



The effects of Co-creation: differences across stages of New Product Development

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by Sara Pereira

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Abstract

Firms increasingly ask for customer participation in the NPD process. However, an important question remains: how do consumers perceive customer participation across the different NPD stages? Does it differ with the products' complexity? These questions are relevant because of the impact of such perceptions on NPD performance. Through a causal mediation analysis, was found a positive relationship between the customer participation at all NPD stages and the higher NPD performance. In low complexity products, the relationship is explained by higher perceived innovativeness and product quality at the ideation stage, higher perceived innovativeness, product quality and lower perceived co-creator expertise at the product development stage, but no mediation effect at the commercialization stage. In high complexity products, the relationship is explained by higher perceived innovativeness and product quality at the ideation stage, higher perceived innovativeness, product quality, co-creator similarity and market knowledge at the product development stage and higher perceived innovativeness, co-creator similarity and market knowledge at the commercialization stage. Finally, the ideation stage in a high complexity product was identified as the NPD stage that gains most from customer participation, however, in a low complexity product, all the NPD stages have similar importance in the higher NPD performance.

Keywords: co-creation, customer participation, NPD performance, NPD stages

Os efeitos da Co-criação: diferenças entre as diversas fases do desenvolvimento de um novo produto

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Abstrato

Cada vez mais as empresas solicitam a participação de consumidores no DNP. Contudo, uma importante questão permanece: como é que os consumidores percebem a participação de outro consumidor nas diferentes fases de DNP? Será que difere com a complexidade dos produtos? Estas questões são relevantes uma vez que tais percepções têm um impacto na DNP *performance*. Através de uma análise causal de mediação, foi demonstrada uma relação positiva entre a participação dos consumidores nas diferentes fases de DNP e uma maior DNP *performance*. Nos produtos de baixa complexidade, esta relação é explicada por uma maior percepção de inovação e qualidade do produto na fase de idealização, uma maior percepção de inovação, qualidade do produto e uma menor percepção de especialização do co-criador na fase de desenvolvimento do produto, mas nenhum efeito de mediação justificou esta relação na fase de comercialização. Nos produtos de elevada complexidade, esta relação é explicada por uma maior percepção de inovação e qualidade do produto na fase de idealização, uma maior percepção de inovação, qualidade do produto, especialização e similitude com o co-criador na fase de desenvolvimento do produto e uma maior percepção de inovação, qualidade do produto, similitude e conhecimento do mercado do co-criador na fase de comercialização. Finalmente, a fase da idealização no produto de complexidade elevada foi identificada como sendo a mais valorizada pelos consumidores. Todavia, no produto de baixa complexidade todas as fases de DNP apresentam uma importância idêntica.

Palavras-chave: co-criação, participação do consumidor, DNP *performance*, fases do DNP

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List of Abbreviation

NPD – New product development

DNP – Desenvolvimento de novos produtos

WTP – Willingness to pay

X1 – Ideation stage

X2 – Product development stage

X3 – Commercialization stage

M1 – Mediator: Perceived innovativeness

M2 – Mediator: Perceived product quality

M3 – Mediator: Perceived co-creator expertise

M4 – Mediator: Perceived co-creator similarity

M5 – Mediator: Perceived co-creator market knowledge

Y1 – NPD performance

ACME – Average causal mediation effect

ADE – Average direct effect

CMA – Causal mediation analysis

1. Introduction

More than 120.000 individuals around the world helped the Boeing's World Design Team with ideas for the design of the new 787 Dreamliner airplane (O'Hern and Rindfleisch, 2010). Web 2.0, the advances in Information and Communications Technologies (ICT) and the increase tools provided to users (Thomke and von Hippel, 2002; Prahalad and Ramaswamy, 2004), turn customers "much more active, knowledgeable, globally aware and willing to use interactive virtual environments to personalize the existing and shape new products" (Tanev et. al., 2011). These new tools "are often as good as those available to professional designers" (von Hippel, 2005, p. 123) and research suggests that an increasing number of consumers are acquiring knowledge and capabilities that are almost equal to the firm's internal new product developers (Leadbeter and Miller, 2004; Prahalad and Ramaswamy, 2004; O'Hern and Rindfleisch, 2009).

In this sense, firms face a new challenge based on the boost of empowered and better-informed consumers seeking greater inputs and control over the new product development (NPD) process (Seybold, 2006). For instance, Apache, Linux and Firefox are managed by communities of volunteer programmers (O'Hern and Rindfleisch, 2010), as well as game modifications are developed mainly by the players (Jeppesen and Molin 2003). Many other firms follow the same procedure and explore the impact of communities in the NPD activity. Fiat, for example, started a website called Fiat Mio Project, inviting people to help Fiat create a car for future. In October 2010, Fiat presented the first futuristic crowdsourced concept car based on the ideas and needs of more than 17.000 of participants around the world.

These examples show that this consumers' empowerment forces firms to progress and innovate according to the customers' needs and wants and the best way to do this is to join users' ideas and feedback to the traditional NPD process.

Nowadays, the customer participation in the development of the new products represent an important role on the product and firm successes (von Hippel, 2001; Cooper, 2001; Kristensson et al., 2004; Ernst, Hoyer, Krafft and Soll, 2010; Poetz and Schreier, 2012) enhancing the NPD performance due the reduction of the risks of product failure and the costs, increase the product quality, the market acceptance and the degree of innovativeness (Huston and Sakkab, 2006; Ogawa and Piller, 2006; Cook, 2008).

However, the different NPD stages in the NPD process require different tasks and capabilities, expertise and processes (Gruner and Homburg, 2000; Cooper, 2001; Ernst,

Hoyer and Rübssaamen, 2010) and, consequently, distinctive intensity of customer participation.

Our research addresses this issue, of knowing when and what the market values regarding customer participation across the NPD stages. This knowledge could help firms enhance cost efficiency, resulting in an increase in NPD performance (Hsieh and Chen, 2005). We look at perceived innovativeness, product quality, co-creator expertise, similarity and market knowledge to understand how customer participation at each NPD stage influences the NPD performance. We focus on three main NPD stages: ideation, product development and commercialization stages. Since the literature has pointed to differences in perception of customer participation value according to product complexity (Schreier, Fuchs and Dahl, 2012), we consider two types of products according to their complexity: high and low complexity products.

Extant research suggests that customer participation increase the NPD performance at the ideation and commercialization stages, although decrease the NPD performance at the product development stage (Chang and Taylor, 2015). Furthermore, the increase in the NPD performance due the customer participation at the ideation stage is mediated by the perceived innovativeness and product quality (Schreier, Fuchs and Dahl, 2012), the perceived co-creator expertise mediates the decrease in the NPD performance due the customer participation at the product development stage (Chang and Taylor, 2015) and the customer participation at the commercialization stage increase the NPD performance due the mediation of the perceived co-creator similarity and market knowledge (Wilson and Sherrell, 1993; Li and Calantone, 1998). Additionally, customer participation has a positive effect on NPD performance in the low complexity products, against what happens with high complexity product due to the difficulty and expertise associated with the tasks and capabilities required. Our hypotheses were developed based on this literature about the NPD stages and the mediators that influence NPD performance and the comparison between these stages on the high vs low complexity product. A priori could be unclear which of the products are more complex. A pilot study to examine the complexity of the products reveals that the participants perceived one of the products as a low complexity product and the other one as a high complexity product. After this and to test our hypotheses we use causal mediation analysis.

Overall, our findings extend the growing literature on the effectiveness of customer participation across NPD stages on NPD performance in seven ways. First, support the theory that co-created products are perceived by consumers as more innovative, higher in

quality, easy to adopt and with a better fit. Second, against Chang and Taylor (2015), but going in line with Gruner and Homberg (2000) our findings suggest that customer participation at the development stage has a positive impact on NPD performance, as well as at the ideation and commercialization stages. Third, our research provides initial evidence of the mediators that influence the relationship between customer participation across the NPD stages and the NPD performance. The ideation stage is mediated by the perceived innovativeness and product quality. Additionally to these two mediators, the perceived co-creator similarity also mediates the customer participation and a higher NPD performance at the product development stage. The commercialization stage is mediated by the perceived co-creator similarity and market knowledge. Fourth, we establish the differences between high and low complexity products regarding customer participation according to the different NPD stages mediated the increases on NPD performance. Specifically, regarding the low complexity product, the higher NPD performance at the ideation stage is mediated by the perceived innovativeness and product quality, at the product development stage the mediators are perceived innovativeness, product quality and co-creator expertise, however, in the commercialization stage, none of the studied mediators have an impact. Regarding the high complexity product, the higher NPD performance at the ideation stage is mediated by the perceived innovativeness and product quality, at the product development the mediators are perceived innovativeness, product quality, co-creator similarity and market knowledge and at the commercialization stage are the perceived innovativeness, co-creator similarity and market knowledge. Fifth, our findings suggest that the perceived innovativeness assume an important role across almost all NPD stages. Sixth, our results show that the effect of customer participation in ideation stage is higher in a high vs a low complexity product, however in the product development and commercialization stages the customer participation effect is higher in a low vs a high complexity product. Finally, our findings also suggest that in the low complexity product all the stages have similar importance, however, in the high complexity product, the stage that shows a higher relevance is the ideation stage.

2. Literature review

2.1. Open innovation

The way firms innovate witness significant changes during the last years. Nowadays, the innovation process is perceived as a relationship between producers, users and other external institutions (Laursen and Salter, 2006). The open innovation model is the system where innovation is not only sourced internally but also draws on external knowledge (Fredberg, Elmquist and Ollila, 2008; Reichwald and Piller, 2009), i.e., the companies open the innovation model to external technologies, ideas and partners (Chesbrough, 2006; Tapscott and Williams, 2007; Osterwalder and Pigneur, 2010).

The open innovation model assumption is that good ideas are not only produced internally (Chesbrough, 2003) but increasingly produced outside the firms, mainly by users (Filieri, 2013).

The traditional NPD model, where companies only use internal ideas to develop new products, is challenged by the outcomes of co-creation (Fuchs and Schreier, 2010). As Maidique and Zirger (1985, p. 303) point out "... the development process for successful products is characterized by frequent and in-depth customer interaction at all levels and throughout the development and launch process".

Customer participation has been defined as "the degree to which the customer is involved in producing and delivering the service" (Dabholkar, 1990, p. 484). For this research, customer participation corresponds to the degree of the customers' involvement in the co-creation and consequently, in the NPD processes of the firms (Bendapudi and Leone, 2003; Fang, 2008), i.e., the degree to which customers are be involved as participants in the development and design of new products (Prahalad and Ramaswamy, 2004; Etgar, 2008; Payne, Storbacka and Frow, 2008). Consumer participation is noted in the open innovation literature (Chesbrough, 2003), the role of lead users (Lilien et al., 2002) and crowdsourcing (Franke, Keinz and Klausberger, 2013).

Customer participation in the innovation process allows companies to understand and fulfil the customer needs better, which results in success for the new product (von Hippel, 2001; Cooper, 2001; Kristensson et al., 2004; Ernst, Hoyer, Krafft and Soll, 2010; Poetz and Schreier, 2012). Some studies show that the process of "cocreation will more closely mirror consumer needs" (Hoyer, Chandy, Dorotic, Krafft and Singh, 2010) and thus provide superior performance in the market. For a superior new product performance,

strong customer orientation and deep knowledge about consumers are fundamental (Atuahene-Gima, 1996; Hauser, Tellis and Griffin, 2006; Carbonell, Rodríguez-Escudero and Pujari, 2009).

2.2. Co-creation in New Product Development

2.2.1. Customer participation as a resource to recognize customer needs

The customer participation in the co-created products played an important role in how firms communicate and engage with consumers (Ramaswamy, 2009; van Doorn et al., 2010), i.e., knowing better customers' wants and needs allows firms to reach higher levels of customer commitment and satisfaction (Hertel et al., 2003)

According to the resource dependence theory (Pfeffer and Salancik, 1978), information about customers' wants and needs and past experiences represents an immeasurable resource, a source of additional value and a strategy for companies to be successful in the development of new products (Gruner and Homburg, 2000; Salomo, Steinhoff, and Trommsdorff, 2003; Carbonell, Rodríguez-Escudero and Pujari, 2009). Most of the new product failures are associated with a firm's inability to access, understand and/or satisfy the customers' needs (Ogawa and Piller, 2006). This information can take two forms: information about customer needs and information about how to solve these needs (Thomke and von Hippel, 2002; von Hippel, 2005; O'Hern and Rindfleisch, 2009). So, the contribution of the customers' participation could be viewed from two distinct and idiosyncratic information needs possessed by consumers (von Hippel, 1998): needs-related knowledge and solution-related knowledge.

Needs related knowledge relates to customers' needs, preferences, desires, satisfaction and motives, i.e., an in-depth understanding of the customers' requirements, systems and operations. A better understanding of this type of knowledge increases the effectiveness of innovation ability and reduces the risk of failure. This type of information is provided through market research and is often the starting point to guide the experts in the ideation process (Piller, Ihl and Vossen, 2011; Poetz and Schreier, 2012). Ulrich and Eppinger (2008, p. 54) note that a firm "must interact with customers and experience the use environment of the product. Without this direct experience (...) innovative solutions to customer needs may never be discovered."

Solution-related knowledge refers to information about how to solve problems, i.e., how to apply technology in the best way to transform the customers' needs in a new product. Ulrich and Eppinger (2008, p. 62) note that a "customers often express their preferences by describing a solution concept or an implementation approach; however, the need statement should be expressed in terms independent of a particular technological solution." This type of information enables a more efficient innovation process since the product developers are engaged in a more direct problem-solving action. The need to have solution information from different domains is higher the more complex the innovation process is (Piller, Ihl and Vossen, 2011; Poetz and Schreier, 2012).

A successful innovation is a combination of these two types of information however the relative proportions could vary (Nambisan, Agarwal and Tanniru, 1999). The need and solution-related knowledge may not locate in the same place. In such instances, it is necessary to transfer an amount of each type of knowledge from one location to another. Nowadays, for customers' inputs to be valuable, inputs need to be more concrete and elaborated requiring a more structured approach in the relationship with customers (Piller, Ihl and Vossen, 2011).

2.2.1. Impact of Customer participation in the NPD process

NPD literature shows that the utilization of user feedback is a critical factor in NPD performance (Cooper and Kleinschmidt, 1990). NPD performance is "the success of new product development efforts" (Troy, Hirunyawipada and Paswan, 2008, p. 136). The NPD performance includes the consumers' behavioural intentions such as purchase intention, willingness to pay (WTP), product's recommendation and loyalty.

Firms can measure customer participating in several dimensions. Involving users in the NPD process benefits NPD performance due to the increase in product quality, the reduction in failure risks and more likelihood of market acceptance (Ogawa and Piller, 2006). At the same customer participation decreases R&D costs and cycle times (Souder et al., 1998, Thomke and Von Hippel, 2002; Hsieh and Chen, 2005; Chesbrough and Schwartz, 2007; Hoyer et al., 2010; Fuchs and Schreier, 2011; Weber, 2011), decreases the amount invested (Mansfield, 1986; Shah 2006), increase the degree of innovation (Huston and Sakkab, 2006; Cook, 2008) and, consequently, increase the probability of success (Grewal et al., 2006; O'Hern and Rindfleisch, 2009; Hoyer et al., 2010).

For brands, a brand or product branded as a “co-created with consumers” is considered “more attractive, innovative, unique and better suited to needs compared with the same product that is presented as non-co-created” (Fuchs and Schreier, 2011; van Dijk, Antonides and Schillewaert, 2014). A co-created brand enhances the purchase intentions, WTP and the engagement/loyalty of the users giving firms a competitive advantage through the creation of unique and useful products.

From the consumers perspective, those that are not involved in the co-creation perceived the ideas created by professionals as less novel (Kristensson et al., 2004), lower in customer benefits and overall quality, but more feasible than ideas created by users (Poetz and Schreier, 2012). Schreier, Fuchs and Dahl (2012) provided evidence that customer participation does not decrease but enhances consumer’s perceptions of the companies’ innovation ability. This is important since empirical evidences show a link between a higher perceived firm’s innovation ability and a positive outcome related to consumers’ purchasing behaviour and intentions, willingness to pay and consumers’ recommendations to other users (Troy and Davidow, 1998; Chun and Davies, 2006; Szymanski, Kroff, and Troy, 2007; Luo and Bhattacharya, 2006; Schreier, Fuchs and Dahl, 2012). Past research has also identified a psychological effect of identification with firms that involve other similar users which in turn raises perceptions of customer-orientation making products more desirable, and positively affecting customer’s purchase behaviour (Fuchs and Schreier, 2011; van Dijk, Antonides and Schillewaert, 2014).

2.3. NPD stages and co-creation

According to Hoyer et al. (2010), NPD is divided into several stages. Each stage accomplishes a different goal; the company’s different decisions performed at each stage, the specific information needed and the involving functions required to progress the project to the next stage (Cooper, 2001). Song, Thieme and Xie (1998, p. 289) defend that “new product success is more likely when a firm employs function-specific and stage-specific patterns of cross-functional integration than when the firm attempts to integrate all functions during all NPD stages.”

Hoyer (2010) categorization includes the following stages: ideation (where the ideas are generated), product development (where the prototype of the new product is created and processed), commercialization (where customers try and test the prototype and the advertising activities) and post-launch (where firm tries to understand how consumers

react to the new product and if the firm is so succeeded that consumer will repurchase the product). Although consumers' participation is possible in all phases of the product development (Füller, Hutter and Faullant, 2011), ideation, development and commercialization are the stages most cited as critical both in product risk of failure and financial performance (Page, 1993; Ford, Aubert and Ryckewaert, 2016). As such this work will focus on these phases.

Therefore, the differentiation of intensity of customer participation at each stage, i.e., the extent to which firms rely on co-creation to develop new products at each phase could be beneficial in relation to the cost efficiency of NPD process (Hsieh and Chen, 2005). Also, the information provided by users in the early stages can be extremely helpful to resolve problems related to market uncertainty, which may reduce costs and prevent problems in the later stages (Rochford and Rudelius, 1997; Hsieh and Chen, 2005; Tidd and Bessant, 2009; Ernst, Hoyer and Rübsaamen, 2010). As such customer participation has different impacts across stages of NPD process since different skills, tasks and expertise are required (Gruner and Homburg, 2000; Brockhoff, 2003; Ernst, Hoyer and Rübsaamen, 2010) resulting in a U-shape over the three stages, i.e., customer participation in the ideation and commercialization stages is more effective and increase new product financial success, unlike in the development stage slows down in time to market and deteriorates new product financial performance (Dahlsten, 2004; Alam, 2006; Chang and Taylor, 2015).

2.3.1. Ideation stage

The idea generation phase is also called "fuzzy front end" which correspond to the period between the consideration of an opportunity for a new product and the product idea judgment ready to enter in the development phase (Tidd and Bessant, 2009). In this stage, the marketers and customer participants discuss and analyse customer's needs and choose the more feasible ideas (Filieri, 2013).

In the ideation stage, the companies engage with users to understand customers' needs and potential ideas (need-related knowledge) and prioritize it in the companies' innovation strategy, which allows to increase the market fit and, consequently, decrease the risk of the new product's failure (Carbonell, Rodríguez-Escudero and Pujari, 2009). Despite the importance of the later phases, successful development of a new product

depends on the quality of the idea/concept (Cooper, 1985, 1988, 1998; McGuinness and Conway, 1989).

Regarding the non-participate consumers, two main factors influence how product quality and innovativeness are perceived: the creativity and diversity of the creators.

The creativity focuses on novelty, i.e., on the generation of something entirely new (novel ideas). Empirical evidence shows a significant relationship between creative personality and innovative performance (Hammond et al., 2011). Creativity gain importance in the sense that “the more heads are involved, the more creative ideas will pop up” (Schreier et al., 2012), i.e., the consumers assume that more people are behind the co-created product than when a firm only uses its professionals. This is linked with to the quantity-quality inference, i.e., the more people giving feedback result in more ideas, the more likely have a more creative product with higher quality (Osborn, 1963) since “If you produce more opportunities, you’ll see more exceptional ones....” (Terwiesch and Ulrich, 2009 p.28), increase the quantity of ideas (without sacrificing the average quality) is the key to find the better ones. Consumers perceived communities as having more participants with different backgrounds, interests and skills when compared to smaller groups. The perception of diversity has an important impact on the ideation stage since providing different perspectives for generating novel ideas (Von Hippel 2005; Schreier et al., 2012). Diversity has the power to improve the team performance due to the participants’ heterogeneity and the increase of skills, abilities, knowledge, information and relevant expertise what consist in a competence diversity. The competence diversity suggests two benefits. First, influence positively the acquisition of information and need-related knowledge. Second, improves the processing of this information both in more in-depth thinking and in a broader range of perspectives regarding make decision process. In the end, more accurate use of knowledge and heterogeneous information, as well as freedom and non-constrain environment, result in a higher innovativeness and product quality (Haon, Gotteland and Fornerino, 2009).

In summary, we suggest that NPD performance is higher when consumer participation is intense at the ideation stage. This participation will translate in higher perceived innovativeness and quality of the ideas due the creativity and diversity of ideas. Customers perceptions of higher firm’s capabilities (innovation ability) are more willing to buy and recommend the product (see Figure 1) (Troy and Davidow, 1998; Chun and Davies, 2006; Szymanski, Kroff, and Troy, 2006; Luo and Bhattacharya, 2006; Schreier, Fuchs and Dahl, 2012).

H1 a) The customer participation in the ideation stage is positively related to higher NPD performance.

H1 b) The positive effect of customer participation on NPD performance at the ideation stage is explained by the higher perceived innovativeness and quality.

2.3.2. Product development stage

In the product development stage, firms can involve customers by sharing the idea/concept and search for users' input and solutions (solution-related knowledge) (Grewal, Lilien and Mallapragada, 2006; Coviello and Joseph, 2012). Gruner and Homburg (2000) suggest the customer participation at the product development stage contribute significantly to new product success and consequently to the firm performance. However, based on Chang and Taylor (2015) meta-analysis customer participation in this phase has a non-significant impact or hurts the new product financial performance, due to the interdependence of tasks and activities (Ernst, Hoyer and Rübsaamen, 2010), i.e., shifting one function may affect other functions negatively changing the processes and increasing the costs of implementation and adaptation.

The literature on customer participation shows a weaker impact of participation on the development stage mainly because non-participant consumers are reluctant to accept that other customers have the skills and capabilities need to develop a new product. Since the information required in this stage is related to the solution-based knowledge, i.e., knowledge linked with know-how skills, the consumers are skeptical about the expertise of the participating consumer (Etgar, 2008; O'Hern and Rindfleisch, 2009; Un and Asakawa, 2015). Conversely, when a participant consumer is perceived as an expert, it triggers the effect of persuasion and the attitude towards the product changes positively. However, when participants are perceived as a non-expert, the effect of persuasion decreases. Consequently, the attitude towards the product is negatively affected (Wilson and Sherrell, 1993). Schreier and colleagues (2012) also unveiled such effect. In high-complex product, even if the lack on the expertise is not significant, the impact on behavioural intentions is negatively more substantial compared to other stages.

In conclusion, we suggest that at the product development stage the NPD performance resulting from customer participation is lower (see Figure 1), due to expectations about the required perceived expertise of participants, to accomplish the tasks (find a solution).

H2 a) The customer participation in the product development stage is negatively related to a higher NPD performance.

H2 b) The negative effect of customer participation on NPD performance at development stage is explained by the lower perceived participants' expertise.

2.3.3. Commercialization stage

In the commercialization stage, consumers are invited to try the prototypes and help to launch (positioning and marketing mix) new products with the firm. The firm watches how consumers react to and evaluate the new products. With the help of a prototype, customers are more able to provide solution-related detailed and precise insights concerning to the usage problems and how to reach the non-participants customers since the users are more aware of the product's characteristics (Gruner and Homburg, 2000; Hsieh and Chen, 2005; Chang and Taylor, 2015). Such awareness allows firms to launch an error-free new product, positioning it better and with the more accurate marketing mix and faster product diffusion (Henard and Szymanski, 2001), thus enhancing financial performance for the new product (Hoyer et al., 2010; Chang and Taylor, 2015).

The opinion of some consumers or certain communities could be more valuable for potential buyers than professionals' opinion (Hoyer et al., 2010; Schreier et al., 2012) since the users have a better understanding of the needs and the link between the customer preferences and the brand than the manufactures (Muñiz and O'Guinn, 2001). Two factors explain such synergies: persuasion and market knowledge.

The first factor, the persuasion of consumers depends on the perceived similarity between the non-participant customers and the participant consumers. Social identity theory (Tajfel, 1982) and similarity-attraction paradigm (Berscheid and Walster, 1978), are theories that explain why individuals tend to be attracted to other individuals that are similar to themselves.

The social identity theory suggests the feeling of belonging to a group creates a psychological state that results in social identity generating a group behaviour. (Tajfel,

1982; Tajfel and Turner, 1985; Bhattacharya, Rao, and Glynn, 1995). In accordance, similarity-attraction paradigm consists of people feeling attracted to and looking for membership in, groups with people similar to themselves. The fact that users belong to the same population (same group) of the consumer and those ones share similar characteristics inherent to the group membership, as opposite to the professionals, “I think that users are more likely to have such [good] ideas ... [Professional designers] do not see the real issues” (in Schreier et al., 2012) allow costumers associate consumer participation to a higher firm product/marketing mix fit, what in the end, results in higher consumers’ behavioural intentions.

Thus, the non-participant customers may be more likely to identify with, and consequently adopt the opinions/products recommended by the attractive sources compared to the unattractive sources (Wilson and Sherrell, 1993).

The second factor is the perceived market knowledge from participant customers, i.e., how customers perceived the organization and structure of the information about the market. Broader market knowledge and a higher understanding of the prototype characteristics in addition to the firm’s knowledge create a product advantage, based on a more accurate product fit. In the end, it will affect positively the product market performance (Li and Calantone, 1998) increasing the customers’ behavioural intentions. Also, a broader knowledge about the market enables the firm to adapt to external changes in the market, achieving a competitive advantage due to the correct market fit. In the end, this firm’s competitive advantage will be reflected in a positive NPD performance (sustained by the increase in the behavioural intentions of the consumers).

In summary, we suggest that at the commercialization stage is related to a higher NPD performance, because of the perceived similarity between the participant and the non-participant customer. At this stage, we argue that it is where the market knowledge of the participant consumers is perceived as higher due to proximity to the market (usage) (see Figure 1).

H3a) The customer participation in the commercialization stage is positively related to higher NPD performance.

H3b) The positive effect of customer participation on NPD performance at commercialization stage is explained by the higher (a) perceived similarity with the co-creators and the higher (b) perceived co-creator broader knowledge about the market.

2.4. Customer participation and product complexity

“Complex tasks are, by their nature, difficult” Campbell (1988, p. 45), i.e., for example, in a product development stage a task is complex when requires a broader variety of different skills, types of knowledge and effort required for a project (Schreier, Fuchs and Dahl, 2012). Also, is related to the project size (the number of technologies, the number of components and the number of functions). However, Tatikonda and Rosenthal (2000, p. 77–78) propose that "project size captures only part of the complexity of a project." Stock, Oliveira and von Hippel (2015), suggest that complexity is the degree of perceived difficult to understand (ideation), apply (product development) and spread (commercialization) a new idea.

The more complex the NPD process is, the more time and resources are required. In the end, complexity influence the speed of the development cycle time (including the understanding and usage of technologies), the quality and the performance of the new products as well as is associated with poor unit-cost outcomes (Kim and Wilemon, 2003). Schreier, Fuchs and Dahl (2012) show a positive effect in customer participation on purchase intentions in the low-complexity products but not in the high-complexity products. The reason highlighted for the researches is “some consumer product categories might be too complex for consumers to perceive users as able to provide meaningful input” (Schreier, Fuchs and Dahl, 2012, p. 29).

In conclusion, we suggest that the perceived complexity of the products and processes has a negative impact on customer participation on NPD performance (see Figure 1).

H4: The positive effect of customer participation in NPD is lower for high complexity products than for low complexity co-created products in all NPD stages.

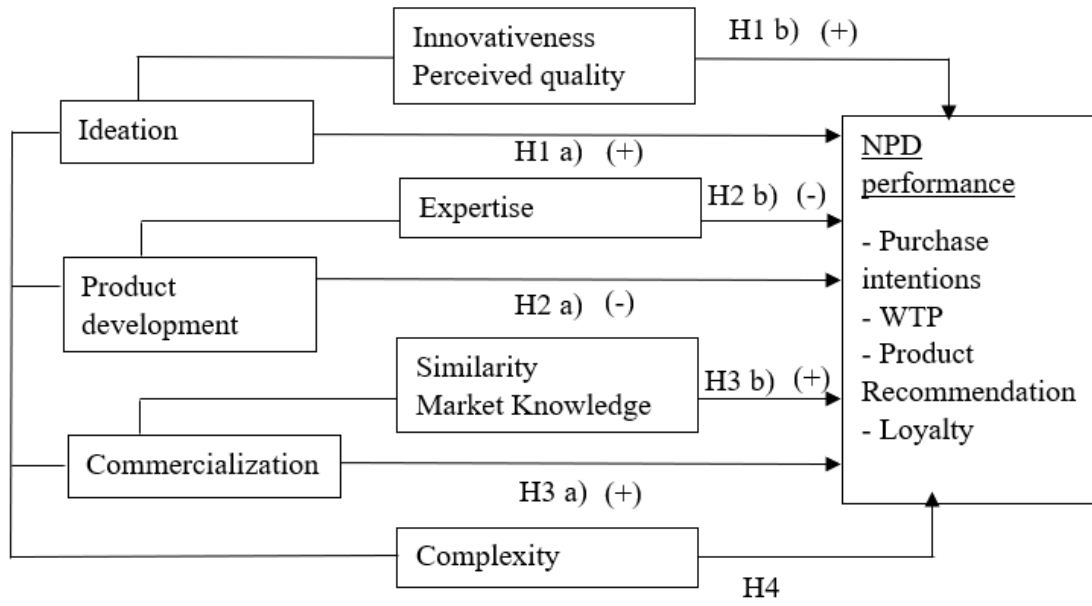


Figure 1. Theoretical framework

3. Methodology

The objective of this research is to understand how consumers perceived other customers' participation across stages of the NPD process and such influence in the NPD performance through the impact on behavioural intentions. Furthermore, we aim to understand why such perceptions might differ at each phase particularly for products with high and low levels of complexity.

Our hypotheses are tested in an experimental design that was conducted via an online survey with students. The use of students for testing has been supported due to the homogeneity of the group reducing the type II error (Calder, Phillips and Tybout, 1981; Peterson, 2001).

An online survey reveals to be the best tool to reach our sample. First, students are familiar with the internet, empirical studies show that 72% of college students are Internet users and 87% of college students have access to the Internet (Anderson, 2001). Second, due constraints in time and budget (Wright, 2005), i.e., the need to quickly collect the information required and the flexibility provided (participants can respond to the survey when they want) encouraged the use of this type of method. Moreover, it also eliminates geographic barriers (Evans and Mathur, 2005). Third, this method should provide better results than personal interviews since reducing the bias of the interviewer (Bronner and Kuijlen, 2007).

3.1. Pilot study

In order to design our main study, we conducted a pilot study to understand product complexity. Thirty respondents answered an online survey. Fifty-three percent of the participants were female and all were between 19 and 29 years old. The goal was to understand whether (a) Walkers potato chips is perceived as a low complexity product and (b) Fiat MIO car is perceived as a high complexity product. In an adapted style from Anderson (1985) and Schreier, Fuchs and Dahl (2012), participants are exposed to the Walkers potato chips and the Fiat MIO car, rating the complexity measurements on a 7-point-Likert scale (where 1= "Strongly disagree", 7= "Strongly agree"). Then, the respondents rated in percentage the complexity of both products and answered to some

demographic questions such as age, gender, degree/level of school completed, nationality and income.

The ANOVA (Table 1) indicated that the participants perceived significantly different levels of complexity in Walkers' potato chips and the Fiat's MIO ($M_{\text{Walker}} = 3.2$ and $M_{\text{Mio}} = 6.57$ $p < .000$) and as well perceived significantly different the complexity between the Walkers potato chips, the Fiat MIO car and the midpoint¹ ($M_{\text{Walker}} = 3.2$, $M_{\text{Mio}} = 6.57$ and $M_{\text{midpoint}} = 4$, $p = .000$). The results suggest that we can proceed with confidence about using these two stimuli for representing high and low complexity products (Figure 2 and 3 – Appendix 1).

Table 1. Pilot study – ANOVA Walkers chips, Fiat MIO car and complexity midpoint

Groups	N	Average	Variance
Walkers's chips	30	3.2	1.95
Fiat car	30	6.57	0.28
Midpoint ¹	30	4	0

	Source of variation	SS	df	MS	F	P-value
Complexity: Fiat car and Walkers chips	Between groups	185.62	2	92.81	124.54	0.000
	Within groups	64.83	87	0.75		
	Total	250.46	89			
Complexity: Fiat car, Walkers chips and midpoint	Between groups	185.62	2	92.81	124.54	0.000
	Within groups	64.83	87	0.75		
	Total	250.46	89			

3.2. Data collection and Sample

Five hundred and eighteen students took part in our main study. The study followed an experimental design 2 (design mode: co-creation, professionals) x 3 (NPD stage: ideation, development, commercialization) between subjects' design. Since the survey was conducted at the university, the respondents are young with ages between 18 and 29 years (97%), well educated (63% with bachelor's degree, 36% with a master's degree), mainly from Portugal (82%) and Germany (13%), with a household disposable income higher than 5.000€ (60%). Female respondents (57%) out-numbered male respondents (43%) (see Appendix 2).

¹ Represent the middle point of the scale, i.e., a medium complexity product.

We tested the hypotheses through an online survey on Qualtrics, i.e., the respondents are assigned randomly to a low complexity product or a high complexity product. The link to the survey was sent through social media and messenger providers. The survey was conducted at Católica Lisbon School of Business and Economics university using both undergraduate and graduate management, economic and finance students.

3.3. Procedure

Before starting the survey, participants must answer a question about their studies background: management, economics and finance, so they could proceed with the survey. This question ensured the similarity between co-creators and non-participant customers could be measured.

Assisted by the pilot study participants that are randomly exposed to the low or high complexity co-created product: one perceived as lower in complexity, a Walkers BUILDER'S BREAKFAST and other perceived as higher in complexity, a Fiat MIO car. We decide to use the real product name and brand based on ecological validity, i.e., the use of real situations/phenomena to investigate them in experimental contexts (Schmuckler, 2001).

Then the randomization continued in attributing participants one of the following scenarios: a NPD stage (ideation, product development and commercialization) either in a co-creation setting or an internally designed product.

Those exposed to low complexity started by reading that the survey is related to potato chips, answering some questions about product involvement. Then, Walkers is presented: "Walkers is the UK's favourite crisps brand and Britain's largest crisp manufacturer, with 16 ranges of crisps and snacks including Walkers Sensations, Doritos and Quavers" along with an image of the Walkers' products range (see Figure 2 – Appendix 3) and respondents are questioned about brand loyalty. After, participants saw a package of Walkers BUILDER'S BREAKFAST chips (see Figure 3 – Appendix 3) with the following description: "Walkers has teamed up with to consumers to create a flavour of chips! Drawing from it online community they achieved a flavour that replicates the taste a full English breakfast, including various forms of bread, pudding, eggs, beans, potatoes and breakfast meats". After being introduced to the product, we ask the participants about who they thought that participate in the creation of the product and in which stage they thought that consumers might take part in the new product development process. Next,

respondents were randomly allocated to the three NPD stages. In the ideation stage scenario, we inform respondents that “Given the success of using the online community, Walkers decided to collaborate with students. These participants came mainly from management, economics and finance. Together with Walkers, they generated the ideas for new flavours. From all ideas submitted, the most voted was BUILDER’S BREAKFAST!”. In the product development stage scenario, we inform that customer’s participation about the following: “Given the success of using the online community, Walkers decided to collaborate with students. These students came mainly from management, economics and finance. Together with Walkers, they developed the product, choosing the main ingredients and participating in all fabrication processes.”. In the commercialization stage scenario, we inform the respondents that customers are involved in the commercialization stage, i.e., “Given the success of using the online community, Walkers decided to collaborate with students. These students came mainly from management, economics and finance. Together with Walkers, they launched the flavour chips BUILDER’S BREAKFAST, designing the package and the advertising!”.

The same procedure was followed for the participants exposed to high complexity scenario. Those exposed to this product started by reading that the survey is related to cars, answering some questions about product involvement. Then, Fiat has presented: “Fiat is an Italian automobile manufacturer. In 2013, Fiat S.p.A. was the second largest European automaker by volumes produced and the seventh in the world” along with an image of the Fiat’s products range (Figure 4 – Appendix 3) and respondents are questioned about brand loyalty. After, participants saw Fiat MIO (Figure 5 – Appendix 3) with the following description “Fiat has teamed up with consumers to create the new car – Fiat MIO! Drawing from it online community they achieved to a compact and agile car, comfortable and safe with innovative traffic solutions for big cities, a pollutant-free engine and the capacity to receive personalized updates, and changes in configuration, and having an interface between car and user”. After being introduced to the product and design mode, we ask the participants about who they thought that participate in the creation of the product and in which stage they thought that consumers might take part in the new product development process. Next, respondents were randomly allocated to the three NPD stages. In the ideation stage scenario, we inform respondents that “Given the success of using the online community, Fiat decided to collaborate with students. These students came mainly from management, economics and finance. Together with Fiat,

they generated the ideas for new features.”. In the product development stage scenario, we inform customer’s participation about the “Given the success of using the online community, Fiat decided to collaborate with students. These students came mainly from management, economics and finance. Together with Fiat, they developed the product, designing the car and choosing the materials to manufacture the Fiat MIO.”. In the commercialization stage scenario, we inform the respondents that consumers are involved in the commercialization stage, i.e., “Given the success of using the online community, Fiat decided to collaborate with students. These students came mainly from management, economics and finance. Together with Fiat, they launched the new car, developing the advertising and promotion of Fiat MIO.”.

After being exposed to the scenarios (NPD stages) both in low and high complexity product, the respondents are invited to answer questions about the perceived innovation and quality, followed by questions about the respondents purchase intentions, WTP, product recommendation and loyalty towards the brand. Then, participants are invited to answer questions about who design for the company namely by rating the creativity and the diversity of those designing for the company, their expertise, similarity between the co-creator and the participant and co-creator market knowledge. Finally, participants filled their demographics such as age, gender, degree/level of school completed, nationality and income.

The last design mode corresponds to control groups, where the new products were developed by professionals, i.e., against what was exhibited as co-created in the other scenarios. We were starting to inform what the survey is about (potato chips or cars) followed by some product involvement questions. After the companies were introduced (Walkers or Fiat along with images Figure 2 and 4 – Appendix 3, respectively) and loyalty questions were made. Next, the respondents are informed that the products (chips or car) are developed by firm’s intern professionals and a brief description of them are made along with product images (see Figure 3 and 5 – Appendix 3, respectively). After, the same questions about the innovativeness, product quality, purchase intentions, WTP, product recommendation, loyalty, co-creator expertise, similarity and market knowledge were made. Finally, participants filled their demographics.

3.3. Measures

3.3.1. Measurement models

The measures were based and adapted from the literature. To avoid any state-dependence effects from repeatedly using the same scale format (7-point scale), we used scales with different scaling formats (e.g. Likert, semantic differential, open questions).

Table 8 indicates in detail the items used to measure each construct related to the NPD stages. Table 9 details the items used to measure the NPD performance, i.e., the consumer behavioural intentions.

Table 8. Measurement items – NPD stages

Construct	Theory	Measurement Items	Scale
Innovativeness (innovation ability)	Adapted from Schreier, Fuchs and Dahl, 2012; Luo and Bhattacharya, 2006	1) I think that a lot of people develop for this company	[1] strongly disagree/ [7] strongly agree
		2) On average, I think this company can draw upon a lot of ideas for new products	
Quality	Wang, Lo and Hui, 2003	1) I think that the people developing for this company are very different from each other	[1] strongly disagree/ [7] strongly agree
		2) I think that the people developing for this company have a very similar background	
		3) I think that the ideas for new products are very different from each other	
Expertise	Adapted from Ratneshwar and Chaiken, 1991	1)What do you think about the firm's innovativeness?	1) [1] not very high/ [7] very high
		2) Product quality is adequate in terms of variety and features?	2) [1] not very strong/ [7] very strong
		3) Overall product quality is adequate based on experiences?	3) [1] not excellent/ [7] excellent
Expertise	Adapted from Ratneshwar and Chaiken, 1991	1) Product quality is adequate in terms of variety and features?	[1] not excellent/ [7] excellent
		2) Product quality is adequate in terms of product convenience?	
		3) Overall product quality is adequate based on experiences?	
Expertise	Adapted from Ratneshwar and Chaiken, 1991	1) In my opinion, the expertise of people developing for this company is high	[1] strongly disagree/ [7] strongly agree
		2) I think that the people developing for this company have the necessary skills (know- how) and competence to develop new products	

Similarity	Adapted from Schreier, Fuchs and Dahl, 2012 and Thompson and Malaviya, 2013	1) I think that the people developing for this company exactly know the specific needs and problems of consumers 2) I think that the people developing for this company are the typical consumers of the products that they develop 3) I think I am similar to the creators of the product	[1] strongly disagree/ [7] strongly agree
Market knowledge	Adapted from Malhotra, Gosain and El Sawy, 2005	Working with customers has helped the firm... 1)...better understand the market segments 2)...better understand the needs of customers 3)...enter in new or emerging markets (opportunities) 4)...better understand intention and capabilities of firm's competitors 5)...find better ways of distribution/selling the products	[1] strongly disagree/ [7] strongly agree
Complexity	Adapted from Anderson, 1985 and Schreier, Fuchs and Dahl, 2012	1) I think this product is a highly engineered product. 2) I think this product requires a lot of technology/ parts 3) I think this product is complex	[1] strongly disagree/ [7] strongly agree
Loyalty	Bennett and Rundle-Thiele, 2001; Söderlund, 1998; Lee and Cunningham, 2001	1) What percentage of your total [product category] purchases are with this brand? 2) I considered other brands when I last bought this product 3) When I last bought this product, this brand was my first choice	1) [1] 0%/ [7] 100% 2); 3) [1] strongly disagree/ [7] strongly agree
Product involvement	Adapted from Rodgers and Schneider, 1993	1) I attach great importance to this product 2) This product interests me a lot 3) It gives me pleasure to purchase this product	[1] strongly disagree/ [7] strongly agree

Table 9. Measurement items – NPD performance (behavioural intentions)

Construct	Theory	Measurement Items	Scale
Purchase intention	Adapted from Schreier, Fuchs and Dahl, 2012	1) If you had the opportunity, would you consider purchasing a product from this company? 2) To me, purchasing a product from this company is...	[1] Completely unlikely / [7] Extremely likely

		3) What would be the future purchase probability of products from this company?	
WTP	Adapted from Schreier, Fuchs and Dahl, 2012	What is the maximum amount of money you want to spend on this product?	Open question
Product recommendation	Adapted from Gebauer et al., 2013 and Schreier, Fuchs and Dahl, 2012	1) I say positive things about this product to other people. 2) How likely is it that you recommend this product to a friend or a colleague?	[1] strongly disagree/ [7] strongly agree [1] Completely unlikely / [7] Extremely likely
Loyalty	Adapted from Sharyn Rundle-Thiele, 2005; Bennett and Rundle-Thiele, 2001	1) I am strongly committed to buying this product from this brand 2) Purchasing this product from this brand would be...	1) [1] strongly disagree/ [7] strongly agree 2) Bad/good Unfavourable/Favourable Negative/ Positive

3.3.2. Measures validation

To test the measurement models, separate statistics were performed and showed in Table 10a) (see in detail in Table 10b) - Appendix 4). After being analysed, all the measurement items are statistically significant, i.e., all the items could be used for the analysis.

Table 10 a). Summary construct statistics

Construct	Mean	S.D.	t-value	df	P-value
Product involvement	7.033	2.736	58.512	517	0.000
Loyalty	3.560	0.778	104.130	517	0.000
Innovativeness	4.876	1.368	81.118	517	0.000
Quality	5.089	1.687	68.657	517	0.000
Purchase intention	5.189	1.543	76.552	517	0.000
WTP	3.119	1.384	51.278	517	0.000
Product recommendation	5.181	1.517	77.732	517	0.000
Loyalty	5.301	1.577	76.489	517	0.000
Expertise	3.776	2.124	40.457	517	0.000
Similarity	4.570	1.332	78.093	517	0.000
Market knowledge	5.463	1.084	114.740	517	0.000

To test the reliability, a Cronbach's alpha test was done. Rivard and Huff (1988) suggested that Cronbach's alpha should be higher than 0.5 and ideally higher than 0.7. Most of the returned values are higher than 0.7, what allows to confirm a high internal consistency in the survey (Table 11).

Table 11. Reliability analysis - Cronbach's alpha test

	N° items	Cronbach's Alpha
Ideation stage	3	0.621
Product development stage	3	0.386
Commercialization stage	3	0.519
Innovativeness	8	0.944
Product quality	3	0.959
Co-creator expertise	2	0.971
Co-creator similarity	3	0.803
Co-creator market knowledge	5	0.921
NPD Performance	10	0.968

4. Results and findings

In order to test differences in the consumers' perceptions between a co-created product and a product created by firm's professionals, we run an ANOVA analysis.

For co-creation scenario perceived innovativeness was significant higher than in the professionals' scenarios ($M_{CC} = 5.47$ and $M_{Prof} = 3.29$, $p < .000$). As well the product quality perceived in the co-creation scenario was significant higher than in the professionals' scenarios ($M_{CC} = 5.82$ and $M_{Prof} = 3.14$, $p < .000$). However, for co-creation scenario perceived expertise was significant lower than in the professionals' scenarios ($M_{CC} = 2.90$ and $M_{Prof} = 6.07$, $p < .000$). Nevertheless, the perceived similarity ($M_{CC} = 5.14$ and $M_{Prof} = 3.07$, $p < .011$) and market knowledge ($M_{CC} = 5.79$ and $M_{Prof} = 4.58$, $p < .000$) in the co-creation scenario were significant higher than in the professionals' scenarios.

Regarding the NPD performance factors, in the co-creation scenario perceived purchase intention ($M_{CC} = 5.84$ and $M_{Prof} = 3.47$, $p < .000$), WTP ($M_{CC} = 3.28$ and $M_{Prof} = 1.95$, $p < .000$), product recommendation ($M_{CC} = 5.74$ and $M_{Prof} = 3.66$, $p < .000$) and loyalty ($M_{CC} = 6.04$ and $M_{Prof} = 3.56$, $p < .000$) were significant higher than in the professionals' scenarios.

Thus, our findings support that the customer participation in the new product development across stages enhances the attractiveness, the innovativeness, a better fit of the customer needs and consequently higher behavioural intentions compared with the non-co-created products. The non-co-created products only reveal higher perceived expertise from the product's creators than in co-creator situation (Table 12).

Table 12. ANOVAS p-values: Co-creation stages vs Control group (Firms' professionals)

	Co-Creation	Professionals	ANOVA p-value
	Mean	Mean	
Innovativeness	5.47	3.29	0.000
Product quality	5.82	3.14	0.000
Expertise	2.90	6.07	0.000
Similarity	5.14	3.07	0.011
Market knowledge	5.79	4.58	0.000
Purchase intention	5.84	3.47	0.000
WTP	3.28	1.95	0.000
Product recommendation	5.74	3.66	0.000
Loyalty	6.04	3.56	0.000

To test the relationship between the NPD stages and the NPD performance we decided to run an ANOVA analysis.

Regarding the ideation stage (Table 13), consumers consider the participation of other customers contribute for a significant higher NPD performance compared to the products created by firms' professionals ($M_{CC} = 5.71$ and $M_{Prof} = 3.41$, $p < .000$), what allows us to accept the hypothesis H1a) where was suggested that customer participation at ideation stage is positively related to higher NPD performance.

Table 13. Ideation stage: NPD performance ANOVA

	Ideation stage	Control group	ANOVA p-value
	Mean	Mean	
Purchase intention	5.94	3.47	0.000
WTP	3.39	2.11	0.000
Product recommendation	5.76	3.66	0.001
Loyalty	6.10	3.56	0.000
NPD performance	5.71	3.41	0.000

However, our results did not find evidence to support the hypothesis H2a) since the customer participation in the development stage (co-created product) was related to a significant higher NPD performance compared to the products created by firms' professionals ($M_{CC} = 5.64$ and $M_{Prof} = 3.41$, $p < .000$) (Table 14), this could be explained by the participants' recognition in the co-creators the required skills and capabilities to develop the new product. These findings are in accordance with Gruner and Homburg (2000) that suggest the customer participation at development stage contribute positively to the higher NPD performance.

Table 14. Product development stage: NPD performance ANOVA

	Product development stage	Control group	ANOVA p-value
	Mean	Mean	
Purchase intention	5.79	3.47	0.000
WTP	3.68	2.11	0.000
Product recommendation	5.74	3.66	0.000
Loyalty	5.98	3.56	0.000
NPD performance	5.64	3.41	0.000

At the commercialization stage (Table 15), the customer participation is positively related to higher NPD performance comparing to professionals' scenarios, i.e., the hypothesis H3a) was supported ($M_{CC} = 5.65$ and $M_{Prof} = 3.41$, $p < .000$).

Table 11. Commercialization stage: NPD performance ANOVA

	Commercialization stage	Control group	ANOVA p-value
	Mean	Mean	
Purchase intention	5.78	3.47	0.000
WTP	3.43	2.11	0.000
Product recommendation	5.77	3.66	0.001
Loyalty	6.04	3.56	0.000
NPD performance	5.65	3.41	0.000

4.1. Mediation analysis

In order to test whether perceived innovativeness, product quality, co-creator expertise, similarity and market knowledge mediate in the different stages the NPD performance we estimated the average causal mediation effect (ACME) and the average direct effect (ADE) based on the nonparametric identification. The data were analysed by using causal mediation analysis (CMA) to understand the effect of variables along the causal pathway if occur a relationship. Additionally, this method allows the dissection of the treatment total effect into direct and indirect effect. We followed Baron and Kenny's (1986) steps and a bootstrapping test performed to test for significance.

To compute the CMA, first, the relationship between the NPD stages (X_i) and the outcome, i.e., the NPD performance (Y) were tested, if the relationship was statistically significant, i.e., if the different NPD stages had an impact on the NPD performance we move on to the second step, otherwise the mediation effect does not occur.

$$Y = \beta_0 + \beta_1 X_i + \varepsilon \quad (1)$$

In the second step, the relation between the stages (X_i) and the mediators (M_i) was measured and only if X_i affects M_i could exist mediation, thus if the relationship is statistically significant we move on to the third step.

$$M_i = \beta_0 + \beta_2 X_i + \varepsilon \quad (2)$$

The third step consists in a measure the relationship between the NPD performance (Y), the mediators (M_i) and the NPD stages (X_i). If X_i is no longer significant or at least be weaker, the effect of X_i on Y goes through M_i . If the effect X_i on Y completely

disappears, exist a full mediation. If the effect of X_i on Y still exists, but in smaller magnitude, occurs a partial mediation.

$$Y = \beta_0 + \beta_4 X_i + \beta_3 M_i + \varepsilon \quad (3)$$

After we find these relationships, we test if the mediation effect is statistically significant. To do this, we use the bootstrapping approach.

In order to test H1b) which stated that at the ideation stage the higher perceived NPD performance was due to higher perceived innovativeness we run a causal mediation analysis. The effect of customer participation on the ideation stage is fully mediated by perceptions of innovativeness (bootstrap 95% confidence interval [CI]: $.34 < CI < .45$). A regression analysis indicated a positive coefficient of perceived innovativeness ($\beta = .78, p < .000$). This result suggests that consumers believe that other consumers can produce more novel ideas than professionals at the ideation stage.

Still in relation to H1b) which also stated that at the ideation stage the higher NPD performance is related to the higher perceived product quality. The effect of customer participation on ideation stage is fully mediated by perceptions of product quality (bootstrap 95% CI: $.34 < CI < .45$). A regression analysis indicated a positive coefficient of perceived product quality ($\beta = 0.65, p < .000$). This result suggests that consumers believe that other customers can produce a product with more quality than professionals at the ideation stage.

At the development stage, the H2b) stated that customer participation is negatively related to higher NPD performance due to the lower perceived co-creator expertise. However, the effect of customer participation at the product development stage leads to higher NPD performance. Additionally, this effect is not mediated by the perceived co-creator expertise, not supporting the H2b). Against to literature we observe that is explained and partially mediated by perceptions of innovativeness (bootstrap 95% CI: $.12 < CI < .25$), product quality (bootstrap 95% CI: $.13 < CI < .25$) and co-creator similarity (bootstrap 95% CI: $.14 < CI < .25$). The single regressions indicated a positive coefficient of perceived innovativeness ($\beta = .75, p < .000$), product quality ($\beta = .62, p < .000$) and co-creator similarity ($\beta = .66, p < .000$). These results suggest that consumers believe, at the product development stage, that co-creators were perceived as similar to them can produce more innovative, higher quality and easy to use products than professionals.

Regarding the commercialization stage, the H3b) stated that in this NPD stage the higher perceived NPD performance was due to higher perceived co-creator similarity. The effect of customer participation on commercialization stage is fully mediated by perceptions of co-creator similarity (bootstrap 95% CI: .18 < CI < .28). A regression analysis indicated a positive coefficient of perceived co-creator similarity ($\beta = .66, p < .000$). This result suggests that consumers believe that consumers perceived as similar can produce products easy to use resulting in higher behavioural intentions than professionals at the commercialization stage.

Still in relation to H3b) which also stated that at the commercialization stage the higher NPD performance is related to the higher perceived co-creator market knowledge. The effect of customer participation on commercialization stage is partially mediated by perceptions of co-creator market knowledge (bootstrap 95% CI: .14 < CI < .24). A regression analysis indicated a positive coefficient of perceived co-creator market knowledge ($\beta = 0.63, p < .000$). This result suggests that consumers believe that other customers have a higher market knowledge can produce and fit better the created products.

Thus, the H3b) was supported by our findings.

Table 16 shows the summary of the mediation effects across the different NPD stages. Table 17 shows the mediators coefficients.

Table 12. Mediation effects: ACME, ADE, Total effect and Prob. Mediated

	Mediator	ACME	ADE	Total Effect	Prop. Mediated
Ideation		0.39	-0.01	0.3778	1.0291
	Innovativeness	[0.34;0.45]	[-0.08;0.06]	[0.31; 0.44]	[0.86; 1.23]
		0.000	0.84	0.000	0.000
		0.3926	-0.0148	0.3778	1.0393
	Product quality	[0.34; 0.45]	[-0.08;0.06]	[0.31; 0.44]	[0.86; 1.25]
		0.000	0.72	0.000	0.000
Product Development		0.18312	0.07595	0.25907	0.70684
	Innovativeness	[0.12;0.25]	[0.01;0.14]	[0.17;0.36]	[0.55;0.95]
		0.000	0.02	0.000	0.000
		0.1864	0.0727	0.2591	0.7195
	Product quality	[0.13;0.25]	[0.02;0.13]	[0.18;0.35]	[0.55;0.91]
		0.000	0.008	0.000	0.000
Commercialization		0.194378	0.064687	0.259065	0.750306
	Similarity	[0.14;0.25]	[0.00;0.13]	[0.18;0.35]	[0.59;1]
		0.000	0.044	0.000	0.000
		0.22996	0.04863	0.27859	0.82545
	Similarity	[0.18;0.28]	[-0.01;0.34]	[0.22;0.34]	[0.64;1.03]
		0.000	0.11	0.000	0.000
Commercialization		0.1871	0.0915	0.2786	0.6715
	Market knowledge	[0.14;0.24]	[0.03;0.15]	[0.22;0.34]	[0.51;0.88]
		0.000	0.004	0.000	0.000

Note: The first values represent the estimator, the middle values represent the 95% confidence interval and the last values represent the p-values.

Table 13. Mediation coefficients

		Estimate	p-value
Ideation stage	(Intercept)	0.92	0.000
	Ideation	-0.01	0.678
	Innovativeness	0.78	0.000
	(Intercept)	1.46	0.000
	Ideation	-0.01	0.563
	Product quality	0.65	0.000
Product development stage	(Intercept)	0.85	0.000
	Product development	0.08	0.002
	Innovativeness	0.75	0.000
	(Intercept)	1.37	0.000
	Product development	0.07	0.003
	Product quality	0.62	0.000
Commercialization stage	(Intercept)	1.50	0.000
	Product development	0.06	0.031
	Similarity	0.66	0.000
	(Intercept)	1.55	0.000
	Commercialization	0.05	0.086
	Similarity	0.66	0.000
	(Intercept)	1.03	0.000
	Commercialization	0.09	0.005
	Market knowledge	0.63	0.000

Table 18 shows the summary of the mediation across the different NPD stages.

Table 18. Mediations summary: Full vs Partial

Mediators	Ideation stage	Product development stage	Commercialization stage
Perceived innovativeness	Full	Partial	-
Perceived product quality	Full	Partial	-
Perceived co-creator expertise	-	-	-
Perceived co-creator similarity	-	Partial	Full
Perceived co-creator market knowledge	-	-	Partial

Finally, H4 argued that the effects of customer participation are different whether products being co-created are of high or low complexity. To test the mediation effects according to the product complexity, we run a causal mediation analysis for each NPD stage in both low and high complexity products.

Regarding the low complexity product, at the ideation stage the effect of customer participation in a higher NPD performance is fully mediated by perceptions of innovativeness (bootstrap 95% CI: .27 < CI < .40) and product quality (bootstrap 95%

CI: $.29 < CI < .47$). The single regressions show a positive coefficient of perceived innovativeness ($\beta = .79, p < .000$) and product quality ($\beta = .70, p < .000$). Although, customer participation at the product development stage lead to a higher NPD performance due the partial mediation based on the perceived innovativeness (bootstrap 95% CI: $.13 < CI < .32$), product quality (bootstrap 95% CI: $.14 < CI < .31$) and co-creator expertise (bootstrap 95% CI: $.12 < CI < .28$). The single regressions show a positive coefficient of perceived innovativeness ($\beta = .76, p < .000$) and product quality ($\beta = .64, p < .000$) and a negative coefficient of perceived co-creator expertise ($\beta = -.50, p < .000$). Interestingly at the commercialization stage no mediation effect was reported.

Regarding the high complexity product, as in the low complexity product scenario, at the ideation stage the effect of customer participation in a higher NPD performance is fully mediated by perceptions of innovativeness (bootstrap 95% CI: $.48 < CI < .67$) and product quality (bootstrap 95% CI: $.42 < CI < .60$). The single regressions show a positive coefficient of perceived innovativeness ($\beta = .88, p < .000$) and product quality ($\beta = .67, p < .000$). Although, customer participation at the product development stage lead to a higher NPD performance due the partial mediation based on the perceived innovativeness (bootstrap 95% CI: $.09 < CI < .32$) and co-creator market knowledge (bootstrap 95% CI: $.05 < CI < .21$) and fully mediated by the perceived product quality (bootstrap 95% CI: $.12 < CI < .30$). and co-creator similarity (bootstrap 95% CI: $.17 < CI < .37$). The single regressions show a positive coefficient of perceived innovativeness ($\beta = .85, p < .000$), product quality ($\beta = .70, p < .000$), co-creator similarity ($\beta = .78, p < .000$) and market knowledge ($\beta = .79, p < .000$). Interestingly, against what happens in low complexity product, at the commercialization stage the effect of customer participation in a higher NPD performance is partially mediated by perceptions of innovativeness (bootstrap 95% CI: $.09 < CI < .23$) and fully mediated by co-creator similarity (bootstrap 95% CI: $.19 < CI < .37$) and market knowledge (bootstrap 95% CI: $.19 < CI < .37$). The single regressions show a positive coefficient of perceived innovativeness ($\beta = .84, p < .000$), co-creator similarity ($\beta = .79, p < .000$) and market knowledge ($\beta = .84, p < .000$).

Tables 19a) and 19b) show the summary of the mediation effects across the different NPD stages regarding the low and high complexity products. Tables 20a) and 20b) show the mediators coefficients.

Table 19 a). Low complexity - Mediation effects: ACME, ADE, Total effect and Prob. Mediated

	Mediator	ACME	ADE	Total Effect	Prop. Mediated
Ideation	Innovativeness	0.33	0.01	0.34	0.97
		[0.27; 0.4]	[-0.07; 0.1]	[0.26; 0.43]	[0.74; 1.23]
		0.000	0.760	0.000	0.000
	Product quality	0.38	-0.03	0.34	1.10
		[0.29; 0.47]	[-0.14; 0.07]	[0.26; 0.42]	[0.81; 1.47]
		0.00	0.47	0.00	0.00
Product Development	Innovativeness	0.22	0.01	0.32	0.68
		[0.13; 0.32]	[0.01; 0.2]	[0.21; 0.44]	[0.44; 0.96]
		0.000	0.036	0.000	0.000
	Product quality	0.23	0.10	0.32	0.97
		[0.14; 0.31]	[0.01; 0.19]	[0.22; 0.44]	[0.51; 0.94]
		0.000	0.020	0.000	0.000
Expertise	0.20	0.13	0.32	0.61	
	[0.12; 0.28]	[0.01; 0.22]	[0.21; 0.44]	[0.43; 0.93]	
	0.000	0.016	0.000	0.000	

Table 19 b). High complexity - Mediation effects: ACME, ADE, Total effect and Prob. Mediated

	Mediator	ACME	ADE	Total Effect	Prop. Mediated
Ideation	Innovativeness	0.57	-0.02	0.55	1.03
		[0.48; 0.67]	[-0.13; 0.1]	[0.47; 0.63]	[0.84; 1.25]
		0.000	0.8	0.000	0.000
	Product quality	0.50	0.05	0.55	0.91
		[0.42; 0.6]	[-0.05; 0.15]	[0.47; 0.64]	[0.75; 1.1]
		0.000	0.34	0.000	0.000
Product Development	Innovativeness	0.20	0.06	0.26	0.76
		[0.09; 0.32]	[-0.02; 0.14]	[0.12; 0.41]	[0.58; 1.11]
		0.000	0.084	0.000	0.000
	Product quality	0.20	0.06	0.26	0.77
		[0.12; 0.3]	[-0.02; 0.15]	[0.12; 0.43]	[0.57; 1.08]
		0.000	0.15	0.000	0.000
Similarity	0.27	-0.01	0.26	1.03	
	[0.17; 0.37]	[-0.08; 0.08]	[0.13; 0.4]	[0.78; 1.5]	
	0.000	0.86	0.000	0.000	
Market knowledge	0.12	0.14	0.26	0.45	
	[0.05; 0.21]	[0.03; 0.27]	[0.12; 0.43]	[0.24; 0.79]	
	0.000	0.004	0.000	0.000	
Commercialization	Innovativeness	0.16	0.09	0.25	0.65
		[0.09; 0.23]	[0.02; 0.16]	[0.14; 0.37]	[0.45; 0.89]
		0.000	0.016	0.000	0.000
	Similarity	0.27	-0.02	0.25	1.10
		[0.19; 0.37]	[-0.09; 0.05]	[0.14; 0.37]	[0.82; 1.57]
		0.000	0.54	0.000	0.000
Market knowledge	0.26	-0.01	0.25	1.05	
	[0.19; 0.37]	[-0.11; 0.08]	[0.16; 0.36]	[0.76; 1.63]	
	0.000	0.84	0.000	0.000	

Table 20 a). Mediation coefficients: low complexity product

		Low complexity product	
		Estimate	p-value
Ideation stage	(Intercept)	1.18	0.000
	Ideation	0.01	0.752
	Innovativeness	0.79	0.000
	(Intercept)	1.68	0.000
	Ideation	-0.03	0.346
	Product quality	0.70	0.000
Product development stage	(Intercept)	1.07	0.000
	Product development	0.10	0.008
	Innovativeness	0.76	0.000
	(Intercept)	1.56	0.000
	Product development	0.10	0.009
	Product quality	0.64	0.000
	(Intercept)	6.64	0.000
	Product development	0.13	0.004
	Expertise	-0.50	0.000

Table 20 b). Mediation coefficients: high complexity product

		High complexity product	
		Estimate	p-value
Ideation stage	(Intercept)	0.76	0.000
	Ideation	-0.02	0.694
	Innovativeness	0.88	0.000
	(Intercept)	1.42	0.000
	Ideation	0.05	0.221
	Product quality	0.67	0.000
Product development stage	(Intercept)	0.72	0.000
	Product development	0.06	0.062
	Innovativeness	0.85	0.000
	(Intercept)	1.32	0.000
	Product development	0.06	0.077
	Product quality	0.70	0.000
	(Intercept)	1.61	0.000
	Product development	-0.01	0.854
	Similarity	0.78	0.000
	(Intercept)	0.46	0.205
	Product development	0.14	0.005
	Market knowledge	0.79	0.000
Commercialization stage	(Intercept)	0.69	0.000
	Commercialization	0.09	0.002
	Innovativeness	0.84	0.000
	(Intercept)	1.61	0.000
	Commercialization	-0.02	0.499
	Similarity	0.79	0.000
	(Intercept)	0.55	0.150
	Commercialization	-0.01	0.780
	Market knowledge	0.84	0.000

Table 21 shows a summary of the mediations effects according to the product complexity.

Table 21. Mediation summary: low vs high complexity products

Mediators	Low complexity product			High complexity product		
	I	PD	C	I	PD	C
Perceived innovativeness	Full	Partial	-	Full	Partial	Partial
Perceived product quality	Full	Partial	-	Full	Full	-
Perceived co-creator expertise	-	Partial	-	-	-	-
Perceived co-creator similarity	-	-	-	-	Full	Full
Perceived co-creator market knowledge	-	-	-	-	Partial	Full

I – Ideation stage

PD – Product development stage

C – Commercialization stage

Table 22 shows a summary of the hypotheses according to product complexity.

Table 22. Hypotheses summary

	Low complexity product	High complexity product
H1 b)	Accepted	Accepted
H2 b)	Accepted	Rejected
H3 b)	Rejected	Accepted

In order to compare the different NPD stages in both high and low complexity product scenarios, we run t-tests with null hypothesis: true difference in means is equal to 0 and an alternative hypothesis: true difference in means is greater than 0.

In the high complexity product, the ideation stage had a similar impact regarding the low complexity product ($p < .44$). However, the observed impact was not equal in the other two stages (product development and commercialization stage). In reality, at the product development ($p < .000$) and commercialization stages ($p < .000$) the impact of customer participation in a higher NPD performance is higher in low complexity product than in high complexity product. Thus, the H4) was accepted for the product development and commercialization stages, however, was not supported for the ideation stage (Table 23).

Table 23. NPD stages: low vs high complexity products

Low complexity product	High complexity product	t-value	df	p-value
Ideation stage	Ideation stage	0.14	505.91	0.443
Product development stage	Product development stage	7.06	490.47	0.000
Commercialization stage	Commercialization stage	5.88	511.71	0.000

In order to know which stage gain more from the customer participation, we run t-tests with null hypothesis: true difference in means is equal to 0 and an alternative hypothesis: true difference in means is greater than 0.

Regarding the low complexity product, due the no rejection of the null hypothesis – ideation vs product development stage ($p < .45$), product development vs commercialization stage ($p < .34$) and ideation vs commercialization stage ($p < .30$) – all the stages show a similar impact on the higher NPD performance (Table 24).

Table 24. NPD stages: low complexity product

Low complexity product		t-value	df	p-value
Ideation stage	Product development stage	0.13	517.92	0.447
Product development stage	Commercialization stage	0.43	507.97	0.335
Ideation stage	Commercialization stage	0.55	491.02	0.292

Concerning the high complexity product, the rejection of the null hypothesis in the ideation vs product development stage scenario ($p < .000$) and ideation vs commercialization stage scenario ($p < .000$), suggest that the stage which gains more from the customer participation is the ideation stage (Table 25).

Table 25. NPD stages: high complexity product

High complexity product		t-value	df	p-value
Ideation stage	Product development stage	7.34	494.42	0.000
Product development stage	Commercialization stage	-0.90	497.94	0.816
Ideation stage	Commercialization stage	6.01	509.74	0.000

5. Discussion and conclusions

Our results provide initial evidence about seven main topics regarding the mediation of the customer participation on the NPD stages and NPD performance according to the product complexity.

First, although the co-created product be perceived as lower in expertise compared to firms' internal workforce, our findings support the theory that consumers perceived the co-created product has higher in innovativeness, product quality, co-creator similarity and market knowledge, purchase intentions, WTP, product recommendation and loyalty, compared to a product created by professionals.

Second, independently of the NPD stage in study, customer participation leads to a higher NPD performance. These findings are against what we hypothesized based on the Chang and Taylor (2015) findings but are in line with was suggested by Gruner and Homburg (2000), one reason for this result could be that the participants recognize in the co-creators the skills and capabilities needed to develop the new product.

Third, at the ideation stage, the relationship between the customer participation and a higher NPD performance is mediated by the perceived innovativeness and product quality, suggesting that consumers perceived the product created by others as novel and better in quality compared to non-co-created products at the ideation stage. These two mediators plus the perceived co-creator similarity mediate the relationship between the customer participation and a higher NPD performance at the product development stage, what suggests that consumers perceived the product created by similar others as novel, higher in quality and easy to adopt compared to non-co-created products in the product development stage. At the commercialization stage, the mediators are the co-creator similarity and market knowledge, suggesting that consumers perceived the product created by similar others as easy to adopt and with better fit compared to non-co-created products in commercialization stage.

Fourth, the mediators for the relationship between the customer participation and the higher NPD performance differ across NPD stages according to product complexity. In the low and high complexity products, the customer participation at the ideation stage enhancing the consumers' behavioural intentions, particularly when is mediated by the perceived innovativeness and product quality, confirming the previous findings and supporting the idea that co-created product is perceived as novel and better in quality. Although, in a low complexity product, at the product development stage, customer

participation results in a higher NPD performance through the perceived innovativeness, product quality and lower through the perceived co-creator expertise mediation, what suggests the consumers perceived co-creator products as novel and with high quality despite the negative impact of the perceived expertise. In a high complexity product, at the product development stage, this relationship results due to the perceived innovativeness, product quality and co-creator similarity and market knowledge mediation, suggesting the customer participation lead to a novel, higher quality, easy to use and with a better fit product. Interestingly, in a low complexity product, the customer participation at the commercialization stage increase the NPD performance but are not mediated by any studied mediators (perceived innovativeness, product quality, co-creator expertise, similarity or market knowledge). However, in a high complexity product, the relationship between the customer participation and a higher NPD performance at the commercialization stage is mediated by the perceived innovativeness, co-creator similarity and market knowledge, supporting the idea that a co-created product is perceived as novel, easy to adopt and with a better fit.

Fifth, the perceived innovativeness assumes a role of mediator in almost every stage in both low and high complexity product.

Sixth, the effect of customer participation in a higher NPD performance at the ideation stage is higher in a high complexity product compared to a low complexity product. However, at the product development and commercialization stages, the effect is higher in a low complexity product vs a high complexity product.

Finally, in the high complexity product, the NPD stage that gains most from customer participation is the ideation stage. However, in the low complexity product, all the stages assume a similar impact on the NPD performance.

6. Theoretical and Managerial implications

6.1. Theoretical implications

Our findings contribute to this emerging literature, in four main topics, by exploring consumers' perception across the different NPD stages in the NPD performance when the products are co-created.

Firstly and foremost, this empirical study support that a co-created product is perceived as novel, easy to adopt and with higher quality and fit.

Secondly, our results show that the consumer participation can enhance the NPD performance across all NPD stages, against the Chang and Taylor (2015) findings that suggest at the product development stage the consumer participation had a non-significant impact or even could damage the NPD performance.

Thirdly, our findings also contribute to understanding how customer participation in the different stages increases the NPD performance. These increases could be mediated by the perception of the non-co-creator participants about innovativeness, product quality, co-creator expertise, similarity and market knowledge. For example, the higher NPD performance at the ideation stage is mediated by the perceived innovativeness and product quality.

Finally, we also contribute to understanding the consumers' participation across the different NPD stages in the NPD performance in the low complexity product and the high complexity product and the differences between these complexity extremes. For example, at the commercialization stage regarding the high complexity product, the increase in NPD performance is mediated by the perceived innovativeness, co-creator similarity and market knowledge, in opposition to what is observed in the low complexity product where none of the studied mediators have an impact. Besides that, for non-participants consumers, the more valued NPD stage in the high complexity product is ideation, against to the similar impact that each NPD stage has in the low complexity product.

6.2. Managerial implications

This empirical study provides several insights for firms considering the use of customer participation to increase firms' NPD performance.

Our results show that if a company understand where and what the consumers value more their participation in the development of a new product, the firms could save money based on the optimization of the use of the consumer participation.

These savings could be reflected in different departments in a company. In the product development department, the customer participation reduces the probability of product rejection and consequently fail since firms know what consumers appreciate and need at each stage depending on the type of product (high or low complexity product). For example, at the product development stage in a high complexity product the customer participation is more relevant when it is associated (mediated) by the perceived innovativeness, product quality, co-creator similarity and market knowledge, in opposite in the low complexity product at the development stage the consumers value more the perceived innovativeness, product quality and co-creator expertise, in the other hand in the low complexity product at the ideation stage the customer participation is more relevant when is only associated (mediated) to the perceived innovativeness and product quality.

In the marketing department, these savings could be noticed by an accurate and efficient marketing mix, advertising the stage most appreciated by the non-participants consumers and where the firm knows that could have a higher impact on possible consumers and consequently on the NPD performance.

In the financial department, the customer participation associate to the right NPD stages and the right mediators (perceived innovativeness, product quality, co-creator expertise, similarity and market knowledge) enhances the purchases intention, WTP and product recommendation (NPD financial performance) and reduce the waste of resources since firms only co-create with customers in the NPD stages that customers' contribution is appreciated.

In summary, knowing what and in what stage the customer participation is more valuable increase the market and product fit, enhancing firms' NPD performance.

7. Limitations and Further research

There are four main limitations that warrant discussion and provide opportunities for further research.

First, while our study focused on five mediators – perceived innovativeness, product quality, co-creator expertise, similarity and market knowledge – other possible and not accounted variables could explain and mediate the relation customer participation across NPD stages and the higher NPD performance. It is even possible these non-accounted variables change the mediation effects observed in this study. Further researches could explore other mediators where customer participation in the different NPD stages could have an impact on the NPD performance.

Second, our study is based on high and low complexity products – contrasting only the extremes of product complexity. However, in practice, many products might be somewhere in between (medium complexity). From the practical perspective, could be interesting to explore the customer participation across the NPD stages that enhances the NPD performance in medium complexity product.

Third, our findings are based on the mediation effect, i.e., the mediators (perceived innovativeness, product quality, co-creator expertise, similarity and market knowledge) explaining the reason for the relationship between the NPD stages and the higher NPD performance. However, further research could be focus on the moderation effects, i.e., the way to check if the third variable influences the direction or strength of the relationship between the NPD stages and the higher NPD performance.

Finally, it would be worthwhile to explore the firms' perspective to see if in practice the customer participation at NPD stages enhances the NPD performance through the mediators used in this study.

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Appendices

Appendix 1. Pilot study analysis

Product Complexity

Table 2. Walkers chips complexity statistics

	Mean	SD	Min	Max
I think this product is a highly engineered product.	3.23	1.59	1	6
I think this product requires a lot of technology/ parts	3.13	1.50	1	6
I think this product is complex	3.23	1.52	1	6

Table 3. Walkers chips complexity perception

	Strongly disagree (1)	2	3	4	5	6	Strongly agree (7)
This product is a highly engineered product.	17%	20%	20%	20%	13%	10%	0%
This product requires a lot of technology/ parts	17%	23%	17%	20%	20%	3%	0%
This product is complex	20%	10%	23%	27%	13%	7%	0%
Average	18%	18%	20%	22%	16%	7%	0%

Fiat MIO car:

Table 4. Fiat MIO car complexity statistics

	Mean	SD	Min	Max
I think this product is a highly engineered product.	6.60	0.62	5	7
I think this product requires a lot of technology/ parts	6.67	0.55	5	7
I think this product is complex	6.43	0.73	4	7

Table 5. Fiat MIO car complexity perception

	Strongly disagree (1)	2	3	4	5	6	Strongly agree (7)
I think this product is a highly engineered product.	0%	0%	0%	0%	7%	27%	67%
I think this product requires a lot of technology/ parts	0%	0%	0%	0%	3%	27%	70%
I think this product is complex	0%	0%	0%	3%	3%	40%	53%
Average	0%	0%	0%	1%	4%	31%	63%

Demographics statistics:

Table 6. Pilot study – Demographic statistics: age, gender, school degree, income and nationality

Age	
17 or younger	0%
18-20	13%
21-29	87%
30 or older	0%

Gender	
Male	47%
Female	53%
Other	0%

School degree	
Less than high school diploma	0%
High school diploma or equivalent degree	0%
No degree	0%
Bachelor's degree	53%
Master's degree	47%
Professional's degree	0%
Doctorate	0%

Income	
Less than 1000€	13%
1000€ to 2000€	7%
2001€ to 3000€	10%
3001€ to 4000€	17%
4001€ to 5000€	13%
5001€ or more	40%

Nationality	
Portuguese	80%
German	13%
Italian	3%
South Korea	3%

Appendix 2. Survey demographics

Table 7. Survey - Demographic statistics: age, gender, school degree, income and nationality

Statistic	N	Mean	SD	Min	Pctl (25)	Pctl (75)	Max
Age	518	2.61	0.55	2	2	3	4
Gender	518	1.57	0.50	1	1	2	2
Degree	518	4.35	0.53	2	4	5	6
Income	518	5.11	1.49	1	5	6	6

Age	
17 or younger	0%
18-20	42%
21-29	55%
30 or older	3%

Gender	
Male	43%
Female	57%
Other	0%

Degree	
Less than high school diploma	0%
High school diploma or equivalent degree	1%
No degree	0%
Bachelor's degree	63%
Master's degree	36%
Professional's degree	0%
Doctorate	0%

Income	
Less than 1000€	7%
1000€ to 2000€	3%
2001€ to 3000€	3%
3001€ to 4000€	4%
4001€ to 5000€	22%
5001€ or more	60%

Nationality	
German	13.1%
Portuguese	82.0%
South Korea	0.4%
Italian	1.2%
French	0.4%
Spanish	0.6%
Polish	0.2%
UK	1.0%
Brazilian	0.6%
Belgian	0.6%

Appendix 3. Survey introduction and products range

Welcome!

This survey should take no longer than 5 minutes. Your honesty and conscientiousness are extremely important for the accuracy of the study, please take your time and read carefully all the questions and potential answers to choose the one that best fits your opinion.

There are no right or wrong answers and all the collected information is anonymous. It will be used exclusively for the purpose of this research and will be kept strictly confidential.

Your contribution is very valuable. Thank you for your time and participation!



Figure 2. Walkers products range



Figure 3. Walkers Potato chips:
Co-created product – low complexity product



Figure 4. Fiat cars range



Figure 5. Fiat MIO car: Co-created product – high complexity product

Appendix 4. Measurement items statistics

Table 10 b). Construct measures and estimates

Construct	Measurement items	Mean	S.D.	t-value	df	P-value	Cronbach's Alpha
Product involvement	I attach great importance to this product	6.853	3.333	46.792	517	0.000	-
	This product interests me a lot	6.664	3.176	47.753	517	0.000	
	It gives me pleasure to purchase this product	7.583	2.712	63.643	517	0.000	
Loyalty	What percentage of your total potato chips purchases are with this brand?	2.301	1.532	34.192	517	0.000	-
	I considered other brands when I last bought this product	5.834	1.133	117.190	517	0.000	
	When I last bought this product, this brand was my first choice	2.544	1.308	44.274	517	0.000	
Creators	Who do you think that participated in the creation of this product?	3.398	2.096	36.888	517	0.000	-
	Participate in Idea generation	4.869	2.874	38.553	517	0.000	
	Participate in Product development	1.927	2.170	20.204	517	0.000	
Innovativeness	Participate in Commercialization	2.251	2.440	20.999	517	0.000	0.944
	High innovativeness	5.255	1.806	66.221	517	0.000	
	Strong innovativeness	5.239	1.684	70.807	517	0.000	
	Excellent innovativeness	5.131	1.772	65.912	517	0.000	
	I think that a lot of people develop for this company	4.838	1.356	81.211	517	0.000	
	On average, I think this company can draw upon a lot of ideas for new products	4.819	1.422	77.140	517	0.000	
	I think that the people developing for this company are very different from each other	4.622	1.468	71.663	517	0.000	
I think that the people developing for this company have a very similar background to me	4.541	1.856	55.684	517	0.000		

Quality	I think that the ideas from those designing for the company for new products are very different from each other	4.564	1.450	71.620	517	0.000	
	Product quality is adequate in terms of variety and features?	5.135	1.740	67.184	517	0.000	
Purchase intention	Product quality is adequate in terms of product convenience?	5.073	1.759	65.653	517	0.000	0.959
	Overall product quality is adequate based on experiences?	5.058	1.768	65.107	517	0.000	
	If you had the opportunity, would you consider purchasing a product from this company?	5.181	1.514	77.896	517	0.000	
WTP	To me, purchasing a product from this company is...	5.263	1.627	73.624	517	0.000	0.935
	What would be the future purchase probability of products from this company?	5.124	1.770	65.874	517	0.000	
Product recommendation	What is the maximum amount of money you want to spend on this product?	3.119	1.384	51.278	517	0.000	-
	I say positive things about this product to other people.	5.181	1.559	75.632	517	0.000	
Loyalty	How likely is it that you recommend this product to a friend or a colleague?	5.181	1.620	72.792	517	0.000	0.902
	I am strongly committed to buying this product from this brand	5.027	1.788	63.974	517	0.000	
Expertise	Purchasing this product from this brand would be good	5.448	1.627	76.222	517	0.000	
	Purchasing this product from this brand would be Favourable	5.429	1.600	77.239	517	0.000	0.960
	Purchasing this product from this brand would be Positive	5.529	1.630	77.216	517	0.000	
	In my opinion, the expertise of people	3.741	2.098	40.589	517	0.000	0.971

Similarity	developing for this company is high						
	I think that the people developing for this company have the necessary skills (know-how) and competence to develop new products	3.811	2.211	39.227	517	0.000	
	I think that the people developing for this company exactly know the specific needs and problems of consumers	4.730	1.306	82.409	517	0.000	
	I think that the people developing for this company are the typical consumers of the products that they develop	4.618	1.458	72.107	517	0.000	0.803
Market knowledge	I think I am similar to the creators of the product	4.363	1.895	52.412	517	0.000	
	Working with customers has helped the firm better understand the market segments	5.741	1.069	122.180	517	0.000	
	Working with customers has helped the firm better understand the needs of customers	5.622	1.125	113.770	517	0.000	
	Working with customers has helped the firm new or emerging markets (opportunities)	5.270	1.347	89.044	517	0.000	0.921
	Working with customers has helped the firm better understand intention and capabilities of firm's competitors	5.232	1.402	84.930	517	0.000	
	Working with customers has helped the firm find better ways of distribution/selling the products	5.448	1.244	99.671	517	0.000	

S.D.: standard deviation

Appendix 5. Mediation effects plots: NPD stages

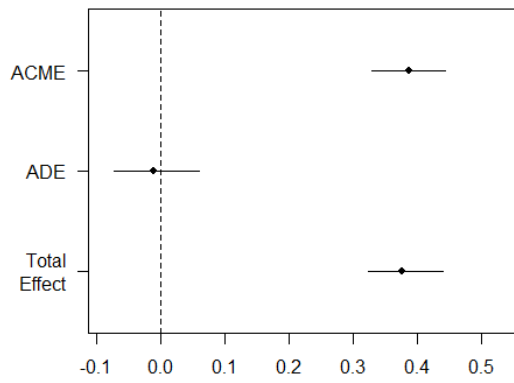


Figure 6. Mediation effects: Mediator: Perceived innovativeness in Ideation stage

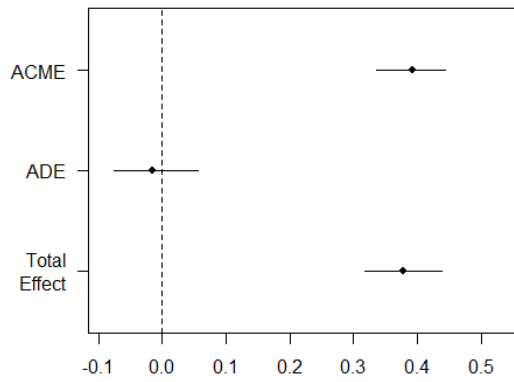


Figure 7. Mediation effects: Mediator: Perceived product quality in Ideation stage

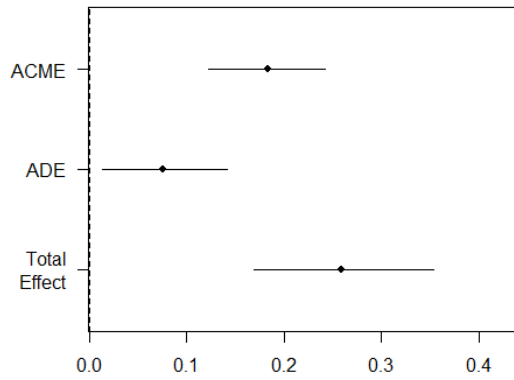


Figure 8. Mediation effects: Mediator: Perceived innovativeness in Product development stage

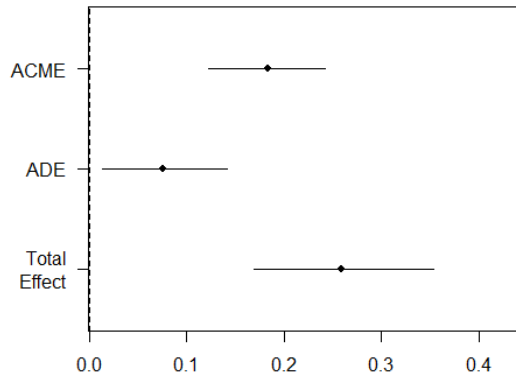


Figure 9. Mediation effects: Mediator: Perceived product quality in Product development stage

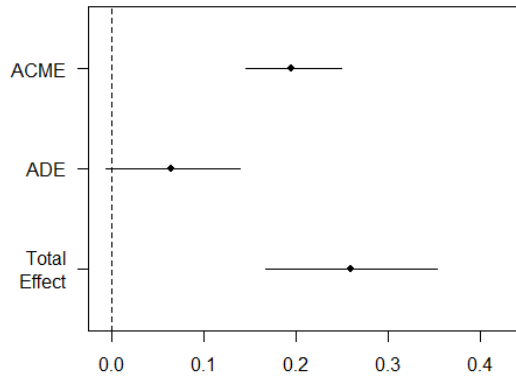


Figure 10. Mediation effects: Mediator: Perceived co-creator similarity in Product development stage

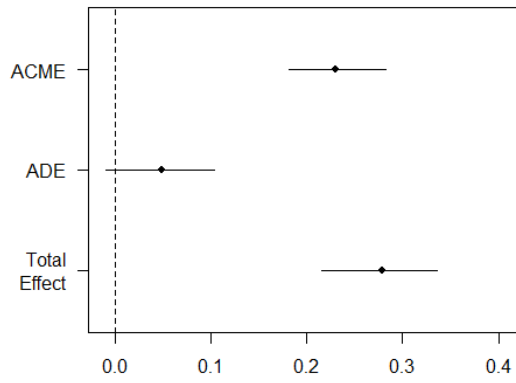


Figure 11. Mediation effects: Mediator: Perceived co-creator similarity in Commercialization stage

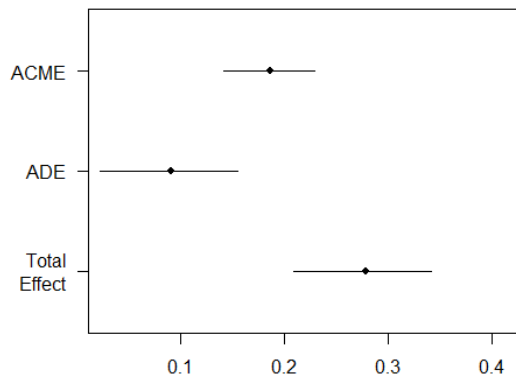


Figure 12. Mediation effects: Mediator: Perceived co-creator market knowledge in Commercialization stage

Appendix 6. Mediation effects plots: low vs high complexity products

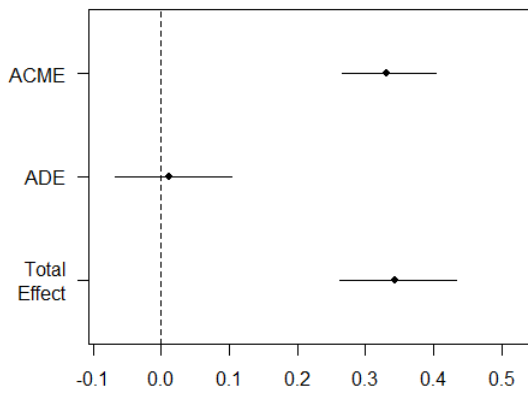


Figure 13. Mediation effects: Low product complexity - Mediator: Perceived innovativeness in Ideation stage

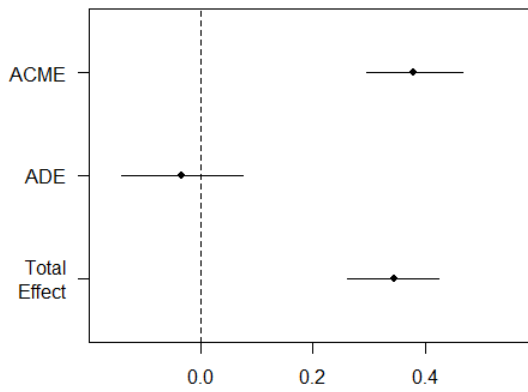


Figure 14. Mediation effects: Low product complexity - Mediator: Perceived product quality in Ideation stage

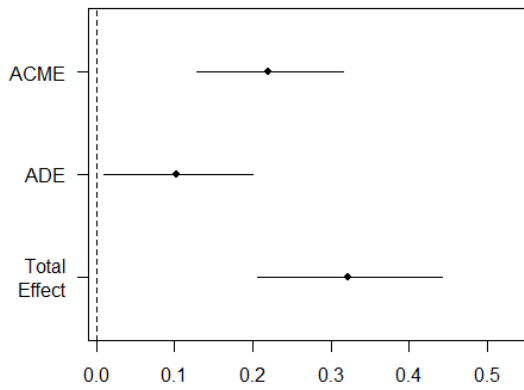


Figure 15. Mediation effects: Low product complexity - Mediator: Perceived innovativeness in Product development stage

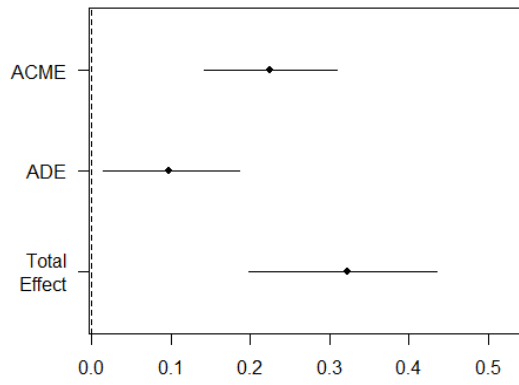


Figure 16. Mediation effects: Low product complexity - Mediator: Perceived product quality in Product development stage

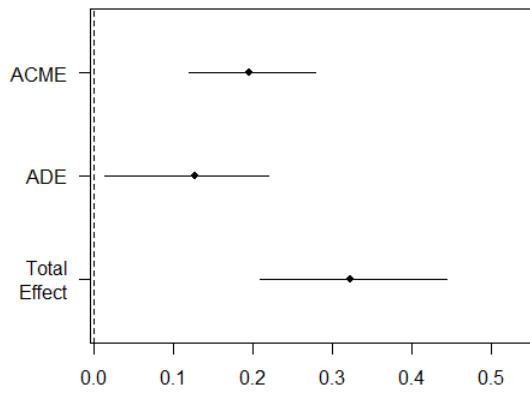


Figure 17. Mediation effects: Low product complexity - Mediator: Perceived co-creator expertise in Product development stage

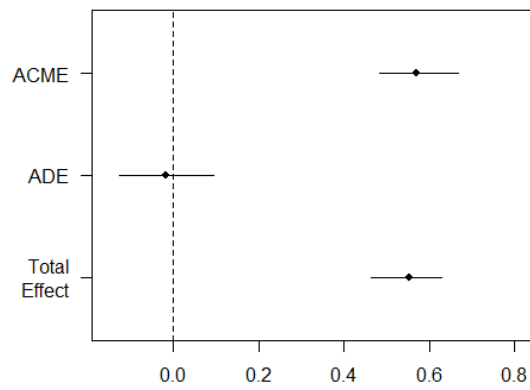


Figure 18. Mediation effects: High product complexity - Mediator: Perceived innovativeness in Ideation stage

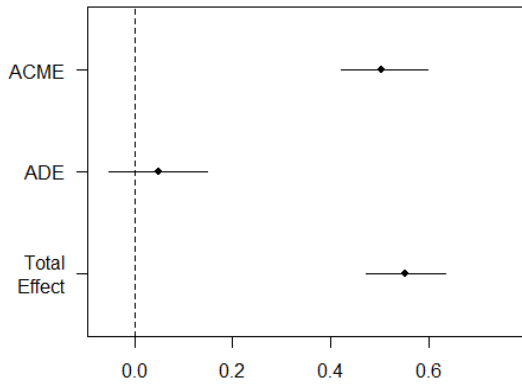


Figure 19. Mediation effects: High product complexity - Mediator: Perceived product quality in Ideation stage

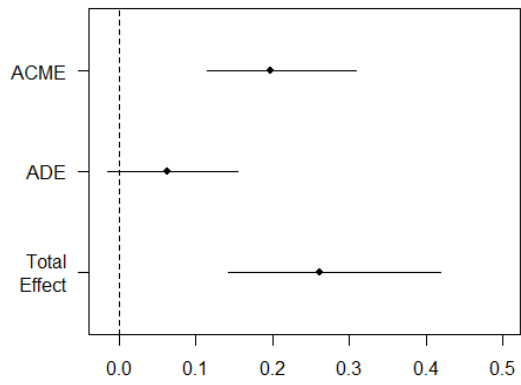


Figure 20. Mediation effects: High product complexity - Mediator: Perceived innovativeness in Product development stage

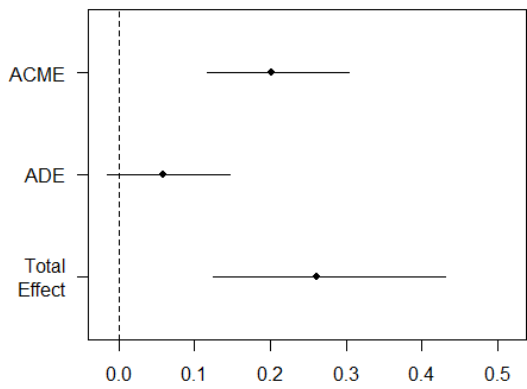


Figure 21. Mediation effects: High product complexity - Mediator: Perceived product quality in Product development stage

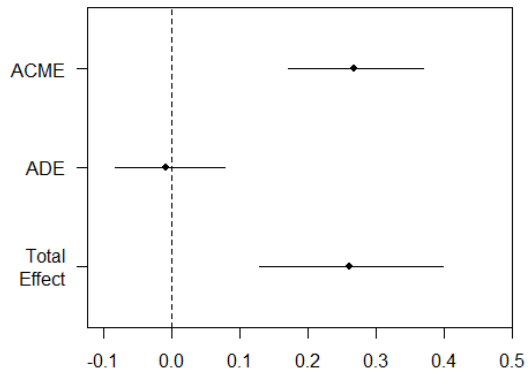


Figure 22. Mediation effects: High product complexity - Mediator: Perceived co-creator similarity in Product development stage

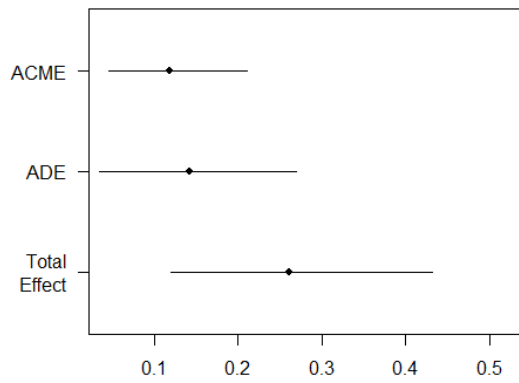


Figure 23. Mediation effects: High product complexity - Mediator: Perceived co-creator market knowledge in Product development stage

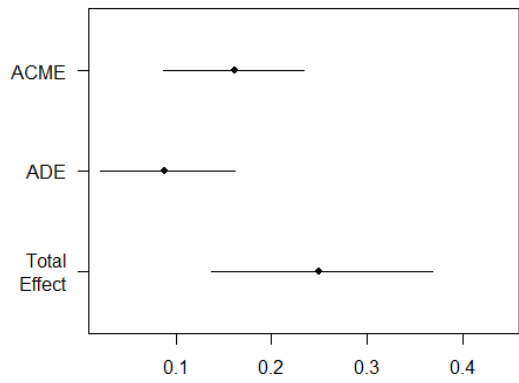


Figure 24. Mediation effects: High product complexity - Mediator: Perceived innovativeness in Commercialization stage

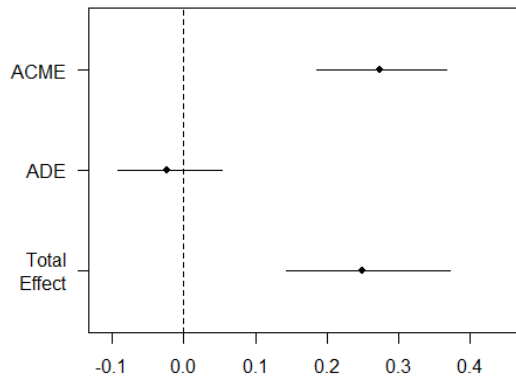


Figure 25. Mediation effects: High product complexity - Mediator: Perceived co-creator similarity in Commercialization stage

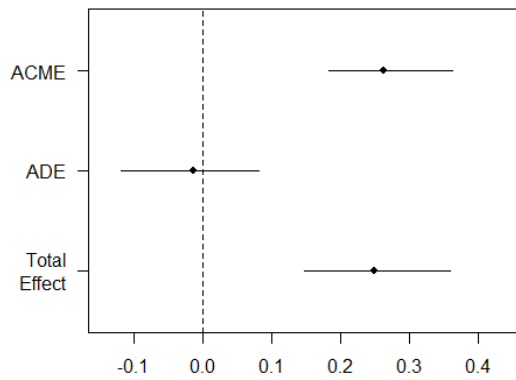


Figure 26. Mediation effects: High product complexity - Mediator: Perceived co-creator market knowledge in Commercialization stage

Notes: Estimation Under the Assumption of Independent Causal Mechanisms. The plots present the estimate ACMEs, ADEs and Total effects under the sequential ignorability assumption along with 95% confidence intervals for each of regressions indicated at the bottom.

The plots were generated by the mediation software.

Appendix 7. The correlation matrix – product complexity

Table 26. Correlation table - Low complexity product

	X1	X2	X3	M1	M2	M3	M4	M5	Y1
X1	1.000	0.431	0.563	0.563	0.607	-0.417	0.398	0.112	0.400
X2	0.431	1.000	0.519	0.447	0.449	-0.533	0.411	0.204	0.468
X3	0.563	0.519	1.000	0.483	0.459	-0.404	0.516	0.407	0.463
M1	0.563	0.447	0.483	1.000	0.889	-0.606	0.739	0.541	0.755
M2	0.607	0.449	0.459	0.889	1.000	-0.612	0.653	0.469	0.780
M3	-0.417	-0.533	-0.404	-0.606	-0.612	1.000	-0.491	-0.339	-0.676
M4	0.398	0.411	0.516	0.739	0.653	-0.491	1.000	0.629	0.613
M5	0.112	0.204	0.407	0.541	0.469	-0.339	0.629	1.000	0.534
Y1	0.400	0.468	0.463	0.755	0.780	-0.676	0.613	0.534	1.000

Table 27. Correlation table – High complexity product

	X1	X2	X3	M1	M2	M3	M4	M5	Y1
X1	1.000	0.361	0.355	0.791	0.747	-0.565	0.628	0.392	0.664
X2	0.361	1.000	0.513	0.238	0.241	-0.136	0.338	0.204	0.262
X3	0.355	0.513	1.000	0.229	0.189	-0.145	0.397	0.496	0.292
M1	0.791	0.238	0.229	1.000	0.932	-0.735	0.773	0.526	0.850
M2	0.747	0.241	0.189	0.932	1.000	-0.741	0.761	0.550	0.853
M3	-0.565	-0.136	-0.145	-0.735	-0.741	1.000	-0.643	-0.394	-0.764
M4	0.628	0.338	0.397	0.773	0.761	-0.643	1.000	0.645	0.796
M5	0.392	0.204	0.496	0.526	0.550	-0.394	0.645	1.000	0.614
Y1	0.664	0.262	0.292	0.850	0.853	-0.764	0.796	0.614	1.000