, provide the developer firm with specific preferences and demand insights, highlighting the development of core functionalities. On the other hand, with new insights into the evolution of downstream industries, customer participation also furnishes pertinent technical information and broadens the perspective for NPD. In summary, through these approaches industrial customers can offer a developer firm professional and precise suggestions based on their specific insights (Fang, Palmatier, and Evans 2008; Yu 2017), thereby expanding the breadth of knowledge sharing.

Furthermore, compared with independent R&D efforts, customer participation transforms the entire NPD process into a joint decision-making and problem-solving venture, constructing a shared-discourse system during this collaborative process (Lin and Huang 2013; Nambisan 2002). As customer participation transcends organizational boundaries, the trial-and-error process and iterative development are no longer pursued as solo endeavors by a firm. Instead, it involves a multi-round negotiation process among the boundary spanners in the development team. Such collaborative engagement aids both parties in recognizing the inherent limitations of their information reservoirs (Yu 2017). With the common goal of developing mutually satisfactory products, both entities engage in reciprocal learning and improvement. This dynamic

process allows for more effective transfer of information from each other and generates novel insights for the new product. In other words, such enhanced mutual understanding between partners fortifies the groundwork for knowledge exchange, extending the process beyond mere selection and transmission of information to the process of collectively interpreting information. This intricate process contributes to deeper knowledge sharing (Ho and Ganesan 2013).

H1a: Customer participation is positively associated with knowledge sharing.

We posit that knowledge sharing promotes NPD performance. First, knowledge sharing in a collaborative process strengthens firms' ability to create new ideas for product development (Lau, Tang, and Yam 2010). Through frequent knowledge sharing with customers, a firm can absorb new inputs as well as improve its capacity for quickly formulating solutions when facing a myriad of problems (Clercq, Thongpapanl, and Dimov 2013; Zahra, Ireland, and Hitt 2000). Identifying customer requirements can help firms accurately recognize market needs and understand the right direction for product development (Morgan, Anokhin, and Wincent 2019; Zhou and Li 2012). Second, because customers can give timely feedback to firms once a product prototype is developed, knowledge sharing can reduce the risk of innovation failure and shrink speed-to-market time for new products (Fang 2008; Morgan, Anokhin, and Wincent 2019). In this regard, supplemental know-how provided by customers can be leveraged to carry out innovation activities across the boundary:

H1b: Knowledge sharing is positively associated with NPD performance.

We further argue that knowledge sharing enables customer participation to influence NPD performance. Firms can achieve better NPD performance through customer participation by gaining valuable insights and detailed demand information. When a customer participates in joint product development, the interactive process allows both parties to express their perspectives and

ideas (Fang 2008; Lin and Huang 2013). At the same time, when the customer is involved in the development process, it can suggest solutions to the developer firm's problems. In the absence of mutual sharing and learning, potentially valuable information and joint efforts will not yield any advantage or meaningful performance outcomes (Carlile 2002; Wang, Wang, and Mardani 2023). In contrast, the more extensive are the knowledge sharing activities that occur between the firm and its customer, the more heterogeneous, novel, and diverse is the information that can be accessed by both partners and integrated to promote the NPD process (Lau, Tang, and Yam 2010; Morgan, Anokhin, and Wincent 2019). Adequate and accurate information can enable both partners to understand product demand and basic requirements, helping the developer firm generate creative ideas and enhance NPD performance (Clercq, Thongpapanl, and Dimov 2013). We thus assume that customer participation cannot lead to superior NPD performance directly, as it relies on knowledge sharing to realize the benefits.

Furthermore, inasmuch as the NPD process involves a range of risks and uncertainties, customer participation can bring a customer and a developer firm together to encounter these challenges (Fang, Palmatier, and Evans 2008; Zhang and Xiao 2020). In such a case, when the developer and the customer share knowledge from each other, problems that arise in the process of customer participation can be effectively resolved, ensuring a favorable development trajectory and enhanced NPD performance (Morgan, Anokhin, and Wincent 2019). It thus highlights the critical role that knowledge sharing plays in helping developer firms realize the potential of customer participation:

H1c: Knowledge sharing partially mediates the relationship between customer participation and NPD performance.

Customer participation, customer–developer conflict, and NPD performance

Extensive customer participation suggests closer interaction and frequent contact across organizational boundaries (Najafi-Tavani et al. 2023). Even when two parties are committed to the common goal of ensuring that new products are ready for the market, broad differences in cultural backgrounds and strategic intentions can generate resistance that must be reckoned with (Barjak and Heimsch 2021; Chan, Yim, and Lam 2010). Two partners engaging in the same task may form inconsistent understandings and divergent expectations (De Dreu 2006; Hwang and Kanghyun 2023). As a result, conflict and clashes may occur. In particular, because there exists no agreement that covers all possible means of cooperation, stronger attachments between two parties may give rise to unplanned assignments. The differences between the two parties are typically viewed as sources of uncertainty, chaos, and disorder (Chan, Yim, and Lam 2010; Oinonen et al., 2018).

Furthermore, by integrating customers into the NPD process, the firm endows its customers with some portion of the power that the firm previously claimed exclusively (Jehn 1995; Zhang and Xiao 2020). Such a “power shift” means that the customer plays a greater role in ensuring that the firm’s innovation outcomes meet the customer’s desires, which may conflict with the firm’s expectations (Fang, Palmatier, and Evans 2008). For example, as the user of the developed products, the customer firm is inclined to place greater emphasis on meeting its personalized requirements, while the developer firm as the provider may prioritize cost control and advancement in professional technology over its traditional product lines. In this circumstance, conflicts can arise around issues involving the appropriation of joint value as well as ambiguity over the parties’ respective roles and responsibilities (De Wit, Greer, and Jehn 2012; Oinonen et al. 2018):

H2a: Customer participation is positively associated with customer–developer conflict.

We posit that customer–developer conflict affects NPD performance negatively. First, when the conflict between the firm and its customer arises, both parties are heavily inclined to protect their own resources (Auh et al. 2014; Bai, Sheng, and Li 2016). Under such conditions, private interests take precedence over common interests, making opportunistic behavior such as speculation more likely, disrupting cooperation, and undermining product co-development (Johnsen and Lacoste 2016; Samaha, Palmatier, and Dant 2011). Second, conflict often adds to the partners’ cognitive load, preventing the firm and its customer from collecting and processing information (Auh et al. 2014; Hwang and Kanghyun 2023). As such, the firm and the customer will shift their attention away from activities that are beneficial to product development (De Dreu and Weingart 2003), thereby influencing NPD performance negatively. Prior studies have also identified negative effects of conflict on team effectiveness (De Dreu and Weingart 2003; De Wit, Greer, and Jehn 2012):

H2b: Customer–developer conflict is negatively associated with NPD performance.

We also argue that customer participation can affect NPD performance through the mediating influence of customer–developer conflict. First, when a customer is involved in the NPD process as the joint developer, both partners exert their influence to guide the NPD direction and meet their respective strategic interests (Fang, Palmatier, and Evans 2008). When the customer’s and firm’s interests and expectations are inconsistent (Barjak and Heimsch 2021), conflict can easily arise. When customer–developer conflict occurs, it may affect both partners’ commitment to innovation and result in diminished NPD performance (Auh et al. 2014; De Dreu and Weingart 2003). In contrast, when no conflict has occurred, customer participation might not generate a negative influence on NPD performance inasmuch as their joint decision-making and problem-solving efforts may resolve the inconsistency and facilitate the NPD process.

Second, risks and uncertainties make it difficult to manage the innovation process. When customer participation brings a customer and developer firm together to cope with problems jointly, the NPD process becomes more complex. Any conflict that arises between them due to disagreements on problem resolution (Chan, Yim, and Lam 2010; De Dreu 2006) likely brings disorder and chaos, ultimately diminishing overall NPD effectiveness. Furthermore, the customer–developer conflict allows both partners embedded in cross-boundary customer participation to maintain their respective identities. When they are immersed in conflict, they are more likely to engage in opportunistic behavior to protect their private interests or appropriate collective interests, undermining co-development of a product (Johnsen and Lacoste 2016; Samaha, Palmatier, and Dant 2011). Thus, these arguments, in combination, suggest that the negative effect of customer participation on NPD performance is delivered through the customer–developer conflict:

H2c: Customer–developer conflict partially mediates the relationship between customer participation and NPD performance.

The moderating effect of previous cooperation experience

We predict that previous cooperation experience weakens the relationship between customer participation and knowledge sharing. First, previous cooperation experience promotes the establishment of common knowledge between a focal firm and its customer (Bonner and Walker Jr 2004; Lioukas and Reuer 2015; You et al. 2020). When the firm and its customer have cooperated extensively, the knowledge shared through customer participation may become redundant (Bernal, Carree, and Lokshin 2022). Because each partner masters only knowledge that is relevant in their own markets, the breadth of the exchanged information may be limited in ongoing cooperation. In particular, when the customer participates in the firm’s NPD process, the presence of common or redundant knowledge is likely to complicate the selection of valid

information during the co-development process (Bäck and Kohtamäki 2016). In other words, previous collaboration between partners makes customer participation less effective at expanding the breadth of knowledge sharing.

Second, prior experience facilitates the establishment of cooperation routines between a firm and its customer (Hoang and Rothaermel 2005). When a customer with previous cooperation experience participates in the NPD, it becomes accustomed to standard procedures that facilitate joint project management (Hoang and Rothaermel 2005; Wang et al. 2017). While the two parties may continue to focus on similar procedures, it may generate very little additional learning or creative thinking (Bäck and Kohtamäki 2016; Hoang and Rothaermel 2005). In this circumstance, customer participation may inhibit the emergence of new ideas and decrease the depth of knowledge sharing in the NPD process:

H3a: Previous cooperation experience weakens the relationship between customer participation and knowledge sharing.

We also predict that previous cooperation experience weakens the relationship between customer participation and customer–developer conflict. First, customers who have participated in cooperation activities with a developer firm are more likely to build fine-grained communication channels to guarantee timely feedback during the NPD process (Bonner and Walker Jr 2004; You et al. 2020). As such, compared with partners with less prior experience in cooperative projects, the two partners may understand how to avoid panicking when unexpected assignments arise the next time the customer participates in product development (Gulati, Lavie, and Singh 2009). Additionally, in the face of inconsistent attitudes towards the same work, prior cooperation experience also accustoms the partners to “seeking common ground while reserving differences” and forming a better understanding of each other’s capabilities and demands (Bernal, Carree, and Lokshin 2022; Gulati and Gargiulo 1999), thereby curbing conflict

associated with customer participation. To summarize, prior cooperation experience may alleviate tensions between customer participation and customer–developer conflict through common communication structures.

Second, previous cooperation between partners can encourage the formation of norms of reciprocity and equity (Wang, Jin, and Zhou 2019). In this case, compared with partners who have not cooperated extensively, the focal developer and its customer are likely to be more confident that neither will privilege their own interests over those of the other partner (Li et al. 2010; Lioukas and Reuer 2015). Hence, concerning “power shifts” that are associated with customer participation in NPD, clashes over joint values and respective responsibilities are less likely to arise. Moreover, as friendship and trust emerge gradually through previous interactions (Inkpen and Tsang 2005; Wang, Jin, and Zhou 2019), both sides will be more tolerant of each other, which can help them overcome issues involving conflicting interests that can arise owing to customer participation (Poppo, Zhou, and Ryu 2008; Svare, Gausdal, and Möllering 2020):

H3b: Previous cooperation experience weakens the relationship between customer participation and customer–developer conflict.

The moderating effect of technological turbulence

We predict that technological turbulence strengthens the relationship between customer participation and knowledge sharing. First, technological turbulence may quickly render existing technologies obsolete and spawn external environmental uncertainties (Gao, Xie, and Zhou 2015; Li et al. 2022). To cope with instability in the external environment, interactions between the partners should be more frequent. In this regard, customer participation can be treated as a critical choice, highlighting its enhanced value in bridging communication channels to achieve alignment between changing demand and firms’ product-development efforts (Eggers, Kraus, and Covin 2014). Thus, in the presence of high technological turbulence, customer participation

may hasten broader information exchange between partners as they seek to acquire detailed information and overcome the constraints associated with existing knowledge stocks. Thus, the effect of customer participation on knowledge sharing should be stronger when technological turbulence is high.

Second, frequent and unpredictable technological change also makes it difficult for firms to use relevant technologies in developing new products (Gao, Xie, and Zhou 2015; Stock 2006). At that time, customer feedback is critical in helping firms address such challenges, identify viable solutions to circumvent technological uncertainty, and facilitate properly directed product development (Cui and Wu 2016). The customer who participates as a joint problem-solver, then, plays a stronger role. In this case, the focal firm is likely to attach greater importance to building a common discourse system during customer participation, making it possible to absorb more knowledge and choose appropriate technologies (Garud and Karnøe 2003). As such, customer participation may enhance knowledge sharing in technologically turbulent environments:

H4a: Technological turbulence strengthens the relationship between customer participation and knowledge sharing.

We also argue that technological turbulence weakens the relationship between customer participation and customer-developer conflict. First, firms operating in turbulent technological environments depend on customers' paying for their products to avoid being squeezed out of the market (Martin, Javalgi, and Ciravegna 2020). Accordingly, the firm is likely to preserve a solid customer relationship to minimize the threat of obsolescence (Zhang et al. 2015). A focal firm is likely to be tolerant of differences with a customer, largely overlooking inconsistent opinions during customer participation, stimulating the use of these differing approaches to cope with external uncertainty. In such a circumstance, the firm can give up particular opinions, thereby

reconciling the contradictions. Therefore, customer participation may cause less customer–developer conflict when technological turbulence is high.

Second, rapidly changing technologies require vulnerable firms to focus on collective rather than individual interests (Shu, Jin, and Zhou 2017). When technological turbulence is low, the partners may have spare energy for negotiating over the distribution of benefits and the division of roles, resulting in growing friction related to customer participation. In contrast, when technological turbulence is high, firms pay more attention to how they can “bake a bigger cake” through effective cooperation instead of dividing joint value in their own favor (Jaworski, Kohli, and Sahay 2000). In other words, clashes over the appropriation of joint value and ambiguity over partners’ respective roles are less likely to occur (Martin, Javalgi, and Ciravegna 2020):

H4b: Technological turbulence weakens the relationship between customer participation and customer–developer conflict.

Methodology

Sampling and data collection

To test our hypotheses, we selected high-tech firms in China as the empirical context. To cope with the complex and unstable market environment in emerging markets, high-tech firms in China often involve downstream customers in their innovation projects and attach great importance to customer participation (Lin and Huang 2013; Wang, Jin, and Zhou 2019). Studying high-tech firms provides us with a suitable context in which to investigate how and when customer participation matters for NPD performance. We conducted surveys in Beijing, Shanghai, and Guangdong and their surrounding areas because high-tech firms in these areas develop more rapidly and can provide us with an appropriate sample.

Building on prior literature, we developed a questionnaire in English and translated the relevant scales into Chinese through conventional translation and back-translation to ensure

consistency and conceptual equivalence (Wang, Jin, and Zhou 2023). We then interviewed 5 senior managers who had participated in customer cooperation projects to verify the relevance and appropriateness of the items. After that, we administered a pre-test to 20 senior managers, all of whom had relevant experience in customer-involved projects. We revised and improved the questionnaire based on the feedback these participants provided.

We worked with a business research firm that collaborates closely with the China National Bureau of Statistics (NBS) and the Ministry of Science and Technology (MST) and has access to a list of high-tech enterprises. We randomly selected 500 companies from the directory of high-tech firms in 2014 using the probability sampling method to eliminate the potential for sampling error (Leonidou and Katsikeas 2010).¹ We collaborated with the research firm and trained interviewers to conduct the survey. We selected one high-ranking executive with long working experience in related industries and enterprises as the key informant in each firm because these individuals were able to describe and explain their firms' strategic actions. This process ensured that the questionnaire responses were informed by a clear understanding of what collaborative projects entail, giving us confidence in the quality and reliability of the information.

The trained interviewers contacted the participating firms by telephone to confirm whether these firms were suitable for the study and whether a senior manager from each firm would accept their interview invitations and then scheduled appointments with these key respondents. Respondents' main positions in their firms included CEO (19.16%), general manager (4.19%), senior marketing manager (44.31%), R&D (11.98%), project manager (5.99%), and other senior-level manager (14.37%). The interviewers then visited the key respondents at the sample firms and distributed the questionnaires. Each respondent was asked to choose a recent collaborative

¹ There were 13,401 firms listed in the directory. We collaborated with a business research firm to randomly select 500 firms from the directory.

innovation project with a customer and then fill out the questionnaire. Questionnaires that were filled out incompletely or did not meet the requirements were regarded as invalid and removed from the sample. Eventually, we obtained 167 valid responses to the survey, with an effective response rate of 33.4%.

To address concerns over non-response bias, we conducted multivariate analysis of variance (MANOVA) and independent sample t-tests on key attributes of the responding and non-responding firms (Shen, Zhou, and Zhang 2022). The MANOVA test results revealed that there were no significant differences between the responding and non-responding firms with respect to firm age, size, ownership, and industry type (*Wilk's Λ* = 0.99; *F* = 0.59; *p* = 0.82). The results of the independent sample t-tests indicated no significant differences between responding firms and non-responding firms with respect to firm age (*t* = 0.11; *p* = 0.91), size (*t* = 0.79; *p* = 0.43), firm ownership (for international joint ventures: *t* = 0.70; *p* = 0.48; wholly owned subsidiaries: *t* = -1.03; *p* = 0.32), or industry type (information technology: *t* = 0.09; *p* = 0.93 ; electronics: *t* = 1.16; *p* = 0.25; electric equipment: *t* = -1.21; *p* = 0.23 ; pharmaceuticals: *t* = -0.36; *p* = 0.72), suggesting that non-response bias is not a concern.

These 167 sample firms operated in high-tech industries, including electric equipment (29.3%), information technology (25.7%), electronics (12.6%), and pharmaceuticals (14.4%). Of these firms, 71.9 percent reported annual sales revenues of more than US\$3 million, and 53.3 percent employed between 100 and 500 people. In addition, 6.6 percent were state-owned and 25.2 percent were foreign-owned, including international joint ventures and wholly owned subsidiaries.

Measures

Table 2 lists the measurement items, which were adapted from the existing literature. We adapted the scales of Foss, Laursen, and Pedersen (2011) to measure *NPD performance*, using two items to assess the overall profitability and market competitiveness of new products. We measured *knowledge sharing* using the scale adapted from Fang, Palmatier, and Evans (2008), consisting of two items, to evaluate the degree to which or how often the customer and the developer exchange technical knowledge, report progress on their projects, and share market and competitor information. We adopted the scale used in Bai, Sheng, and Li (2016) to measure *customer-developer conflict*, using three items to assess the degree to which inconsistencies in needs, organizational goals, or viewpoints between the developer firm and the customer arise in the collaboration process. For *customer participation*, based on Cui and Wu (2016), we used four items to measure the degree to which the customer and the developer are able to jointly and collaboratively complete NPD-related tasks, such as understanding market demand, establishing NPD goals, and developing and improving new product.

*****Insert Table 2 here*****

Previous cooperation experience was adapted from Lioukas and Reuer (2015) using two items to evaluate how long the developer and the customer had been building their relationship and working together. To measure *technological turbulence*, we use three items from Cui and Wu (2016) to evaluate the rapidity of technological change in a sample firm's industry.

Control variables

We included a series of control variables to account for potentially confounding effects. As larger and older firms may have more resources available and experience to cope with challenges involved in customer participation and hold greater power in exchanges with customers (Bai, Sheng, and Li 2016; Rokkan, Heide, and Wathne 2003), we controlled for *firm size* and *firm age*.

The former was measured by the log-transformed number of employees and the latter was calculated as the number of years since the firm was established. Because *firm ownership* may cause exchange patterns with customers to vary (Handley and Angst 2015), we included two dummy variables, international joint ventures (IJV) and wholly owned subsidiaries (WOS), using domestic firms as the baseline (Li et al. 2008). In addition, we created four dummy variables to account for heterogeneity in the four primary industries (i.e., information technology, electronics, electric equipment, and pharmaceuticals), with other industries as the baseline. Because industrial competition helps both parties act proactively and collaboratively to address cut-throat rivals effectively, we also controlled for *market competition*, which was measured using a three-item scale adapted from Hoque, Mia, and Alam (2001) to evaluate the intensity of competition among the firms that operate in the same industry.

Construct reliability and validity

Before testing our hypotheses, we used IBM SPSS Amos (Analysis of Moment Structures) software to perform confirmatory factor analysis (CFA) to assess the convergent and discriminant validity of all multi-item constructs (Wang, Jin, and Zhou 2023). As the results reported in Table 2 indicate, the CFA measurement model fits the sample data satisfactorily: $\chi^2/df = 1.76, p < 0.01$, the confirmatory fit index (CFI) = 0.91, the incremental fit index (IFI) = 0.91, the root mean square error of approximation (RMSEA) = 0.07, the root mean square error (RMR) = 0.07, and the standardized root mean square error (SRMR) = 0.06. The composite reliability values are greater than the recommended 0.70, demonstrating appropriate reliability of the constructs (Lance et al. 2006). All individual items' standardized coefficients are significant, supporting convergent validity. Furthermore, the square root of the average variance extracted (AVE) for each construct is significantly greater than the correlation coefficients of that

construct with all other constructs, indicating the discriminant validity of the constructs (Hair et al. 2010). We conducted a series of chi-square difference tests to determine whether a two-factor model could fit better than a one-factor model for each pair of constructs (Koufteros, Cheng, and Lai 2007). In each case, the chi-square for the one-factor model is significantly higher than that for the two-factor model. These results show that our measures exhibited acceptable psychometric properties.

Common method bias

Because our dependent and independent variables are self-reported, we addressed the threat of common method bias and detected it in several ways. We separated the predictor and criterion variables into separate sections so that it was difficult for respondents to speculate about their hypothesized relationships. To reduce response apprehension, we promised to protect respondents' anonymity and assured them that there were no right or wrong answers. Furthermore, as recommended by Podsakoff et al. (2003), we compared our measurement model with a latent method factor model. In the former model, all the scale items were loaded onto their theoretical constructs. In the latter model, all the measurement items were loaded onto the respective theoretical constructs as well as a latent common method factor. The change in model fit obtained by the addition of the latent method variance was not significant, indicating that common method bias is unlikely to be a concern in our study.

Analyses and results

In Table 3 we report the descriptive statistics for the constructs included in this study. To test our mediation hypotheses, we used the IBM Statistical Package for the Social Sciences (SPSS) to conduct a stepwise regression approach (Boyd et al. 2012) and to test H3 and H4 we adopted moderated regression analysis. We mean-centered the independent and moderating

variables to create the interaction terms and test the moderation hypotheses (Aiken, West, and Reno 1991). The results are presented in Table 4 and Table 5. We checked the values of variance inflation factors (VIFs) in all regression models. The largest VIF was 2.14, well below the threshold of 10, indicating that multicollinearity poses no concerns.

*****Insert Tables 3 & 4 & 5 here*****

The mediating effects of knowledge sharing and customer–developer conflict

We used Model 2 to test the main effect of customer participation on NPD performance. The results in Table 4 indicate that customer participation has a significant and positive effect on NPD performance ($\beta = 0.40, p < 0.01$). Model 3 in Table 5 indicates that customer participation is positively associated with knowledge sharing ($\beta = 0.49, p < 0.01$), providing support for H1a. Model 3 in Table 4 shows that knowledge sharing is also significantly related to NPD performance ($\beta = 0.35, p < 0.01$), in support of H1b. When knowledge sharing is included in the model, the positive impact of customer participation on NPD performance diminishes (dropping from $\beta = 0.40$ to $\beta = 0.22$). These results indicate that knowledge sharing partially mediates the relationship between customer participation and NPD performance, providing support for H1c.

Similarly, Model 6 in Table 5 reveals that customer participation is positively related to customer–developer conflict ($\beta = 0.26, p < 0.05$), in support of H2a. Model 4 in Table 4 suggests that customer–developer conflict is negatively associated with NPD performance ($\beta = -0.22, p < 0.01$), thus supporting H2b. With customer–developer conflict included in the model, the positive effect of customer participation on NPD performance strengthens (rising from $\beta = 0.40$ to $\beta = 0.47$), which suggests that customer–developer conflict plays a partial mediating role in the relationship between customer participation and NPD performance, in support of H2c. Furthermore, as shown in Table 4, when we included both mediators (i.e., knowledge sharing

and customer–developer conflict) in the model, the model fit was significantly improved ($R^2 = 0.26$ in Model 2; $R^2 = 0.36$ in Model 5), providing further support for H1c and H2c.

The moderating effects of previous cooperation experience and technological turbulence

In Table 5 we report the results pertaining to the moderating effects of previous cooperation experience and technological turbulence. In Models 1–3 and Models 4–6, respectively, we treat knowledge sharing and customer–developer conflict as dependent variables. We enter the control variables in Model 1 and Model 4; we include the independent variable (i.e., customer participation) and moderators (i.e., previous cooperation experience and technological turbulence) in Model 2 and Model 5. The interaction terms between the independent variable and moderators are added to Model 3 and Model 6.

Regarding the moderating effects of previous cooperation experience, we find that the interaction term between customer participation and previous cooperation experience is negatively associated with knowledge sharing (Model 3: $\beta = -0.14$, $p < 0.05$). Thus, H3a is supported. To facilitate further interpretation, in Figure 2 we plotted the relationships for the low (mean – SD) and high (mean + SD) conditions for each significant moderation effect (Aiken, West, and Reno 1991). As Panel A of Figure 2 shows, the positive effect of customer participation on knowledge sharing becomes weaker when previous cooperation experience is high ($\beta = 0.37$, $p < 0.05$) than when it is low ($\beta = 0.62$, $p < 0.001$).

*****Insert Figure 2 here*****

As shown in Model 6 of Table 5, the interaction term between customer participation and previous cooperation experience has a negative effect on customer–developer conflict (Model 6: $\beta = -0.25$, $p < 0.05$), in support of H3b. Panel B of Figure 2 reveals that, when previous cooperation experience is low, customer participation has a positive effect on customer–

developer conflict ($\beta = 0.49, p < 0.01$); however, when previous cooperation experience is high, the effect becomes nonsignificant ($\beta = 0.04, p > 0.10$), providing further support for H3b.

H4a and H4b pertain to the moderation effects of technological turbulence. As Table 5 shows, the interaction between customer participation and technological turbulence has a positive and significant effect on knowledge sharing (Model 3: $\beta = 0.19, p < 0.05$), in support of H4a. Furthermore, as shown in Panel C of Figure 2, the positive effect of customer participation on knowledge sharing is greater when technological turbulence is high ($\beta = 0.68, p < 0.001$) than when it is low ($\beta = 0.30, p < 0.05$). However, Model 6 in Table 5 indicates that the interaction term between customer participation and technological turbulence has a negative but nonsignificant effect on customer–developer conflict (Model 6: $\beta = -0.09, p > 0.10$), failing to support H4b.

Robustness checks

In the main analysis, we used subjective NPD performance to capture the outcomes of customer participation. We also measured other aspects of innovation performance and relevant objective indicators. First, we considered market innovativeness, which is also a critical aspect of new products (Jin, Shu, and Zhou 2019). To measure market innovativeness, we used three items adapted from Lee and O'Connor (2003) and Talke, Salomo, and Kock (2011) to evaluate the degree of innovativeness inherent to product features and benefits.² We used market innovativeness as the dependent variable and re-examined the research model. Likewise, the results indicate that both knowledge sharing and customer–developer conflict partially mediate

² The three items for market innovativeness are: 1) The benefits the product offers are new to customers; 2) this product introduces many completely new features to the market; 3) the product shows an unconventional way of solving problems.

the effect of customer participation on market innovativeness, which is consistent with previous findings (please find the results reported in Appendix, Table A-1).

Second, we also collaborated with the research firm to collect some objective data pertaining to firm performance. In particular, we collected net profits, sales revenues, and total assets about all the firms in our final sample. We used profitability (calculated as net profits/sales revenues) and ROA (calculated as net profits/total assets) as the dependent variables and re-examined the relationship between customer participation and performance outcomes as well as the mediation effects (please find the results reported in Appendix, Table A-2).³ For firm profitability, the results reveal that customer–developer conflict has a partial mediation effect, which is same as previous ones. Knowledge sharing, however, has a full mediation effect on the relationship between customer participation and profitability, which exhibits a small difference from previous analyses and suggests differences across performance indicators.⁴ For firm ROA, the results show that both knowledge sharing and customer–developer conflict have a partially mediating effect on its relationship with customer participation, which is consistent with previous results.

Endogeneity issue

Several factors may simultaneously influence customer participation and NPD performance, which makes our empirical analysis susceptible to an endogeneity problem. We address this issue by using the two-stage control function approach (Petrin and Train 2010), which has been

³ As some values for these two variables are missing, the sample for the robustness tests includes 155 firms.

⁴ In general, NPD performance improves overall performance. There are also, however, several differences between them. For example, NPD performance mainly reflects long-term performance while overall performance reflects current performance. Thus, it may result in minor differences in the results of the mediation analyses. Given these differences between overall performance and NPD performance, we encourage future studies to explicitly clarify the distinctiveness underlying the theoretical mechanisms with customer participation.

used widely in prior innovation or survey-based studies (e.g., Katsikeas et al. 2018; Wang, Jin, and Zhou 2023). To address this concern, we must find an appropriate instrumental variable that meets relevance and exclusion requirements. For the relevance requirement, the instrumental variable should relate to the independent variable (i.e., customer participation). For the exclusion requirement, it should not have direct effects on the dependent variables (or uncorrelated with error term in the regression) (Petrin and Train 2010; Wooldridge 2010).

In our study, we treat government support as the instrumental variable. Government support can help firms obtain critical resources from the government and encourage investment that persuades their customers to engage in NPD (Sheng, Zhou, and Li 2011), while it is unlikely to directly influence interactions between the developer firm and the customer or the corresponding outcomes.⁵ The results reveal that government support has a positive and significant effect on customer participation, whereas the direct effects on the dependent variables (i.e., knowledge sharing, customer–developer conflict, NPD performance) are not significant (please find the results reported in Appendix, Table A-3), providing empirical validation of our instrumental variable. An Anderson-Rubin test indicates that the error term of the dependent variables is not significantly related to government support ($F = 0.974, p > 0.10$), meeting the exclusion restriction. Thus, government support could serve as a valid instrumental variable.

In the first stage of the control function approach, we regressed customer participation against the government support and control variables (please see the Appendix, Table A-3). In the second stage, we included the residual term of the first-stage regression to control for bias

⁵ We adopted a four-item scale from Bai, Sheng, and Li (2016) and Sheng, Zhou, and Li (2011) to measure government support: 1) The government and its agencies have implemented policies and programs that have been beneficial to business operation; 2) the government and its agencies have provided needed technology information and other technical support; 3) the government and its agencies have provided very important market information; 4) the government and its agencies have helped your firm to obtain licenses to import technology, manufacturing and raw materials, and equipment.

and serve as the endogeneity correction. In this situation, customer participation as the explanatory variable is no longer associated with the error terms of the dependent variables, establishing the independence assumption regarding customer participation and thus addressing endogeneity concerns (Petrin and Train 2010). The results of the second-stage model were consistent with previous results (please find the results in Appendix, Tables A-4 & A-5).

Discussion

Based on a sample of 167 high-tech firms in China, this study examines theoretical mechanisms underlying the relationship between customer participation and NPD performance and investigates contingent effects of previous cooperation experience and technological turbulence (please see the results depicted in Figure 3). First, the results provide consistent support for the mediated hypotheses, indicating that knowledge sharing positively mediates the effect of customer participation on NPD performance, while customer–developer conflict negatively mediates this relationship. In this way, this study not only explicates the mechanisms underlying the relationship between customer participation and NPD performance, thereby complementing prior studies of the process mechanism (Fang, Palmatier, and Evans 2008; Lin and Huang 2013; Yu 2017), it also highlights the coexistence of the bright and dark sides of customer participation, which extends and integrates results in prior studies focusing on either factor independently (e.g., Knudsen 2007; Zhang and Zhu 2019). Our study thereby addresses ambiguity regarding the effects of customer participation and potentially reconciles the mixed findings in previous empirical studies (Fang 2008; Najafi-Tavani et al. 2022).

*****Insert Figure 3 here*****

Second, the study confirms the hypothesized moderating role of previous cooperation experience. In particular, previous cooperation experience mitigates the positive and negative

effects of customer participation on knowledge sharing and customer–developer conflict, respectively. This finding indicates that previous cooperation experience shrinks the learning space but encourages relationship-building to reduce the potential for conflict to arise (Poppo, Zhou, and Ryu 2008; Wang, Jin, and Zhou 2019).

Third, regarding the moderating effect of technological turbulence, the results reveal that it strengthens the effect of customer participation on knowledge sharing. This finding indicates that technological turbulence in the marketplace can bring partners together, help them develop mutual commitments, and thus increase knowledge sharing in the process of customer participation. This is consistent with the findings of Gao, Xie, and Zhou (2015) and Shu, Jin, and Zhou (2017). However, the results fail to support the moderating effect of technological turbulence on the relationship between customer participation and customer–developer conflict (H4b). One possible reason is that, while technological turbulence enhances partner solidarity in the customer participation process and alleviates the potential for conflict, the associated uncertainty may make it difficult for partners to establish mutual consensus (Candi, Van Den Ende, and Gemser 2013), resulting in additional conflict between the customer and the developer firm. It is also possible that the firms in our sample operate in high-tech industries and therefore are accustomed to turbulence and are not sensitive to the pace of technological development. Thus, in such cases, it might not lead to effective responses from both partners in the cross-boundary collaboration.

Given that the response to and perception of technological turbulence may be associated with firm-level characteristics, we conducted tests to examine whether any such characteristic (e.g., firm age, firm size) may affect the moderating role of technological turbulence. The results reveal that three-way interaction between customer participation, technological turbulence, and

firm age is not significant, while three-way interaction between customer participation, technological turbulence, and firm size has a positive effect on customer–developer conflict. This finding indicates that, for larger firms, when technological turbulence is high, customer participation exacerbates customer–developer conflict. Because the sample in our study does not involve non-high-tech firms, however, it is less likely to directly compare the effectiveness of technological turbulence between different types of firms. We encourage future studies to seek a more comprehensive understanding of the effects of technological turbulence, including perceived differences between collaboration partners (the developer firm and the industrial customer) and the perceived differences between different types of firm (high-tech firms and non-high-tech firms).⁶

In addition, regarding the effects of the key control variables, the results reveal that both WOS and market competition are positively related to NPD performance (please see Table 4). Market competition creates pressure and motivates a focal firm to commit more resources to facilitate NPD (Lee 2009), and WOS status can help the focal firm acquire more advanced technological and managerial resources from foreign parents to enhance NPD performance (Kotabe, Jiang, and Murray 2011).

Theoretical implications

By investigating whether, how, and when customer participation matters for firm NPD performance in the B2B context, this study makes several contributions to the extant literature. First, we extend prior studies to integrate the bright and dark sides of customer participation and explicate the theoretical mechanisms underlying its relationship with NPD performance. Differing from traditional studies that characterize only the benefits or challenges arising from

⁶ We thank the reviewing team for suggesting these insightful points.

the co-development process (Knudsen 2007; Lin and Huang 2013; Zhang and Zhu 2019), our study incorporates both aspects into the research framework and reflects a more evenly balanced understanding of customer participation. Further, while existing studies investigate mainly the direct consequences of customer participation (Najafi-Tavani et al. 2023; Zhang and Xiao 2020), our study provides a more refined understanding by explicating the underlying mechanisms. In particular, building on the boundary spanning theory, our research demonstrates two distinct mechanisms that drive the effects of customer participation on NPD performance. Whereas customer participation may improve NPD performance through knowledge sharing, it can also hurt NPD performance by exacerbating conflict between the developer and the customer. Therefore, by explicating the abovementioned mechanisms and integrating the bright and dark sides of customer participation, we resolve the ambiguous or inconsistent results reported in previous studies and advance the customer participation literature.

Second, our study enriches the customer participation literature by investigating the moderating effects of previous cooperation experience and technological turbulence. Prior studies have explored primarily contingent conditions of customer participation at the firm, customer, and product levels (Fang 2008; Lin et al. 2013; Najafi-Tavani et al. 2023; Yu 2017; Zhang and Xiao 2020). We add to this line of research by considering relational and environmental conditions, deepening our understanding of the relationship between customer participation and NPD performance. Furthermore, prior studies show that previous cooperation affects the quality of knowledge exchange and relationship development (Lioukas and Reuer 2015; Poppo, Zhou, and Ryu 2008). Our study extends these studies to show that previous cooperation experience weakens the effects of customer participation on knowledge sharing and strengthens the effects on customer–developer conflict. On the one hand, knowledge sharing

brought by customer participation will become inefficient as additional learning and creative thinking opportunities become rare; on the other hand, knowledge sharing can enhance mutual understanding and establish norms that help to resolve conflicts, highlighting the trade-offs involved in the role prior experience plays in the collaborative innovation process. Moreover, prior studies indicate that technological turbulence makes a firm's existing technological base obsolete and creates serious threats (Li et al. 2022). Complementing the extant literature, we show that, when technological turbulence is high, customer participation can promote knowledge sharing. Harmful conditions in the external business environment may enhance the beneficial role customer participation plays in the innovation process.

Third, we extend the application of boundary spanning theory beyond other contexts to explain the effectiveness of and mechanisms that underlie customer participation and provide support to the arguments generated by the boundary spanning theory. The boundary spanning theory has been applied in various contexts at varying levels, such as organizational and environmental contexts (Friedman and Podolny 1992), headquarters and subsidiaries of multinational firms (Mäkelä et al. 2019; Schotter and Beamish 2011), and the exchange and integration of knowledge between individuals/teams/groups/firms (e.g., Colman and Rouzies 2019; Khan, Lew, and Sinkovics 2015; Liu and Meyer 2020; Mell et al. 2022; Tortoriello, Reagans, and McEvily 2012; Zhao and Anand 2013). Our study extends the application to explicate customer participation and investigates how the boundary spanning strategy affects innovation outcomes. While previous research links boundary spanning to the roles of boundary spanners and highlights individual or organizational skills, capabilities, or characteristics (Levina and Vaast 2008; Mäkelä et al. 2019; Marrone, Tesluk, and Carson 2007), we have limited knowledge of the process and the contingencies that affect boundary spanning actions of

customer participation. Our study emphasizes that the main actors in boundary-spanning activities must respond to and meet each other's requirements and exercise dual functions, and customer participation thereby generates a double-edged effect on NPD performance.

Our results also provide insights into the value of the boundary spanning strategy, underlining contextual conditions matter to a greater extent than previously recognized (Fan and Stevenson 2019; Liu and Meyer 2020; Mäkelä et al. 2019). Creating appropriate conditions to support boundary spanning outcomes is critical for innovation success (Søderberg and Romani 2017; Tortoriello, Reagans, and McEvily 2012). In particular, our study highlights relational and environmental factors are critical for the influences of customer participation on knowledge sharing and conflict development, which in turn affect NPD performance.

Managerial implications

Our findings also provide important implications for managers that should help them understand how best to enhance NPD performance in customer participation projects.

Beware of the double-edged sword of customer participation. While customer participation plays a significant role in the innovation process, managers can leverage its positive role through advanced knowledge sharing between firms and customers, thereby strengthening firms' ability to develop new products. Managers should, however, also be wary of the fact that customer participation can generate conflicts regarding boundary spanners' roles in the co-creation process, which may undermine NPD performance. Managers should strive consciously to mitigate the negative effect arising from the customer–developer conflict.

Consider relational and environmental factors. Firms need to grasp relational and environmental factors firmly to make better use of the advantages brought by customer participation to avoid or resolve problems in the product development process. When a firm has

previous cooperation experience with a given customer, customer participation may generate only limited knowledge sharing. In such cases, firms need to construct other channels to gather information about customer requirements and preferences to facilitate innovation success. In contrast, prior collaboration can promote trust with the customer and reduce the risk of conflict. Furthermore, managers should improve their sensitivity to changes and uncertainties in the technological environment and take appropriate action. In a technologically turbulent environment, the firm needs to bear in mind that customer participation may be quite effective at improving knowledge sharing. The firm should attach greater importance to customer input, understanding customer needs accurately, and effectively developing competitive products.

Limitations and future research

This study should be interpreted in light of several limitations, providing directions for future research. First, according to the boundary spanning theory, our findings offer initial insights into the specific challenges associated with and the mechanisms that underlie customer participation and reveal the mediation effects of knowledge sharing and customer–developer conflict.

Customer participation may also, however, affect innovation along other paths and bring other challenges. Future research could further explicate the mechanisms and pay special attention to the dark side of customer participation, investigating issues such as opportunistic behavior, unmanageable ambiguity, and commitment-breaking in the co-development process.

Furthermore, when a firm and its customer partner engage in the co-development process, they need to interact and work together to cocreate value. The characteristics, attitudes and emotional responses of specific boundary spanning actors are likely to affect each other and in turn influence innovation outcomes. We encourage future studies to further investigate interaction between the boundary spanning actors.

Second, drawing on the boundary spanning theory, our study examines the contingent role of only one relational factor and one environmental element. Further inquiry into other factors and the combined effects of these contingent factors would produce a more complete understanding of the relationship between customer participation and NPD performance. We encourage future studies to explore the moderating roles of other environmental conditions (e.g., change in market demand, competition intensity), relational factors (e.g., interdependence between partners), and project characteristics (e.g., complexity, stage). Furthermore, each innovation project involves customers with varying characteristics that are important for the collaboration process. It is better to consider the characteristics of customers involved in NPD, including type, knowledge, motivation, cultural values, hierarchical status, and so on.

Third, while our study regards customers as co-developers in collaboration projects, customers may also participate in innovation activities in other ways (Zhang and Xiao 2020). Future research could explore how distinct types of customer participation affect NPD performance, investigate their benefits and costs, and explicate the underlying mechanisms. Fourth, the sample includes only high-tech enterprises in China. Related future research could apply our research framework in other countries/regions or use sample firms from other industries to corroborate our findings. Furthermore, while we focus on customer participation in B2B markets, we encourage future research to examine our model in other settings (e.g., B2C markets) to further explore the similarities and differences.

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Conflict of interest statement

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Table 1 Literature Review about the Relationship Between Customer Participation and Innovation Related Outcomes in the B2B Context

Study	Sample	IV	Definition of CP	Me/Mo	DV	Research findings	Process mechanism	Bright/Dark side	Contingency
Najafi-Tavani et al. (2023)	225 high-tech Iranian manufacturing firms	Customer involvement	The extent to which a developer firm's key customers engage with and provide input in different phases of the NPD process	Mo: Absorptive capacity, desorptive capacity	New product performance (NPP)	There is an inverted U-shaped relationship between customer involvement and new product performance.	No	Bright & Dark	Firm
Najafi-Tavani et al. (2022)	273 Iranian manufacturing firms	Customer involvement	The extent to which a customer firm participates in the product innovation process of the developer	Mo: Relationship quality, role ambiguity	Product innovation performance	There is an inverted U-shaped relationship between customer involvement and product innovation performance, and the interplay of relationship quality and role ambiguity significantly moderate this association.	No	Bright & Dark	Relational & Firm
Zhang and Xiao (2020)	148 B2B innovation projects in US	Customer as data provider (CDP), Customer as data analyst (CDA)	/	Mo: Customer need tacitness, customer need diversity	New product performance (NPP)	Both types of customer involvement facilitate NPP. Customer need tacitness negatively moderates the effect of CDP on NPP while customer need diversity yields a positive moderation effect; Customer need tacitness positively moderates the effect of CDA.	No	Bright	Customer
Zhang and Zhu (2019)	376 B2B firms in China	Customer participation	The extent to which the customer is involved in the firm's NPD process	Mo: Customer affective & calculative commitment, total & asymmetrical interdependence, supplier's relational capability	Product innovation capability	Customer participation positively impacts product innovation capability of B2B firms, which will be moderated by customer affective commitment, calculative commitment, supplier's relational capability, total interdependence, and interdependence asymmetry.	No	Bright	Firm & Customer
Wang, Jin, and Zhou (2019)	238 high-tech firms in China	Customer participation	The extent to which a firm involves its customers to share resources and jointly develop new products	/	NPD performance	Customer participation is positively related to NPD performance.	No	Bright	No

Study	Sample	IV	Definition of CP	Me/Mo	DV	Research findings	Process mechanism	Bright/Dark side	Contingency
Yu (2017)	245 software development projects	Customer participation	The extent to which customers provide or share information and knowledge, make suggestions, and become involved in decision making during the value co-creation and delivery process	Me: Knowledge integration Mo: Project complexity	Product performance, process performance	Knowledge integration mediates the positive relationship between customer participation and project performance. Project complexity strengthens the main effect of customer participation.	Yes	Bright	Project
Lin and Huang (2013)	179 high-tech firms in Taiwan	Customer participation as an information resource & as a codeveloper	The degree to which the customer is involved in a manufacturer's NPD activity	Me: Inter-organizational relationships	NPD performance	Inter-organizational relationships mediate the impact of customer participation on NPD performance	Yes	Bright	No
Lin et al. (2013)	196 NPD projects of Taiwanese high-tech firms	Customer participation as an information resource & as a codeveloper	The degree to which the original equipment manufacturing customer is involved in a manufacturer's NPD activity	Mo: Product innovativeness	NPD outcome: Development speed, development cost, product quality	Product innovativeness negatively moderates the impact of customer participation as information providers on NPD outcome and positively affects the relationship between customer participation as a co-developer and NPD outcome.	No	Bright	Project
Fang, Palmatier, and Evans (2008)	188 manufacturers in China	Customer participation in NPD	The extent to which the customer is involved in the NPD process	Me: Information sharing, coordination effectiveness, relationship-specific investment Mo: Customer participation formality	New product value	Customer participation affects NP value creation by enhancing information sharing and customer-supplier coordination and by increasing customer and supplier specific investments. Customer participation formality promotes customer and supplier relationship-specific investments.	Yes	Bright	Customer
Fang (2008)	143 customer-component manufacturer dyads in China	Customer participation as an information resource (CPI) & as a codeveloper (CPC)	The extent to which the customer is involved in the manufacturer's NPD process	Mo: Downstream customer network connectivity, Process interdependence and complexity	New product innovativeness, Speed to market	Customer participation (CPI and CPC) has mixed effects on new product innovativeness and speed to market, which is also moderated by downstream customer network connectivity and process interdependence.	No	Bright	Customer & Project

Study	Sample	IV	Definition of CP	Me/Mo	DV	Research findings	Process mechanism	Bright/Dark side	Contingency
Knudsen (2007)	557 firms (seven European countries)	Customer involvement	/	/	NPD performance	Customer involvement has a negative effect on innovative performance.	No	Dark	No
Gruner and Homburg (2000)	310 German firms	Intensity of customer interaction, characteristics of the involved customers	/	/	NP success	The intensity of customer interaction in the product development process is positively associated with NP success and this effect varies by process stage.	No	Bright	No
Campbell and Cooper (1999)	88 US firms	Customer partnership (vs inhouse projects)	A formal working relationship in which both partners worked closely together and shared both the costs and benefits of the project	/	NP performance, NP advantage	New products developed via customer partnerships don't have superior performance when compared to in-house development projects.	No	Bright	No
Our study	167 high-tech firms in China	Customer participation	The extent to which the customer is involved in the manufacturer's NPD process to jointly develop new products	Me: knowledge sharing; customer-developer conflict Mo: previous cooperation experience; technological turbulence	NPD performance	Customer participation can improve NPD performance through knowledge sharing, but decrease NPD performance via exacerbating conflict between the developer firm and its customer. Previous cooperation experience and technological turbulence influence these effects.	Yes	Bright & Dark	Relational & Environmental

Notes: IV = independence variable; Mo = moderator; Me = mediator; DV = dependent variable
CP = customer participation; NP = new product; NPD = New product development.

Table 2. Construct Measurement and Validity Assessment

Item	SFL
<i>NPD performance: CR=0.78, AVE=0.64, HSV=0.17</i>	
From the profitability standpoint, our new product development program has been successful.	0.74
Compared to major competitors, our new product program is far more successful.	0.85
<i>Knowledge sharing: CR=0.77, AVE=0.45, HSV=0.29</i>	
Our R&D team share with the customer firm about the project related technical information and the status of progress.	0.66
Our R&D team shares with the customer firm about the market and competitor related information.	0.71
<i>Customer-developer conflict: CR=0.81, AVE=0.60, HSV=0.05</i>	
Our R&D team often feels that the customer firm are too critical to be satisfied.	0.61
Our R&D team and the customer firm frequently have arguments because of disagreements between each other.	0.91
It is often difficult for our R&D team and the customer firm to achieve agreement on the objectives of the project.	0.79
<i>Customer participation: CR=0.72, AVE=0.40, HSV=0.29</i>	
Our R&D team thoroughly cooperates with the customer firm to fully assimilate their technical requirements.	0.76
Our R&D team and the customer firm fully cooperate to establish new product development goals and priorities.	0.50
Our R&D team works closely with the customer firm to develop new products.	0.65
Our R&D team and the customer firm work jointly to evaluate and refine new products.	0.58
<i>Previous cooperation experience: CR=0.76, AVE=0.61, HSV=0.12</i>	
Generally speaking, the relationship between our firm and the customer firm has lasted for a long time.	0.82
We have cooperated with the customer firm for a long time.	0.74
<i>Technological turbulence: CR=0.76, AVE=0.52, HSV=0.16</i>	
It is very difficult to forecast where the technology will go in our industry.	0.85
Most technological developments in our industry are radical changes on existing techniques.	0.63
The technological changes in our industry can bring many opportunities for firms.	0.65
<i>Market competition: CR=0.75, AVE=0.51, HSV=0.16</i>	
Competition in our industry is very intense.	0.82
Competitors take new actions very frequently.	0.71
Fierce price competition is a prevalent phenomenon in our industry	0.60

Notes: Overall model fit: $\chi^2/df = 1.76$, $p < 0.01$, comparative fit index (CFI) = 0.91, incremental fit index (IFI) = 0.91, root mean square error of approximation (RMSEA) = 0.07, root mean square error (RMR) = 0.07; standardized root mean square error (SRMR) = 0.06

SFL = standardized factor loading; CR = composite reliability; AVE = average variance extracted. All the scales are measured with seven-point Likert scales (1 = “strongly disagree” and 7 = “strongly agree”).

Table 3. Descriptive Statistics and Correlations

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. NPD performance	1														
2. Knowledge sharing	0.41**	1													
3. Customer-developer conflict	-0.22**	-0.07	1												
4. Customer participation	0.37**	0.50**	0.14†	1											
5. Previous cooperation experience	0.20*	0.23**	-0.19*	0.23**	1										
6. Technological turbulence	0.08	0.17*	0.12	0.24**	0.28**	1									
7. Market competition	0.24**	0.12	-0.05	0.18*	0.33**	0.40**	1								
8. Firm age	-0.07	0.02	0.08	-0.13†	-0.01	-0.04	0.06	1							
9. Firm size	0.10	-0.05	0.04	0.02	0.04	0.05	0.17*	0.24**	1						
10. IJV	-0.02	-0.16*	0.12	-0.07	0.02	-0.07	-0.02	0.08	0.12	1					
11. WOS	0.25**	0.15†	-0.03	0.09	0.00	0.20**	0.03	-0.05	0.07	-0.14†	1				
12. Information technology	0.02	0.04	-0.01	0.11	0.12	0.13†	0.12	-0.16*	-0.04	0.12	-0.13†	1			
13. Electronics	-0.01	-0.12	-0.01	-0.07	-0.09	-0.01	-0.01	0.05	0.04	-0.07	0.04	-0.22**	1		
14. Electric equipment	0.08	0.08	0.06	0.15*	-0.05	0.03	-0.15*	0.00	-0.10	-0.17	-0.01	-0.38**	-0.24**	1	
15. Pharmaceuticals	-0.09	-0.03	-0.03	-0.06	-0.09	-0.20*	0.06	0.10	0.09	0.20*	-0.12	-0.24**	-0.16*	-0.26**	1
Mean	5.05	4.96	3.63	5.14	5.65	4.92	5.16	2.18	5.24	0.10	0.15	0.26	0.13	0.29	0.14
S.D.	0.93	0.79	1.08	0.71	0.92	0.97	0.89	0.65	1.05	0.30	0.36	0.44	0.33	0.46	0.35

Notes: N=167, † p < 0.10, *p < 0.05, **p < 0.01 (two-tailed).

Table 4. Customer Participation and NPD performance: The Mediating Effects of Knowledge Sharing and Customer-Developer Conflict

Variables	NPD performance				
	Model 1	Model 2	Model 3	Model 4	Model 5
Firm age	-0.13 (0.11)	-0.09 (0.11)	-0.14 (0.10)	-0.06 (0.10)	-0.11 (0.10)
Firm size	0.07 (0.07)	0.06 (0.07)	0.08 (0.06)	0.06 (0.06)	0.08 (0.06)
IJV	0.12 (0.24)	0.17 (0.23)	0.29 (0.22)	0.29 (0.22)	0.38† (0.22)
WOS	0.73** (0.20)	0.65** (0.20)	0.57** (0.19)	0.60** (0.19)	0.53** (0.18)
Information technology	0.23 (0.22)	0.06 (0.21)	0.05 (0.21)	0.02 (0.21)	0.02 (0.20)
Electronics	0.20 (0.25)	0.10 (0.24)	0.18 (0.23)	0.06 (0.23)	0.13 (0.23)
Electric equipment	0.42 (0.21)	0.21 (0.21)	0.22 (0.20)	0.18 (0.20)	0.20 (0.19)
Pharmaceuticals	-0.03 (0.26)	-0.16 (0.25)	-0.20 (0.24)	-0.21 (0.24)	-0.24 (0.23)
Market competition	0.26** (0.09)	0.24** (0.09)	0.24** (0.08)	0.22** (0.08)	0.23** (0.08)
Previous cooperation experience	0.16* (0.08)	0.10 (0.08)	0.06 (0.08)	0.03 (0.08)	0.01 (0.08)
Technological turbulence	-0.14† (0.08)	-0.17* (0.08)	-0.18* (0.07)	-0.13† (0.08)	-0.14† (0.07)
Customer participation		0.40** (0.10)	0.22* (0.11)	0.47** (0.10)	0.29** (0.11)
Knowledge sharing			0.35** (0.10)		0.32** (0.09)
Customer-developer conflict				-0.22** (0.06)	-0.19** (0.06)
R ²	0.18	0.26	0.32	0.32	0.36
Δ R ²		0.08**	0.06**	0.06**	0.10**
F	3.15**	4.52**	5.57**	5.43**	6.19**

Notes: Standard errors are shown in parentheses;

† p < 0.10, *p < 0.05, **p < 0.01 (two-tailed).

Table 5. The Moderating Effects of Previous Cooperation Experience and Technological Turbulence

Variables	A: Knowledge sharing			B: Customer-developer conflict		
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Firm age	0.09 (0.10)	0.15 (0.09)	0.16 (0.09)	0.11 (0.14)	0.14 (0.13)	0.18 (0.13)
Firm size	-0.05 (0.06)	-0.06 (0.05)	-0.06 (0.05)	0.02 (0.09)	0.01 (0.08)	0.02 (0.08)
IJV	-0.39† (0.21)	-0.35† (0.18)	-0.39* (0.18)	0.47 (0.30)	0.54† (0.28)	0.56* (0.28)
WOS	0.35* (0.18)	0.23 (0.16)	0.17 (0.16)	-0.02 (0.25)	-0.24 (0.25)	-0.22 (0.25)
Information technology	0.22 (0.20)	0.17 (0.18)	0.02 (0.18)	0.02 (0.28)	-0.20 (0.27)	-0.05 (0.27)
Electronics	-0.17 (0.22)	-0.21 (0.20)	-0.16 (0.20)	0.01 (0.32)	-0.18 (0.31)	-0.06 (0.31)
Electric equipment	0.20 (0.18)	-0.04 (0.17)	-0.02 (0.17)	0.16 (0.26)	-0.10 (0.26)	-0.18 (0.31)
Pharmaceuticals	0.16 (0.22)	0.11 (0.20)	0.14 (0.20)	-0.10 (0.32)	-0.24 (0.31)	-0.09 (0.11)
Market competition	0.10 (0.07)	-0.12 (0.07)	0.00 (0.07)	-0.05 (0.10)	-0.08 (0.11)	-0.09 (0.11)
Previous cooperation experience		0.11† (0.06)	0.07 (0.06)		-0.32** (0.10)	-0.39** (0.10)
Technological turbulence		0.02 (0.06)	0.03 (0.06)		0.22* (0.10)	0.23* (0.10)
Customer participation		0.51** (0.08)	0.49** (0.08)		0.31* (0.13)	0.26* (0.12)
Customer participation × Previous cooperation experience		H3a	-0.14* (0.07)		H3b	-0.25* (0.11)
Customer participation × Technological turbulence		H4a	0.19* (0.08)		H4b	-0.09 (0.12)
R ²	0.09	0.32	0.36	0.03	0.13	0.17
Δ R ²		0.23**	0.04*		0.10**	0.04*
F	1.67†	5.91**	5.84**	0.51	1.97*	2.19*

Notes: Standard errors are shown in parentheses;

† p < 0.10, *p < 0.05, **p < 0.01 (two-tailed).

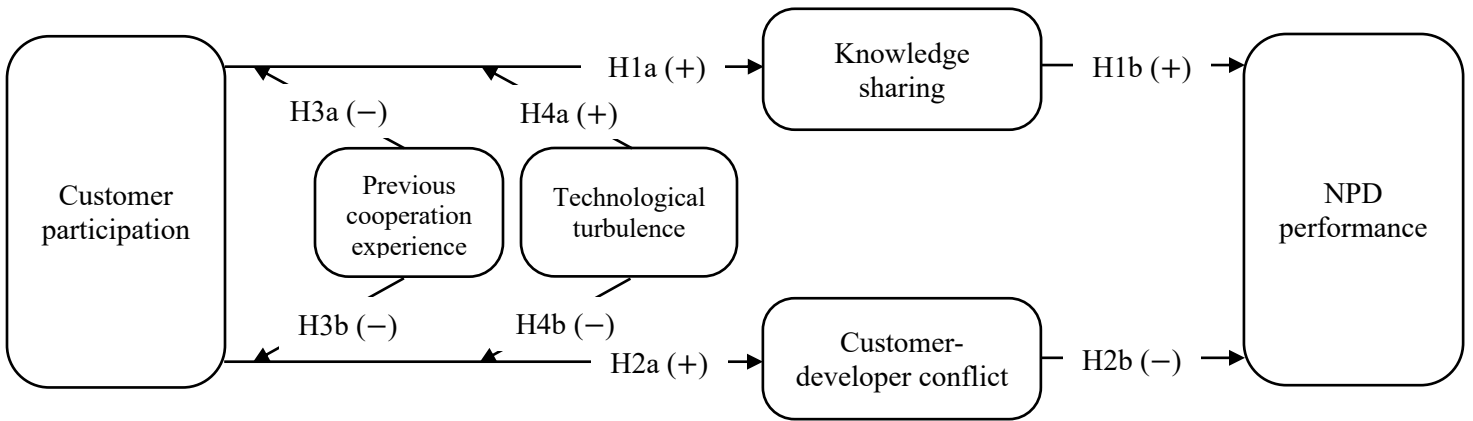
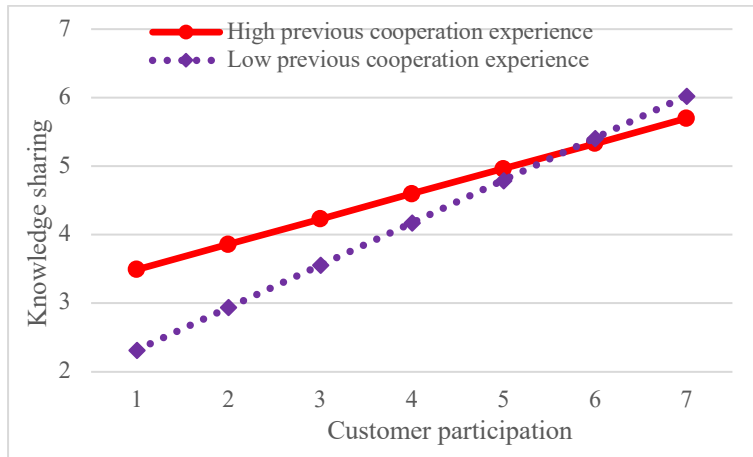
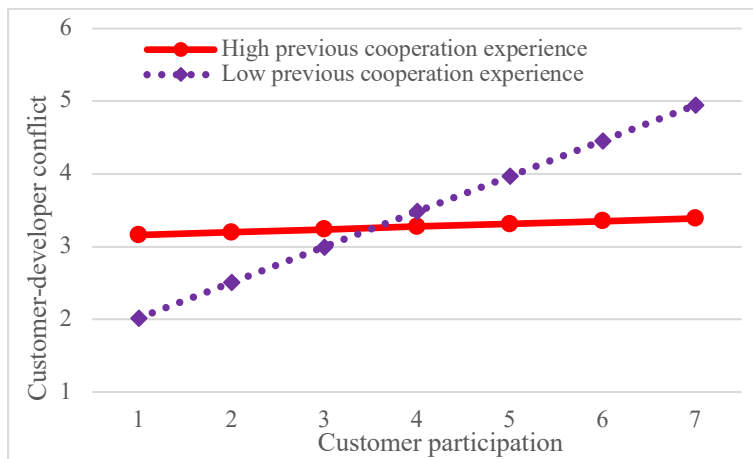


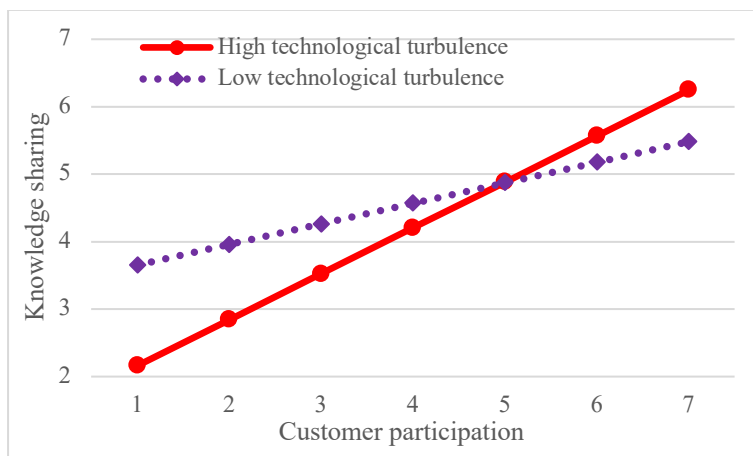
Figure 1. Theoretical Framework



Panel A: H3a



Panel B: H3b



Panel C: H4a

Figure 2. Decomposing the Interaction Effects

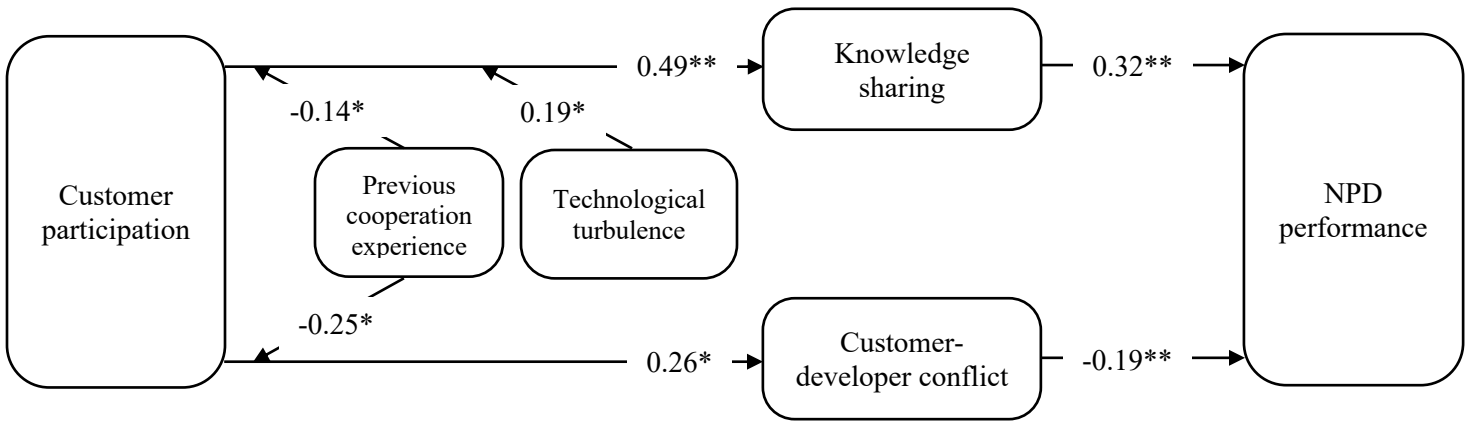


Figure 3. Results of Hypotheses Testing

Appendix

Table A-1. Robustness Tests: Cooperation Effectiveness and Market Innovativeness

Variables	Market Innovativeness		
	Model 1	Model 2	Model 3
Firm age	-0.05 (0.09)	-0.08 (0.09)	-0.04 (0.09)
Firm size	-0.03 (0.06)	-0.01 (0.06)	-0.02 (0.06)
IJV	0.11 (0.19)	0.18 (0.19)	0.17 (0.19)
WOS	0.28† (0.17)	0.23 (0.17)	0.26 (0.17)
Information technology	-0.04 (0.18)	-0.05 (0.18)	-0.07 (0.18)
Electronics	0.09 (0.21)	0.14 (0.21)	0.07 (0.21)
Electric equipment	0.27 (0.18)	0.28 (0.17)	0.26 (0.18)
Pharmaceuticals	-0.20 (0.21)	-0.22 (0.21)	-0.23 (0.21)
Market competition	0.16* (0.07)	0.16* (0.07)	0.15* (0.07)
Previous cooperation experience	0.04 (0.07)	0.02 (0.07)	0.01 (0.07)
Technological turbulence	0.00 (0.07)	0.00 (0.07)	0.03 (0.07)
Customer participation	0.35** (0.09)	0.24* (0.09)	0.39** (0.09)
Knowledge sharing		0.21* (0.08)	
Customer-developer conflict			-0.11* (0.05)
R ²	0.24	0.27	0.26
Δ R ²		0.03*	0.02*
F	4.10**	4.40**	4.14**

Notes: Standard errors are shown in parentheses;

† p < 0.10, *p < 0.05, **p < 0.01 (two-tailed).

Table A-2. Robustness Tests: Firm profitability and ROA

Variables	A: Firm Profitability			B: Firm ROA		
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Firm age	0.01 (0.02)	-0.01 (0.02)	0.01 (0.02)	-0.03 (0.08)	-0.06 (0.08)	-0.02 (0.08)
Firm size	-0.01 (0.02)	-0.01 (0.02)	-0.01 (0.02)	-0.03 (0.05)	-0.02 (0.05)	-0.03 (0.05)
IJV	-0.03 (0.05)	-0.01 (0.05)	-0.01 (0.05)	-0.09 (0.17)	-0.04 (0.17)	-0.05 (0.17)
WOS	0.11* (0.05)	0.09* (0.04)	0.09* (0.05)	0.36* (0.15)	0.30* (0.15)	0.33* (0.15)
Information technology	0.03 (0.05)	0.03 (0.05)	0.03 (0.05)	0.34* (0.16)	0.34* (0.16)	0.33* (0.16)
Electronics	0.08 (0.06)	0.09 (0.06)	0.07 (0.06)	0.17 (0.18)	0.22 (0.18)	0.17 (0.18)
Electric equipment	0.04 (0.05)	0.04 (0.05)	0.04 (0.05)	0.14 (0.15)	0.14 (0.15)	0.12 (0.15)
Pharmaceuticals	0.14* (0.06)	0.14* (0.06)	0.14* (0.06)	0.26 (0.19)	0.25 (0.18)	0.25 (0.19)
Market competition	0.05* (0.02)	0.05* (0.02)	0.05* (0.02)	0.01 (0.06)	0.01 (0.06)	-0.00 (0.06)
Previous cooperation experience	0.01 (0.02)	-0.00 (0.02)	-0.01 (0.02)	0.06 (0.06)	0.04 (0.06)	0.03 (0.06)
Technological turbulence	-0.06** (0.02)	-0.07** (0.02)	-0.06** (0.02)	-0.07 (0.06)	-0.08 (0.06)	-0.05 (0.06)
Customer participation	0.05* (0.02)	0.02 (0.03)	0.07** (0.02)	0.24** (0.08)	0.15† (0.08)	0.27*** (0.08)
Knowledge sharing		0.06** (0.02)			0.17* (0.08)	
Customer-developer conflict			-0.05** (0.02)			-0.10* (0.05)
R ²	0.19	0.23	0.24	0.17	0.20	0.19
Δ R ²		0.04**	0.05**		0.03*	0.02*
F	2.82**	3.27**	3.43**	2.36**	2.64**	2.56**

Notes: Standard errors are shown in parentheses;

N = 155

† p < 0.10, *p < 0.05, **p < 0.01, ***p < 0.001 (two-tailed).

Table A-3. Endogeneity Issue-Control Function Approach: The First Stage Regression

Variables	Customer participation	Knowledge sharing	Customer-developer conflict	NPD performance
Firm age	-0.08 (0.08)	0.16 (0.09)	0.15 (0.13)	-0.08 (0.11)
Firm size	-0.00 (0.05)	-0.07 (0.05)	-0.01 (0.08)	0.05 (0.07)
IJV	-0.18 (0.18)	-0.37* (0.19)	0.48† (0.29)	0.14 (0.23)
WOS	0.20 (0.15)	0.23 (0.16)	-0.24 (0.25)	0.65** (0.20)
Information technology	0.43* (0.17)	0.03 (0.18)	-0.17 (0.27)	0.07 (0.22)
Electronics	0.28 (0.19)	-0.20 (0.20)	-0.13 (0.31)	0.12 (0.24)
Electric equipment	0.52** (0.16)	-0.04 (0.17)	-0.09 (0.26)	0.21 (0.21)
Pharmaceuticals	0.44* (0.20)	0.15 (0.21)	-0.13 (0.32)	-0.11 (0.25)
Market competition	0.06 (0.07)	-0.02 (0.07)	-0.08 (0.11)	0.23** (0.09)
Previous cooperation experience	0.13* (0.06)	0.11† (0.06)	-0.32** (0.10)	0.10 (0.08)
Technological turbulence	0.05 (0.06)	0.01 (0.06)	0.19* (0.10)	-0.19* (0.08)
Customer participation		0.50** (0.08)	0.27* (0.13)	0.38** (0.10)
Government Support	0.21** (0.07)	0.05 (0.08)	0.17 (0.12)	0.08 (0.09)
F	3.38**	5.47**	1.99*	4.22**

Notes: Standard errors are shown in parentheses;

† $p < 0.10$, * $p < 0.05$, ** $p < 0.01$ (two-tailed).

**Table A-4. Endogeneity Issue-Control Function Approach:
The Second Stage Regression (1)**

Variables	A: Knowledge sharing			B: Customer-developer conflict		
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Firm age	0.09 (0.10)	0.18 (0.09)	0.19 (0.09)	0.11 (0.14)	0.22 (0.15)	0.26† (0.14)
Firm size	-0.05 (0.06)	-0.07 (0.05)	-0.07 (0.05)	0.02 (0.09)	0.01 (0.08)	-0.00 (0.08)
IJV	-0.39† (0.21)	-0.32† (0.19)	-0.37* (0.19)	0.47 (0.30)	0.63* (0.29)	0.65* (0.29)
WOS	0.35* (0.18)	0.18 (0.18)	0.12 (0.18)	-0.02 (0.25)	-0.41 (0.27)	-0.38 (0.27)
Information technology	0.22 (0.20)	-0.09 (0.23)	-0.07 (0.23)	0.02 (0.28)	-0.54 (0.36)	-0.38 (0.36)
Electronics	-0.17 (0.22)	-0.27 (0.21)	-0.21 (0.21)	0.01 (0.32)	-0.37 (0.33)	-0.25 (0.33)
Electric equipment	0.03 (0.18)	-0.17 (0.25)	-0.13 (0.25)	0.16 (0.26)	-0.53 (0.39)	-0.48 (0.39)
Pharmaceuticals	0.16 (0.22)	0.03 (0.23)	0.07 (0.23)	-0.10 (0.32)	-0.51 (0.36)	-0.44 (0.35)
Market competition	0.10 (0.07)	-0.04 (0.07)	-0.01 (0.07)	-0.05 (0.10)	-0.13 (0.11)	-0.14 (0.11)
Previous cooperation experience		0.08 (0.08)	0.04 (0.08)		-0.43** (0.13)	-0.50** (0.13)
Technological turbulence		-0.01 (0.07)	0.01 (0.07)		0.15 (0.11)	0.16 (0.11)
Customer participation		0.77* (0.37)	0.71* (0.36)		1.12* (0.57)	1.06* (0.56)
<i>Endogeneity correction</i>		-0.26 (0.38)	-0.22 (0.37)		-0.85 (0.58)	-0.83 (0.58)
Customer participation × Previous cooperation experience			-0.14* (0.07)			-0.24* (0.11)
Customer participation × Technological turbulence			0.19* (0.08)			-0.09 (0.12)
R ²	0.09	0.32	0.35	0.03	0.15	0.18
Δ R ²		0.23**	0.03*		0.12**	0.03*
F	1.67	5.47**	5.45**	0.51	1.99**	2.20**

Notes: Standard errors are shown in parentheses;

† p < 0.10, *p < 0.05, **p < 0.01 (two-tailed).

**Table A-5. Endogeneity Issue-Control Function Approach:
The Second Stage Regression (2)**

Variables	NPD performance				
	Model 1	Model 2	Model 3	Model 4	Model 5
Firm age	-0.13 (0.11)	-0.05 (0.12)	-0.11 (0.11)	0.00 (0.11)	-0.06 (0.11)
Firm size	0.07 (0.07)	0.05 (0.07)	0.07 (0.06)	0.05 (0.06)	0.07 (0.06)
IJV	0.12 (0.24)	0.21 (0.23)	0.32 (0.22)	0.35 (0.23)	0.43* (0.22)
WOS	0.73** (0.20)	0.57** (0.21)	0.51* (0.21)	0.48* (0.21)	0.44* (0.21)
Information technology	0.23 (0.22)	-0.10 (0.28)	-0.07 (0.27)	-0.22 (0.28)	-0.18 (0.27)
Electronics	0.20 (0.25)	0.02 (0.26)	0.11 (0.25)	-0.07 (0.25)	0.03 (0.25)
Electric equipment	0.42 (0.21)	0.01 (0.26)	0.07 (0.30)	-0.11 (0.30)	-0.04 (0.29)
Pharmaceuticals	-0.03 (0.26)	0.01 (0.31)	-0.29 (0.27)	-0.40 (0.28)	-0.39 (0.27)
Market competition	0.26** (0.09)	0.21* (0.09)	0.22* (0.09)	0.18 (0.09)	0.20* (0.08)
Previous cooperation experience	0.16* (0.08)	0.05 (0.10)	0.02 (0.10)	-0.05 (0.10)	-0.06 (0.10)
Technological turbulence	-0.14† (0.08)	-0.21* (0.09)	-0.20* (0.08)	-0.17* (0.08)	-0.17* (0.08)
Customer participation		0.77* (0.45)	0.50 (0.44)	1.02** (0.44)	0.75* (0.44)
<i>Endogeneity correction</i>		-0.39 (0.46)	-0.30 (0.45)	-0.58 (0.45)	-0.47 (0.44)
Knowledge sharing			0.35** (0.10)		0.31** (0.09)
Customer-developer conflict				-0.23** (0.06)	-0.20** (0.06)
R ²	0.18	0.26	0.32	0.32	0.37
Δ R ²		0.08**	0.06**	0.06**	0.11**
F	3.15**	4.22**	5.18**	5.18**	5.86**

Notes: Standard errors are shown in parentheses;

† p < 0.10, *p < 0.05, **p < 0.01 (two-tailed).