



CATÓLICA  
LISBON  
BUSINESS & ECONOMICS

## Co-Creation under complex products

The impact of observing consumers' expertise and perceived consumers' similarity on the perceived innovation ability of companies.

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Dissertation written under the supervision of Cláudia Costa

Dissertation submitted in partial fulfilment of requirements for the MSc in Strategy and Entrepreneurship, at the Universidade Católica Portuguesa, 5<sup>th</sup> of April of 2019

## Abstract

**Title:** Co-Creation under complex products: The impact of observing consumers' expertise and perceived consumers' similarity on the perceived innovation ability of companies.

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Companies have been increasingly involving consumers in their innovation process to grasp the consumers needs in a superior way. Research acknowledges this joint creation of value involving consumers and company professionals as being beneficial for both the firm and the consumers. Despite that, for consumers that are not involved in the innovation process, usually mentioned as observing consumers, there are some conditions under which this innovation process is not beneficial. Complex products, for example, is one of the cases in which research shows that involving consumers in the innovation process is not beneficial, due to observing consumers being sceptic of the expertise of other users, which consequently damages their perceptions of the co-creators to provide meaningful inputs. In this study we explore if characteristics such as the observing consumers expertise and his perceived similarity with the co-creator enable this innovation process to be beneficial even under complex products. First, our study suggests that if a firm provides additional information that validates the co-creators' expertise then, consumers perceive firms that design with students higher in terms of innovation ability when compared with company professionals. Secondly, our study suggests that when consumers are provided with additional information regarding the co-creators' expertise and they feel similar to the creator, the innovation ability of the firm is positively affected. This paper adds to existing literature on co-creation under complex products and shows that there are specific conditions in which this innovation process is beneficial under complex products.

**Keywords:** co-creation under complex products, expertise, perceived similarity.

# Sumário

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As empresas têm cada vez mais envolvido os consumidores no seu processo de inovação de forma a captar as necessidades dos mesmos de maneira superior. Essa criação conjunta de valor envolvendo consumidores e profissionais é reconhecida como sendo benéfica tanto para a empresa como para os consumidores. Apesar disso, para os consumidores fora do processo de inovação, geralmente mencionados como consumidores observadores, existem algumas condições sob as quais esse processo não é benéfico. Produtos complexos é um dos casos em que envolver os consumidores no processo de inovação não é benéfico, devido ao ceticismo por parte dos consumidores relativamente à expertise de outros usuários. Esse ceticismo prejudica as percepções relativamente às capacidades do cocriador em fornecer ideias significativas no processo. Neste estudo, exploramos se características como a expertise do consumidor observador bem como a similaridade com o cocriador permitem que este processo de inovação seja benéfico sob produtos complexos. Primeiro, o nosso estudo sugere que quando são fornecidas informações que validam a expertise dos cocriadores, os consumidores avaliam as empresas que produzem com os seus consumidores, mais alto em termos de inovação quando comparado com empresas que produzem internamente. Em segundo lugar, o nosso estudo sugere que, quando os consumidores recebem informações sobre a experiência dos cocriadores e se sentem semelhantes aos mesmos, as percepções de inovação da empresa são afetadas positivamente. Este estudo acrescenta à literatura existente sobre cocriação sob produtos complexos e mostra que existem condições específicas em que este processo de inovação é benéfico em produtos complexos.

**Palavras-chave:** cocriação sob produtos complexos, expertise, similaridade.

## Acknowledgements

First, I would like to thank my supervisor Professor Cláudia Costa, her guidance and valuable opinions throughout the whole process were crucial to conclude my dissertation and I cherish all the support I got.

Secondly, I would like to thank my family for giving me the support to pursue my studies with full autonomy and trust in my choices, as well as being there for everything I needed throughout my masters and personal life.

Thirdly, to all my friends and girlfriend that were always there throughout all the highs and lows in my academic journey, giving advices or simply helping me relax when I needed, I cherish all of you and this thesis would have been impossible without your support.

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# 1. Introduction

One of the main goals of organizations is to successfully launch new products since there is evidence that novel products provide corporate growth and profitability (Sorescu, Chandy, and Prabhu, 2003).

However, developing new products can also be one of the most complex and difficult tasks for companies, due to its reliance on the correct understanding of what the market really wants (Rindfleisch and O'Hern, 2010). In order to acquire and take advantage of knowledge external to the organization, companies have been shifting from a merely internal new product development (closed innovation models) to an external and open model (Salter et al. 2014), where companies integrate their consumers in different stages of the process (open innovation).

A firm pinpointed as one of the pioneers of open innovation is LEGO, which started innovating with consumers in the late 1980s, by launching a competition called LEGO MINDSTORMS, where over 200 teams of university students were challenged to design a new product for the company produce. Following its huge success, LEGO developed a website called LEGO IDEAS (<https://ideas.lego.com>) where their consumers' from all over the world could share and vote in other consumers ideas for future products to be developed by the company. The website is still running up to this date, and the products that are chosen to be marketed are provided with recognition in the packaging of the product and royalties to the consumer-creator (LEGO, 2019).

In the beginning of the century, in addition to the LEGO case, other successful cases of multinationals innovating with consumers started to emerge, such as BMW, Ikea and Unilever, and researchers started to get more interested in the topic of open innovation. Prahalad and Ramaswamy (2000) research, defined the value gained by companies collaborating with their customers as "co-creation of value", where new products are a joint creation between professionals and consumers (Prahalad and Ramaswamy, 2004).

Current literature suggests that co-creation of value has advantages for both firms and consumers. For the specific case of firms, by involving users in the firm's innovation process rather than using professional designers, companies can positively impact the consumers' perception of their firm's innovation ability which consequently, leads to positive outcomes regarding purchase intentions, willingness to pay, and consumers' willingness to recommend

the firm. This positive effect of involving users in the innovation process is usually referred to as the “user innovation effect” (Schreier et al., 2012).

Furthermore, companies that engage in a co-creation (innovation) process develop advantages for their NPD (number of ideas, diversity, customer-insights, just-in-time knowledge) in comparison to an internal innovation process, which consequently makes the firm perform better in terms of demand, time to market, brand loyalty, willingness to pay and willingness to recommend. (Fuchs et al., 2011; Peck and Shu, 2009; Schreier et al., 2012)

Regarding consumers, co-creation helps building trust through this dialogue between companies and consumers, which consequently makes brands be perceived by the broader market as more authentic and closer to the consumers (Randall et al., 2011). Additionally, consumers that participate in this innovation process tend to develop a higher sense of loyalty and closeness with the firm, which consequently affects their purchase intentions and willingness to recommend (Fuchs et al., 2011; Peck and Shu, 2009; Morrison, 2004).

However, current literature provides evidence that there are some specific cases where co-creation may not be beneficial. Schreier et al. (2012) research identifies complexity of the product as a moderator of the perceived innovation ability of the firm. Under complex products, companies that co-create with consumers are rated lower in terms of perceived innovation when compared with companies that develop new products internally with company professionals. This happens under complex products due to consumers being skeptical about the co-creator’s ability to provide meaningful inputs due to a lack of expertise in the underlying domain of the product (Schreier et al., 2012).

The aim of our study is to address an existing gap in the literature by exploring if characteristics such as the observing consumers expertise and his perceived similarity with the co-creator moderate the positive effect that co-creation has on the perceived innovation ability of firms that co-create under complex products (Schreier et al., 2012). Furthermore, we intend to also study if by providing additional information that validates the co-creator’s expertise, such as its area of study, positively affects how consumers perceive the firm’s innovation ability under complex products, disregarding consumer specific characteristics.

Our study has managerial interest because understanding the conditions in which co-creation can be beneficial for complex products allows such firms to consider this innovation process to generate a competitive advantage. Currently, research has mainly pointed to the downsides in terms of consumers product perceptions (e.g. Schreier et al., 2012; Dahl et al., 2014).



Additionally, by exploring how the consumers characteristics affect their perceptions of co-creation, managers can find relevant information of how to market co-created products to their target accordingly to the consumers characteristics that moderate how potential buyers perceive co-creation.

This study aims to extend the literature on the concept of co-creation, by providing novel research in how moderators, such as observing consumers expertise and perceived similarity, impact co-creation under complex products. First, observing consumers with a strong basis of knowledge/expertise in the underlying area of the co-created product might perceive the underlying design task as less complex, which consequently should enhance their perceptions of a firm’s innovation ability even under more complex products (Schreier et al., 2012). Second, consumers who feel similar to the co-creator prefer firms that use consumers in their innovation process (Jiang et al., 2010), we believe that this positive effect is transferable for complex products when consumers are provided with information of the creator that makes them feel like they belong to the firm’s participating user community (Dahl et al., 2014). Figure 1, just below represents our conceptual model.

This thesis structure is organized as follows: In chapter two, there is the literature review, where the existing literature on co-creation is presented and important moderators for our study are identified. Chapter three regards the research method used for this study and presents the measures incorporated in the analysis. In chapter four the results of the study are outlined, followed by the discussion of academic and managerial implications in chapter five. Lastly in chapter six, limitations of the study are discussed, and areas of possible future research are suggested.

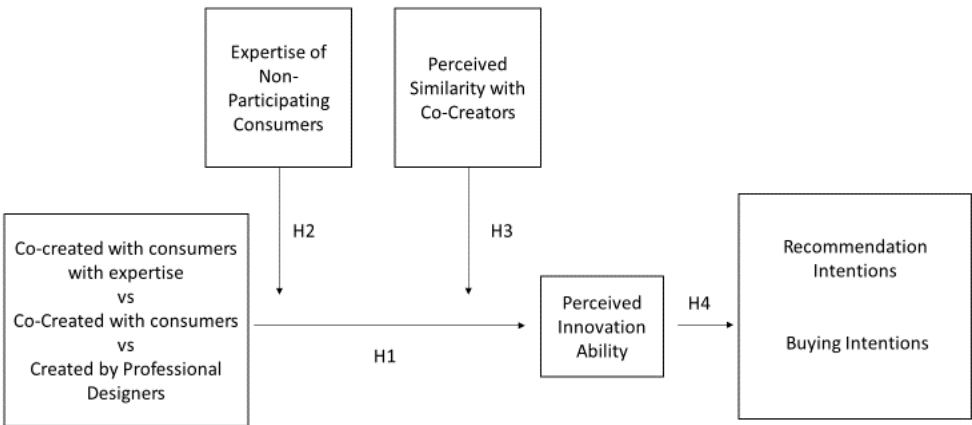


Figure 1 - Our Concept model

## 2. Literature Review

### 2.1 The evolution of company's value creation

Companies have been shifting their R&D practices from an internal to an external paradigm, as they try to find new ways to acquire and take advantage of knowledge external to the organization (Salter et al. 2014), since it provides a better understanding of what the market really wants (Rindfleisch and O'Hern, 2010).

By actively engaging with consumers, firms can attain specific consumer needs that they could not get internally, increasing their chances of making better market fit products, which consequently ensures corporate growth and profitability to the firm (Sorescu, Chandy, and Prabhu, 2003). Furthermore, research agrees that most novel products do not fail due to technical shortcomings but rather due to lack of understanding of what the consumers real needs are (Ogawa and Piller, 2006).

This shift in paradigms is also gaining support due to evidence of great success of consumers innovating and modifying existing products to better match their daily needs (von Hippel, 1986).

Moreover, the proliferation of technology, like the internet, makes these consumer insights more accessible for firms since it enables both parties to engage in an open dialogue more easily. Within this line of reasoning, the internet also provides the tools necessary for consumers to learn about businesses, either on their own or through collective knowledge of other consumers (Prahalad and Ramaswamy, 2000).

Taking all into consideration, it becomes clear why companies are starting to integrate consumers in innovation processes that traditionally used to be fully internally developed. By shifting to an external paradigm, companies can capture the market's needs which consequently enhances their chances of making market fit products (Rindfleisch and O'Hern, 2010).

## 2.2. Co-Creation

As companies have been shifting into involving consumers in their traditionally internal processes, several types of consumer-involvement initiatives have been developed and consequently studied by the academia.

O'Hern and Rindfleisch's (2008) definition clearly defines and separates co-creation from the other types of consumer involvement. According to the authors, consumer involvement can be categorized into three different stages of consumers involvement in companies' innovation: (1) Consumer Innovation, (2) Consumer Design, (3) Co-Creation.

Firstly, Consumer Innovation is a process fully controlled by the consumers, where the users themselves, solely innovate for their own benefit (von Hippel, 2005). The companies are not involved in the innovation process but commercialize the user-made innovation at a large scale. Consumer Design, on the other hand, is a process where the user usually contributes in the beginning of the NPD, for example, by giving ideas for new products to be developed by firms (Roser et al., 2009), and then the consumer-driven firm takes control of the process again and selects the ideas they want to pursue by themselves. Lastly, Co-Creation is described as a process where consumers and firms jointly contribute to the product innovation process. The main difference when compared to Consumer Design is that the consumers can contribute in the product innovation process at any given stage (Prahalad and Ramaswamy, 2004).

Roser (2009) extends O'Hern and Rindfleisch's (2008) definition describing co-creation as: *“an active, creative and social process, based on collaboration between producers and users, that is initiated by the firm to generate value for customers”*.

Taking all definitions into consideration, the focus of our research is in co-creation and as such, in the next few chapters, we will narrow down from all consumer involvements into simply co-creation, drawing specifically from Roser's definition of co-creation.

## 2.3 Benefits of co-creation

Extant literature highlights several advantages of including consumers in the innovation process, both in terms of the company point of view (e.g. Fuchs et al., 2011; Peck and Shu, 2009; Schreier, Fuchs, and Dahl, 2013) as well as the consumers point of view (e.g. Schreier

et al., 2012; Dahl et al., 2014; Morrison, 2004), that are distinct to each other and important to highlight separately.

### 2.3.1 Company point of view

Regarding the company point of view, the main objective of firms to incorporate users in their processes is to increase their overall performance.

By co-creating with their consumers, companies generate certain advantages (further explained below) when compared to their competitors which positively impacts their overall performance by generating higher demand, faster time to market, increased brand loyalty, willingness to pay and willingness to recommend from the consumers. (Fuchs et al., 2011; Peck and Shu, 2009; Schreier, Fuchs, and Dahl, 2013)

Past research has identified four main arguments that explain why companies that incorporate users in their innovation process tend to perform better: (1) Number of ideas, (2) diversity of ideas, (3) gain consumer-insights, (4) just-in-time knowledge (Schreier et al. 2012).

First, by incorporating users into the innovation process companies can increase the number of ideas for innovations, thus, according to the popular quantity–quality inference (Osborn 1963): The more ideas on the table, the more likely it is that highly creative new products will be generated (Troy, Szymanski, and Varadarajan 2001; Valacich et al. 1995; Van Gundy 1988).

Secondly, in accordance with the number’s argument, by raising the number of people working in the innovation process it leads to a pool of creators with more diverse backgrounds, interests and skillsets, which should end up generating products of higher desirability (Schreier et al., 2012).

Regarding the consumer-insights, since the users designing for the firm have the same characteristics as those who they are creating for, they are perceived as better equipped to interpret customers’ needs and wants (versus professional designers), due to specific knowledge attained by product use, leading to more successful innovations (Nishikawa et al., 2013).

Lastly, according to Henkel and von Hippel (2005), just-in-time knowledge about customer preferences is the most important factor for the innovation process. Furthermore, Ogawa and

Piller (2006) state that most innovations do not fail because of technical shortcomings, but rather due to the difficulty of producing exactly what customers want. Thus, the co-creation innovation process enables companies to have just-in-time knowledge by actively engaging with consumers, recognizing potential flaws and opportunities in their innovations at a faster pace, enabling the company to be a step ahead of their competitors (Roser et al., 2009).

In conclusion, companies that engage in a co-creation innovation process develop advantages (number of ideas, diversity, customer-insights, just-in-time knowledge) in comparison to an internal innovation process, which consequently makes them perform better in terms of demand, time to market, brand loyalty, willingness to pay and willingness to recommend. (Fuchs et al., 2011; Peck and Shu, 2009; Schreier et al., 2012)

### 2.3.2 Participating consumers point of view

Regarding the participating consumers point of view, innovation scholars provide evidence that involving users in the innovation process of firms translates in positive effects in the participating consumers in terms of: (1) consumer's relationship with the brand, (2) purchase intention and (3) willingness to recommend the product (Fuchs et al., 2011; Peck and Shu, 2009; Morrison, 2004)

First, Liu et al. (2012) finds evidence that participating consumers in the innovation process of a company develop empathy towards the brand. In this line of enquiry, Fuchs et al. (2011) found that consumers that take part in co-creation initiatives develop stronger loyalty towards the brand and a strong feeling of "ownership" towards the developed product. Participating consumers also tend to have higher levels of product satisfaction (Moreau and Herd, 2010).

Secondly, research agrees that involving consumers in the innovation process impacts their purchase intentions positively. Peck and Shu's (2009) provide evidence that having a strong sense of ownership towards a product generates a greater sense of product demand, therefore companies can use this innovation process to generate a competitive advantage. Sawhney et al. (2005) also found that participants have higher intentions to purchase products that were created by themselves and developed an increase in brand loyalty towards the brand.

Lastly, co-creation can also be used as a powerful communication tool by companies. As evidenced by Morrison (2004), the usage of users in the innovation process of companies, is

likely to transfer positive perceptions of the firm to the participating consumers leading to an acceleration of diffusion to other consumer groups through word of mouth.

Taking all into consideration, researchers agree that user involvement in the innovation process affects positively the participating consumers. The participants develop a higher sense of loyalty which consequently affects their purchase intentions and willingness to recommend. (Fuchs et al., 2011; Peck and Shu, 2009; Morrison, 2004)

### 2.3.3 Non-Participating Consumers point of view

More important than firms and consumers that take part in the co-creation process is the impact of knowing that a product was co-created has on the broader market, since they represent the majority of consumers that buy the product. These consumers that do not participate in the development of the product are often referred to as “observing” consumers (Fuchs and Schreier 2011; Schreier et al. 2012) and research agrees that co-creation is also attractive for this type of consumers.

Perceived innovation ability can be defined as the consumers’ belief that a company is able to produce innovative products (Brown and Dacin, 1997; Gürhan-Canli and Batra, 2004). Literature on user innovation provides support that co-creation enhances consumers’ perceptions of a firm’s innovation ability (Schreier et al., 2012).

By involving users in the firm’s innovation process rather than using professional designers, companies can positively impact the consumers’ perception of their firm’s innovation ability which consequently, leads to positive outcomes regarding purchase intentions, willingness to pay, and consumers’ willingness to recommend the firm. This positive effect of involving users in the innovation process is usually referred to as the “user innovation effect” (Schreier et al., 2012).

Nishikawa et al. (2017) research found that labelling the products as “ideated by consumers” increased the products performance by up to 20% when compared to products ideated by professional designers, further validating the positive perceptions that the co-creation process transfers to the observing consumers. Companies can use this “user innovation effect” to differentiate themselves from competitors, consequently, creating a competitive advantage and increasing their performance (Nishikawa et al., 2017).

Furthermore, modern consumers are looking for brands that do not focus solely on their economic agenda, but rather companies that treat their customers as sincere friends or as being part of a broader community (Beverland, 2005). In this line of reasoning, co-creation helps building trust through this dialogue between companies and consumers, which consequently makes brands be perceived by the broader market as more authentic and closer to the consumers (Randall et al., 2011).

## 2.4 The impact of product complexity in Co-Creation

While there is evidence that co-creation is beneficial for companies and consumers, for observing consumers, studies point to certain boundaries that limit the positive effects of co-creation (e.g. Schreier et al., 2012; Dahl et al., 2014). Schreier (2012) while studying consumers' perceptions of firms selling products designed by users, found that the positive innovation effect of co-creation loses its power when the underlying design task becomes too complicated. As product complexity increases, consumers start questioning other users as able to provide meaningful inputs in the innovation process (Schreier et al., 2012).

A product can be defined as complex when its creation process, requires a great variety of distinct skills and types of expert knowledge in technology, materials or processes (Hobday 1998; Novak and Eppinger 2001). In fact, consumers in their daily lives, can identify and compare the complexity necessary to design different products. As an example, most consumers identify the design of a t-shirt as simple when compared to the skills and expertise necessary to design a robotic toy or a car (Schreier et al., 2012).

Within this line of enquiry, Moreau and Herd's (2010) research shows that professionals tend to have a significant advantage, either real or perceived, over consumer-creators, in terms of their knowledge, training and experience, which consequently transfers the perception towards the market that consumer-creators do not have the necessary set of skills to undergo in the innovation process of more complex products.

This difference in product complexity is important because it draws attention to the skills and competences needed to design a product when undergoing in a co-creation process. Under highly complex products, the broader market does not perceive other users as being able to provide meaningful inputs in the innovation process, which consequently hinders the positive innovation effect of co-creation (Schreier et al., 2012).

While current literature provides evidence that complexity of the underlying product acts as a moderator of the perceived innovation ability of firms that create alongside users, current literature has neglected whether if by providing additional information regarding the co-creator which validates his expertise, prevents consumer skepticism, thus enabling the positive innovation effect of involving users to happen even under complex products. As such, we hypothesize:

*H1: For complex products, higher levels of perceived co-creator's expertise increases the perceived innovation ability of firms that co-create (vs. professional designers).*

Additionally, to better understand the effect of product complexity in the perceived benefits of co-creation one needs to understand the impact of non-participants expertise in the co-creation effect. In fact, consumers expertise may directly impact the consumers perception of how complex a product really is (Schreier et al., 2012). Observing consumers with a strong basis of knowledge/expertise in the underlying area of the co-created product might perceive the underlying design task as less complex. Consequently, if consumers with expertise in fact perceive the process as less complex their perceptions of a firm's innovation ability would be enhanced, even under more complex products (Schreier et al., 2012).

In fact, Dahl et al. (2014) while studying moderators of the positive effect of co-creation, found a significant and positive innovation effect of co-creation under complex products when observing consumers with expertise fell similar to the co-creators in terms of expertise.

Hence, the non-participants consumers' expertise should act as a moderator that enhances the innovation ability perceived by these consumers even under more complex product categories. As such, we hypothesize:

*H2: The higher the expertise of non-participating consumers in the product domain the higher the perceived innovation ability of firms that co-creates (vs. professional designers).*



## 2.5 Perceived Similarity with co-creators

Drawing from literature of source similarity in persuasion, members of a target audience are more likely to identify with, and therefore adopt, the opinions of similar others (Wilson and Sherrell, 1993). In the specific case of co-creation, perceived similarity becomes extremely relevant when measuring the positive effect of co-creation, since consumers more easily identify themselves with the co-creators (versus professional designers) (Dahl et al., 2014).

Furthermore, the human desire for positive social identity, makes people overestimate the positive qualities of similar others relative to dissimilar others (Tajfel and Turner, 1986). Similarly, Kiesler and Corbin (1965) research also provides evidence that people tend to like similar others and as such perceive the attitudes of those as more appropriate.

McGuire (1985) terms this as source attractiveness, which can be defined “*as the familiarity, likability, and similarity of the source to the message recipient*”. This source attractiveness, according to persuasion theories, consequently makes the source of the message be more persuasive (Wilson and Sherrell 1993).

In the specific case of co-creation, Thompson and Malaviya (2013) while studying whether brands benefited from communicating to non-participating consumers that an advertisement was consumer-created, found that perceived similarity with the creator is an important moderator in the non-participating consumers perceptions. In their study they propose a skepticism–identification model of creator influence, which hypothesizes two opposing effects when disclosing a product as consumer-created, skepticism and identification.

The model hypothesizes that when non-participating consumers are in a condition in which no source information is provided they become skeptic of the consumer-creator skills and expertise for the job, which consequently damages the overall consumers perceptions. However, when revealing background information that the creator has in common with the viewers, (i.e., a fellow college student) the negative effect is reversed, thus generating a positive effect towards the consumers perceptions of the firm.

This goes in line with Dahl et al. (2014) research which found that non-participating consumers who perceive to be similar to the participating consumers prefer products of the firm that involve consumers in the innovation process, when compared with the products produced by professional designers. For this identification to happen, consumers need to be provided with information of the creator that makes them feel like they belong to the firm’s participating user community (Dahl et al., 2014).

In this line of enquiry, Jiang et al. (2010) research provides evidence that incidental similarities between a salesperson and a customer (e.g., a shared birthday or birthplace) resulted in higher intentions to purchase from the consumer. Taking all into consideration, this should make non-participant consumers perceived similarity with co-creators an important variable to be taken into consideration while studying co-creation. As such, we hypothesize:

*H3: Higher levels of perceived similarity with the co-creator enhances the perceived innovation ability of firms that co-create (vs company professionals) in complex products.*

## 2.6 Behavioral Outcomes

Current literature supports that co-creation is also beneficial in terms of behavioral outcomes of the consumer towards the brand (Schreier et al., 2012; Lude et al., 2016). Research suggests that firms that are perceived as having higher levels of innovation ability compared to their competitors, make the consumer more likely to recommend the firm to others, have higher intentions to purchase and are willing to pay more for their products (Schreier et al. 2012). In this line of enquiry, Lude et al. (2016) research found similar results regarding these behavioral outcomes of the consumers. As such, we hypothesize:

*H4: Firms with higher levels of perceived innovation ability display higher behavioral attitudes from the consumer (recommendation intentions and buying intentions)*

## 3. Methodology

### 3.1 Data Collection and Sampling

The main objective of this thesis is to understand if characteristics such as the observing consumers expertise and his perceived similarity with the co-creator moderate the positive effect that co-creation has on the perceived innovation ability of firms that co-create under complex products. To get a clear view of the impact of the non-participants consumer expertise and perceived similarity in the consumer's perception, we test the variables under different scenarios that will be explained in detail in the next section.

This study was conducted through a web survey to collect consumer's responses. This was considered the best approach given time and budget constraints, to achieve quick collection of information, cost minimization and to eliminate potential geographic barriers. (Evans and Marthur 2005)

Two hundred and sixty seven participants took part in the study (55% male, mean age = 21). Furthermore, 40% of the individuals were in the area of study of management and economics, closely followed by 33% of individuals in engineering. This study followed a 3 x (design source: engineering students vs students vs professionals) x 2 (observing consumers' expertise: high vs low) x 2 (perceived similarity: high vs low) between subjects group design experiment. Participants were randomly selected by sharing the survey's link in the researcher's own network through email and Facebook.

As specified in the literature review, perceived innovation ability from the consumers is not only influenced by the design mode (i.e. product developed by co-creation versus developed internally by the company) but also by the consumers perceived similarity with the creator (i.e. high versus low similarity). Additionally, to test whether observing consumer expertise influences the perceived innovation ability or not we targeted a sample with a mix of people of high and low expertise in the underlying domain of the product to draw valid conclusions of the impact of the variable.

The product we decided to use for our research was robotic toys. The reason behind this choice relies on the fact that Schreier et al. (2012) research provides evidence that this product is perceived by consumers as being complex to design, which should be important to validate our conclusions. Furthermore, it is a product that already has examples of companies co-creating in the market, like the case of LEGO that has a specialized line of robotic toys called

Mindstorms, where the designs of the robots are done by the LEGO community and then the company decides which products make it to the mass market.

### 3.2 Procedure

To test our hypothesis, it was designed an online survey using Qualtrics, clustered in three different scenarios, which were randomly and equally distributed among participants by using the randomizer option available in the program. This allows us to have an equal number of responses for each scenario.

Our research conditions have 3 different scenarios, and goes as follows:

Co-creation with High expertise	Co-creation with Low expertise	Developed internally by the company
“Designed in partnership with engineering students”	“Designed in partnership with students”	“Designed by company professionals”

*Table 1 - Design Scenarios*

Participants start by reading a standardized background information about the company (“Company X [real brand name blinded] is a company that specializes in robotic toys. As with many firms nowadays, this company has an online user-community”). The last cue comes to avoid any confounding effects from having a community (versus marketing products designed by users).

Participants are then presented with a colored picture of “a product recently marketed by the company” (picture of robotic toy from LEGO Mindstorms line) and up until now, all participants are exposed to identical concrete product stimuli before treatment.

Participants then receive their group-specific treatment, by being provided background information about the company’s design approach. In Scenario 1, participants are told that these robotic toys were “designed in partnership with engineering students”; hence, being informed that for this firm, new products are regularly designed alongside the companies’ user community (Co-creation). For Scenario 2, participants are told the same as in Scenario 1 with the sole difference of saying that the products were simply “designed in partnership with students”. In contrast for Scenario 3, participants are told that the product was “designed by company professionals”; hence, being informed that for this firm, new products are regularly



Purchase intent	(Bruner and Hensel 2001)	If you had the opportunity, would you consider purchasing a product from this company?  To me, purchasing a product from this company is...	very unlikely [1]/likely [7]
Familiarity with user innovation  ( $\alpha=0,793$ ) <sup>1</sup>	(Franke, Von Hippel, and Schreier 2006)	1) Have you ever invented a new use for a product that the manufacturer never intended?  2) Have you ever developed a product yourself (either modifying an existing product or creating a new artifact from scratch)?  3) Do you personally know other people who have already developed a product themselves (either modifying an existing product or creating a new artifact from scratch)?	No [0] / Yes [1]
Recommendation Intent	(Bruner and Hensel 2001)	How likely is it that you recommend this firm to a friend or a colleague?	Completely unlikely [0] / Extremely likely [10]
Willingness to pay	(Bruner and Hensel 2001)	What is the maximum amount of money (in euros) you would spend in a Robotic Toy from Company X?	Open question
Product Complexity	(Schreier et al. 2012)	How complex to design you believe the product is?	Not complex at all to design [1]/ Very complex to design [9]
Design expertise  ( $\alpha=0,838$ )	(Ratneshwar and Chaiken 1991)	1) In your opinion, how high is the design expertise of the people designing for this company?  2) Do you think that the people designing for this company have the necessary skills (know-how) and competence to design new	(1) They have very low [1]/They have very high design expertise [7]  (2) They don't have the necessary

<sup>1</sup> The questions used for the reliability test were number 2 and 3 presented in the table.

		products?	skills [1]/They have the necessary skills [7]
Consumer Expertise	(adapted from Dahl et al. 2014)	How would you rate your own expertise in the underlying area of the product (Robotics)?	Not very high[1] / Very high[7]
Perceived Similarity	(adapted from Thompson and Maviya 2013)	How similar do you think you are to the creators of the product?	very dissimilar [1]/very similar [7]
Newness	(Schreier et al. 2012)	How “new” do you perceive the company’s business model, i.e., their way to develop new products?	Not very new [1]/ Very new [7]

*Table 2– Measurement items used in the online questionnaire*

To ensure the credibility of our study for multiple-item questions we used the Cronbach’s alpha, where an alpha superior than 0,7 is generally accepted by researchers (Nunnally and Bernstein, 1994). Our variables with multiple-item questions were Innovation ability, Familiarity with user innovation and Design Expertise, out of the following only familiarity with user innovation needed to be adapted from 3 variables ( $\alpha=0,656$ ) into 2 variables to have a Cronbach’s alpha higher than 0,7 ( $\alpha=0,793$ ).

## 4. Results

To understand how our moderators impact the perceived innovation ability of firms, we run several analyses of variances (ANOVA) and analyses of the means (t-tests).

### 4.1 Perceived Innovation Ability

First, we performed a manipulation check to see if participants understood the design scenario they were assigned to (between engineering students vs students vs company professionals), To do so, we performed a One Way ANOVA to test how design source impacted innovation ability, under our 3 different design sources(Designed by Engineering Students, Designed by Students, Designed by Company Professionals). Our results indicate that individuals did rate firms differently according to the design source, thus validating that participants understood our scenarios  $M_{\text{Eng. Students}} = 5,162$ ;  $M_{\text{Students}} = 4,468$ ;  $M_{\text{Company Professionals}} = 4,690$ ;  $F(2,264) = 9,610$ ,  $p = 0,000$ .

Dependent Variable: Innovation Ability

Design Source	N	Mean	Std. Deviation	Std. Error
Engineering Students	85	5.162	1.0404	.1128
Students	71	4.468	.9722	.1154
Company Professionals	111	4.690	1.0492	.0996
Total	267	4.781	1.0592	.0648

Table 3 - Innovation ability per design source

Dependent Variable: Innovation Ability

	df	F	Sig.
Between Groups	2	9.610	.000
Within Groups	264		
Total	266		

Table 4 – ANOVA table for Innovation ability per Design Source

Dependent Variable: Innovation Ability

Design Source	Mean Difference	Std. Error	Sig.	
Eng. Students	Students	.6947	.1650	.000
	Company Professionals	.4723	.1479	.005
Students	Eng. Students	-.6947*	.1650	.000
	Company Professionals	-.2225	.1560	.329
Company Professionals	Eng. Students	-.4723*	.1479	.005
	Students	.2225	.1560	.329

Table 5 – Differences in Innovation Ability per Design Source



Additionally, our H1 hypothesizes that providing information of the co-creators' expertise (engineering students vs. students) enhances the perceived innovation ability of firms under complex products. Our results go in line with our hypothesis by indicating that when engineering students design new products consumers perceive firms as having higher levels of innovation ability than when students design for the firm and interestingly even when company professionals  $M_{\text{Eng.Students}} = 5,162$ ;  $M_{\text{Students}} = 4,468$ ;  $M_{\text{Company Professionals}} = 4,690$ ;  $F(2,264) = 9,610$ ,  $p = 0,000$ .

Moreover, looking at the differences our results show a statistically significant difference in perceived innovation ability for firms that design with engineering students versus students ( $p = 0,000$ ), as well as between engineering students and company professionals ( $p = 0,005$ ). However, there were no statistically significant differences between students and company professionals ( $p = 0,329$ ), so we cannot reject the hypothesis that both groups means are equal. Our results goes in line with current literature since it suggests that the positive effect of co-creation is dissipated under complex products when no information about the co-creator is provided (Schreier et al. , 2012).

Additionally, these results demonstrate that by simply adding information regarding the area of study of the co-creator it enhances the perceived innovation ability of firms that co-create even under complex products, thus supporting H1. Within the line of enquiry of Thompson and Malaviya (2013) research, a possible explanation for our results is that when provided with further information regarding the co-creator that validates his expertise, consumers stop being sceptic about the co-creators' ability to develop new products, which consequently makes them rate higher the perceived innovation ability of firms that co-create.

## 4.2 The effect of observing consumer's expertise

H2 hypothesizes that non-participating consumers with expertise in the product domain perceive the innovation ability of firms that co-create with consumers higher than company professionals.

To test our hypothesis, we started by performing an analysis of means (t-test) where we test whether observing consumers with expertise rate the innovation ability of firms differently from non-expert consumers. We divided these two groups by considering experts consumers, the ones that rated their expertise as a 4 or higher in a 1 to 7 scale.

Our t-test provided a significant and positive effect of expertise in how consumers rate the perceived innovation ability of firms  $M_{\text{Expert}} = 5,030$ ;  $M_{\text{Non-Expert}} = 4,617$ ;  $t(265)=3,265$  ,  $p=0,001$ .

Next, we performed a Two-Way ANOVA where we used innovation ability as our dependent variable and design source and observing consumers expertise as our independent variables. With this test we intend to check whether this positive effect of consumer expertise in perceived innovation ability of firms is still significant across the different design groups.

The test revealed that observing consumers expertise does not have a significant interaction effect with design source  $F(2,261)= 0,658$  ,  $p=0,519$  . Thus, H2 is rejected, since we find no evidence that observing consumers expertise directly moderates the relationship between design source and the perceived innovation ability of firms.

Dependent Variable: Innovation Ability

Source	df	F	Sig.
Intercept	1	5619.173	.000
Design Source	2	10.146	.000
Consumers Expertise	1	9.594	.002
Design Source * Consumers Expertise	2	.658	.519
Error	261		
Total	267		

*Table 6 – Design Source\*Consumer Expertise on Innovation Ability*

### 4.3 Perceived Similarity

H3 hypothesizes that higher levels of perceived similarity with the creator of the product (engineering students, students or company professionals) strengthens the positive effect of co-creation in the perceived innovation ability of the firm.

We started our analysis by doing a t-test where we check whether our participants that feel similar to the creator of the product, rate the perceived innovation ability of a firm differently from those that do not feel similar. We divided these two groups by considering the ones that feel like the creator of the product, if they rated their perceived similarity with the creator as a 4 or higher in a 1 to 7 scale.

Our t-test provided a significant and positive effect of similarity in participants rated the perceived innovation ability of firms  $M_{\text{Similar}} = 5,005$  ;  $M_{\text{Non-Similar}} = 4,569$ ;  $t(265)=3,442$  ,  $p=0,000$ .

Furthermore, we performed a Two-Way ANOVA where we used innovation ability as our dependent variable and design source and perceived similarity as our independent variables. The intention of this test is to check whether this positive effect of perceived similarity is still significant across the different design groups.

The test revealed that the participants similarity with the creator has a significant interaction effect with design source  $F(2,261)= 2,877$  ,  $p=0,05$  .

Dependent Variable: Innovation Ability

Source	df	F	Sig.
Intercept	1	4574.990	.000
Design Source	2	5.653	.004
Similarity	1	11.959	.001
Design Source * Similarity	2	2.877	.058
Error	261		
Total	267		

*Table 7 - Design Source \* Similarity on Innovation Ability*

The descriptive table just below, shows that when the creators are Engineering Students and Company Professionals, perceived similarity with the co-creator matters, since consumers that feel similar to the creator rate the innovation ability of the firm higher. However, in the case of where the creators are Students, our results suggest that similarity with the creator does not increase the perceived innovation of the firm, which further supports our idea of skepticism when no further information about the co-creator is provided.

Dependent Variable: Innovation Ability

Design Source	Similarity	N	Mean	Std. Deviation
Company Professionals	Low	88	4,555	1,060
	High	23	5,209	0,841
Students	Low	16	4,475	1,416
	High	55	4,465	0,818
Engineering Students	Low	33	4,655	1,221
	High	52	5,485	0,758

*Table 8 - Innovation Ability Means by Design Source \* Similarity*

Dependent Variable: Innovation Ability

Design Source*Similarity Contrasts	Differences	P value
Company Professionals, High - Engineering Students, High	-0.276	0.876
<b>Company Professionals, High - Students, High</b>	<b>0.743</b>	<b>0.033</b>
Company Professionals, High - Company Professionals, Low	0.654	0.058
Company Professionals, High - Engineering Students, Low	0.554	0.312
Company Professionals, High - Students, Low	0.734	0.209
<b>Engineering Students, High - Students, High</b>	<b>1.019</b>	<b>&lt;.0001</b>
<b>Engineering Students, High - Company Professionals, Low</b>	<b>0.930</b>	<b>&lt;.0001</b>
<b>Engineering Students, High - Engineering Students, Low</b>	<b>0.830</b>	<b>0.003</b>
<b>Engineering Students, High - Students, Low</b>	<b>1.009</b>	<b>0.006</b>
Students, High - Company Professionals, Low	-0.089	0.995
Students, High - Engineering Students, Low	-0.189	0.954
Students, High - Students, Low	-0.009	1.000
Company Professionals, Low - Engineering Students, Low	-0.100	0.996
Company Professionals, Low - Students, Low	0.079	0.999
Engineering Students, Low - Students, Low	0.179	0.991

*Table 9 - Tukey test on Innovation Ability by Design Source \* Similarity*

Looking into our Tukey post-hoc test we find that only some of the interactions are significant (highlighted in bold). Despite that, there are some interesting results where we can draw conclusions from.

First, our results suggest that under complex products, Company Professionals have a significant advantage from Students in terms of perceived innovation ability when being compared by consumers that feel similar to the creator of the product  $M_{\text{Students-High}} = 4,465$ ;  $M_{\text{Company Professionals-High}} = 5,209$ ;  $p = 0,033$ . This result goes in line with Moreau and Herd's (2010) research which shows that professionals tend to have a significant advantage, either real or perceived, over consumer-creators, in terms of their knowledge, training and experience, which consequently transfers the perception towards the market that consumer-creators do not have the necessary set of skills to undergo in the innovation process of more complex products.

Secondly, our results suggest that under complex products, students tend to not trust other students with the ability to provide relevant innovative ideas for new products, whereas engineering students perceive other engineering students as being able to provide relevant innovative ideas  $M_{\text{Eng. Students - High}} = 5,485$ ;  $M_{\text{Students-High}} = 4,465$  ( $p < 0,0001$ ).

Taking all into consideration, our results support our H3 since our main interaction is significant ( $p=0,05$ ).

### 4.4 Behavioral Outcomes

The behavioral outcomes we studied are recommendation intent, purchase intent, and willingness to pay. We chose these variables since numerous studies confirm that co-creation tends to impact these variables positively (Schreier et al., 2012; Nishikawa et al., 2017).

Starting with recommendation intent, we performed a One-Way ANOVA with recommendation intent as our dependent variable and design source as our independent variable, to clearly see if participants have different recommendation intents by each design scenario.

Dependent Variable: Recommendation Intentions

	df	F	Sig.
Between Groups	2	7.078	.001
Within Groups	264		
Total	266		

Table 10 – ANOVA table for Recommendation Intentions per design source

Dependent Variable: Recommendation Intentions

Design Source	N	Subset for alpha = 0.05	
		1	2
Company Professionals	111	4.054	
Students	71	4.493	4.493
Engineering Students	85		4.729
Sig.		.064	.445

Table 11 - Recommendation Intentions per Design Source

Our ANOVA provided a statistically significant difference in recommendation intent per design source  $M_{Eng.Students} = 4,729$ ;  $M_{Students} = 4,493$  ;  $M_{Company Professionals} = 4,054$   $F(2,264)=7,078$  ,  $p= 0,001$

Looking into our post-hoc test, we can see that products designed by engineering students are rated significantly higher compared to company professionals. However, products designed by students are not statistically different from engineering students and company professionals, so we cannot reject the hypothesis that their recommendation intents are

similar. Taking all into account, our results support H4 since it shows that the design group that is perceived higher in terms of innovation ability is also the one with higher recommendation intentions (Engineering Students).

Regarding purchase intention, we followed the same procedure with the sole difference of now using purchase intention as our dependent variable, as compared to recommendation intent.

Despite engineering students having a higher mean than the other two design groups, our ANOVA did not provide a statistically significant difference in purchase intentions between the different design groups source  $M_{\text{Eng.Students}} = 4,447$ ;  $M_{\text{Students}} = 4,183$ ;  $M_{\text{Company Professionals}} = 4,009$  ;  $F(2,264) = 2,373$  ,  $p = 0,095 > 0,05$ .

Dependent Variable: Purchase Intentions

Design Source	N	Mean	Std. Deviation	Std. Error
Engineering Students	85	4.447	1.4680	.1592
Students	71	4.183	1.3970	.1658
Company Professionals	111	4.009	1.3382	.1270
Total	267	4.195	1.4034	.0859

*Table 12 - Purchase Intentions per Design Source*

Dependent Variable: Purchase Intentions

	df	F	Sig.
Between Groups	2	2.373	.095
Within Groups	264		
Total	266		

*Table 13 – ANOVA table for Purchase Intentions per Design Source*

Further looking into the consumers purchase intentions, we looked into the consumer's willingness to pay by performing a One-Way ANOVA similar to the other behavioral outcomes, using design source as our independent variable.

Again, despite a high discrepancy in means between engineering students and the other two design scenarios ( $M_{\text{Eng.Students}} = 157,118$ ;  $M_{\text{Students}} = 121,662$ ;  $M_{\text{Company Professionals}} = 121,396$ ) , our ANOVA revealed that there are no statistically significant differences in the consumer's willingness to pay by design scenario, meaning that we cannot reject the hypothesis that the consumers' willingness to pay is the same in all design scenarios  $F(2,264) = 1,054$ ,  $p = 0,350$  .

Since we did not find statistically significant differences in both our variables that tested the buying intentions of the consumer, we cannot validate the hypothesis, that under complex products the buying intentions of consumers are positively affected by higher levels of perceived innovation ability from firms.

Dependent Variable: Maximum Amount

Design Source	N	Mean	Std. Deviation	Std. Error
Engineering Students	85	157.118	188.246	20.418
Students	71	121.662	146.203	17.351
Company Professionals	111	121.396	207.339	19.679
Total	267	132.839	186.734	11.427

*Table 14 - Maximum Amount per Design Source*

Dependent Variable: Maximum Amount

	df	F	Sig.
Between Groups	2	1.054	.350
Within Groups	264		
Total	266		

*Table 15 - ANOVA table for Maximum Amount per Design Source*

## 5. Findings and Discussion

The main purpose of this study was to explore if the observing consumers expertise and his perceived similarity with the co-creator moderated the perceived innovation ability of firms that co-create under complex products. The current literature of co-creation states that the positive innovation effect of co-creation loses its power when the underlying design task becomes too complicated, due to consumers doubting other users as being able to provide meaningful inputs in the innovation process (Schreier et al., 2012).

Our findings suggest that if a firm provides additional information that validates the co-creators' expertise then, consumers perceive firms that design with students higher in terms of innovation ability when compared with company professionals(H1). Drawing from the research of Dahl et al. (2014), we argue that this happens because when observing consumers are provided with background information of the co-creator, that validates their expertise in the underlying domain of the product, consumers stop being sceptic about the co-creator's ability to create innovative products.

Moreover, our study suggests that the positive effect of co-creation in the perceived innovation ability of firms verified in H1, also ends up influencing positively the consumers recommendation intentions(H4). This finding goes in line, with current literature for co-creation which suggests that the consumers recommendation and buying intentions increase for firms that have higher levels of perceived innovation ability (Schreier et al., 2012; Nishikawa et al., 2017; Randall et al., 2011). Despite that, we were not able to replicate similar results in our study for buying intentions.

This study also hypothesized that the effect of co-creation on observing consumers for complex products implies two important moderators the observing consumers' expertise in the underlying domain of the product (H2) and perceived similarity with the co-creator (H3).

First, regarding the observing consumers expertise in the underlying domain of the product. Despite our study finding that consumers with expertise in the underlying domain of the product rate the innovation ability of firms higher when compared to non-expert consumers, we did not find evidence supporting our theorized relationship that observing consumers with expertise rate firms differently in terms of perceived innovation ability according to design source and therefore H2 was rejected.



Secondly, regarding perceived similarity acting as a moderator of the perceived innovation ability for firms that co-create, our study suggests that consumers that feel similar to the creator of the product perceive higher innovation ability for the firm. Furthermore, this positive effect of similarity on the innovation ability of the firm also happens accordingly to the design source. Our study suggests that when consumers are provided with additional information regarding the co-creator expertise and they feel similar to the creator, the innovation ability of the firm is positively affected, whereas if no information is provided regarding the co-creator, the innovation ability of the firm does not increase with similarity. This finding goes in line with the skepticism-identification model proposed by Thompson and Malaviya (2013) which hypothesizes that when non-participating consumers are in a condition in which no source information is provided they become skeptic of the consumer-creator skills and expertise for the job, which consequently damages the overall consumers perceptions. However, when revealed background information that the creator has in common with the viewers, (i.e., a fellow college student) the negative effect is reversed, thus generating a positive effect towards the consumers perceptions of the firm.

Additionally, our study finds evidence that for complex products, when consumers feel similar to the design source and no information regarding the co-creator is provided, companies that use professionals have a significant advantage in terms of perceived innovation ability. However, when information regarding the co-creator is provided, the firm that co-creates is the one that performs better in terms of perceived innovation ability, thus supporting our H3.

## 5.1 Academic Implications

As firms have been starting to integrate their consumers more into their innovation process, scholars have been increasingly researching the effects of co-creation. Exhaustive research has already been made regarding the perceptions of observing consumers in the co-creation innovation process (e.g. Fuchs and Schreier, 2011 ; Nishikawa et al., 2017; Moreau and Herd, 2010), however there are still questions to be answered regarding the effect of co-creation under complex products, and researchers have been calling for further research on the matter (e.g. Schreier et al., 2012, Dahl et al., 2014) . Our study contributes to current literature in the following research fields: (1) the effects of co-creation under complex products, (2) the

effects of co-creation in buying behaviors of complex products, (3) the effects of observing consumers expertise in co-creation and (4) the effects of perceived similarity in co-creation.

First, our study shows that creator's perceived expertise is influential under complex products in valuing firms' corporate abilities, particularly innovation ability. Current literature in co-creation suggests that firms that co-create have a significant advantage compared to firms that use company professionals in terms of perceived innovation ability and buying intentions of consumers (Schreier et al., 2012; Nishikawa et al., 2017). However, under complex products this positive effect is dissipated due to consumers being sceptic of the co-creators' ability to provide meaningful innovations. (Schreier et al., 2012). Our research provides novel evidence to the current literature, by showing that if a firm provides additional information that validates the co-creator's expertise then, the positive innovation effect of co-creation still happens under complex products.

Second, our study strengthens the literature on the effect of co-creation under complex products in the recommendation and buying intentions of consumers. Current knowledge in user innovation suggests that when firms are perceived as being more innovative they have increased recommendation and buying intentions from consumers. (Schreier et al., 2012; Nishikawa et al., 2017). Our study provides novel knowledge by showing that this positive effect translates onto complex products in terms of recommendation intentions when provided additional information that validates the co-creator's expertise.

Third, our study presents novel findings by exploring how the observing consumers expertise affects their perceived innovation ability of firms that co-create. This has important implications for the academia as our results initiate a new research perspective of how observing consumers' own characteristics affects the perception of co-created products.

Lastly, our study strengthens the literature on the effect of perceived similarity in co-creation. Current research suggests that perceived similarity moderates the positive effect of co-creation in the perceived innovation ability of firms, since consumers that feel similar to the co-creator rate firms that co-create higher in terms of perceived innovation ability, in comparison with company professionals (Dahl et al., 2014). Our findings suggest that under complex products perceived similarity also moderates the positive effect in the perceived innovation abilities of firms that co-create with the caveat, that for this positive effect to happen consumers need to be provided with additional information regarding the co-creator.

## 5.2 Managerial Implications

Firms have been increasingly incorporating consumers in their innovation process since it enables them to capture the market's needs, which consequently enhances their chances of making market fit products (Rindfleisch and O'Hern, 2010), as well as enhance their observing consumers perceptions of the firm (Schreier et al., 2012). Despite that, most firms under complex products are wary of incorporating consumers in their innovation process since current literature suggests that under complex products the positive effect of co-creation is dissipated (Schreier et al., 2012). The findings of this study provide a new perspective where firms under complex products can still retain the positive effect of co-creation, thus offering important managerial implications.

First, our findings identified that if firms provide additional information regarding the co-creator, which validates his expertise in the underlying domain of the product, companies get valuable returns, such as positive perceptions of the firm's innovation ability, as well as consumers recommendation intentions even under complex products. By stating that the product was, for example, ideated by engineering students rather than simply students in a product where engineering expertise is needed, the consumers stop doubting the co-creator's expertise on the job, which consequently enables firms to differentiate themselves from their competitors that use company professionals, thus generating competitive advantage (Nishikawa et al., 2017; Dahl et al., 2014).

Second, our findings suggest that the observing consumers expertise does not moderate the positive perceptions generated by the co-creation. This information is relevant for managers because in terms of marketing their product, companies do not need to take special attention into their target's expertise to successfully market a complex product as co-created.

Lastly, our study provides evidence that perceived similarity with the co-creator moderates the positive perceptions of consumers towards firms that co-create under complex products. This finding provides important information for firms in how to market their co-created products, since it informs managers that by providing information of the co-creator, which facilitates this similarity with their consumer to happen (like a similar area of study), they can generate positive perceptions towards the firm in terms of perceived innovation ability and recommendation intentions.

## 6. Limitations

This study has some limitations that should be considered when analyzing our results. First, this study was conducted with only one product category, robotic toys. Despite the product of choice being carefully picked, by choosing a product that already has companies co-creating in the market (LEGO) and that has research which illustrates that consumers perceive this product as being a complex product to design (Schreier et al. 2012), it may be that for other types of complex products, such as cars, we may find different results than the ones attained in this study, thus we recommend further research on co-creation under other complex products.

Additionally, this study only focused on a product that is sold business-to-consumer. It is expectable that for the business-to-business sector our results do not apply, since the advantages and disadvantages of co-creation are essentially different between sectors, which consequently would need a different research approach to study the business-to-business sector. (Ramaswamy and Gouillart, 2010)

Another limitation of our study is that in the literature review we link many advantages for firms to be perceived higher in terms of innovation ability. Literature suggests that when a firm is rated highly in terms of innovation ability, consumers get increased buying behaviors and recommendation intentions towards the brand (Schreier et al., 2012; Nishikawa et al., 2017). Despite that, we were not able to fully replicate these results, particularly for buying behaviors, thus further research should be made under complex products to check whether similar results are found.

Furthermore, despite having collected 267 answers from our survey for our analysis the dataset ended up being unbalanced despite taking the proper measures in Qualtrics to ensure an equal number of observations per scenario. This happened due to participants opening the questionnaire and not finishing it. This unbalance in our dataset may have biased some of our results in questions with plenty of clusters, such as the effect of perceived similarity due to a small amount of observations in some of the clusters.

Lastly, the questionnaire was spread through the researchers own personal network and most of the respondents were fellow students, which created a small chunk of participants feeling similar to the creator when the product was designed by company professionals. At the same time a major chunk of the sample was composed of engineering students with interest in

robotics (either because of personal interest or work related) which may have evoked a deeper knowledge and relatedness to the experiment's topic. Thus, different outcomes could be found for the general population. Therefore, further research with a more diverse public sample is recommended.

This present thesis provides a first step for future research to study conditions in which co-creation under complex products may be beneficial. Future research should look into other observing consumer characteristics which may impact how a firm is perceived, such as the consumers familiarity with user innovation, or even the consumers personality traits, since consumers that are more individualistic may rate firms that co-create lower, than collectivist individuals. Taking all into consideration, this study provides evidence that co-creation under complex products can be beneficial under certain circumstances, and we encourage future research to further explore the topic so that the academia better understands the impacts of using this innovation process.

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# Appendix

## Appendix 1: Descriptive details of questionnaire measurement items

	N	Minimum	Maximum	Mean	Std. Deviation	Variance
Similarity	267	1.0	7.0	3.539	1.751	3.069
Expertise	267	1.0	7.0	3.202	1.809	3.275
Recommendation Intentions	267	1.0	7.0	4.386	1.305	1.704
Purchase Intentions	267	1.0	7.0	4.195	1.403	1.969
Maximum Amount	267	.0	2000.0	132.839	186.734	34869.647
Innovation Ability	267	1.0	7.0	4.781	1.059	1.122
Product Complexity	267	2.0	8.0	4.993	1.103	1.218
Interest in Robotic Toys	267	1.0	7.0	3.966	1.666	2.777
Designer Expertise	267	1.00	7.00	4.986	1.284	1.651

*Table 16 - Descriptive table of main variables*

## Appendix 2: Demographic details of questionnaire measurement items

Variable: Age of Participant				
	Frequency	Percent	Valid Percent	Cumulative Percent
< 18 years	9	3.4	3.4	3.4
> 25 years	11	4.1	4.1	7.5
18-21 years	141	52.8	52.8	60.3
22-25 years	106	39.7	39.7	100.0
Total	267	100.0	100.0	

*Table 17 - Age Distribution of Participants*

Variable: Gender of Participant				
	Frequency	Percent	Valid Percent	Cumulative Percent
Female	120	44.9	44.9	44.9
Male	147	55.1	55.1	100.0
Total	267	100.0	100.0	

*Table 18 - Gender Distribution of Participants*

Variable: Area of Study of Participant				
	Frequency	Percent	Valid Percent	Cumulative Percent
Engineering	88	33.0	33.0	33.0
Law	4	1.5	1.5	34.5
Management and Economics	107	40.1	40.1	74.5
Mathematics	2	.7	.7	75.3
Other	26	9.7	9.7	85.0
Sciences	40	15.0	15.0	100.0
Total	267	100.0	100.0	

*Table 19 – Area of Study Distribution of Participants*

Variable: Professional Status of Participant				
	Frequency	Percent	Valid Percent	Cumulative Percent
Other	3	1.1	1.1	1.1
Studying	209	78.3	78.3	79.4
Working	23	8.6	8.6	88.0
Working and Studying	32	12.0	12.0	100.0
Total	267	100.0	100.0	

*Table 20 – Professional Status Distribution of Participants*