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Teach well, learn better - Customer involvement and new product performance in B2B markets: The role of desorptive and absorptive capacity

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A B S T R A C T

Customer involvement has received significant attention in the B2B relationship literature and is identified as an undeniable source of sustainable competitive advantage for manufacturing industries. Our study extends this research stream and re-examines the relationship between customer involvement and new product performance, employing the dynamic capability perspective. We hypothesise the moderating effects of absorptive and desorptive capacity on the relationship between customer involvement and new product performance. A survey of 225 high-tech Iranian manufacturing firms is used to test our research hypotheses. The research findings reveal the existence of an inverted U-shaped relationship between customer involvement and new product performance. Our findings also confirm the complementary effects of absorptive and desorptive capacity and suggest when, and under what levels of these two dynamic capabilities, involving key customers in new product development projects could be a successful strategy for developer firms.

1. Introduction

Successful new product development (NPD) is seen as the lifeblood of modern businesses (Najafi-Tavani, Mousavi, Zaefarian, & Naudé, 2020; Najafi-Tavani, Sharifi, Soleimanof, & Najmi, 2013). However, studies show that developer firms from various industrial backgrounds have been experiencing NPD project failure rates as high as 50% over the last 20 years (Zhan, Tan, & Huo, 2019). To deal with such remarkable NPD failure rates, achieving competitive know-how and market intelligence through involving supply chain partners, in particular business customers, has become a strategic priority for developer firms (Hemonnet-Goujot, Manceau, & Abecassis-Moedas, 2019; Morgan, Obal, & Anokhin, 2018; Zhang & Xiao, 2020).

Customer involvement (CI) reflects the extent to which a developer firm's key customers engage with and provide input in different phases of the NPD process (Anning-Dorson, 2018; Cui & Wu, 2017; Lin & Germain, 2004). In recent years, practitioners have increasingly recognised the significant role of CI for the success of developers' NPD. Despite its potential benefits, real-world experiences however show that CI may not always be beneficial for the developer's NPD process. One example is the OLED display co-development project between Samsung-Display and Apple that did not turn out as planned, due to the occurrence of uncertainty that arose from a lack of mutual understanding about the jointly developed product (Wang, Jin, Zhou, Li, & Yin, 2020). This possible dark side of CI has also been echoed in the pertinent literature, suggesting that CI comes with potential risks and drawbacks (Blut, Heirati, & Schoefer, 2020; Heidenreich, Wittkowski, Handrich, & Falk, 2015; Hurtak, Kashyap, & Ehret, 2022).

This contradictory evidence regarding the role and consequences of CI has led some recent papers to introduce CI as a “*double-edged sword*”, with a non-linear effect on the developer's product development performance (see Tang & Marinova, 2020; Zhao, Feng, & Wang, 2015). However, since the introduction of the double-edged sword effect of CI, scholars' viewpoints on the curvilinear relationship between CI and new product performance have varied, as some suggested a U-shaped relationship (Homburg & Kuehnl, 2014; Millson, 2015) while others found an inverted U-shaped association (Najafi-Tavani, Zaefarian, Naudé, Robson, & Abbasi, 2022; Tang & Marinova, 2020). The common ground between these viewpoints is that CI could be beneficial or detrimental for the new product performance depending on the level of knowledge/information uncertainties (information overload, knowledge asymmetry, etc.) in the relationship between the developer and the key

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customer. This has raised a key question in the pertinent literature on how the developer can curb the potential negative effect of CI by managing the level of knowledge related uncertainties in their relationships with key customers.

Uncertainties related to knowledge and information flow can trigger undesirable outcomes such as adversely affecting co-development efforts and their success rate (Najafi-Tavani et al., 2022). These uncertainties in a dyad would take place in the absence of appropriate information processing capabilities (i.e., *absorptive capacity* or AC) that help the developer firm to understand and observe the contributions and offerings of the counterpart (Gligor, Pillai, & Golgeci, 2021; Yu, Zhao, Liu, & Song, 2021). AC reflects the ability of firms to identify, assimilate, and utilise external knowledge (Ferreras-Méndez, Newell, Fernández-Mesa, & Alegre, 2015; Zahra & George, 2002). AC can therefore enable firms to acquire commercialisable external ideas, combine them with internal knowledge, and use them to enhance their product development projects (Naqshbandi & Tabche, 2018; Seepana, Huq, & Paulraj, 2021). Based on this logic, a few recent studies explored the contingent impact of AC, as a key form of dynamic capability, on the relationship between CI and new product performance (e.g. Morgan et al., 2018; Xie, Wang, & García, 2021). In testing the research hypotheses, these studies however theorised a linear and positive relationship between CI and the developer's performance. More importantly, while they paid central attention to the favourable effect of AC as an important dynamic capability, the role of *desorptive capacity* (DC) as a complementarity capability of firms' efficient learning was neglected.

DC reflects the developer firm's ability to recognise and target opportunities to exploit internal information and knowledge and to efficiently transfer them to their business partners (here customer) (Lichtenthaler & Lichtenthaler, 2009; Roldán-Bravo, Ruiz-Moreno, & Llorens-Montes, 2018). Appropriate levels of DC can therefore enable the developer firm to act in a teaching capacity and transfer relevant internal information to the customer regarding the NPD project and the developer's internal operation. This in turn allows the customer to better realise what is expected from them, which can significantly reduce the cognitive distance between the two parties and also strengthen mutual understanding (Roldán-Bravo, Stevenson, Ruiz-Moreno, & Llorens-Montes, 2020). While the main focus of AC is on improving inward knowledge flow, DC acts in reverse, with the ultimate focus on enhancing outward knowledge flow (Roldán-Bravo, Ruiz-Moreno, & Llorens-Montes, 2016; Szász, Rácz, Scherrer, & Deflorin, 2019). Considering the two distinctive roles of AC and DC, the lack of appropriate levels of each of these dynamic capabilities can adversely impact the quality of knowledge flow and learning in any business partnerships. Drawing on this logic, some recent work in the supply chain literature suggests that the effects of AC and DC should be considered together in assessing the efficient knowledge transfer between the business partners (Aliasghar & Haar, 2021; Sikimic, Chiesa, Frattini, & Scalera, 2016; Whitehead, Zacharia, & Prater, 2019). To date, the concept of DC, its interplay with AC and their potential complementary effects on the link between CI and new product performance have however remained untested in the pertinent literature.

Against this background, this study revisits the relationship between CI and new product performance[1] with two main purposes in mind. First, we aim to contribute to the exiting literature by providing strong empirical support for the existence of CI's double-edged sword effect. Specifically, in line with the theoretical viewpoint of emerging work (e.g., Najafi-Tavani et al., 2022; Tang & Marinova, 2020; Zhao et al., 2015), we predict an inverted U-shaped relationship between CI and new product performance. Our second purpose is to extend the dynamic capability view in the developer-customer relationship literature by examining the joint moderating effects of AC and DC on the relationship between CI and new product performance. We argue that AC and DC are two key contingent factors, and that their distinct levels can alter the efficacy of CI due to their decisive roles in managing knowledge transfer and learning process between the developer and their key customer. Specifically, we examine when and under what levels of AC and DC involving the key customer can improve or harm the developer's new product performance. Our findings suggest that the presence of high levels of both dynamic capabilities are required for achieving superior new product performance.

2. Theoretical background and research hypotheses

2.1. CI and new product performance

CI in NPD projects is widely considered as a key driving strategy for introducing innovative solutions and products into B2B markets (Morgan et al., 2018; Najafi-Tavani, Najafi-Tavani, Naudé, Oghazi, & Zeynaloo, 2018; Zhang & Xiao, 2020). To discuss customers' contribution in NPD, several terms have been used in the B2B literature. Among these terms 'CI' (Anning-Dorson, 2018; Najafi-Tavani et al., 2020; Zhang & Xiao, 2020), 'customer participation' (Dong & Sivakumar, 2017; Morgan, Anokhin, & Wincent, 2019; Wang et al., 2020), 'customer integration' (Homburg & Kuehnl, 2014; Millson, 2015; Wiengarten, Li, Singh, & Fynes, 2019), and 'customer engagement' (Hardwick & Anderson, 2019; Storbacka, 2019) are the most common ones that all echo the same concept, that business customers' input is required for successful development of new products (Griffith & Lee, 2016; Najafi-Tavani et al., 2022).

Conceptualisation of CI in the literature stretches on a continuum from 'solely providing market information' to 'highly engaged' in NPD and innovation activities. The B2B literature therefore suggests two main views on CI. First, CI could occur in the form of providing feedback, information, and knowledge with the aim of product development improvement (Cui & Wu, 2016; Menguc, Auh, & Yannopoulos, 2014). From this point of view, the developer's key customer is a valuable information source (Goyal, Ahuja, & Kankanhalli, 2020; Joshi & Sharma, 2004; Zhang & Xiao, 2020), that enables the developer to not only reduce the chance of product failures but also to offer innovative solutions to address both articulated and unarticulated market needs (Najafi-Tavani et al., 2020). From the second viewpoint, the developer sees the key customer as a "*co-developer*" partner with more extensive involvement in the development process in terms of offering knowledge (e.g., ideas and market information) and in-house capabilities (e.g., human resource, technology, etc.) (Cui & Wu, 2017; Wang et al., 2020). We concur with the latter view and consider CI as the operationalised strategy in which the key customer is regarded as a valuable information source who actively participates as a co-developer in the NPD process.

Despite increasing attention being paid to CI as a key antecedent of NPD performance, the findings of previous studies are inconsistent as some researchers have suggested a positive relationship (e.g., Najafi-Tavani et al., 2020; Smets, Langerak, & Rijsdijk, 2013; Tseng & Chiang, 2016; Zhang & Xiao, 2020), while others have found a non-significant or negative association between CI and new product performance (e.g., Belderbos, Carree, & Lokshin, 2004; Knudsen, 2007; Lööf & Heshmati, 2002) (The main papers identified in this debate are shown in Table 1). To explain and address these inconsistencies, scholars have used two main approaches: first, some studies have adopted a contingency approach and explored the potential impact of boundary conditions that may affect the CI–performance relationship. For example Fang (2008) examined the moderating roles of customer network connectivity, process interdependence and process complexity, and Najafi-Tavani et al. (2020) studied cultural distance and customer dependence on the supplier as two boundary conditions that affect the relationship between CI and firm's new product performance.

Second, some scholars have suggested a double-edged sword effect

[1] We consider new product performance as the extent to which a developer achieves its stated objectives in terms of financial performance, development speed, and development cost of a newly developed product (Cui & Wu, 2016)

Table 1
Key studies on business customers role in developers' product performance.

Source	Empirical approach	Consequences	Moderators	Summary of key findings
A. Studies on linear impact of CI:				
Anning-Dorson (2018)	An online survey of 201 and 171 employees from Ghanaian and UK-based firms respectively.	-Firm performance -Product innovation -Process innovation	-Country difference (Ghana vs. UK)	-CI capability + firm performance (Ghanaian context) -CI capability – firm performance (UK context) -CI capability + product innovation (UK and Ghanaian context) -CI capability + process innovation (UK and Ghanaian context)
Cui and Wu (2016)	An online survey of 245 managers involved in product innovation from the US-based firms.	-New product performance (NPP)	-Technological capability	Technological capability –↓ CI as co-developers-NPP Technological capability +↓ CI as innovators-NPP
Cui and Wu (2017)	An online survey of 236 managers involved in product innovation from the US-based firms.	-New product innovativeness -New product advantage	-Experimental NPD approach	-Experimental NPD approach +↓ CI an information source-New product innovativeness -Experimental NPD approach –↓ CI as co-developers-New product innovativeness -CI an information source × CI as co-developers – New product innovativeness
Fang (2008)	A mailed survey of 143 managers from component manufacturer-customer dyads.	-New product innovativeness -New product speed to market	-Customer network connectivity -Process interdependence -Process complexity	-Customer network connectivity –↓ Customer participation as an information resource-New product innovativeness -Customer network connectivity +↓ Customer participation as an information resource-New product speed to market -Process interdependence +↓ Customer participation as a codeveloper-New product innovativeness -Process interdependence –↓ Customer participation as a codeveloper-New product speed to market
Feng, Sun, Sohal, and Wang (2014)	A mail survey of 176 senior managers from Chinese manufacturing firms.	-Time to market	–	-CI – Time to market
Feng et al. (2010)	A mail and email survey of 139 employees from the Chinese manufacturing firms.	-Product quality -Delivery reliability -Process flexibility -Customer service	–	-CI + Product quality -CI + Delivery reliability -CI + Process flexibility -CI + Customer service
Feng, Sun, Zhu, and Sohal (2012)	A mail survey of 176 managers from Chinese manufacturing firms.	Time to market	-IT implementation	CI – Time to market IT implementation –↓ CI-Time to market of new products
Griffith and Lee (2016)	A survey of 201 marketing managers from the US-based firms.	New product advantage	-Cross-national collaboration	-Customer participation as an information source + New product advantage -Cross-national collaboration –↓ Customer participation as an information source-New product advantage -Cross-national collaboration +↓ Customer participation as a development source-New product advantage
He, Lai, Sun, and Chen (2014)	A sample of 320 firms extracted from the International Manufacturing Strategy survey.	-NPP	–	-Customer integration + NPP
Joshi and Sharma (2004)	A mail survey of 169 marketing managers from Canadian manufacturing firms.	-NPP	–	-Customer knowledge development + NPP
Knudsen (2007)	A survey of 557 R&D managers from European firms.	-Innovative performance	–	CI – Innovative performance
Koufteros, Vonderembse, and Jayaram (2005)	A mail survey of 244 managers from manufacturing firms.	-Product innovation -Quality	–	-Customer integration + Product innovation -Customer integration + Quality
Lau, Tang, and Yam (2010)	A survey of 251senior managers from manufacturing firms operating in Hong Kong.	-Product performance -Product innovation	–	-Product co-development with customer + Product performance
Menguc et al. (2014)	A mail survey of 216 general managers from high-tech manufacturing firms in Canada.	-NPP	-Incremental product innovation capability -Radical product innovation capability	-CI + NPP -Incremental product innovation capability +↓ CI-NPP -Radical product innovation capability –↓ CI-NPP
Morgan et al. (2019)	An online survey of 226 managers from the US-based large manufacturing firms.	- New service development performance (NSDP)	-Complexity of customer needs -Competitive intensity	-Customer participation + NSDP -Complexity of customer needs +↓ Customer participation-NSDP -Complexity of customer needs –↓ Customer participation-NSDP
Morgan et al. (2018)	An online survey of 243 senior managers from the US-based manufacturing and service firms.	-NPD performance -New product innovativeness	-AC	-Customer participation + NPD performance -AC + ↓ Customer participation-NPD

(continued on next page)

Table 1 (*continued*)

Source	Empirical approach	Consequences	Moderators	Summary of key findings
				performance -AC + ↓ Customer participation-New product innovativeness
Najafi-Tavani et al. (2020)	-An online survey of 264 managers from the Chinese manufacturing firms.	-Developer performance	-Cultural distance -Customer dependence	CI + Developer performance Cultural distance –↓CI-Developer performance
Smets et al. (2013)	An online survey of 63 managers from the manufacturing firms.	-NPP	–	-Customer participation + NPP
Tsai (2009)	A sample of 1346 manufacturing firm extracted from the Taiwanese technological innovation survey.	-Product innovation performance	-AC	-AC –↓ Customer collaboration-Product innovation performance
Tseng and Chiang (2016)	An onsite survey of 32 travel product developers in Taipei.	-NPP	-Communication quality -Organizational culture -Perceived value	-Cocreation with customer + NPP -Communication quality –↓ Cocreation with customer-NPP -Organizational culture +↓ Cocreation with customer-NPP
Wang, Jin, and Zhou (2019)	An onsite survey of 238 senior managers from high-tech firms operating in China.	-NPP	–	-Customer participation + NPP
Wang et al. (2020)	-An onsite survey of 181 managers from high-tech manufacturing firms located in China.	-Customer developer conflict	-Market newness -Technology newness	-Customer participation as an information provider – Customer developer conflict -Customer participation as a codeveloper + customer developer conflict -Market newness –↓ Customer participation as information provider-Customer developer conflict -Market newness –↓ Customer participation as a codeveloper-Customer developer conflict -Market newness +↓ Customer participation as a codeveloper-Customer developer conflict
Wiengarten et al. (2019)	A sample of 293 manufacturing firms operating in 38 countries extracted from the International Manufacturing Strategy survey over a 20-year period.	-Financial performance	-Firm's competitive priorities (i.e., cost, quality, delivery, and flexibility)	Firm's competitive priorities (i.e., cost, quality, and delivery) + ↓ Customer integration-Financial performance
Zhang and Xiao (2020)	An online survey of 148 managers involved in B2B innovation projects in the US.	-NPP	-Customer need tacitness -Customer need diversity	-Customer as data provider + NPP -Customer as data analyst + NPP -Customer need tacitness –↓ Customer as data provider-NPP -Customer need tacitness +↓ Customer as data analyst-NPP -Customer need diversity +↓ Customer as data provider-NPP
B. Studies on non-linear impact of CI:				
Homburg and Kuehnl (2014)	A survey of 285 senior managers from service and manufacturing firms.	-New product innovation -New service innovation	–	-Customer integration ∪ New product innovation success -Customer integration ∩ New service innovation
Millson (2015)	A survey of 131 NPD managers NPD from manufacturing firms operating in the US.	-New product market success	–	-Customer integration + new product market success -Customer integration ∪ new product market success
Najafi-Tavani et al. (2022)	An onsite survey of 546 senior managers from 273 Iranian manufacturing firms.	-Product innovation performance	-Relationship quality -Role ambiguity	-CI ∩ Product innovation performance -Relationship quality × Role ambiguity ↓ CI- Product innovation performance
Storey and Larbig (2018)	An online survey of 126 managers from the European-based firms.	-Customer knowledge assimilation -Concept transformation	–	-CI + Customer knowledge assimilation -CI ∪ Customer knowledge assimilation -CI + Concept transformation -CI ∩ Concept transformation
Tang and Marinova (2020)	An online survey of 182 NPD managers and personnel from biotech firms operating in the US.	-NPD Performance	-Perceived diagnostic value of customer knowledge (PDV)	-Customer knowledge sharing behaviours ∩ NPD performance -Shared common customer knowledge ∩ NPD performance -Customer knowledge sharing behaviours + Shared common customer knowledge -PDV ↓ Shared common customer knowledge-NPD performance
Zhao et al. (2015)	A mail survey of 195 senior managers from Chinese manufacturing.	-Financial performance	-Top management support	-Customer integration ∩ Financial performance -Top management support +↓ Customer integration-Financial performance

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Table 1 (*continued*)

Source	Empirical approach	Consequences	Moderators	Summary of key findings
C. This study	An onsite survey of 225 senior managers from high-tech Iranian manufacturing firms.	-NPP	-Absorptive capacity -Desorptive capacity	-CI ∩ NPP -Absorptive capacity × Desorptive capacity ↓ CI- NPP

Note: ∪: U-shaped relationship; ∩: Inverted U-shaped relationship; ×: Interaction; −: Negative relationship; +: Positive relationship; ↓: moderates; +↓: Positively moderates; −↓: Negatively moderates.

for CI, and argued that the CI-performance link is not a simple linear relationship (e.g., Najafi-Tavani et al., 2022;Tang & Marinova, 2020; Zhao et al., 2015), suggesting the existence of a curvilinear association between CI and new product performance. There is, however, still an inconsistency in the findings of these studies regarding the non-linear relationship between CI and new product performance (see Table 1).

As argued earlier, despite the existence of contradictory views regarding a dominant type of the curvilinear relationship between CI and the developer's performance, a degree of uncertainty in customer-developer relationships is highlighted as a key factor in turning CI into an effective or ineffective strategy for the developer's product development process (Blut et al., 2020; Najafi-Tavani et al., 2020; Wang et al., 2020). The source of uncertainties in a developer-customer partnership could be classified into two main categories. First, uncertainties deriving from the existence of conflict and ambiguity in terms of roles and responsibilities among individuals or teams involved in co-development activities (Potter & Lawson, 2013). Second, uncertainties that are linked with knowledge and information flow in the dyad (Tang & Marinova, 2020; Zhao et al., 2015). The knowledge/information uncertainties can occur when there is an information overload in the relationship or in the case of knowledge asymmetry between the partners. High levels of knowledge/information uncertainties not only significantly harm the developer-customer relationship but can also trigger the occurrence of role conflict and ambiguity among co-NPD team members from the two firms that further disrupt the partnership progress (Najafi-Tavani et al., 2022). As such previous studies have considered knowledge/information uncertainties as one of the key sources of poorly performing developer-customer partnerships.

A few recent studies therefore endeavoured to introduce contingent factors associated with the level of uncertainty in the developer-customer relationship which can either increase the efficacy of CI or else exacerbate its harmful effect on new product performance. For example, with the focus on knowledge/information uncertainties, Zhao et al. (2015) examined the moderating role of top management support using a resource based view, and Najafi-Tavani et al. (2022) employed a relationship management perspective, confirming the contingent role of relationship quality and role ambiguity in shaping the inverted U-shaped effect of CI.

In our study, we concur with these authors' theoretical viewpoint and predict a curvilinear (i.e., an inverted U-shaped) relationship between CI and new product performance. Further, we argue that AC and DC are two key contingent factors, and that their different levels can alter the efficacy of CI due to their roles in managing the knowledge and information related uncertainties between the developer and their key customer. These views are expanded in the following sections.

2.1.1. *Inverted U-shaped relationship between CI and new product performance*

We argue that CI can enhance the developer's new product performance up to certain levels (when CI increases from low to moderate levels[2]). From a knowledge-based view and under these circumstances, the key customer can offer the developer their valuable market intelligence. Customers' information is known as one of the key drivers of NPD creativity due to the fact that customers' inputs can potentially propose new ideas and perspectives that can be considerably different from those of the developer (Cui & Wu, 2016; Im & Workman, 2004). In particular, access to customers' market-based resources can enable the developer to better recognise both articulated and unarticulated market needs, decreasing the chances of unsuccessful innovation (Anning-Dorson, 2018; Song, Ming, & Xu, 2013). From an operational view the key customer can act a co-developer in which they directly engage in co-value creation and the NPD decision-making process (Cui & Wu, 2017; Morgan et al., 2018). This direct engagement can provide the developer a great opportunity to have wider access to customer's ideas, improving the chance of creating more customer-driven innovative products (Casidy & Nyadzayo, 2019; Mahr, Lievens, & Blazevic, 2014). The involvement of key customers can also enable developers to exploit their partners' tangible and intangible resources (e.g., know-how and technology advances) which may not be available internally (Menguc et al., 2014).

On the other hand, we argue that high levels of CI may not be beneficial for the developer's new product performance. Although CI could still provide valuable knowledge and insights, the excessive involvement can result in undesirable levels of uncertainty that can turn CI into an ineffective strategy for the developer firm (Najafi-Tavani et al., 2022; Tang & Marinova, 2020; Zhao et al., 2015). According to Najafi-Tavani et al. (2022) uncertainties that the developer may confront when the customer is highly involved in the NPD project mainly arise from the act of receiving too much information from the customer, making it very difficult for the developer to digest and embed new knowledge efficiently. Such information bombardment can potentially force the developer to allocate more time and resources to deal with the information overload which in turn comes with some unforeseen financial and non-financial consequences such as a delay in the new product introduction or a significant increase in the development cost (Tang & Marinova, 2020; Villena, Revilla, & Choi, 2011). Further, the uncertainty can occur in terms of confusion in identifying what customer input is (or is not) critical and useful for NPD. Dealing with this confusion can become very time consuming and may result in undesirable cognitive/and financial resource consumption (Najafi-Tavani et al., 2022; Zhao et al., 2015).

Therefore and in line with the suggestion of previous works (e.g., Najafi-Tavani et al., 2022; Tang & Marinova, 2020; Zhao et al., 2015), we propose that CI has a double-edged sword effect in which new product performance increases from low to moderate levels of CI and decreases from medium to high levels of CI. Thus, we expect:

H_1. There is an inverted U-shaped relationship between customer involvement and new product performance.

2.2. *The importance of AC and DC in shaping CI consequences*

Using a dynamic capability perspective, we argue that the relationship between CI and new product performance is contingent on the levels of the developer firm's AC and DC. Dynamic capabilities refer to a firm's behavioural and operational orientation to continuously "*integrate, reconfigure, renew and recreate its resources and capabilities and, most importantly, upgrade and reconstruct its core capabilities in response to the*

[2] Note that at very low levels of CI, we do not expect the key customer to provide any beneficial offering for the NPD project. However, we argue that increasing CI from low to moderate levels (not the absolute low involvement) could gradually provide input into the developer's NPD project.

changing environment to attain and sustain competitive advantage" (Wang & Ahmed, 2007, p. 35). Among different types of dynamic capabilities, those related to learning and knowledge management practices are identified as being among the most important in enhancing innovation processes of firms involved in business collaborations. These capabilities play a vital role as they enable firms to obtain, generate and configure and integrate internal and external knowledge effectively to deal with rapid changes in the business environment by producing new and innovative products (Chen, Luo, Chen, & Guo, 2022; Faccin, Balestrin, Martins, & Bitencourt, 2019). The literature reports AC and DC as the two pivotal forms of knowledge/learning-based dynamic capabilities that facilitate effective knowledge transfer between firms in the business network (Aliasghar & Haar, 2021; Lichtenthaler & Lichtenthaler, 2010; Meinlschmidt, Foerstl, & Kirchoff, 2016).

AC as a key building block of dynamic capabilities in interfirm relationships (here developer-customer), enables developers to identify and assimilate useful knowledge and utilise it in NPD and innovation processes (Aliasghar & Haar, 2021; Naqshbandi & Tabche, 2018; Seepana et al., 2021). In fact, AC empowers the developer to effectively recombine internal and external knowledge, and to develop and improve routines and practices that facilitate the use of existing knowledge with new observed knowledge in the NPD project (Morgan et al., 2018). Therefore, AC plays a critical role in improving interfirm knowledge transfer as well as interfirm learning (Braojos, Benitez, Llorens, & Ruiz, 2020; Najafi-Tavani et al., 2018; Tsai, 2001; Xie et al., 2021). As such, AC can reduce the levels of knowledge/information related uncertainties by 1) enabling the developer to distinguish and recognise beneficial versus non-beneficial external information and 2) facilitating the external knowledge embeddedness in internal processes.

DC as another key from of dynamic capability reflects the developer's outward knowledge transfer activities (Meinlschmidt et al., 2016; Roldán-Bravo et al., 2020; Szász et al., 2019). This inverse mode of AC enables the developer firm to identify internal knowledge and transfer it effectively to the customer (Braojos et al., 2020; Masucci, Brusoni, & Cennamo, 2020; Roldán-Bravo et al., 2018). We argue that the outward knowledge transfer enables the developer to effectively manage knowledge/information uncertainties. This can be done by improving the customer contribution to the developer's product development process in at least three ways. First, by providing useful knowledge/information regarding the NPD project, the developer can help the customer to utilise, employ, and assign its internal processes and capabilities more efficiently to the co-innovation activities (Riquelme-Medina, Stevenson, Barrales-Molina, & Llorens-Montes, 2021), which in turn can enhance the outcomes of CI in the NPD process. Secondly, by transferring the internal knowledge, the developer can better communicate their needs related to the new product under development to the customer (Puranam, Singh, & Chaudhuri, 2009; Ziegler, Ruether, Bader, & Gassmann, 2013) and thus the customer can adjust and trim its offering in line with the developer's expectations. Thirdly, sharing internal knowledge can be seen by the customer as a sign of goodwill, therefore enhancing the levels of customer trust in the relationship with the developer. In such a trust-based relationship, the customer would be more willing to share its internal knowledge and technology with the developer (Rungsithong & Meyer, 2020).

2.2.1. The joint effects of AC and DC on the CI–new product performance link

Drawing on the dynamic capability perspective, we have argued for the importance of AC and DC in shaping the outcome of CI for the developers' NPD. Employing a complimentary perspective, we further argue that it is critical to study the concurrent effects of AC and DC to understand when and under what levels of the two dynamic capabilities, CI could promote or hinder new product performance. The logic behind this claim is that AC and DC are two key building blocks of dynamic capabilities in improving knowledge transfer between partners, thus facilitating the learning process in joint NPD projects (Aliasghar & Haar, 2021; Meinlschmidt et al., 2016; Roldán-Bravo et al., 2020). On one hand, AC enables firms to identify and embed partners' knowledge and DC, on the other hand, allows firms to identify and transfer internal knowledge to the external parties (Roldán-Bravo et al., 2016). The two dynamic capabilities can therefore be considered as important complementarity factors in managing learning and knowledge flow as well as any uncertainties associated with them. However, the absence or poor levels of both or each of the two capabilities independently can significantly alter the outcomes and performance of the developer's relationship with the key customer due to the lack of appropriate capabilities in dealing with knowledge/information uncertainties in a partnership. We thus argue that the efficacy of CI in the NPD project is contingent on the levels of both of a developer's AC and DC capabilities. We expect that under different levels of AC and DC, CI affects new product performance differently.

For moderate to high (hereafter labelled "high") levels of both AC and DC, we anticipate a positive relationship between CI and new product performance. We argue that this condition allows the smooth inward and outward knowledge exchange between the partners which in turn reduces knowledge/information related uncertainties in the collaboration, thus improving the efficacy of CI in co-NPD activities. On the other hand, for low to moderate (hereafter labelled "low") levels of both AC and DC, we expect that CI will turn into a less efficient strategy for NPD. This is because in this condition, the developer-customer relationship would experience high levels of knowledge/information uncertainty due to a lack of appropriate mechanisms for effective learning and knowledge transfer in the dyad. Finally, in the presence of low levels of AC and high levels of DC (or high levels of AC and low levels of DC), we anticipate a double-edge sword effect for CI on new product performance. Under these conditions, the developer may enjoy customer input and offerings up to certain level. However, when CI increases to excessive levels, due to the lack of appropriate levels of either AC or DC the developer may struggle to deal with high levels of knowledge/information uncertainty effectively, thus resulting in a less effective CI strategy.

Therefore, we suggest the following hypothesis:

H2. The interaction of AC and DC will moderate an inverted U-shaped relationship between CI and new product performance, in which there is a difference between the effect of CI on new product performance under different levels of AC and DC.

3. Research methodology

3.1. Sample selection and data collection

We conducted an on-site questionnaire survey to collect primary data from a sample of high-tech manufacturing firms operating in Iran (i.e., biotechnology, electronics, information and communication technologies, pharmaceuticals, and scientific, medical, and optical instruments). Iran's economy in general is oriented to acquire technology and knowledge, employ best practices, and learn from interfirm collaborations in order to innovate in different industries and consequently shrink the technological and knowledge gaps the country has with developed countries (Scaringella & Burtschell, 2017). In fact the country, as one of the Next Eleven emerging regions, can be seen as a bridge between developed and underdeveloped countries, and as such, findings from this region can be considered as a reliable predictors of what will happen to countries advancing behind the next eleven emerging regions (Vesal, Siahtiri, & O'Cass, 2021). Moreover, the context of Iran, given its economy, culture, and development stage, is an appropriate representation of other developing countries in regions such as the Middle East and North Africa.

Iran's manufacturing, and in particular high-tech sector, is highly dependent on intra-country collaborative relationships between domestic businesses because of international sanctions which have significantly limited international B2B relationships. Therefore, collaborating with local partners such as business customers has become the main source of innovation by its manufacturing firms (Najafi-Tavani et al., 2018). Based on the above arguments, we therefore argue that a sample from the Iranian high-tech manufacturing sector provides an appropriate research context to study the relationship between CI and new product performance and factors affecting this relationship.

We paid particular attention to designing our survey instrument through the following three procedures. First, we adapted all measures in our survey from the pertinent literature (see Section 3.3). Secondly, we translated an English version of our questionnaire into Farsi and asked two bilingual business academics to back-translate the questionnaire items into English to reveal conceptual equivalence. Finally, we conducted eight interviews with senior managers, who have appropriate level of knowledge regarding the product development process, to confirm the content and face validity of our measurements.

Our initial sampling frame comprised 900 high-tech manufacturing firms, which were randomly selected from the Iranian Ministry of Industry, Mine and Trade database. Before approaching firms in our sample, we first checked if they have been operating in the B2B sector in the last five years, have a minimum number of ten personnel, and had introduced a new product to the market in the last three years. This resulted in a total of 587 potential respondents.

In the next step, we contacted firms via email and phone to request their initial consent to participate in our study and made a personal appointment with key informants (i.e., CEO, vice president, managing director, NPD manager, or R&D manager).[3] As a result, we secured a personal appointment with 290 informants (one informant from each firm in our sample). It should be noted that out of 290 informants, 37 cancelled their appointments a few days after giving their initial consent to participate in the survey due to urgent personal or business matters. We then visited the remaining 253 participants in their firm and asked them to answer the questionnaire considering their latest product introduced to the B2B market. This on-site data collection process resulted in obtaining 225 usable responses[4] from firms aged from 5 to 65 years and with the number of employees ranging between 10 and 878. Table 2 presents descriptive statistics of the sample in terms of distribution of different firm-sizes, industries, and titles of respondents. After collecting the data, we conducted non-response bias and late-response bias tests, neither of which were found to be a cause for concern in our study.

Table 2
Descriptive profile of respondents.

Respondents' profile	Percent
Industry	
Biotechnology	12.3%
Electronics	16.9%
Information and communication technologies	26.1%
Pharmaceuticals	20.7%
Scientific, medical, and optical instruments	24.0%
Firm's number of employees	
10–50	12.0%
51–100	20.1%
101–250	30.2%
251–500	22.1%
501–878	15.6%
Informant's position	
CEO	14.0%
Managing director	23.4%
NPD manager	31.2%
R&D manager	10.8%
Vice president	20.6%

3.2. Common method bias

Since we collected our data using a single informant, there is a need to check for the existence of common method bias (CMB). We used the marker variable technique to check for the presence of this potential bias. In the first step, we considered the second smallest (positive) corelation among the variables as a proxy for the marker variable (the corelation between trust and innovation novelty = 0.005). We then calculated the CMB-adjusted correlations for all research variables based on the value of our marker variable. As a result, no difference was found at statistically significant levels, suggesting that CMB is not problematic in our research. We also employed the unmeasured latent single-method-factor approach as a further test. We performed a confirmatory factor analysis and included a latent common method (LCM) construct in our research measurement model. We then compared the fit indices of the LCM model ($\chi^2 = 118.982$; *d.f.* = 83; NFI = 0.920; RFI = 0.900; TLI = 0.968; and RMSEA = 0.044) and our original measurement model ($\chi^2 = 118.982$; *d.f.* = 84; NFI = 0.921; RFI = 0.901; TLI = 0.969; and RMSEA = 0.043) and found no significant difference, which confirms that CMB is not an issue in our analysis.

3.3. Measures

To measure *new product performance*, we adapted a five-item scale from Moorman and Rust (1999) and Cui and Wu (2016) which assesses the extent to which a firm achieved its stated objectives in terms of financial performance, development speed, and development cost of a newly developed product. *CI* was measured using a five-item scale adapted from the study of Feng, Sun, and Zhang (2010) and Cui and Wu (2017) to assess the level of involvement of the key customer in the developer's NPD. For the measures of *AC*, we adapted a three-item scale from Wagner (2012) which assesses the capability of the developer to identify, assimilate, and utilise its key customer's knowledge. *DC* was measured using a three-item scale from Roldán-Bravo et al. (2016) to assess the capability of the developer firm in identifying and transferring internal knowledge to its key customer.

To minimise the possibility of the model's misspecification, we also employed a number of *control variables.* First, we controlled for a developer's specific characteristics, namely *firm's age*, *number of employees*, *number of products introduced to the market in the last five years*, *firm's R&D to turnover ratio,* and the *firm's innovation novelty* (new to the market versus new to the firm) associated with a developer's new product. Further, and using relationship management theory (Håkansson & Snehota, 1995), we also controlled for developer-customer relationship characteristics such as a *relationship age*, and the levels of *trust* and *conflict* between the partners perceived by the developer firm. Finally, as environmental turbulence may affect our results, we included three single item factors to capture the potential impact of *market turbulence*, *technology turbulence*, and *competitive intensity*. It should be noted that to assess the research constructs, participants were asked to consider a recent new product that was developed and introduced to the market and take into account one of their business customers that had been involved directly in the development process of this newly developed product. A full description of our measurement items is presented in Table 3.

[3] Given that our measurements were mainly concerned with NPD process and CI, the questionnaire was addressed to a person who is active in product development process and has good levels of knowledge about the firm's overall position. It should be noted that the range of informants in our study was widely used in previous studies concerning customer involvement and NPD/product innovation performance (e.g., Chen, Arnold, & Tsai, 2021; Cui & Wu, 2017; Menguc et al., 2014).

[4] Out of the 253 questionnaires collected from participants we removed 28 responses with >5% missing data from our dataset.

Table 3
Measurements.

Scales	Loadings
New Product Performance (adapted from Cui & Wu, 2016; Moorman & Rust, 1999) (AVE = 0.605; CR = 0.859)	
Return on investment relative to its stated objective	0.787
Sales relative to its stated objective	0.812
Market share relative to its stated objective	0.791
Development cost relative to its stated objective*	–
Development speed relative to its stated objective	0.718
Customer Involvement (adapted from Cui & Wu, 2017; Feng et al., 2010) (AVE = 0.534; CR = 0.851)	
During the NPD process:	
This customer provided frequent feedback and input on the new product's prototypes and designs	0.735
This customer often put forward suggestions to improve the new product	0.764
This customer had a major influence on the design of the new product	0.726
This customer's involvement constituted a significant portion of the overall product development effort	0.718
This customer was actively involved in a variety of product design and development activities	0.709
Absorptive Capacity (adapted from Wagner, 2012) (AVE = 0.620; CR = 0.830)	
We are able to identify and use relevant knowledge from this customer	0.809
We have adequate routines to analyse external knowledge from this customer	0.828
We can successfully combine new knowledge obtained from this customer with existing knowledge and exploit it in concrete applications	0.721
Desorptive Capacity (adapted from Roldán-Bravo et al., 2016) (AVE =0.619; CR = 0.830)	
We are able to identify relevant knowledge from our firm to this customer	0.762
The transfer of knowledge to this customer is well organised	0.821
Our firm supports the knowledge transfer process to this customer sufficiently	0.777
Control variables	
Firm's age;	–
Number of employees	–
Number of products introduced to the market in the last five years	–
R&D to turnover ratio	–
Developer-customer relationship's age	–
Trust - We have trust in this customer (adapted from Palmatier, 2008)	–
Conflict - We have significant disagreements in our working relationship with this customer (adapted from Bai, Sheng, & Li, 2016)	–
Innovation novelty – 'new to the market' versus 'new to the firm' (adapted from Mention, 2011)	–
Technology turbulence - The technology in our industry is changing rapidly (adapted from Jaworski & Kohli, 1993)	–
Market turbulence - In our business, customers' product preferences change quite a bit over time (adapted from Jaworski & Kohli, 1993)	–
Competitive intensity - Competition in our industry is cutthroat (adapted from Jaworski & Kohli, 1993)	–

Notes: New product performance was measured using seven-point scales anchored by 1 = 'very poor' and 7 = 'very good'; Customer involvement, absorptive capacity, desorptive capacity, trust, conflict, technology turbulence, market turbulence, and competitive intensity were measured using seven-point scales anchored by 1 = 'strongly disagree' and 7 = 'strongly agree'; Innovation novelty is a binary variable 0 = product is new to the firm and 1 = product is new to the market; *: Deleted based on loadings; AVE: average variance extracted; CR: composite reliability.

4. Analysis

4.1. Reliability and validity

Before examining the research hypotheses, we conducted confirmatory factor analysis using AMOS 26 to purify our data and confirm the reliability and validity of the measurements employed. Based on the output of confirmatory factor analysis, we eliminated one item that performed poorly. After eliminating this item, the fit indices showed the model to fit the data sufficiently well, with $\chi^2 = 118.982$; *d.f.* = 84; NFI = 0.921; RFI = 0.901; TLI = 0.969; and RMSEA = 0.043. As presented in Table 3, all remaining item loadings are found to be significant at 0.01 level and above a threshold of 0.70. In addition, all composite reliabilities (CRs) are higher than the acceptable level of 0.7 and significant at 0.05. Similarly, the calculated average variance extracted (AVE) values for each construct are above the cut of point of 0.5 and significant at 0.05. The above analysis, therefore, depicts the convergent validity of our research model. We also assessed discriminant validity by confirming that the square root of the AVEs for the constructs in the model are higher than the inter-construct correlations (see Table 4).

4.2. Endogeneity

In our model, variables such as AC, DC and trust can potentially increase the extent to which a customer contributes to the NPD process. Moreover, the existence of conflict between the parties may affect a partnership adversely and as a result can decrease the likelihood that a developer involves its key customer in the NPD process (Johnsen & Lacoste, 2016; Wang et al., 2020). Since these variables may theoretically affect CI, our independent variable may not be completely exogenous.

To deal with this type of endogeneity bias, we used a three-stage least squares procedure (Hamilton & Nickerson, 2003). First, we regressed CI against AC, DC, trust, and conflict to calculate a predicted value for the independent variable (Eq. (1)). The results revealed that all the variables mentioned above show significant relationships with CI, enhancing our confidence to employ a three-stage least squares procedure to correct for this type of endogeneity bias.

$$\mathrm{CI} = \beta_0 + \beta_1\,(\mathrm{AC}) + \beta_2\,(\mathrm{DC}) + \beta_3\,(\mathrm{trust}) + \beta 4\,(\mathrm{conflict}) + \zeta \tag{1}$$

In the next step, as specified in Eq. (2), we calculated residuals for customer involvement that are free from the effect of AC, DC, trust, and conflict.

$$\mathrm{CI}_{\mathrm{residual}} = \mathrm{CI} - \mathrm{CI}_{\mathrm{predicted}} \tag{2}$$

We then regressed new product performance against $\mathrm{CI}_{\mathrm{residual}}$ as well as the control variables. It should be noted that instead of including the original value for the control variables (firm's age, number of employees, number of products introduced to the market in the last five years, and relationship age), we inserted the natural logarithm values to free our regression equation of skewness bias (Model 1 in Table 5). We then inserted the quadratic term of our independent variable of $\mathrm{CI}_{\mathrm{residual}}$ and two moderators, AC and DC into the equation model (Model 2 in Table 5). To test our moderation hypothesis, in the last stage, we included the three-way quadratic interaction term of $\mathrm{CI}^2_{\mathrm{residual}} \times \mathrm{AC} \times \mathrm{DC}$ to our new product performance equation (Model 3 in Table 5). Note that to capture the actual impact of $\mathrm{CI}^2_{\mathrm{residual}} \times \mathrm{AC} \times \mathrm{DC}$ on new product performance, we controlled all two-way and three-way interactions related to AC, DC, $\mathrm{CI}_{\mathrm{residual}}$, and $\mathrm{CI}^2_{\mathrm{residual}}$ in Models 3 (i.e., $\mathrm{CI}_{\mathrm{residual}} \times \mathrm{AC}$, $\mathrm{CI}_{\mathrm{residual}} \times \mathrm{DC}$, $\mathrm{CI}^2_{\mathrm{residual}} \times \mathrm{AC}$, $\mathrm{CI}^2_{\mathrm{residual}} \times \mathrm{DC}$, $\mathrm{AC} \times \mathrm{DC}$, $\mathrm{CI}_{\mathrm{residual}} \times \mathrm{AC} \times \mathrm{DC}$).[5]

$$\begin{aligned}\text{New product performance} = {} & \beta_0 + \beta_1\,(\mathrm{CI}_{\mathrm{residual}}) + \beta_2\,(\mathrm{CI}_{\mathrm{residual}})^2 + \beta_3\,(\mathrm{AC}) \\ & + \beta_4\,(\mathrm{DC}) + \beta_5\,(\mathrm{CI}_{\mathrm{residual}} \times \mathrm{AC}) \\ & + \beta_6\,(\mathrm{CI}_{\mathrm{residual}} \times \mathrm{DC}) + \beta_7\,(\mathrm{CI}_{\mathrm{residual}}{}^2 \times \mathrm{AC}) \\ & + \beta_8\,(\mathrm{CI}_{\mathrm{residual}}{}^2 \times \mathrm{DC}) + \beta_9\,(\mathrm{AC} \times \mathrm{DC}) \\ & + \beta_{10}\,(\mathrm{CI}_{\mathrm{residual}} \times \mathrm{AC} \times \mathrm{DC}) \\ & + \beta_{11}\,(\mathrm{CI}_{\mathrm{residual}}{}^2 \times \mathrm{AC} \times \mathrm{DC}) \\ & + \beta_{Controls}\,(\mathrm{Controls}) + \zeta\end{aligned} \tag{3}$$

[5] To deal with the multi-collinearity problem, we mean-centred both moderator variables before creating the interaction terms.

Table 4
Inter-construct correlation estimates and square root of the AVEs.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
(1) NPP	**0.778**														
(2) CI	0.241**	**0.731**													
(3) AC	0.201**	0.263**	**0.787**												
(4) DC	0.177**	0.240**	0.257**	**0.787**											
(5) Age	−0.026	−0.046	−0.040	−0.085	–										
(6) NOE	0.089	0.083	0.102	0.083	0.335**	–									
(7) NPIM5	0.177**	0.172**	0.013	0.023	0.126	0.107	–								
(8) R&D.r	0.297**	0.071	0.079	0.095	−0.035	0.047	0.238**	–							
(9) R.age	0.080	0.133*	0.074	−0.021	0.377**	0.163*	0.143*	0.118	–						
(10) Trust	0.055	0.238**	0.065	0.119	−0.009	0.095	0.040	0.096	0.160*	–					
(11) Conflict	−0.023	−0.241**	−0.195**	−0.156*	0.003	−0.063	−0.081	0.060	−0.002	−0.016	–				
(12) IN_{dummy}	0.056	0.019	0.082	0.152*	−0.067	0.006	0.008	0.060	0.019	0.005	0.023	–			
(13) TT	−0.020	0.126	0.014	0.095	−0.163*	0.033	−0.068	0.059	−0.038	0.121	−0.063	0.063	–		
(14) MT	0.087	0.076	0.048	0.045	−0.402**	−0.085	0.028	−0.052	−0.078	0.067	−0.024	0.094	0.230**	–	
(15) CoI	0.093	0.073	0.085	0.107	−0.354**	−0.029	0.083	0.067	−0.040	−0.026	−0.095	0.053	0.197**	0.254**	–
Mean	4.912	4.048	5.022	4.628	18.800	208.486	8.551	0.057	6.707	5.169	2.142	0.567	5.004	4.324	5.418
SD[a]	1.688	1.475	1.439	1.332	12.214	287.675	6.538	0.032	4.046	1.700	1.253	0.660	1.710	1.665	1.621

Notes: The bold, underlined figures on the diagonal are the square root of AVEs; ** $p < 0.01$; * $p < 0.05$; a: Standard deviation; NPP: New product performance; NOE: Number of employees; NPIM5: Number of products introduced to the market in the last five years; R&D.r; R&D to turnover ratio; R.age: Relationship age; IN: Innovation novelty; TT: Technology turbulence; MT: Market turbulence; CoI: Competitive intensity.

Table 5
Regression results.

	Model 1		Model 2		Model3	
	β	Sig.	β	Sig.	β	Sig.
Control variables						
Firm's Age	0.001	0.988	0.011	0.896	0.041	0.599
Firm's NOE	0.072	0.299	0.052	0.435	0.049	0.446
NPIM5	0.059	0.398	0.076	0.249	0.063	0.327
R&D.r	0.277	**0.000**	0.255	**0.000**	0.256	**0.000**
R.age	0.015	0.839	−0.021	0.759	−0.057	0.396
Trust	0.021	0.756	0.027	0.670	0.018	0.766
Conflict	−0.029	0.659	−0.014	0.821	−0.003	0.957
IN_{dummy}	0.034	0.605	0.056	0.379	0.108	0.081
TT	−0.088	0.200	−0.068	0.296	−0.078	0.207
MT	0.107	0.143	0.105	0.129	0.115	0.084
CoI	0.053	0.458	0.058	0.396	0.056	0.391
Predictors						
$CI_{residual}$	0.158	**0.017**	0.077	0.237	0.107	0.103
$CI^2_{residual}$			−0.285	**0.000**	−0.315	**0.000**
AC			0.103	0.116	0.215	**0.015**
DC			0.092	0.157	−0.012	0.887
Interactions						
$CI_{residual} \times AC$					0.086	0.222
$CI_{residual} \times DC$					0.113	0.134
$CI^2_{residual} \times AC$					−0.117	0.238
$CI^2_{residual} \times DC$					0.261	**0.007**
AC×DC					−0.070	0.413
$CI_{residual} \times$ AC×DC					0.013	0.873
$CI^2_{residual} \times$ AC×DC					0.313	**0.004**
R^2	0.149		0.253		0.350	
Adjusted R^2	0.100		0.198		0.277	
F-Value	3.012**		4.585**		4.802**	

Notes: Dependent variable: New product performance; NOE: Number of employees; NPIM5: Number of products introduced to the market in the last five years; R&D.r; R&D to turnover ratio; R.age: Relationship age; IN: Innovation novelty; TT: Technology turbulence; MT: Market turbulence; CoI: Competitive intensity; ** $p < 0.01$; The bold and underlined figures represent *p* values below 0.05.

4.3. Results

Table 5 presents the outcome of our regression analysis. In Model 2, the β coefficient for the squared term, $CI^2_{residual}$ is negative and significant ($\beta = -0.285$, $p < 0.01$), providing provisional support for our first hypothesis which suggests the presence of an inverted U-shaped relationship between $CI_{residual}$ and new product performance. To make sure about the existence of this inverted U-shaped relationship, we checked whether our findings pass the two criteria suggested by Haans, Pieters, and He (2016). First, our analysis confirmed that the nonlinear relationship is sufficiently steep at both ends of the data range as the slope at $(CI_{residual})_{Low}$, ($\beta_1 + 2\beta_2(CI_{residual})_{Low} = 1.959$), is positive and significant, while the slope at $(CI_{residual})_{High}$, ($\beta_1 + 2\beta_2(CI_{residual})_{High} = 2.034$), is negative and significant.[6] Second, by estimating the 95% confidence interval for the turning point of 0.135 ($-\beta_1/2\beta_2$) of the curvilinear relationship between $CI_{residual}$ and new product performance, our analysis depicts that it is positioned well within our data range. Further, we added the cubic term, $CI^3_{residual}$ to our regression equation to make sure a relationship between $CI_{residual}$ and new product performance is not S-shaped rather than U-shaped. This robustness check resulted in an insignificant relationship between $CI^3_{residual}$ and new product performance, further confirming our theoretical proposition. Overall, the above results support H_1 and provide us with strong statistical evidence

[6] The lowest and highest values for $CI_{residual}$ in our data are −3.301 and 3.704 respectively.

for the existence of an inverted U-shaped relationship between $CI_{residual}$ and new product performance, in which new product performance increases from low to intermediate levels of $CI_{residual}$, while it decreases from intermediate to high levels of $CI_{residual}$.

In Model 3, the β coefficient for the interaction term, $CI^2_{residual} \times AC \times DC$ is positive and significant ($\beta = 0.313$, $p < 0.01$), supporting H_2. This finding suggests the presence of joint effects of AC and DC on CI-new product performance link. To facilitate the interpretation of the joint moderating effects of AC and DC, we plotted Fig. 1 using the unstandardised β coefficient values. As Fig. 1 suggests, the impact of CI on new product performance varies significantly depending on the levels of both AC and DC. We discuss this finding in more detail in the next section.

5. Discussion and implications

The stories of many global business cases show that involving customers may not always be beneficial for gaining competitive advantage in the NPD process (Najafi-Tavani et al., 2022; Wang et al., 2020). Because of this, businesses have for many years been trying to develop and employ appropriate capabilities and mechanisms to increase the efficacy of business customer's engagement in their NPD projects. While some recent works have considered CI as a double-edged sword phenomenon and attempted to discuss conditions under which CI could be most effective in NPD processes, the B2B literature is still at the early stages of exploring such conditions. Drawing from the dynamic capability perspective, our study revisited the CI-new product performance link to shed new light on when and under what levels of AC and DC, involving key customers could benefit developers' new product performance.

5.1. Theoretical implications

Overall, our research extends the existing literature on the CI-new product performance link in at least two ways. First, our study provides strong empirical evidence for, and confirms the existence of, an inverted U-shaped association between CI and new product performance reported by some emerging works in the literature (Najafi-Tavani et al., 2022; Storey & Larbig, 2018; Tang & Marinova, 2020). Our findings suggest that working closely with key customers can be beneficial for developers as it provides valuable knowledge and resources. However, excessive levels of CI can negatively impact new product performance due the emergence of high levels of uncertainties in the co-development process. Uncertainties and ambiguities associated with CI play an important role in the determination of CI's effectiveness, and can be traced back to knowledge asymmetry between the partners, information overload occurrences in NPD projects, and the absence of effective mechanisms in distinguishing fruitful and effectual customers' inputs from fruitless and ineffectual ones (Harmancioglu, Wuyts, & Ozturan, 2021; Najafi-Tavani et al., 2022; Zhao et al., 2015).

Secondly, our study demonstrates the efficacy of the dynamic capability perspective in further elaborating CI's contribution to the developer's new product performance. Using the dynamic capability perspective, we examined the joint moderating effects of AC and DC on the CI-new product performance relationship. The consideration of the contingent effects of AC and DC enabled us to explore when and under what conditions CI can improve or hamper the developer's new product performance.

Our findings are the first to provide empirical support for the contention that the joint effects of AC and DC can regulate the efficacy of involving key customers in NPD. This result extends previous works that have suggested the complementarity role of AC and DC in improving learning and knowledge transfer between supply cain partners (Aliasghar & Haar, 2021; Meinlschmidt et al., 2016; Roldán-Bravo et al., 2020). As Fig. 1 shows, our statistical findings suggest that there is a difference between the effect of CI on new product performance under the conditions of high versus low levels of AC and DC. While the combination of high levels of both AC and DC (blue line) is the most effective

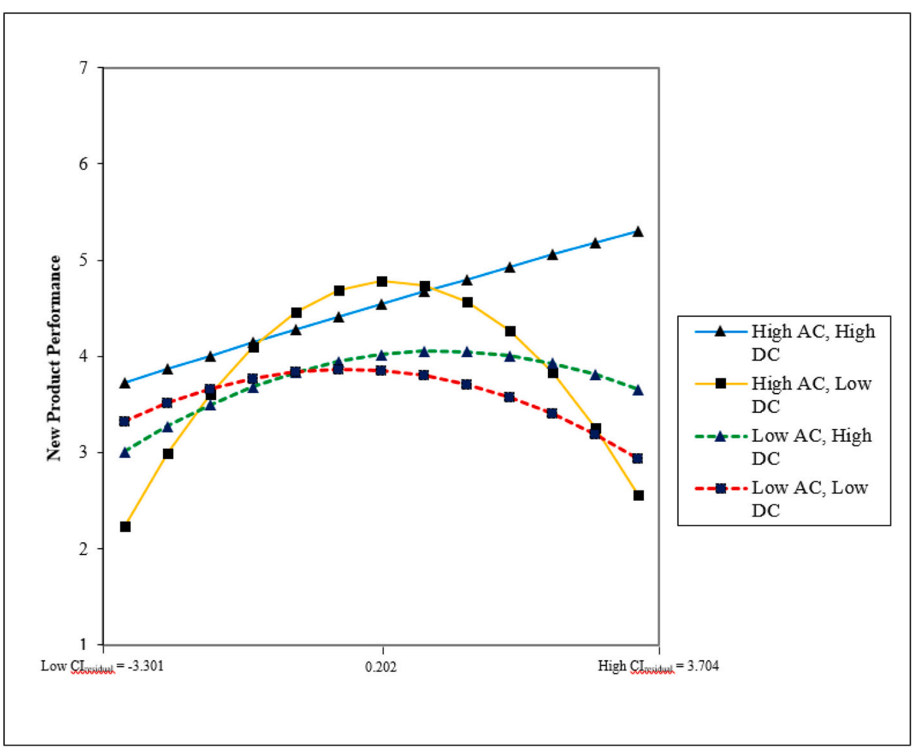

Fig. 1. Interaction of $CI^2_{residual} \times AC \times DC$ and new product performance.
Note: $CI_{residual}$ here represents a value of customer involvement that is free of the effect of AC, DC, trust, and conflict. The "High" and "Low" labels used for the moderators present "low to moderate" and "moderate to high" values respectively.

form of CI, the combination of low levels of both AC and DC represents the most damaging scenario for involving key customers in NPD projects. Under high levels of AC and DC, while the upward and positive slope for the left-half of the link between CI and new product performance remains unchanged, the downward slope for the right-half of this relationship becomes upward and positive. In other words, under these unique conditions, CI and new product performance shows a positive and almost linear relationship. This result suggests that both AC and DC can act as relational facilitators in developer-customer relationships due to their key roles in enhancing knowledge and information exchange between the parties. The effective knowledge transfer can reduce the cognitive distance and strengthen mutual understanding in the dyadic relationship (Roldán-Bravo et al., 2020) which in turn decreases the amount of knowledge/information uncertainty associated with CI, resulting in more effective co-development activities. The comparison of the blue and red lines however suggests that the absence of high levels of both AC and DC can turn CI into an ineffective strategy due to the existence of poor smooth inward and outward knowledge transfer in the developer-customer relationship.

The remaining two combinations in Fig. 1 (i.e., amber and green lines) present a more complex and nuanced interaction between AC and DC and their synchronised effects on the CI–new product performance association. The joint effects of high levels of AC and low levels of DC, or low levels of AC and high levels of DC, turn CI into a double-edged sword as both conditions suggest the existence of an inverted U-shaped relationship between CI and new product performance. This finding asserts that under moderate to high levels of CI, the absence of high levels of either AC or DC will result in an adverse effect on new product performance. This is because the developer would struggle to manage the knowledge/information uncertainties associated with high levels of CI due to the absence of appropriate levels of AC and DC. Under these conditions, the partners would experience high levels of cognitive distance which muddy the waters and exacerbate the adverse effect of uncertainties associated with CI on the co-development activities. From low to moderate levels of CI, however, the levels of uncertainty linked with customer offerings is relatively low. Therefore, the absence of high levels of either AC or DC results in a less detrimental effect on CI efficacy.

Overall, these findings have an important theoretical implication. We found that the synchronised effect and the combination of different levels of AC and DC regulates the extent of usefulness and/or harmfulness of CI in enhancing the developers' new product performance. AC and DC are two important dynamic capabilities in improving collaborative NPD relationships as they play a critical role in managing knowledge/information uncertainties in the dyad. However, the presence of high levels of either AC or DC on their own are not adequate to guarantee a productive implementation of CI strategy. Instead, the two dynamic capabilities ought both to be at high levels to develop and maintain an appropriate learning infrastructure for the developer to assimilate the customer's offering into NPD projects. The results above also address the contradictory findings in the CI literature regarding the true nature of the relationship between CI and developers' performance. We showed that the linearity and/or non-linearity of CI-performance link relies on the levels of both AC and DC. This finding is in line with the result of a very few recent studies suggesting that it is vital to capture the impact of key contingent factors and boundary conditions in explaining and interpreting the relationship between CI and developers' performance (see for example Najafi-Tavani et al., 2022).

5.2. Managerial implications

The research findings suggest important implications for practice. Involving key customers can provide benefits for new product performance. However, managers should be aware of the potential detrimental effect of knowledge/information uncertainties associated with the excessive levels of CI in the NPD process. To successfully deal with such uncertainties, firms should enhance their inward and outward knowledge transfer and learning capabilities (see Najafi-Tavani et al., 2020).

On one hand, managers need to develop a set of inbound learning mechanisms to improve their ability to seize, assimilate, and employ information offered by key customers. On the other, to support the inward knowledge transfer and to secure receiving desirable inputs from their customers, mangers should also pay close attention to the outward knowledge transfer mechanisms and develop practices that can enhance such mechanisms. DC related capabilities provide a reliable knowledge transfer context in which the developer firm acts a teacher and the key customer firm as a student (Roldán-Bravo et al., 2018). When the key customer is fully aware of the needs and expectations of the developer firm, they can in turn provide more calibrated and customised offerings for the NPD project. The clear lesson for managers is that too much investment in AC without enhancing DC may result in information overload and constantly receiving undesirable customer's inputs which can increase the knowledge/information uncertainty in the co-development partnership, resulting in poor efficacy of the CI strategy. Therefore, managers should plan the simultaneous development of AC and DC to benefit from their synergetic effects. The development of the two dynamic capabilities needs particular attention and effort from managers on the enhancement of supporting capabilities such as human capital and relational capabilities (see Bianchi, Frattini, Lejarraga, & Di Minin, 2014; Bianchi & Lejarraga, 2016; Zobel & Hagedoorn, 2020).

Managers should also consider that it may not always be possible to achieve the optimum levels of AC and DC due to a lack of financial and non-financial recourses. Therefore, adjustment of the level of CI should be considered as another mechanism through which managers can safeguard the success of product development projects. That is, managers can decide on the extent of CI at any point in time, following careful consideration of the state of both AC and DC.

5.3. Limitations and directions for further research

The results and findings of our study should be considered in the light of some potential limitations which provide directions for future studies. First, we examined the moderating roles of two key forms of developer's dynamic capabilities, AC and DC, in the link between CI and new product performance. Future studies can investigate the moderating effects of customers' dynamic capabilities on the relationship between CI and new product performance. Secondly, we focused on dyadic relationships in examining the joint effects of AC and DC. Drawing on the collaborative innovation networks perspective (Najafi-Tavani et al., 2018; Tsai, 2009), future research can adopt our proposed moderating framework and examine the contingent roles of AC and DC in the relationship between collaborating with a network of partners (such as customers, suppliers, competitors, and universities) and new product performance. Next, we did not directly capture the levels of certainty and uncertainty associated with CI. The measurement of certainty/uncertainty by future research could thus help in further understanding the role of CI in improving or harming developers' NPD process. The final limitation of this study lies in the fact that in our study we examined our hypotheses using data from high-tech manufacturing industry in a single country, Iran. Future studies can focus on international collaborations to further confirm our proposed conceptual framework by taking into account some other important factors in the international context, such as a cultural distance.

Data availability

Data will be made available on request.

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