LUND UNIVERSITY
School of Economics and Management

The Composition of a Radical Symphony

An Enquiry into the Possible Relation between Collaborative Design and Idea Quality in the Front End

by

Ancuta Boiciuc

Romy Roosken

May 2020

Master's Programme in Corporate Entrepreneurship and Innovation

Supervisor: Sotaro Shibayama

Examiner: Joakim Winborg

Abstract

Date of the Seminar: 28th of May 2020

Course: ENTN39 Master's Corporate Entrepreneurship and Innovation
Internship and degree project (Master's thesis 15 ECTS)

Authors: Ancuta Boiciuc and Romy Roosken

Supervisors: Sotaro Shibayama

Examiner: Joakim Winborg

Title: The Composition of a Radical Symphony - An Enquiry into the Possible Relation between Collaborative Design and Idea Quality in the Front End

Keywords: Radical innovation, Front-End of Innovation, Collaborative design, Idea owner, Designer, Completeness, Comprehension, Requirements, Expectations, Individual Comprehension, Mutual understanding, Quality, Workability, Relevance, Specificity

Research Question: *How do individuals in collaborative design influence the quality of radical ideas?*

Methodology: The methodological scheme for this research is a qualitative case within a case study following an abductive approach. A case company within the hospitality industry was used as the observational context to conduct this research upon and analyse the unique characteristics of each selected project. The main data source consisted of the semi-structured interviews of projects with radical ideas, which included collaborative design in the front-end of innovation. Furthermore, the data analysis consisted of a within-case analysis, to present the identified causal links between collaborative design and quality dimensions, followed by a cross-case analysis to determine the similarities and differences between projects. Finally, a theoretical framework was composed, to outline the answer to the research question.

Theoretical perspective: This study sheds light on the connection between collaborative design and the qualitative aspect of ideas in the front end of innovation. The purpose is to showcase how subjective factors within collaborative design have an influence on the quality of radical selected ideas.

Conclusion: This research prevailed that mutual understanding of initial set requirements among actors positively impacted the specificity of an idea in the selection stage. Thus, actors' understanding of the requirement seeds into specific and clear ideas. Moreover, joint comprehension of the meaning behind the established requirements was crucial to conceive into relevant ideas. Additionally, the study revealed that

collaborative design in relation with quality is path dependent by nature, hence the individual’s actions executed in IG influences the decision made in IS. Finally, this research confirmed that the assessment of information’s completeness complements understanding actors’ interpretation in the selection stage of FEI.

Acknowledgements

It is with great honor to be able to write the following words, as the current master’s thesis represents the fruit of the academic work we have dedicated uncountable hours to accomplish. The insightful, challenging and unforgettable past months have modeled the individuals we are today. Being able to embark on this journey of self-discovery and intense learning through our student experience in the Corporate Track of the Master’s programme of Entrepreneurship and Innovation, has taught us essential matters: out of comfort perspective and hard work. We were challenged to reach outside our own limits and deliver more than self-imagined and for that we are extremely grateful.

A fundamental piece of the creation puzzle of this research we owe it to our supervisor Sotaro Shibayama, who has always been a vital support and contributor to the accomplishment of the thesis. His advice, unconditional cooperation and open-minded thinking has positively left a mark on our experience. Another acknowledgement we would like to present is to our case company mentor, for his kind and continuous support throughout our internship and for always encouraging and assisting us in challenging situations. Nevertheless, we would like to show our regards for all the interview participants, who took their time out of these uncertain times to openly contribute to this study.

Finally, we have felt tremendous support from our fellow colleagues and we want to thank them for embarking on this adventure together. Us, the researchers are immensely thankful for having been there for each other, pushing to strive for more and our close family for supporting us to achieve this milestone.

Ancuta Boiciuc and Romy Roosken
Lund, 19 of May 2020

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List of Abbreviations

Front End of Innovation = FEI

New Product Development = NPD

New Process Development = NpD

Case Company = CC

Idea Generation = IG

Idea Selection = IS

1.Introduction

1.1 Background

Businesses are nowadays required to promptly adapt to the changing environment, which has led to a more complex product and design development (Bocken et al., 2013). Consequently, literature focused on how to manage innovation development processes efficiently. The innovation process contains the entire journey from initial idea to commercialization of a product (Kahn, Evans Kay & Uban, 2005; Ulrich & Eppinger, 2012). The coordination of these processes is divided, whereby most literature clustered it in three phases; 'Front End of Innovation (FEI); 'New Product Development' (NPD) and 'Commercialization' (Brem, 2008; Koen, Bertels & Kleinschmidt, 2014; Koen, Ajamian & Clamen, 2001; Ulrich & Eppinger, 2012). Please see figure 1 for visualization of the stages.

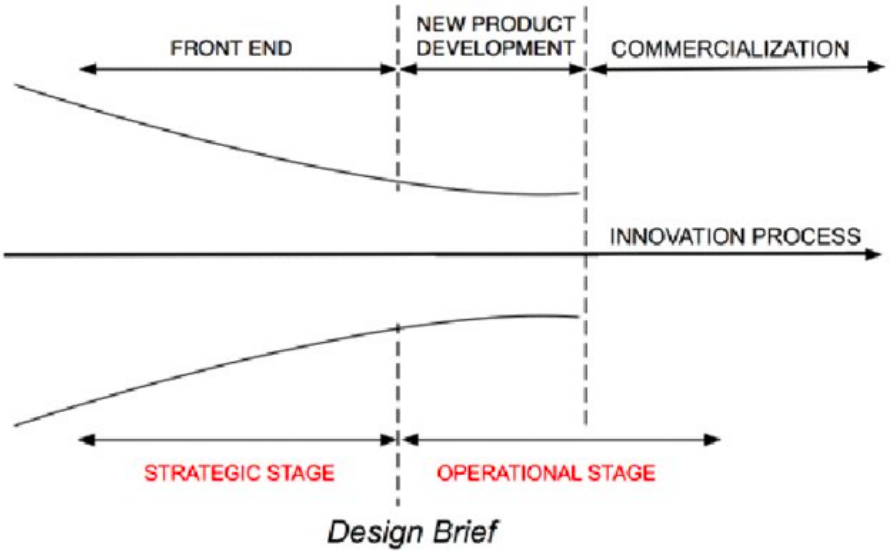

Figure 1: Innovation design process (Dewulf, 2013)

One of the critical drivers to increase the probability of a successful innovation process is to put the emphasis on FEI (Cooper, 1994; Khurana & Rosenthal, 1988; Koen, Bertels & Kleinschmidt, 2014; Murphy & Kumar, 1997). FEI consists of the start of opportunity identification, which feeds into ideas and ends when the idea is approved and judged for further development (Kim & Wilemon, 2010). Subsequently, the process will continue in the NPD stage, where the idea will be developed until it is ready for pre-commercialization (Kahn, Evans Kay & Uban, 2005).

Decision-making within FEI has a higher influence on later innovation processes, since it impacts the design, costs and resource allocation (Cooper, 1988). The costs for changes are higher in the later stages, which can be prevented by profound preparation in FEI (Brem, 2008; Dewulf, Wever & Brezet, 2012; Herstatt & Verworn, 2004). Despite the fact this issue is empirically recognized, there exists an ambiguous understanding of how to manage and organize FEI (Edkins et al., 2013).

Businesses tend to place more emphasis on incremental ideas, due to a higher certainty in the development process and less risky circumstances to deliver solutions (Eling & Herstatt, 2017; Khurana & Rosenthal, 1998; Reid & de Brentani, 2004). However, radical ideas have a higher chance to forge into a long-term sustainable competitive advantage and enable a company to stay behind rivalries (Barczak, Griffin & Kahn, 2009; Kuratko, Morris & Covin, 2011). Nevertheless, working with radical ideas requires an extensive effort during the front-end, to understand new markets and accumulate new knowledge (Frishammar et al., 2016).

The management of radical ideas in FEI goes in conjunction with high ambiguity and uncertainty of information (Eling & Herstatt, 2017; Jugend et al., 2018; Reid & de Brentani, 2004; Rizova et al., 2018). This is mainly due to the unpredictability of market and financial feasibility (Herstatt & Verworn, 2004; Khurana & Rosenthal, 1998). Uncertain information relates to the gap between the information possessed by individuals and the required information to implement a radical innovation successfully in subsequent stages (Daft & Macintosh, 1981). As proposed by Yus (1999), the higher the uncertainty of information, the greater the chance individuals will fill the gap by their own cognitive framework, thus the higher the level of equivocality (Clarkson & Eckert, 2005). Equivocality means *'the extent to which project participants grapple with multiple, and plausibly conflicting, meanings and interpretations of the information available to them'* (Rizova et al., 2018, p.40; Daft & Macintosh, 1981). Due to high uncertainty of information, the decision-making processes for radical innovations in the early stage of FEI is more difficult to comprehend (de Oliveira et al., 2015; Leifer, 1998; Williams & Samset, 2010). Collaboration in decision-making processes is seen as a crucial factor to reduce equivocality and enhance comprehension during FEI (de Oliveira et al., 2015; Sukhov, 2018).

This paper focuses on collaboration in the design section of FEI, called collaborative design (Kleinsmann, Valkenburg & Buijs, 2007). Collaborative design begins when an individual exchanges an opportunity with a designer, in which information is interpreted and feeds into new ideas that are later evaluated. A final idea is selected and submitted for concept development, which completes the collaborative design.

Radical innovation mostly stems from individuals, who come across ideas, which can be classified as uncertain due to lower degree of familiarity for a business (Björk & Magnusson, 2009). In order to manage uncertainty, there is a need for individuals with various expertise to collaborate and work together towards reducing the commercial and technological risks (Clarkson & Eckert, 2005).

Collaborative design within the innovation process received more attention within academics, since designers and project managers are the key drivers behind achieving a successful design process (Bocken et al., 2013). Collaborative design involves individual work as well as teamwork (hybrid structure) in between heterogeneous entities (Kleinsmann et al., 2012). As described by Ostergaard & Summers (2003), 70% of the work is done by individual followed by teamwork, in the form of handovers, joint designing and negotiation for clarifications and finally the selection of best qualified ideas (Eckert, Clarkson & Stacey, 2001; Stacey & Eckert, 2001; Terwiesch & Ulrich, 2009).

Scholars have focused on understanding the quantitative aspect behind generating ideas within collaboration, however there is still a gap in how the teamwork between individuals impacts the qualitative features of an idea (Björk & Magnusson, 2009; Girotra, Terwiesch & Ulrich, 2010, Terwiesch & Ulrich, 2010; Teza et al., 2015). Investigating the qualitative aspects of an idea can determine and improve its performance in the later development stages of innovation (Shah & Vargas - Fernandez, 2002).

To summarize, the management of radical innovations within FEI requires another approach, due to the high level of equivocality and ambiguity of information (Daft & Macintosh, 1981; Rizova et al., 2018). One of the critical factors, to manage radical innovation, is the collaborative design in FEI, since collaboration involves exploring possible opportunities and reaching a consensus on which idea to further pursue (Calsamiglia & Van Dijk, 2004; Ostergaard & Summers, 2003).

1.2 Problem Discussion

The descriptive aspect of information transmitted between actors within collaborative design and how this enhances the communication flow, has mainly been investigated (Blyth & Worthington, 2001; de Oliveira et al., 2015; Dewulf, Wever & Brezet, 2012; Parkman, 2010; Phillips, 2004). Albeit it is crucial (Blyth & Worthington, 2001), the way individuals are making sense of the information and assess its completeness is congruent with their own inherited object worlds (Bucciarelli, 1996; Larsson, 2003). Additionally,

Bacon et al (1994) investigated thoroughly how the completeness of the project description within the initial stage of innovation shortens the overall development time. Nevertheless, this research omitted the interrelationship with the quality of ideas. The individual's role regarding transmitted information has been investigated and it resulted that the description and usability of information could alter communication in collaborative design. This is mainly substantiated by unclear and incomplete product descriptions, containing possible product technicalities, market segments and criteria, whereby this information serves as guidance for individuals involved in collaborative design (Boos, 2007; Eckert, Clarkson & Stacey, 2001; Francisco & Zanela Klein, 2020).

Moreover, the informational aspect of collaboration is researched exponentially, particularly how reduction of information equivocality can enhance communication flows in between individuals within an organization (Daft & Macintosh, 1981; Rizova et al., 2018). The research of Rizova et al (2018) sheds light on how to resolve the degree of equivocality in FEI by means of network centrality within collaboration. In addition, ambiguity of information within the pre-stage of product development can harm the communication flow between actors participating in collaborative design (Stacey & Eckert, 2003). Ambiguity of information leads to distinctive interpretations and negatively influences the course of previously taken design decisions, and the requirements behind them (Stacey & Eckert, 2003). Nevertheless, ambiguity can also lead to different understandings of design among actors, which results in creativity and thus benefits the novelty of the idea (Eckert, Maier & McMahon, 2005).

To sum up, previous literature sought how information flows within collaborative design can be enhanced by taking into account the subjective factors among actors (Coughlan & Macredie, 2002; Eckert, Clarkson & Stacey, 2001; Eckert, Maier & McMahon, 2005; Francisco & Zanela Klein, 2020; Minneman, 1991; Mylopoulos et al., 2007; Pohl, 1994; Stacey & Eckert, 2003). None of these studies have placed the emphasis on the quality dimensions of generated ideas in FEI, instead the focus lied on the effectiveness of communication flows and reduction of barriers in the design process.

Previously, quality has been investigated at the end of the development process, by assessing the commercial and technical fit (Hermans & Liu, 2013). Recently, scholars have been shifting their attention towards the front end, looking at assessing the quality of generated ideas, to determine if worth pursuing in the development phase (Dean et al., 2006). Consequently, idea assessment has transitioned from a simple go or no-go classification to a more holistic perspective on quality, involving distinctive criteria (for example relevance, specificity) (Sukhov, 2018, Dean et al., 2006).

Furthermore, several variables have been discovered to influence quality assessment, from motivation of participants, the role of opportunity identification, group structures, to the process of transforming an initiative into an outcome (Blohm et al.,2010; Bretschneider, Rajagopalan & Leimeister, 2012; Girotra, Terwiesch & Ulrich, 2010, Terwisch & Ulrich, 2010).

Despite the growing interest in idea quality, the subjective factors of collaboration, involving actor's mutual understanding and individual comprehension of information received, have not been studied in relation to idea quality in FEI (Blohm et al., 2010). This interrelation is crucial, as by focusing on quality, potential barriers can be reduced in the later stage of the innovation process.

Therefore, the identified research gap will be addressed by the following research question, in which individual's role in collaborative design will be explored in relation with the quality of radical ideas. Hence, the research question will be:

'How do individuals in collaborative design influence the quality of radical ideas?'

1.3 Research Purpose

The aim of this study is to seek how subjective factors in collaborative design impact the quality of ideas in FEI. This paper builds upon existing literature for several reasons. Prior literature identified the importance for a business to generate and select the best idea in FEI, rather than only focusing on the generation of high volume of ideas (Björk & Magnusson, 2009). In the same vein, this study investigates how behavioural elements of collaborative design influence the generation and selection of the best idea rather than focusing on the high volume. Specifically, the emphasis will be placed on the core of collaborative design consisting of individuals' assessment and perception of information exchanged and how individuals understand each other when it comes to the generation and selection of the best ideas. The study of Sukhov (2018) examines the subjective factors of individuals in relation to quality, nevertheless they primarily explore how incomplete descriptive information influences the individual's perceived value of the quality. On the contrary, this study does not explore the descriptive aspects, however it explores how individuals comprehend initial established requirements and how their expectations, individual and mutual understanding influences the procedure of the generation and selection of a qualitative idea. Therefore, this research aims to understand how idea quality can be enhanced in a collaborative context, by focusing on individuals and their behavioral processes.

1.4 Case Company

The case company (CC) chosen for this research is a provider of solutions within the hospitality industry, headquartered in Sweden, with offices and production facilities across the globe. Being a leader within the market allowed CC to establish a strong presence in the domain of take-away products and table setting. The company is known for its wide selection of products, which fit several types of customers, however in recent years, CC discovered the need for working closer with innovation. In order to keep its competitive advantage, CC decided to establish a new development process (NPD), which will ensure that ideas come from in-house and make a difference in the life of its existing customers.

The NPD follows a new structure as it allows the company's employees to design the future products, whereas before, new solutions would come from distributed partners. Within the initial stage of the NPD,

the so-called 'Idea' phase, employees with complementing expertise are set out to collaborate, to come up with innovations.

Furthermore, the relationship between the collaborators is informal, however the decision power is very well established. The information transmitted across the initial NPD phase is based on subjective opinions or judgements, which makes this case unique if one remarks on the topic of this study: influence of collaborative design on idea quality. Moreover, the methods used by the employees to communicate during the initial design phase, such as informal conversations and formal documents, allow the researchers to come across several points of interest regarding the role of collaborative design.

Nevertheless, CC also saw the opportunity of shifting from a traditional product-based firm towards providing services and expanding its customer base to new areas. This decision allows the researcher to pursue a study, which can be considered more generalizable, as it includes a particular setting for innovation and collaborative design.

In conclusion, the CC is a suitable research object for this study, as it meets an unique series of features of conducting innovation in FEI. It also provides an intriguing setting for collaborative design, which builds a great foundation for the discovery of relational effects of collaborative design on the qualitative aspects of ideas.

2.Literature Review

The following chapter presents suitable reviewed literature within the spheres of this study and consists of three blocks. Firstly, 'Innovation' is presented by touching up the particularities of FEI, specifically for idea generation and selection. Secondly, 'Collaborative design' looks at the actors involved and their role in a collaboration and how they understand, evaluate and interpret information. Finally, 'Quality' highlights the importance of and the required dimensions to measure the quality of ideas within FEI.

2.1 Innovation

2.1.1 Innovation process

Innovation has become a crucial success factor for companies to stay ahead of their rivalries in the continuously changing environment (Khurana & Rosenthal, 1998). Consecutively, the literature focused on how to manage innovation development processes efficiently. The innovation process starts with an initial idea and ends with the commercialization of a product (Kahn, Evans Kay & Uban, 2013; Ulrich & Eppinger, 2012).

2.1.2 Front end of innovation

The Front End of Innovation (FEI) consists of the start of opportunity identification, which feeds into ideas and ends when the idea is approved and judged for further development (Kim & Wilemon, 2010). Subsequently, the process will continue in the New Product and Development (NPD) stage, where the idea will be further developed until a product is ready for pre-commercialization (Koen et al, 2001). The commercialization phase involves the production and product-to-market involved activities.

The study of Kahn, Evans Kay & Uban (2013) has explored the stages of the innovation process and analyzed critical success drivers to manage the stages within the process. As confirmed in prior research, one of the critical drivers to increase the probability in a successful innovation process is to put the emphasis on the FEI (Cooper, 1994; Khurana & Rosenthal, 1998; Koen, Bertels & Kleinschmidt, 2014; Murphy & Kumar, 1997).

Herstatt & Verworn (2004) have visualized the importance of managing FEI. Within figure 2, it is stated that the decision-making within the initial stages of the innovation process has a higher impact on later

innovation processes, since it will impact the design, costs and resource allocation (Cooper, 1988). Subsequently, the costs for changes are higher in the later stages, which can be prevented by profound preparation in the initial stages (Brem, 2008; Dewulf, Wever & Brezet, 2012; Herstatt & Verworn, 2004).

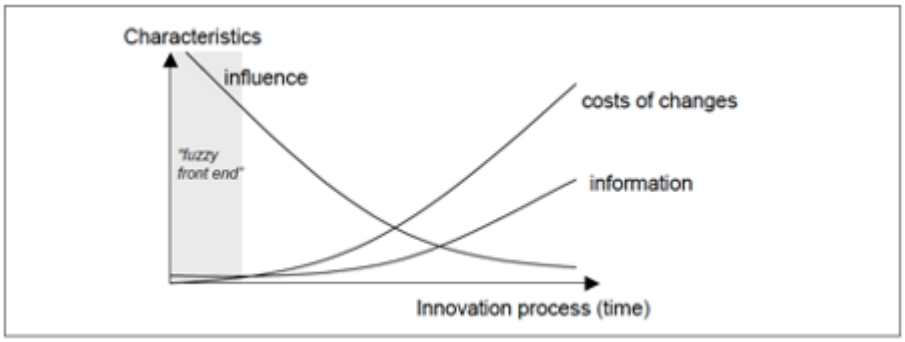

Figure 2 - Importance of Front End of Innovation (Herstatt & Verworn, 2004)

Additionally, as described by Edkins et al (2013), various definitions consist within the literature in the field of FEI. Kim and Wilemon (2010) state that FEI starts when opportunity is identified and ends when the idea is judged and approved for continuous development. Additionally, Khurana and Rosenthal (1998, p. 59), identify FEI as the process of *'product strategy formulation and communication, opportunity identification and assessment, idea generation, product definition, project planning, and executive review'*. As described by Reid & de Brentani (2004), FEI can be simply defined as all the predevelopment activities until the organization decided to start with organizational level absorption of the innovation process (Cohen & Levinthal, 1990). Lastly, Eling & Herstatt (2017, p.14) described FEI as follows; *'the very first phase of the NPD process that starts with the discovery of an opportunity or a raw idea for product innovation and ends when the GO decision is made to developing a new product'*.

As this study focuses on design collaboration for generation of qualitative ideas, it is appropriate to perceive FEI as the process where firstly an opportunity is determined, leading to a generation of ideas, an evaluation and lastly a final idea is selected for development (Kim & Willemon, 2010).

Moreover, one of the most important activities are the identification, generation and the selection of ideas within FEI (O'Brien, 2020; Teza et al., 2015, Cooper, 1988). Managing ideas is paramount since the composition of ideas will feed into concept development and eventually in a commercialized product. Additionally, activities within FEI are path-dependent since the efficient flows within subsequent processes are congruent on the information received in the initial stages (Reid & de Brentani, 2004).

Within the context of design, involved actors collaboratively seek for solutions to solve an initial established problem (Hannola & Ovaska, 2015). Subsequently, the idea generation and selection phase is paramount within the collaborative design, hence it contains the exploration phase of ideas through conceptualization, followed by the idea selection (Rietzschel, Nijstad & Stroebe, 2010; Kijkuit & van den Ende, 2007). The idea selection will discern the most qualified ideas and therefore goes in conjunction with design consensus among actors about the specific direction and compromises to be made regarding necessary trade-offs (Faure, 2004). Thus, collaborative design involves a sequential problem solving situation, whereby individuals need to explore ideas, aiming to solve the initial problem, and sequentially discern the best qualified idea, worth developing (Minneman, 1991).

Idea generation

Idea generation has also been defined as the building up process from managing knowledge to the configuration of ideas (Koen, Ajamian & Clamen, 2001). Idea generation is seen as one of the most important driving forces of successful development of product and processes, because it translates an identified opportunity into a concrete concept, which should eventually solve an identified problem (Kornish & Ulrich, 2014; O'Brien, 2020; van den Ende, Frederiksen & Prencipe, 2015). Therefore, idea generation is a combination of management and design decisions, in which certain goals, functions and requirements are setting the tone of later design processes (Vila & Albiñana, 2015).

Idea selection

As the ideas receive more attention and become detailed within the idea generation phase, they have to be submitted through a decision process, in order to identify which idea will be further pursued (Kijkuit & van den Ende, 2007). Nevertheless, decision-makers need to have a thorough understanding of the generated ideas and their applicability in a business context, in order to choose a viable idea (Forde & Fox, 2016). Furthermore, evaluating and selecting an appropriate idea can be considered as a method of quality control, which will ensure the project is still a viable investment (Cooper, 1988). Therefore, it is essential to pay special attention to the selection process, to ensure innovation does not suffer in the consequent development stages (Soonvald & Elerud-Tryde, 2011).

2.1.3 Three innovation horizons

Innovation can be classified under radical and incremental. Radical ideas in FEI require incorporating technology from a new angle and approaching different customer demands (Jugend et al., 2018; Leifer,

1998). Whilst incremental ideas refer to minor adaption on existing technologies and markets. (Darawong, 2018; Jugend et al., 2018; Terwiesch & Ulrich, 2009).

The degree of innovation can be assessed by means of 'The Three Horizons model'. The level of innovation of an idea is determined by means of technology uncertainty (assessing business capabilities and external technological advancements) and market uncertainty (information availability of a potential customer segment) (Terwiesch & Ulrich, 2009). Within figure 3, the degree of innovation is distinguished into three horizons, in which horizon 1 relates to incremental innovation and horizon 2 and 3 is classified under the radical innovation (Terwiesch & Ulrich, 2009).

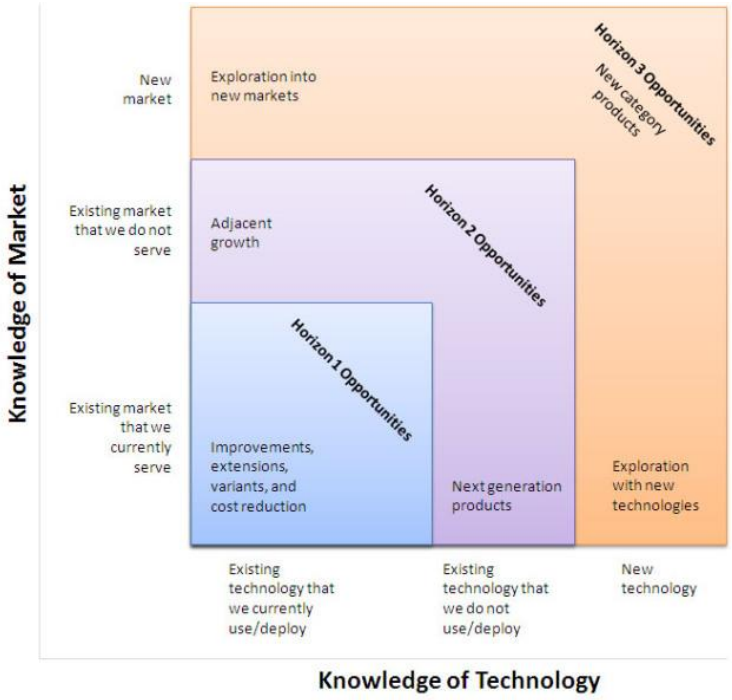

Figure 3: Innovation design process (Terwiesch & Ulrich, 2009)

2.2 Collaborative design

Collaborative design is a social interactive process that requires participation of individuals towards sharing information and organizing design tasks and resources (Chiu, 2002; Clarkson & Eckert, 2005). During collaborative design, group members cooperate by exchanging ideas, opinions and various information, which can stimulate their creativity and increase their chances of generating new ideas (Kobayashi & Higashi, 2009).

2.2.1 Collaborative structures

The structure of groups in correlation with the innovation process has been discussed by Girotra, Terwiesch and Ulrich, 2010 and they distinguish collaborative structure into the team structure and hybrid structure. The team structure is the collaboration of individuals alongside each stage of the idea generation process. Nevertheless, the hybrid structure is a sequence of first the individual work, followed by team collaboration within the idea generation process (Girotra, Terwiesch & Ulrich, 2010, Terwiesch & Ulrich, 2010; Robbins, 2007).

2.2.2 Interaction in Collaborative design

Robin, Rose & Girard (2007) has compiled a framework with the types of interaction within Collaborative design. The authors divided these into four types of interactions, which are visualized in figure 4. Out of those four, the focus will be placed on actor/artefact and actor/actor, as these interactions constitute the foundations for collaborative design in FEI, where an individual passes on design information to another actor in the initial stage, which is further jointly understood and assessed between actors in the subsequent stage (Eckert & Stacey, 2001).

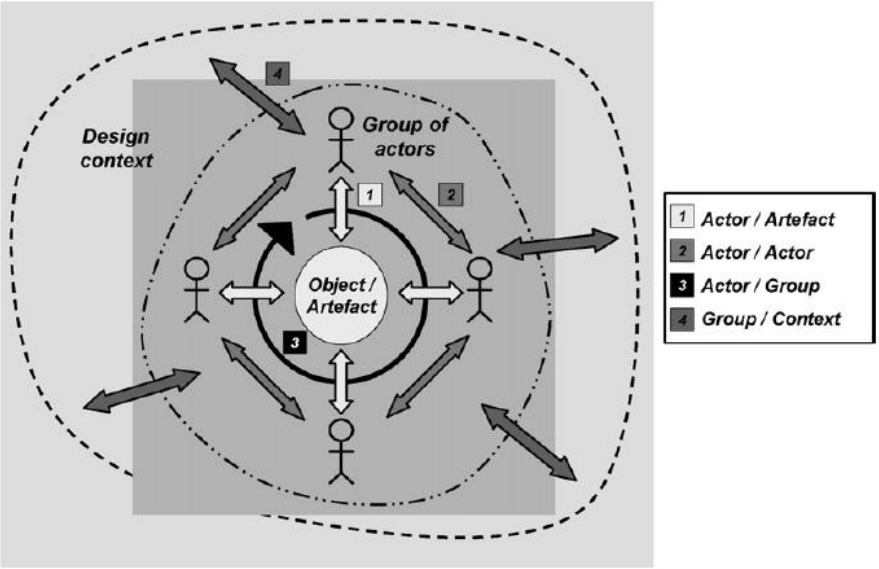

Figure 4: Interactions among actors (Robin, Rose & Girard, 2007)

The interactions are described as follows:

- **Actor/Artefact,** refers to the interaction where an individual absorbs information from an artefact. Within this interaction, it is important to assess the individuals' interpretation of the assimilated information (Blyth & Worthington, 2001; Phillips, 2004).

- A**ctor/Actor** interaction involves the communication and understanding between two individuals mostly possessing diverse fields of expertise (Moenaert et al., 1995; Monell & Piland, 2000; Ostergaard & Summers, 2003; Reid & de Brentani, 2004).

2.2.3 The role of an artefact

Within collaborative design, a hybrid team structure is employed, where individual work is produced in one stage of the innovation process and handed over in the following stage (Eckert, 2001). The collaborative design between actors will take place through reference of objects (Blyth & Worthington, 2001; Eckert, 2001). These references of objects are in academics called artefacts and serve as repositories to capture knowledge in between individuals and a tool to enhance an individual's understanding of the information transmitted and the context behind it (Dewulf, Wever & Brezet, 2012; Phillips, 2004).

Through these briefs, the individual is transmitting knowledge and information to another actor (Nonaka, 1991). Bringing the individual's expertise to a common place is a difficult process, because personal knowledge is hard to comprehend by others (Davenport, Beers & DeLong, 1995, Alavi & Ledner, 2001). The transfer of knowledge belongs to a transmitter-receiver model, where both parties may have different views on the information received (Lin et.al, 2005). Transferring knowledge is of high relevance, as knowledge acquires value if it is shared among actors (Mishra & Bhaskar, 2011). Each actor is assumed to look after aligning their interests and maximizing the benefits of working on the collaboration (Kleinsmann et al., 2012). The receiver might for example want to see value in the information received and this value is only achieved once the receiver evaluates the information (Lin et al., 2005).

2.2.4 **Completeness of information**

Effective collaborative design among individuals is multi-dimensional in nature, meaning that both the artefact as well as the individuals' utterances on how the information is perceived are crucial success factors (Bly, 1988; Eckert, Maier & McMahon, 2005; Minneman, 1991).

Understanding and evaluating information can be looked at from several perspectives, such as accuracy and completeness of information (Shankaranarayanan & Yu Cai, 2005). Completeness is defined as having all the necessary elements or all the required skills to make information whole (Strong & Wang, 1997). When it comes to collaborative design, it is essential to underline that sometimes the actors will not have the full context, which leads them to fill the gap by using their own understanding (Larsson,

2003). Therefore, completeness is related to the individual's perception (Shankaranarayanan & Yu Cai, 2005, Strong & Wang, 1997).

Each consumer of information essentially has different needs, which result in contrasting assessments of completeness (Eckert, Clarkson & Stacey, 2001). As information is related to a context (Nonaka, 1991), so is completeness, which depends on the intended use for the information (Weiskopf et al. 2013). Basically, whether information is complete depends exclusively on the sender's intentions, the information's characteristics and the receiver's perception (Shankaranarayanan & Yu Cai, 2005, Weiskopf et al. 2013). Perceived completeness can be classified into the requirements and expectations of the individual in regards to the information (Weiskopf et al. 2013).

A requirement can be defined as an individual's necessity to pursue a further activity or need (Weiskopf et al. 2013). Requirements can also be classified as the 'what', needed by an actor, to resolve a problem. Furthermore, they can also refer to understanding 'why' an actor needs to perform a specific task (Clarkson & Eckert, 2005). Forming requirements is a process, which depends on how an individual transforms informal declarations into explicit specifications (Clarkson & Eckert, 2005). Requirements can be seen as the provider of guiding points in the process of understanding the sent or received information and what is the purpose of the information in the collaborative process (Clarkson & Eckert, 2005).

On the other side, collaborating actors will value the knowledge and information transferred based on their prior experience (Nonaka, 1991). Therefore, this valuation will be based on the individual's expectations (Lin et al., 2005). Expectations are defined as the difference between what an individual comes across in the collaboration, by assessing prior experiences, and what one expects to encounter (Gkorezs & Kastritsi, 2016). Individuals form expectations depending on what the information would be used for in the collaborative context (Richardson, 1959).

There are several factors contributing to the formation of expectations. They are the basis of expectations and how individuals value information (Lin et al., 2005): (1) whether the knowledge transmitted is tacit or explicit (Nonaka, 1991); Tacit refers to the personal knowledge, difficult to convey to others, whereas explicit refers to the methodical knowledge, which can be easily communicated and transmitted through a system (Nonaka, 1991). (2) the sender's area of expertise; (3) the background in which the knowledge will be used; (4) the relationship between the sender and receiver; (5) the receiver's area of expertise.

The importance of expectations is related to how an individual experiences the management of information. If expectations are met, individuals will experience a positive outcome, yet if the opposite occurs, the later collaborative process might be affected.

2.2.5 **Comprehension of information**

Comprehension in collaborative design refers to the interrelationship between two actors and how they transmit their interpretation on information in between each other (Buijs & Kleinsmann, 2006). Specifically, individual comprehension of information about an objective within collaborative design might influence the mutual understanding between actors in later stages (Chiu, 2002; Girard & Robin, 2006; Robin, Rose & Girard, 2007). Comprehension can be distinguished into individual and mutual understanding and will be elaborated below.

a. Individual comprehension

Individual comprehension refers to how one comes to process the completeness of information, how an individual perceives the reaction of another actor to information and his/her own placement in regards to decision making in collaborative design (Minneman, 1991).

Interpretation of idea representation

Interpretation of idea representation refers to individuals' understanding of the specificities of the idea/conceptual design presented by another actor (Kleinsmann & Valkenburg, 2008; Boos, 2007; Eckert & Stacey, 2000; Kleinsmann et al., 2012; Stacey & Eckert, 2001). Miscommunication can arise when elements in representations are missing, in which the recipient has to fill the gap by its own interpretative skills (Daft & Macintosh, 1981; Eckert & Stacey, 2000). Individuals' idiosyncrasies can mismatch the objective behind the representation of the idea transmitted, also resulting in miscommunications, later in the innovation process (Bucciarelli, 1996; Eckert & Stacey, 2000; Yus, 1999).

Within FEI, individuals generate ideas and hand them over through oral or written specifications (Batat, 2010). As corroborated by Eckert & Stacey (2000), individuals showcase their ideas in words or documents without revealing inspirational sources, in which ideas are conceived. Nevertheless, sources of inspiration are a fundamental aspect to convert individuals' tacit knowledge into explicit knowledge, which recipients can base their interpretations on (Bly, 1988; Eckert & Stacey, 2000; Kleinsmann et al., 2012; Nonaka, 1991; Robin, Rose & Girard, 2007)

Moreover, when inspirational sources are omitted, a recipient will comprehend the information through its own prior obtained sources of information, which might differ from the transmitter (Boos, 2007; Eckert & Stacey, 2000; Stacey & Eckert, 2001). It is paramount to share inspirational sources, so the recipient is able to comprehend the individual's knowledge and thus the mutual objective of the presented idea (Eckert & Stacey, 2000).

Integrate it into own understanding of the situation

As described by Bucciarelli (1996), collaborative design is not only dependent upon understanding individual completeness of ideas generated and the comprehension behind the nature of the design. It involves understanding the object worlds an individual is adhering to. The same description of an idea can be understood differently amongst individuals, due to the diverse set of interests, worldviews and expertise inherited in individuals' object worlds (Bucciarelli, 1996; Eckert, 2001; Larsson, 2003). Differences between individual object worlds have been recognized and are socially constructed. Individuals involved in collaborative design have the tendency to place high empathy on the manifestation of their own efforts (Eckert, Maier & McMahon, 2005; Minneman, 1991). As a result, they hold preferences they tend to push through communication, which impacts the receivers' understanding (Eckert & Stacey, 2000; Ostergaard & Summers, 2003).

Look at the implications of the information of own tasks

Individuals might convey imprecise ideas, ambiguous by nature, because conceptualization of information is congruent to individuals' own conventional cognitive scheme, referring to how they make sense and understand information through their own experience and interaction with other actors (Chiu, 2002; Eckert, Clarkson & Stacey, 2001; Stacey & Eckert, 2001; Davidson, 2002). When information is not specified through interactive negotiation, individuals will unconsciously create conventional assumptions on which information is of higher value (Eckert, 2001; Eckert & Stacey, 2000; Yus, 1999). Consequently, the recipient will significantly commit more time on the information perceived as highly important, whilst the sender might have a contrasting perception of the same information (Taifa, Hayes & Stalker, 2020).

b. Understanding Each Other

Collaborative design within the idea generation and selection requires individual as well as collaborative skills. Each participant owns only a certain component of the design configuration, therefore it is essential that actors share information, to efficiently create a suitable idea (Kleinsmann et al., 2012). Prior research dug into communication and collaboration alongside the design process (Chiu, 2002; Kobayashi &

Higashi, 2009; Ostergaard & Summers, 2003; Robin, 2005). Mutual understanding in relation to collaborative design has been described as a process where actors are *"able to integrate and explore their knowledge and the larger common objective"* (Kleinsmann & Valkenburg, 2008, p. 486).

Actors involved in collaborative design attempt to form frames, to achieve a common sense of project guidelines and the needed solutions (Kleinsmann, Valkenburg & Buijs, 2007; Francisco & Zanela Klein, 2020; Schön, 1987). The compilation of frames is multidisciplinary by nature, in which actors negotiate to assure they obey a 'shared way' of interpreting the identified problem (Kleinsmann et al., 2012; Valkenburg & Dorst, 1998). Frames consist of an intervention called 'reflecting' (Schön, 1987).

'Reflecting' is prevailing in collaborative design, because of individuals' ability to reflect upon current activities and issues, to eventually comply with new subsequent tasks in line with set objectives (Schön, 1987). This indicates individuals are able to work within a frame they have self-composed.

Additionally, successful collaborative processes hinge upon individuals' ability to comply towards mutual set objectives as well as assessing which knowledge is of priority (Boos, 2007). This also corroborates with the transactive memory system, which refers to an individual's ability to discern specific knowledge possessed by other team members and assess which knowledge is most beneficial to share amongst team members in correspondence with an established goal (Wegner, 1987). Weighting knowledge as a team activity is paramount to collaborative design, as it leads to goal-directed behavior and shared rationality (Kleinsmann, Valkenburg & Buijs, 2007; Valkenburg & Dorst, 1998).

To conclude, individual and mutual understanding among actors within a collaborative design is paramount to steer every participant towards the same direction and to explore and discern the most qualified ideas. How individuals understand each other' alongside the idea generation and selection phase can influence the subsequent stages and thus the quality of the selected idea. For this reason, this study will focus on the investigation of collaborative design in FEI, by looking at the dimensions of completeness and comprehension and their respective subdimensions (see figure 5).

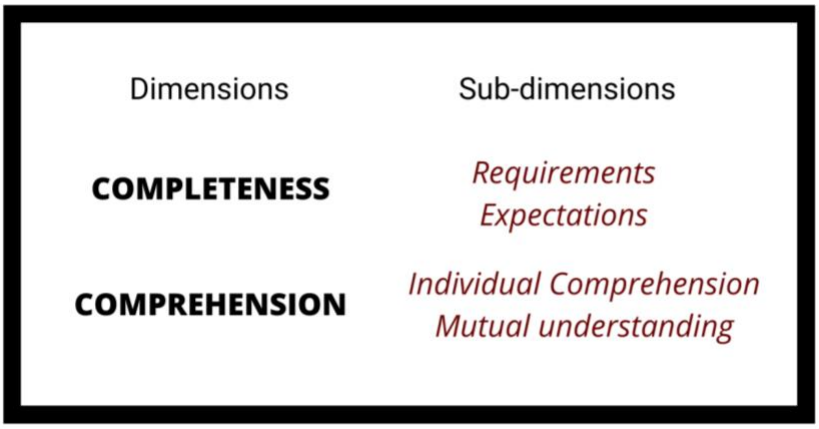

Figure 5: Collaborative design dimensions

2.3 Quality

How does one judge what is a good idea and how does one define the qualitative aspect of an idea? The following content aims at looking at the overall understanding of quality and its relevance to the innovation process, followed by an examination of idea quality within FEI, and a presentation of the quality dimensions employed in this study.

2.3.1 Definition of Quality

Quality ideas are the ones who are most capable of turning into a successful solution and match the expectations of decision makers (Reinig & Briggs, 2008). When it comes to the innovation process, quality has been perceived, defined and measured by recurring to different aspects and metrics (Dean et al., 2006). For FEI, quality is assessed by looking at the idea(s) generated throughout the process and whether they meet a specific threshold on several criteria (Dean et al., 2006). Contrarily, the NPD stage approaches quality by analyzing it from a finalized product's perspective, where technicality and commercialization are essential criteria (Sukhov, 2018; Soderquist & Godener, 2004, Hermans & Liu, 2013). The relationship between the two stages and evaluation of quality is emphasized by Cooper (1996), who highlights the importance of evaluating the quality of ideas within FEI, as it determines and influences the outcome within NDP.

2.3.2 Quality in FEI

In the front end of innovation, scholars have been interested in generated ideas and how selected ideas impact the later stages of innovation (Girotra, Terwiesch & Ulrich, 2010, 2010; Dean et al., 2005; Sukhov, 2018; Kudrowitz & Wallace, 2013; Dziallas, 2018). In the discussion of quality in FEI, several researchers looked at quality of ideas as a benchmark for assessing the outcome of this early stage of innovation (Perez, 2017). Dean et al (2006) chooses to look at idea quality as a solution that is implementable and will solve an encountered issue. Girotra, Terwiesch and Ulrich, (2010) showcase that idea quality should be perceived as the expected value of an idea, assuming the required resources are allocated.

Furthermore, Sukhov (2018) looks at idea quality from the perspective of assessing which ideas should be further pursued. On the contrary, Salomo & Mensel (2001) discusses idea quality from the standpoint of comparing the idea proposed in the front end with the final product developed. If the idea proposed is highly detailed and is carried throughout the innovation process, then the idea would be very efficient and had a high degree of specification (Salomo & Mensel, 2001).

Prior research focused on the generating ideas, specifically on how internal learning and creativity can enhance the quantity of individual idea creation (Verworn, 2009). Particularly, it was revealed as crucial to scrutinize how to manage ideas and how this is related to the translation of internal success in later NPD stages (Peloza, Montford & Ye, 2015; van den Ende, Frederiksen & Prencipe, 2015). Even though encouraging individuals to generate a high number of ideas is of importance, the focus should also lie on finding the idea that best solves the initial discovered problem. Because FEI is the step prior to development, the attention has to shift to use a company's internal network, to establish a thorough method to assess idea quality (Björk & Magnusson, 2009).

2.3.3 Dimensions of idea quality

The capability to generate ideas is highly important in the innovation process (Dean et al., 2006). However, evaluating the qualitative aspect of ideas can become difficult, because actors have to find the most suitable way to rate each individual idea and mutually agree upon an appropriate idea (Dean et al., 2006). In this study, the aim is to investigate the impact of individuals, in a collaborative context, on quality, therefore it is essential to establish a framework of quality dimensions. Dean et al. (2006) proposes a list of variables, which can be integrated to assess the quality of an idea: workability, relevance and specificity.

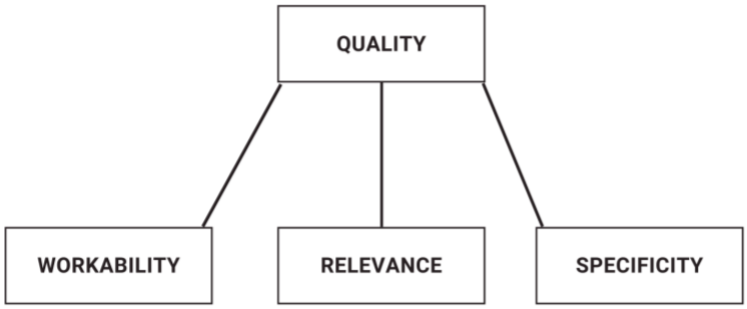

Figure 6: Dimensions of Idea Quality (Dean et al.,2006)

Workability, which derives from the adjective 'workable', refers to an idea that is realistic and practical, that also has a high chance of becoming effective once implemented (Dean et al., 2006). Dean et al. (2006) choose to refer to workability by looking at whether an idea imposes any restrictions and can easily be implemented. It also refers to feasibility, as it relates to workability in the context of implementation of an idea (Dean et al., 2006). Feasibility can be defined as the opportunity of an idea to be achieved or be reasonable (Dean et al., 2006). Lastly, workability also refers to whether the idea can be accepted in the specific context it is being developed and later presented (Dean et al., 2006).

For the purpose of this study, workability will be analyzed based on two sub-dimensions: feasibility and acceptability (Dean et al., 2006).

Relevance is referring to the level to which an idea can be used in the needed context (Dean et al., 2006). It is also related to how an idea is appropriate to a present issue and how doable is for the idea to fix the issue (Dean et al. 2006). On the contrary, Blohm et al. (2010) refer to relevance as whether an idea is of economic potential and that it fits strategically to the necessities of the customers. However, in the context of this research, relevance is considered as having a suitable and efficient idea. Therefore, it will be studied using the following sub-dimension: effectiveness (Dean et al., 2006).

Specificity, which comes from the adjective 'specific', draws on the concept that an idea has to relate to a particular thing and not something else, and that the idea has to be clear. Dean et al. (2006) discusses the term 'specificity' in the context of how well an idea is conceptualized and whether it is understandable, clear and contains all the necessary information to further proceed with it. The attention is drawn to clarity and the level of detail of an idea within the front end. Clarity is referred to how transparent and clear an

idea is to the receiver (Dean et al.,2006). In addition, clarity is linked to the level of communicating an idea in terms of chosen words and grammar (Dean et al., 2006).

Furthermore, the level of detail looks into how much information one has about an idea and how complex it is in regards to the issue at stake (Dean et al.2006). Blohm et al. (2010, p.4) uses the concept of 'elaboration' to refer to the detailed aspect of an idea. Therefore, within this research, specificity is perceived as how clear and detailed an idea is in the context of the front end. It will be studied by using the following sub-dimension: clarity (Dean et al., 2006).
As a sum up of dimensions of idea quality, figure 7 will contain the chosen dimensions and their respective sub-dimensions, which will be used in the context of this research.

Dimensions	Sub-dimensions
WORKABILITY	*Feasibility* *Acceptability*
RELEVANCE	*Effectiveness*
SPECIFICITY	*Clarity*

Figure 7: The dimensions and sub-dimensions of idea quality

3. Methodology

In the coming chapter, the methodological preferences, such as research purpose, design, process, data collection and analysis are being presented.

3.1 Research Design and Approach

3.1.1 Epistemology and Ontology

This study explores the social elements, which might have an impact on the processes within a business’ FEI. Consequently, the epistemological position of interpretivism is applied, since the study advocates the comprehensive and explanatory notion of social constructs operating within a specific environment (Bryman & Bell, 2011). To clarify, the study investigates how individuals are interpreting the world around them and this social science is subjectively analyzing human actions (Bryman & Bell, 2011). A phenomenological approach is used, where the perception of individuals preceding certain actions is explored (Bryman & Bell, 2011). Especially with regards to this study, critical factors, such as an individual's comprehension and completeness of information influences the collaborative design between heterogeneous actors, which is socially conceived. The processes within FEI are seen as social entities, in which the heterogeneous actors play a pivotal role in revising their perceived importance and contribution in social phenomena. Therefore, in regards to the ontological position, the constructionist approach is applied.

3.1.2 Research strategy

The aim of this study is to investigate the relation between collaborative design and quality in the IG and IS phase of FEI. A qualitative research will be employed, in order to dig into the social factors of collaborative design influencing idea quality. This study investigates social construction processes, in which the emphasis is placed on how informants are constructing their world around them and how this influences organizational processes (Gioia, Corley & Hamilton, 2012). The informants are seen as ‘knowledgeable agents’, which allow them to elaborate upon their own experience, actions, interpretations and worldviews (Gioia, Corley & Hamilton, 2012).

Within this context, an abductive research approach is adopted, in which existing theory (deductive approach) and gathered data (inductive approach) are analyzed in proximity (Gioia, Corley & Hamilton, 2012). Emergent themes may arise alongside the analyzes of inductive data and vice versa, in which an iterative approach is employed involving the cyclical process between data and theory (Bryman & Bell, 2011).

The deductive approach embraces the theoretical saturation as well as the support to configure and specify constructs for the theory-building research (Eisenhardt, 1989). In this way, the interpretivists (the researchers), will avoid becoming trapped in an overload of data and at the end probe for accurate empirical grounded theory (Eisenhardt, 1989). The identified features derived by means of deductive research approach will be used as the basis for the compilation of interview guidelines, questionnaires and observations.

3.1.3 Case-within-case research design

The aim of this design is to focus on the particularization of exploring a certain situation within a single case company (Bryman & Bell, 2011). Within this study, it will be explored what kind of impact, social constructs have on collaborative design and whether this affects the quality of ideas in FEI. In order to explore the unique features of collaborative design, a case within a case strategy will be applied (Mills, Durepos & Wiebe, 2010). This research strategy is employed as a method to break down the studied phenomena into particular situations. Therefore, the CC will be divided into sub-cases (projects) to obtain a coherent view on similarities and differences between the selected cases (Bryman & Bell, 2011).

When choosing a case study design, control is not an interest for researchers, as by applying a constructionist approach, the aim is to look at collaborative design and quality as complementary and interacting, without causing a predefined result (Mills, Durepos & Wiebe, 2010). The result from using such a design strategy is the formation of a theoretical framework, which is more generalizable, than having to study the chosen phenomena in a single situation within the CC. The sub-cases are selected based on relevant criteria, in line with the study's purpose, to allow for a consistent and comprehensive data collection and analysis process.

For analysis, the building theory process of Eisenhardt (1989) is applied, where the particularities of each project will be respected and taken into consideration. This building theory process puts the emphasis on continuously analyzing data collection in parallel with existing theory. A within-case study approach will

be employed to study the relationship between collaborative design and quality, in each situation, followed by a cross-case analysis (Eisenhardt, 1989), to identify similarities and differences among projects.

3.2 Research process

Within the initial stage, unstructured interviews are being held, in order to gain insight and explore possible issues encountered in the field (Bryman & Bell, 2011). The researchers try to prevent a biased view, due to emergent variables derived by literature, by giving voice to the interviewees as early as possible (Gioia, Corley & Hamilton, 2012). In tandem to unstructured interviews, prior literature is examined to seek for a research gap (Gioia, Corley & Hamilton, 2012). By applying subsequent revealed findings, a draft research question has been formulated with the aim to set the stage and get an understanding of emergent constructs (Eisenhardt, 1989). Subsequently, the research direction is identified, and continuous collection of data and prior conducted research is compared. Based on this knowledge, the research question is revised, and selection of the particular projects is finalized (Bryman & Bell, 2011).

Adjacent to the unstructured interviews, the semi-structured interviews will function as the main source. In this study, retrospective processes within a specific period are analyzed, so researchers get a thorough understanding of the social phenomena occurring within various studied projects (Bryman & Bell, 2011).

A purposive sampling approach is employed, probing towards strategic selection of participants involved in each case. Since a strategic sampling has been applied, the population is not generalizable, which serves as a limitation. Nevertheless, the strength lies within the particularities of the investigated situation (Bryman & Bell, 2011). The selection of the sampling is congruent with the participants involved within the idea generation and idea selection. The sampling selection will be further elaborated in section 3.3.3.

3.3 Data collection Method

3.3.1 Case company

In 2018, CC recognized the need to adapt promptly to the changing external environment and therefore started to encourage the generation of new ideas, followed by the development of a systematic ideation process. The specific set-up of the initial stage of the ideation process (FEI) involves two or more actors,

who collaborate until they produce an idea which is qualified enough to leave the concept development stage.

Underneath, the different phases obeyed by CC, are visualized, the idea phase referring to opportunity analysis, the 'concept phase' representing the idea generation, whilst 'feasibility phase' serving as the 'idea selection' phase within academics. For this study, the focus lies on the investigation of the process between gate 1 and gate 3, which are the equivalent of idea generation and selection. In gate 1, a project opportunity is submitted for further development by an 'owner' to a 'designer'. He/she conceptualizes the project into several ideas in gate 2, which are evaluated in the feasibility phase and ultimately one idea is selected at gate 3.

Figure 8: FEI in the case company

3.3.2 Unstructured interviews

Eight qualitative interviews have been conducted, following an unstructured approach, as part of the initial stage of data collection. The snowball sampling is used to select the interviewees, meaning no sampling criteria is used to select interview participants. The selection is based upon the recommendation of previously interviewed participants, suggesting potential interviewees (Bryman & Bell, 2011).

Unstructured interviews are conducted with the objective to unravel emergent themes within the CC and acquire a research scope (Bryman & Bell, 2011). The interviews followed a very flexible approach, where open questions were used based on pre-established topics like the firm's innovation activities, development of products and services and FEI (Bryman & Bell, 2011). The questions aimed at discovering also the potential challenges faced by the participants during the innovation process.

Title	Day	Date	Duration
Head of Agency	Monday	03-02-2020	50 minutes
Marketing Manager	Tuesday	04-02-2020	57 minutes
Customer Service Manager	Thursday	06-02-2020	56 minutes
Environmental Coordinator, CSR	Monday	10-02-2020	56 minutes
Marketing Director Product & Brands	Monday	17-02-2020	44 minutes
Head of Marketing Communication	Thursday	20-02-2020	52 minutes
Product & Concept Designer	Monday	24-02-2020	52 minutes
Head of Project Manager	Wednesday	18-03-2020	55 minutes

Table 1: Participants, unstructured interviews

3.3.3 Semi structured interviews

After the unstructured conversations, eight semi-structured interviews were conducted, to gain valuable insights into the topics related to the research question: collaborative design and idea quality (Bryman & Bell, 2011).

Project selection

Within this study, multiple projects were selected to acquire a deeper understanding of a general social phenomena (Bryman & Bell, 2011). Four projects were investigated, in which two or more participants were involved in each project. The selection of projects was based on the following criteria: (1) radicalness, (2) idea generation & selection, (3) collaboration.

1. Radicalness

As described in section 2.1.3, the three innovation horizon model was employed, to identify the degree of radicalness of each case. Since all cases were categorized within horizon 3, the degree of innovativeness was radical.

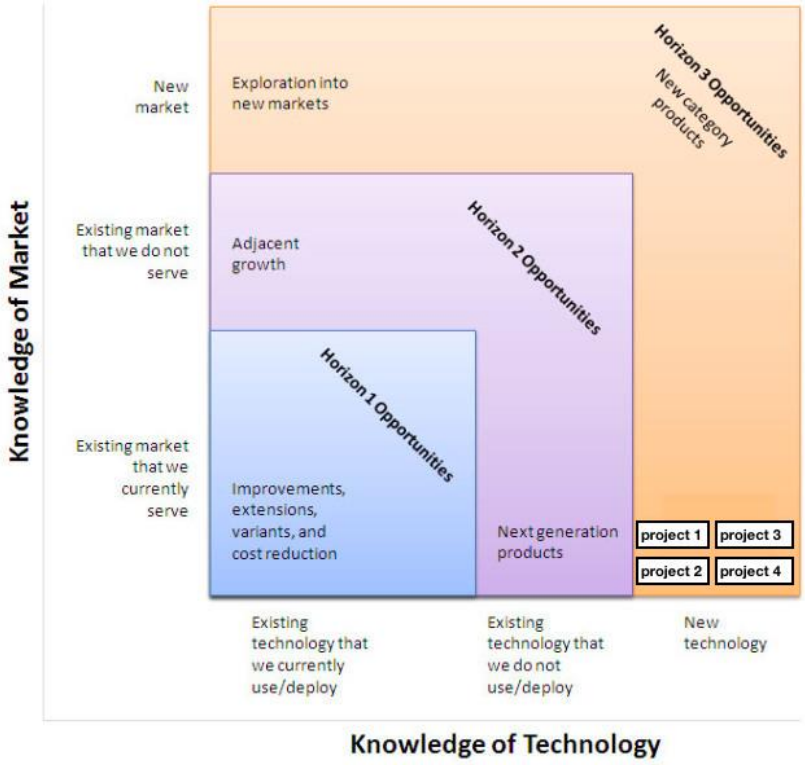

Figure 9: Project selection criteria Radicalness

2. Idea generation and idea selection

As previously mentioned, the projects are selected based upon the path dependency of two stages within FEI. As previously mentioned, FEI is path dependent meaning that efficient flows within subsequent processes are congruent on the information received and activities achieved in the initial stages (Reid & de Brentani, 2004). These initial path dependent stages are composed of the opportunity analysis, followed by the generation of ideas, resulting in the selection of ideas and when approved continue to the concept development phase. The four selected projects went through the idea generation and idea selection process, which this study specifically focuses on.

3. Collaboration

The research question aims to answer the effect of collaborative design on idea quality. Within this study, collaboration involved two actors, namely the person who transmits the information and the one who receives the information. Every project within this case study was selected by means of the role of participants in the project involved. Thus, each case within the single case study contained a 'transmitter' and 'receiver' who collaborated in the 'idea generation' and 'idea selection'.

Interviewee selection

As aforementioned, the aim is to generate a deep understanding of how collaborative design alongside FEI has an effect on idea quality. A purposive sampling has been adopted, in which researchers selected their participants by means of a systematic approach (Bryman & Bell, 2011). Three criteria have been obeyed during the selection of the interviewees;

1. Participants have gained experience in the field of innovation management and obtain contextual knowledge with regards to the set innovation stages.
2. Selected participants qualify either as the 'idea owner' responsibility or 'project designer' within the selected case.
3. Participants have collaborated alongside the idea generation and selection phase within the Front End of Innovation.

Project & Interviewee Description

In order to give more context to the background of the selected projects, their characteristics will be showcased below and why they fit with the above-mentioned criteria, alongside the interviewed participants.

Project 1 - Project P

Within this project, the opportunity was identified by the project owner. The identified problem contained the need to find a solution for food packaging, for smaller portion sizes. The company seeked to deliver a product requiring new technology and form of design for the already existing market. The collaboration involved a product owner and a designer. Specifically, within the idea generation stage, a meeting took place, where the owner (transmitter) presented the identified idea towards the designer (receiver). As the process proceeded, roles switched and the designer (transmitter) transmitted the initial design towards the owner (receiver) within the idea selection phase. Within those meetings, proposals, specificalities and sources of inspirations were discussed with the main objective to identify the problem and finally solve the problem by means of conceptual product design.

Project P		
Employee	**Position**	**Interview date**
1P - Designer	Project and Concept Designer	15/04-2020
2P - Owner	Marketing Director Products & Brands	24/04-2020

Table 2: Interviewee selection, project P

Project 2 - Project T

A need was identified by the owner (transmitter) to develop a CO2 emission tool for the sales department to visualize the ecological footprint per product. In this case, the market existed already, nevertheless the technology behind the service required was uncertain. Collaboration existed in between the owner and designer (receiver). Simultaneously, the owner and designer cooperated with an external consultant (receiver) for the development of the tool. The collaboration in between the project owner and designer was explored as well as the cooperation with the project owner and designer and consultant. This project required a sequential problem solving process, hence the project owner identified the problem transmitted towards the designer and consultant. Subsequently, they switched roles and the consultant (transmitter) conceptualized an idea with the purpose to solve the problem, identified by the owner (receiver). Finally, joint discussions took place to negotiate around the conceptualization of the idea.

Project T		
Employee	**Position**	**Interview date**
3T - Designer	Product Manager	16/04-2020
4T - Owner	Environmental Coordinator	23/03-2020
5T - Designer	Customer Success Manager (external consultant)	27/04-2020

Table 3: Interviewee selection, project T

Project 3 - Project V

As project V is concerned, the opportunity revolved around providing a new service to the customers, which will involve the use of augmented reality. With this technology, the customers would be able to visualize the CC's products in their own setting. The expertise needed to conceptualize the opportunity was not present in-house, so the owner looked for external consultants (designers) to achieve the objective. The collaboration took place between the owner (transmitter) and selected consultant (receiver) and their communication occurred primarily online. The opportunity was sent at the beginning of idea generation, whereas the designer (transmitter) generated a proof of concept, which was evaluated with the owner (receiver) iteratively during idea selection.

Project V		
Employee	**Position**	**Interview date**
8V - Owner	Innovation & Business Development Manager	16/04-2020

Table 4: Interviewee selection, project V

Project 4 - Project A

The owner (transmitter) aimed at creating a novel range of products, which could bring a competitive advantage to the CC. The products should ensure the ultimate healthy eating experience and contribute to the emotional side of a healthy meal. Through the initial innovation stage, the owner had a close collaboration with the designer (receiver) and their communication was based on formal documents, as well as informal discussions. The opportunity encountered by the owner allowed the designer (transmitter) to generate a series of concepts (ideas). The concepts were presented to the owner (receiver) at the beginning of idea selection and were later evaluated.

Project A		
Employee	Position	Interview date
6A - Designer	Project and Concept Designer	20/02-2020
7A - Owner	Marketing Manager	05/05-2020

Table 5: Interviewee selection, project A

3.3.4 Interview guide

Within this study, the interview guide was designed following the approach suggested in Bryman and Bell (2011) in regards to semi-structured interviews. The interview guide allowed for a flexible dialogue, yet had a structured path to follow during the conversation with the interviewees (Bryman & Bell, 2011).

Topics

The research question was divided into two main categories, collaboration and idea quality, which allowed for further development of the interview questions, which were derived from the literature review. After the first version of the interview guide, it was acknowledged that since the interviewees have distinct roles in the selected projects, it was essential to revise the guide and order the questions in a flow that fits with the answers sought with the research question (Bryman & Bell, 2011). The interview guide was built around five main pillars: (1) interview guidelines (2) project background, (3) collaborative design in idea generation, (4) collaborative design in idea selection and (5) idea quality. The interview guide was built around five main pillars: (1) interview guidelines (2) project background, (3) collaboration in idea generation, (4) collaboration in idea selection and (5) idea quality.

Types of questions

Researcher's prior obtained theoretical perspectives can influence the findings by asking biased questions (Eisenhardt, 1989). It is paramount researchers avoid steering interviewees in the direction to forge answers, which confirms their own interpretations on existing theory (Bryman & Bell, 2011). For this reason, several types of questions (introducing, follow-up, direct, probing, specifying, structuring) were used in the interview guide to acquire a considerable number of relevant insights (Bryman & Bell, 2011, p.477-479) By recurring to this method, the researchers could discover insightful details regarding the collaborative design context the participants were part of, their approach to understanding information, their behaviour in relation to other actors and the efforts necessary to reach the design outcome.

1. Interview guidelines
The first pillar looks at giving an overview to the participant of the purpose of the interview and the structure of conversation. Nevertheless, it also aims to receive consent on recording the interview and ensure confidentiality of participants' identity (Bryman & Bell, 2011).
2. Project background
This category aims to acquire an overall understanding of the product/service created during the project in question. Therefore, it strives to capture the context of what was developed, in what form, to whom it brings value and its level of innovation. In order to ensure the selection criteria are met, the participants are asked to describe who is involved in the FEI process (Terwiesch & Ulrich, 2009)
Collaborative design
Collaborative design between actors is divided in two phases, according to FEI stages: idea generation and selection. Within each phase, the researchers will investigate the two dimensions of collaborative design: completeness and comprehension. For completeness, the questions will aim at discovering how the information fulfilled the expectations and requirements (sub-dimensions) of the interviewee. Hence, comprehension will tackle two aspects: individual comprehension and mutual understanding. The aim of these sub-dimensions will be explained within each phase.
3. Collaborative design in Idea Generation
In order to understand how the project opportunity was transmitted, questions regarding how collaborative design was initiated are conducted, followed by specific questions regarding completeness and comprehension. **Completeness** In order to lead the conversation into the investigation of completeness of information, the interviewees are asked to introduce the context to which they have sent or received the opportunity (Shankaranarayanan & Yu Cai, 2005). Furthermore, more specific questions are directed to the discovery of how the information related to the opportunity followed their own requirements and expectations (Weiskopf et al. 2013; Clarkson & Eckert, 2005).

Comprehension The researchers will tackle the individual's comprehension of the opportunity and how this opinion is brought up in the communication between interviewees (Bucciarelli, 1996; Eckert, 2001; Kobayashi & Higashi, 2009; Stacey & Eckert, 2001). In addition, how each interviewee describes the communication during this phase will be investigated.
4. Collaborative design in Idea selection
During the second phase, it is essential to explore how individuals discern the best ideas stemming from the idea generation phase leading towards the final decision of which idea proceeds in the development phase (Faure, 2004). **Completeness** The interviewee will be asked to once more introduce the context in which the generated ideas were presented. In addition, the expectations and requirements will be questioned, in order to tie in the investigation on completeness (Weiskopf et al. 2013). **Comprehension** In regards to comprehension, the aim is to gain insights from the participants into how the two sub-dimensions of comprehension, individual comprehension and mutual understanding influenced the communication related to selecting a final idea (Bucciarelli, 1996; Eckert, 2001; Kobayashi & Higashi, 2009; Stacey & Eckert, 2001).
5. Idea Quality
The last category looks at identifying the participants' evaluation of the selected idea. There are three criteria used to investigate the participant's perception of the qualitative aspect and specific questions for each criteria are grounded on the reviewed literature (Dean et al., 2006). As the assessment of idea quality is conducted, the interviewee is asked how he/she perceived collaborative design during the entire process influenced the evaluation of the idea.

Table 6: Interview guide explanation

During collaborative design, the idea owner and designer switch roles within the project's course, therefore the questions were tailored to acquire valuable insights on both spectrums. In idea generation, the owner sends an opportunity to the designer, therefore takes the function of a transmitter. Simultaneously, the designer will receive this opportunity and will be classified as receiver. As the collaborative design continues and the second phase begins (idea selection), the roles convert. Within the

second phase, the idea owner will receive potential ideas from the designer, created based on the initial opportunity. For this reason, the designer serves as transmitter, whilst simultaneously the owner functions as receiver within the collaborative design. This process is sequential problem-solving collaboration process and is visualized below:

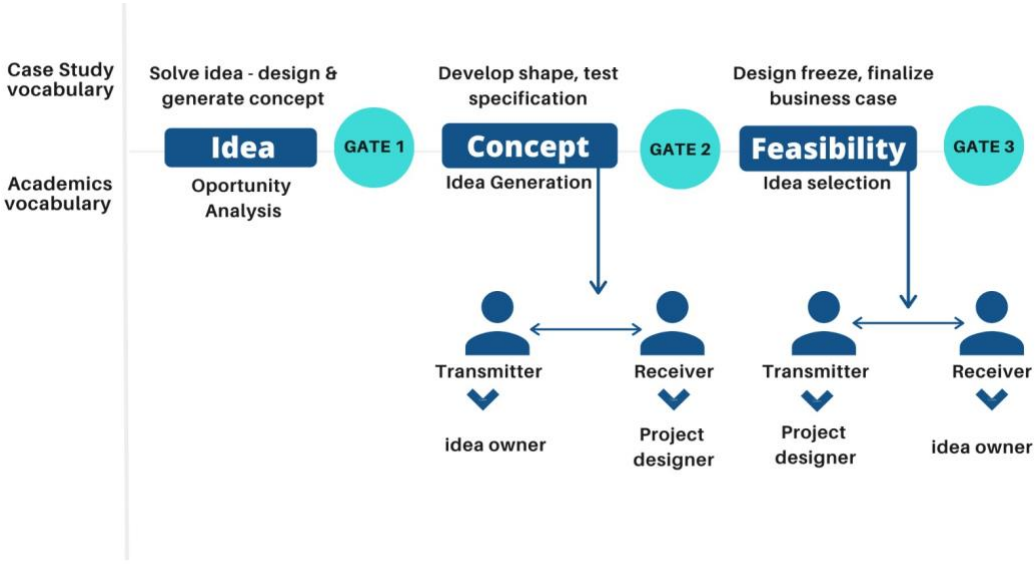

Figure 10: collaborative design in the case company

Consequently, there are established two interview guides, in order for this transition of roles and responsibilities to be fully explored by researchers (see appendix 1A & 1B).

3.3.5 Interview preparations

Due to unforeseen circumstances, the interviews were conducted in an online setting. The researchers had to accommodate the situation, to still allow for capturing valuable insights from each interviewee. Several options were considered in terms of appropriate tools to conduct online interviews, and ultimately a conference meeting offered an adequate setting for the interviews. In addition, in order to create an appropriate situation for both parties, the interviewees were asked to schedule a timing for the meeting that fits their current situation and the platform used to conduct the meeting was accessible and user-friendly.

In addition, the interviewees received prior to the scheduled meetings a summary of the researchers' objectives, the purpose of the interview and the overall covered topics. At the start of the interviews, each

interviewee was asked for permission to record the conversation and use the transcribed information for research purposes (Bryman & Bell, 2011).

During the interviews, the researchers took separate roles and responsibilities. One of the researchers took an 'active' role, asking the questions and the other a 'passive' approach, taking notes of the discussion and intervening with follow-up questions (Bryman & Bell, 2011). Secondly, having both researchers to be part of the interviews allowed for comparison of reflections post interview and diverse views regarding data collected. The interviews were conducted in English as both researchers possess an international background, yet it was not perceived as a limitation due to the high English proficiency of the interviewees.

3.3.6 Ethical considerations

Since the study will investigate the individual's role in collaborative design, it became relevant to consider certain issues revolving around the ethical concepts. Bryman and Bell (2011) touch upon the concern of whether or not (1) the parties involved during the study will be harmed, or (2) have been asked for consent, (3) their privacy was invaded or finally (4) it lead to certain deception.

Consequently, the identity of the participants and private information will be protected, leaving only the necessary information for the study, to be further used for analysis. Furthermore, the participants will be asked prior if wishing to take part in the intended study and will be given the opportunity to withdraw from answering questions that might intervene with their privacy (Bryman & Bell, 2011). Lastly, before the beginning of the interview the participant will be informed of the use of a recording device, asked for permission to record the interview and the legal aspects of the study will be presented in the GDPR form.

3.4 Data analysis

3.4.1 Data Analysis Method

Developing grounded theory derived by collected data can be executed by means of two methods, namely the approach of Gioia, Corley and Hamilton (2012) and Eisenhardt (1989).

As described by Eisenhardt (1989), predefined constructs in existing literature can serve as a guideline for the research structure to build theory upon in the later stages. In this research, the framework of

collaborative design is employed to select the projects and consequently the participants for the semi-structured interviews.

The data collection approach by Gioia, Corley and Hamilton (2012) hinges on a systematic approach, in which all data is funneled down into 1st and 2st order concepts and themes, emerging in segregated dimensions. Merging and distilling data from the selected projects might obscure observing the relationship between dimensions of collaborative design and quality in each project. Nevertheless, within-case data explores unique elements within the specific situation and subsequently compares them by means of cross-case analysis (Eisenhardt, 1989). The protocol by Gioia, Corley and Hamilton (2012) is standardized and data is merged together in several dimensions, which tend to proceed together (Gioia, Corley and Hamilton, 2012, p. 20). Eisenhardt's (1989) approach looks at data from different angles, in order to couple within-group similarities and intergroup differences.

Additionally, the replication logic of the data collection approach obeyed by Eisenhardt (1989) explores whether a relationship between various constructs is manifested within various cases. Constructive relationships need to be substantiated by prior conducted literature to dig into the reasoning behind casual relationships (Eisenhardt, 1989). On the contrary, Gioia, Corley and Hamilton's (2012) approach consciously avoids prior obtain literature to prevent confirmation bias, whilst in this study it is most beneficial to analyse existing theory, in order to understand and compare prior theory in tandem with emergent interrelations between constructs. Therefore, the building theory approach by Eisenhardt (1989) will be employed within this study.

3.4.2 Data Analysis process

First of all, an interview guide has been compiled by the researchers, which is aligned with prior analysed theory from the literature review (Bryman & Bell, 2011). First, a pilot interview has been conducted, to reach a fluent dialogue when asking questions, which led to further adjustments. Right after conducting the eight semi-structured interviews, transcriptions have taken place. Each researcher has individually coded the transcriptions, in the form of quotes, in order to encourage divergent views on emergent interrelated constructs (Eisenhardt, 1989). Additionally, "convergent perceptions" between researchers "add to empirical grounding', as it allows for transparent processing of collected data (Bryman & Bell, 2011; Eisenhardt, 1989, p. 538). Therefore, this principle is obeyed within this research.

The quotes are structured through a tabular display compatible with the concepts derived from literature. The tabular approach is used, in order to display the data in a structured manner without intensive distillation of data, in which the quotes maintained the language used by interviewees (Eisenhardt, 1989). Within-case analysis is employed, to cope with overburden of data and get a better understanding of each case as a stand-alone entity. The main objective is to identify which particular dimensions of collaborative design have an effect on the quality dimensions and how this relationship relates to reviewed literature.

This study focuses on how individuals, in a collaborative design context, influence idea quality. The collaborative design has been divided into two stages: idea generation and idea selection. In the latter stage, the generated ideas are evaluated, one appropriate idea is chosen and quality is assessed. Furthermore, as explained, within each stage, the individuals switch their responsibility and role in the collaborative design, shifting between transmitter and receiver of information. Due to the role switch between individuals, collaboration in idea generation differs from idea selection, and so their respective influence on idea quality.

Subsequently, cross-case analysis is conducted through examining the interrelationships, affinities and discrepancies in between cases analysed from within-case analysis. The aim is to discover whether there is a pattern in the collaboration-quality relationship across cases (Eisenhardt, 1989). Emerged patterns will be correlated with literature, by which new concepts will be identified. This substantiates the abductive approach, hence existing theory is analysed in parallel with collected data (Bryman & Bell, 2011).

3.4.3 Credibility, transferability, dependability and confirmability

One of the first issues concerning the choice of pursuing a case study for the research design is the external validity or transferability of the chosen context (Bryman & Bell, 2011). Considering the research will be focusing on investigating particular FEI processes, it might seem difficult to generalize the findings and conclusions to other surroundings. Naturally, by using a qualitative approach and selecting interviewees based on a predefined criteria, one might question its external validity. Nevertheless, the interviews and observations will allow for findings that will provide rich data, which can be used on a broader perspective.

Secondly, since the credibility of the research might be challenged, it is important to convince the potential readers of the study's internal validity. Therefore, the process used for this study has been presented in a transparent manner and by interviewing both an idea owner and a designer, gaining their perspectives on collaboration and evaluation of ideas within the front end, the reader will be ensured of the integrity of

the findings generated (Bryman & Bell, 2011). As a result, the interview guide aimed to discover whether the quality evaluation has been influenced by collaboration variables in both FEI stages (IG and IS). In addition, during the data analysis the researchers presented how individuals in both idea generation and selection influenced the quality of the selected idea. This allowed for a compelling credibility of the study, as it will be presented the causality and impact of the independent variable (individuals in collaborative design) on the dependent variable (idea quality) (Bryman & Bell, 2011).

The third criterion is concerning the dependability or reliability of the research, especially whether the study can be repeated. In the case of this study, there is no concern regarding accessing the participants, as their contact information used to reach them is publicly available. As the topic of the study refers to collaboration between two actors and its influence on quality of ideas selected, by interviewing idea owners and designers, the study can be reciprocated within another design context (Bryman & Bell, 2011).

The final issue is regarding the confirmability or objectivity of the study. It refers to the transparency of the procedures applied during the research and how raw data leads to findings and conclusions. Since the research is being conducted by a group of two individuals, both parties involved are auditing each other's work to keep a clear track and diminish the impact of personal values (Bryman & Bell, 2011).

4. Findings

Throughout this chapter, the findings for each project are showcased within 4 sections: (1) background, (2) collaborative design in idea generation, (3) collaborative design in idea selection and (4) evaluation of quality. collaborative design will be presented by looking at the sub-dimensions completeness (requirements and expectations) and comprehension (individual comprehension and mutual understanding). Furthermore, quality is introduced within three dimensions: workability, relevance and specificity. The full quotes used in this chapter are available in Appendix 2.

4.1 Project P

4.1.1 Background

Project P started with the aim to create a *"smaller size"* (1P) for a product, to fit an existing range of solutions offered by CC. The opportunity was identified by the owner by looking at the trends (*"sustainability movement" - 2P*) emerging within the food industry. The owner (1P) and designer (2P) were primarily involved within the idea phase of the project. The owner was responsible for gathering information to eventually identify and analyze the opportunity. This information will be later sent to the designer, who *"took over and did the investigation" (2P)*, based on the opportunity.

4.1.2 Collaborative design in idea generation

4.1.2.1 Completeness

Requirements

The owner assessed the communication of the opportunity as clear, hence the interviewee was confident that his/her requirements were *"pretty straightforward"* (2P). On the other hand, for the designer, it was essential to receive *"a defined problem"* (1P) from the owner, and the designer prefered to know *"how much time" (1P)* the owner had assigned to the project. These details enabled the designer to continue with his/her work.

Expectations

The owner recalled the information about the opportunity as transmitting a *"rough idea of what is aimed for" (2P)*, so the designer could proceed with his/her own work. Furthermore, the designer expected there would be *"room to think out of the box (...) to find new alternatives" (1P).*

4.1.2.2 Comprehension

Individual comprehension

The owner considered the opportunity worth pursuing due to its *"potential with the segments*" (2P), while the designer considered it "*interesting*", as it was a *"first project*" for the *"product range"* (1P).

Mutual understanding

The owner recalled communicating about *"who they are targeting and what kind of solutions they would need to have to fulfill customers' needs"* (2P). In addition, the designer considered the discussion as a one sided situation, where the main objective was to *"understand the owner more about what he/she wants to do with the portfolio"* (1P)

4.1.3 Collaborative design in idea selection

4.1.3.1 Completeness

Requirements

The second phase of the collaborative design followed through as the designer explained how the concepts were created with a certain design flexibility, however following the initial need of having a *"product family"* (1P). The owner mentioned that his/her expectations were based on the initial *"brief"* and however, it was expected for the designer to come with *"a couple of different options"* (2P). Therefore, the initial requirements were once more mentioned as an essential factor when it came to the owner's expectations of the concepts generated, as they should *"fulfill the requirements"* (2P).

Expectations

An interesting discovery was the designer's disclosure of the objective behind sending the generated concepts to the owner. He/she wanted to *"understand what the owner wants in terms of design",* as the owner was a *"customer, who orders from the designer"* (2P). The designer also mentioned that there are *"always difficulties" to present ideas,* since one had to *"explain something in a clear and simple way and*

*leave out all the unnecessary informatio*n", to focus on the requirements. Being able to achieve this depended on how well "*the information received"* (2P) *was* interpreted by the designer. .

4.1.3.2 Comprehension

Individual comprehension

In terms of personal assessment of likelihood of success, the interviewees had contrasting points to share. The owner stated his own preference of the concepts and assumed the designer will have a *"preference as well"*. Furthermore, the owner highlighted once more the initial requirements were "*quite or very important"* in the assessment, as they "*steer the decisions later on"* (2P). However, the designer expressed that the assessment was influenced by what the owner *"wants to see"* (1P) presented.

Mutual understanding

The designer remembers the concepts were evaluated by looking for "*something that wouldn't stick out super much but still stick out" (1P)* and that would be possible in production. When asked if the personal assessment was brought into the evaluation discussion, the owner recalled that if the concepts "*are not really fulfilling the requirements stated in the beginning, then they become less interesting" (2P)*. However, the designer highlighted that even though her personal assessment is brought up, ultimately the owner "*is supposed to like it" (1P)*. Regarding the selection of the final concept, the interviewees mentioned that there is no *"strict process" (2P)*, based on *"subjective considerations" (2P)*

4.1.4 Evaluation of quality

Workability

According to both owner and designer, the final selected idea is overall feasible, however the actors agree when it comes to classifying the feasibility as uncertain. The concepts *are "translated to technical drawings*" (2P) and it *"depends on the suppliers"* (1P), to make the idea feasible.

Relevance

Furthermore, the idea was "*in line with the overall strategy of the business*" (2P), as in the opinion of both owner and designer, the idea met *"the requirements"* (2P), and it solved the *"problems identified in the beginning" (1P).*

Specificity

When looking at the specificity of the idea, the designer explained that the level of detail of the idea is attributed to her work. This is also confirmed by the owner, mentioning how important was the ``*creative approach"* (2P), brought by the designer, to accomplish the desired level of detail.

Effect collaborative design-Quality

In terms of the effect of collaboration on quality, the owner attributed quality of idea to the "successful" (2P) collaboration with the designer. In contrast, the designer believed his/her opinions matter, however the owner was *"the one that owns the product"*. The owner's initial requirements and his/her interpretation had an effect on the quality, yet the collaboration process is considered *"interactive, with a lot of different players"* (2P).

4.2 Project T

4.2.1 Background

Within this project, it was the CC's aim to build a tool, which can be used to compare CO2 emission behind the production of each product. By means of the CO2 emission tool, the sales team presents *"the entire lifecycle of a product*" (5T). Additionally, customers can judge their purchases on accurate data, looking at the *"carbon footprint"* (4T).

Two employees from CC closely collaborated with an external consultant, knowledgeable in the field of building web applications. Additionally, the consultant was responsible to launch the application, whilst it was the CC's task to supply the consultants with the necessary *"calculations"* for the tool (4T).

An iterative collaboration has taken place in between CC and consultant. Besides this, the collaboration between two employees will be analysed within the case company, in which employee 4T served as project owner and employee 3T served as project designer.

4.2.2 Collaboration in idea generation

4.2.2.1 Completeness

Requirements

The owner's aim for the project was to create a tool entirely customized for CC. Prior research was done *"to see if there were more (tools) like this" (4T)*, however, the existing solutions "*were not going to get anything close" (4T)* to what it was needed. The collaboration started after the owner found a consultant to work with and defined the initial objective of the project. Consecutively, the designer was *"told to be involved"* (3T) by the management and given responsibilities attached to the role.

Expectations

Since the designer was never involved in a NPD project within CC, he/she did not have experience with *"any collaborative design of this kind"* (3T). Moreover, there were no "*formal templates or processes" (3T)* available from the upper management with regards to expectation or requirements in order to solve the scope of the project. This was mainly due to the high degree of innovativeness and therefore information about specific technicalities to develop the product was unfamiliar for the company.

4.2.2.2 Comprehension

Individual comprehension

The owner assumed the designer "*had the same information as her manager"* (4T). However, in reality, the designer did not receive in-depth information from her boss concerning the project scope. Additionally, both did not discuss whether they acquired the same level of information, in which the assumption of the owner was still consistent until they "*bumbled through*" the miscommunication. The designer also hesitated how *"all this information that is needed for the tool"* (3T) can be found and would need *"more help outside"* their collaboration.

Within the initial stage of the project, the involved actors did not receive a specific project role. The moment the designer was assigned as project leader by the upper management, confusion arose, since the owner would have preferred to *"own that space of that title" (4T)* (project leader). Nevertheless, through open discussions between the two actors (3T and 4T) this confusion was resolved *("talked about" - 4T)*

Mutual understanding

The collaboration between owner and designer did not suffer, despite the lack of prior information available with regards to practicalities to solve the initial defined problem. A lot of face-to-face conversations took place, in which problems were discussed *"about it first with each other" (4T)*. Both actors (3T and 4T) were aligned alongside the process, mainly "*preparing for a meeting that we were having with the consultancy company that we had hired to do this." (4T)*

The collaboration between the consultant (5T) and CC was organized in a structured manner, with *"skype conversations and the meetings had agendas (...), like a checklist" (3T).* This structured way of working has led to a shared understanding and the actors *"managed to keep with the deadline" (3T)*. Moreover, questions and answers went back and forth, in the form *"weekly meetings"* (5T) to discover the gap between missing elements and information available by both parties (CC and consultancy). The discussion of both parties' interpretation concerning the information took place through dialogues.

4.2.3 Collaborative design in idea selection

4.2.3.1 Completeness

Requirements

Within this phase, CC compiled a *"list of requirements together with the consultancy company"* (4T). The consultant recalled that many back and forth conversations took place in between the consultant and CC to investigate the *"details when it comes to the tool and the pages of the tool"* (5T). Conversations concerning points of improvements were discussed in every meeting, in which the owner and designer provided the consultant with information and follow up tasks.

Expectations

A lack of resources resulted in a different approach to the collaboration between actors, as mentioned by the designer. They had to deal with the little resources available and therefore a discussion was needed to continue the process as smoothly as possible ("*we were in the same team at that point and saying we need more resources and this is something that neither me or the owner can do*", 3T). The consultant also *"advised to do things a little bit differently" (5T)* and came with suggestions on how they should tackle certain problems and design specific elements of the tool.

4.2.3.2 Comprehension

Individual comprehension

The perceived level of success by the owner depended if the tool was "*still too complex*" for the end-users and if "*it is actually fulfilling what it was meant to do"* (4T). Furthermore, the likelihood of success with regards to the generated idea depended upon the high level of deliverables from *"a very professional consultant*" (3T) and the initial preparation of the owner.

Mutual understanding

The evaluation during the idea selection phase was an iterative process, in which it was discussed "what *could be improved or not"* (3T). Ongoing evaluation occurred in parallel with discussion of points of improvements. A prior set requirement list, compiled by the owner, was used as a checklist, which *"hit the checkmarks"* (4T) of what the tool *"was sought to do"* (4T).

4.2.4 Evaluation of Quality

Workability

The feasibility of the idea depended on the collaboration between the designer and owner, due to the divergent set of expertise. Moreover, as stated by the owner, a clearly defined initial idea was contingent with the feasibility of the idea. Additionally, the owner mentioned that *"as soon there is a push from upper management"* (4T), the idea became feasible.

Relevance

When it came to the relevance of the idea, the owner based his/her reasoning on the usability of the tool in its later stages. Furthermore, he/she pointed to collaboration as a decisive factor *"to tackle the initial problem"* (4T). The designer and the consultant also confirmed that *"the initial aim was achieved"* (3T) with the creation of the tool.

Specificity

The level of detail of the idea was influenced by the designer's understanding of *"what data the consultant needed to do the tool"* (3T). The designer mentioned it was not '*hard to just send out data'* (3T) to the consultant, however it required the designer to comprehend what the purpose of the data was in the first place.

Effect collaborative design - Quality

Both the owner and designer agreed upon the fact that having *"a structure in the beginning*" (4T) conceived into better collaboration and thus affected the idea quality. Furthermore, *"being aligned"* (4T) concerning task divisions and responsibilities also influenced the quality of the idea. The consultant mentioned that the creation of the tool was a result of the *"cooperation*" (5T) with CC and that the level feasibility was positively influenced by the collaboration between the actors.

4.3 Project V

4.3.1 Background

The idea for the project V came to life as the result of *"an innovation workshop*" (8V) held by CC, whereby several employees from different departments and externals were present. The project looked at how CC could create an application, focused on *"augmented reality"* (8V), to add an additional service to their current customers. When it came to the employees involved in the idea phase, the owner mentioned that several employees participated in the development of the concept, yet the main collaboration occured between the owner (8V) and an external consultant, the designer.

4.3.2 Collaborative design in idea generation

4.3.2.1 Completeness

Requirements

When it came to the assembly of information regarding the opportunity, the owner expressed one of the requirements was to identify "*different providers, who had worked with augmented reality technology*" (8V) before.

Expectations

For the selected consultant to be able to contribute to the project, the owner compiled the useful information. Due to the difference in expertise between the owner and designer, the owner encountered difficulties arranging the information for the designer, he/she felt insecure about *"asking the right questions"* and had challenges *"understanding if the consultant understood*" (8V) the objective.

4.3.2.2 Comprehension

Individual comprehension

As the owner *"looked back at the idea"* (8V), how the opportunity was interpreted, he/she expressed the influence of how novel the idea was for the case company in the assessment of the idea's potential.

Mutual Understanding

The intriguing discovery was the owner's view on how the discussion between each other occured, in regards to the discovered opportunity. The conversations revolved around whether the designer can *"guide the owner through the project from the development point of view"* (8V). Furthermore, the owner recalled how important it was to acquire a trust-worthy and guiding partner for the Collaborative design.

4.3.3 Collaborative design in idea selection

4.3.3.1 Completeness

Requirements

As the owner reflected over the concept received from the designer, he/she mentioned that the expectations were fulfilled and *"even better"* (8V) than expected.

Expectations

For the owner, it was essential the designer would deliver *"something that could be tested for real"* (8V) and match initial requirements. According to the interviewee, these expectations were exceeded as the owner was *"quite impressed"* and *"very pleased" (8V).*

4.3.3.2 Comprehension

Individual comprehension

The owner chose to evaluate the likelihood of success of the idea by looking at how *"more potential customers"* (8V) could be reached with this project.

Mutual Understanding

When it came to the discussion on how to evaluate the idea, the owner recalled that it did not follow *"a specific process"* (8V). The essential criteria was how much it would appeal to the end-users of CC and if the idea would still have a high potential. The owner's assessment was also brought to the discussion in

the evaluation process, to essentially evaluate whether the idea fit the end-user's expectations and what features *"can be added in the future"* (8V).

The final selection of the idea was a process the designer was not entirely involved in, as the owner mentions the decision was done in collaboration with "*recommendations*" (8V) from the management of the case company.

4.3.4 Evaluation of Quality

Workability

In regards to the feasibility aspect of the idea, the owner revealed that *"from a technical perspective, it was 100% sure*". However, the implementation part and *"getting it out there*" (8V) will be much more difficult. As company objectives were concerned, the owner was confident the idea fit *"what the company wanted to bring out to the market"*.

Relevance

When it came to the relevance of the idea in relation to the initial problem, the owner claimed the idea fully solved the encountered issues in regards to how *"a customer sees those products look on the table and in their environment"* (8V).

Specificity

The owner acknowledged the need for continuous discussion with regards to the level of detail. As mentioned it needed *"a couple rounds"* (8V) of discussion to arrive towards the expected degree of specificity.

Effect collaborative design - Quality

Firstly, the owner referred to the importance of collaborative design to achieve a successful tool. Secondly, the necessity of having a partner, *"10 times better (...) to help forward*" (8V) during the collaboration was highly emphasized by the owner. Lastly, the continuous discussion in between the actors was mentioned as essential in the development process of the idea.

4.4 Project A

4.4.1 Background

Project A was initiated with the intention of creating *"a product family" (6A)* which could enhance the eating "experience" (7A) of the customers. During the idea phase, the product owner (7A) and the designer (6A) of the CC were involved.

4.4.2 Collaborative design in idea generation

4.4.2.1 Completeness

Requirements

The designer stated that he/she was approached directly by the owner. The owner already had a clear overview of what *"he/she wanted to have"* (6A) and held expectations concerning the background information of the opportunity. The designer wanted to know what he/she is supposed to deliver, *"the research conducted by the owner"* (6A) and how the research done by the owner led to a specific opportunity.

Expectations

When it came to expectations, the designer referred to the importance of *"background information"* for the opportunity and design *"limitations"* (6A) to be aware of. Furthermore, he/she expected to receive a thorough *"description*" of the identified problem from the owner, in order to be able to conceptualize the idea. In this case, the expectations were fulfilled and the information received allowed the designer to *"think out of the box to find new alternatives"* (6A). The owner was already accustomed to working with the designer in a *"tight collaboration"* (7A), therefore the expectations were already set from prior experiences.

4.4.2.2 Comprehension

Individual comprehension

As personal interpretation was concerned, the designer recalled that the clarity of the information received allowed to have a *"positive impression*" (6A). Not having a clear description of the problem might cause issues in regards to the design thinking process, yet in this case *"it was very positive to get such a narrow*

problem" (6A). The owner stated that his/her interpretation was based on the *"information gathered and the analysis that was done" (7A)* during the identification of the opportunity.

Mutual understanding

The designer conveyed that his/her interpretation *"influences"* the conversation with the owner, however there is always a need for *"neutrality in the discussions"* (6A). The owner looked from *"the industry and buyer perspective"* (6A) while the designer looked at the functionality of the opportunity. Therefore, the outcome of the discussion was influenced by the participant's role in the collaboration process. The owner recalled how important the *"initial talks"* regarding the opportunity were, to allow the designer to "*find the right way"* and present *"both strong points and weak points of the concept"* (7A).

4.4.3 Collaborative design in idea selection

4.4.3.1 Completeness

Requirements

The designer described the "*background and research"* in order to convey the ideas generated towards the owner, and the *"different functionalities, different possibilities in the items*" (6A) were considered as crucial information to fulfill the owner's requirements. Furthermore, the owner stated that the ideas presented by the designer *"matched almost perfectly"* with the requirements as *"they are also the scope of the project"* (7A) and not following them could lead to exploring options outside of this scope.

Expectations

The designer mentioned that the ideas proposed during this phase should *"get as close to a final product as possible"* (6A), to match the owner's expectations. Furthermore, the designer claimed that during the process of arranging the information for the owner, the functionality and the novelty of the opportunity had a high influence on the result. Nevertheless, the owner expected from the designer *"the research, the results and the different routes that are available"* (7A).

4.4.3.2 Comprehension

Individual comprehension

When asked how the likelihood of success was assessed, the designer was convinced the ideas proposed "*will satisfy the owner's needs*" (6A). The designer saw a risk in proposing radical solutions because "*if one finds the right person that is interested in applying innovation, the owner says yes of course. But if*

one finds another person that is a little bit more conservative, the owner says no" (6A). Furthermore, the complexity of the ideas had to be reduced in order to make "*the innovation less frightening for the users*" (6A). *"Adapting to the owner's willingness of experimentation"* (6A) also influenced the designer's work.

However, the owner mentioned that his/her work experience played a vital role in judging *"if a certain concept will appeal to a broad audience or to a narrow audience" (7A).* Moreover, the initial interpretation of the opportunity played a significant part of the assessment for the generated concepts. The owner stressed the importance of *"capturing the need"* (7A), established at the beginning of the collaborative design, in the design process.

Mutual understanding

The designer mentioned that in order to bring the assessment of the ideas in the discussion, there was a need for further external research, to also convince the owner of the ideas' potential ("*Because if I didn't do that, then me and the owner would have the discussion. I don't think it is going to work."* - 6A). The communication between the actors was *"a very organic discussion" (6A)*, as it did not follow a specific *"protocol"* (6A), where each could bring their interpretation to the discussion.

Nevertheless, the owner expressed how throughout the evaluation process of the generated concepts, *"personal belief, based on experience and research"* (7A) had a decisive role. The designer only "*presents ideas and concepts and then the decision is taken by the owner." (7A).*

4.4.4 Evaluation of Quality

Workability

The designer observed that the idea turned out to be less feasible from a technical perspective, as it was *"difficult for the sourcing team" (6A)* to find the appropriate component. The owner also confirmed that there were several issues in regards to feasibility, which surprisingly the actors were *"quite aware of in the start of the project* "(7A). Nevertheless, from a business perspective, the idea *"fit extremely well"* (6A) with the company's objective, despite having an item which was less feasible.

Relevance

The designer believed that the project was a success, yet the idea *"solved the problem almost to 90%*" (6A), as it lacked an additional element which could not be added during the later stages of development.

However, the owner recalled that the idea selected solved entirely the initial problem, presented at the start of the collaborative design, as the actors "*were convinced that the idea would do that" (7A).*

Specificity

The level of detail of the idea was classified as satisfying by the designer and owner, with a slight change "*halfway into the product*" (6A), due to issues with the *"product's material"* (7A).

Effect collaborative design - Quality

Finally, the designer mentioned several aspects of collaborative design to have an influence on the quality of the final idea. Firstly, it was important the owner had "*a very well defined problem that wanted to be solved"* (6A) and the intentions for the project and the method used to hand over the responsibility to the designer. Second, the working style of the owner had a role to play. Lastly, *"a mutual understanding and mutual passion about making this product be something that would stand out" (6A)* had an effect on the qualitative aspect of the chosen idea.

The owner admitted the collaborative design with the designer had a "*central*" role in the development of the final idea. However, the objective had to be clearly understood by the designer. "*The decision maker is the product owner and if the designer isn't really clear on what the product owner is expecting, it will be a longer process because you will ping pong, a lot of things." (7A)*.

5. Data analysis & Discussion

In this chapter, the presented data from chapter four will be discussed. Firstly, a within-case analysis of each project will be presented, where the relationships between collaborative design and quality dimensions will be analyzed within idea generation (IG) and selection (IS). Secondly, the encountered relationships will be compared across projects, to discover potential similarities and differences. Finally, the discussion will conclude with a generated theoretical framework on how collaborative design influences quality.

5.1 Within-case analysis

Quality in FEI is looked as a metric to determine the outcome of this early stage in the innovation process (Cooper, 1996). The ideas selected for further development are evaluated based on certain criteria to determine whether an idea is a solution, which can be implemented, solves the initial problem and fits strategic objectives (Dean et al., 2006). For each project, there are 4 dimensions for collaborative design and 3 quality dimensions. Therefore, there could be 12 possible relationships. However, for each project, the researchers present and discuss the relationships, which have directly shown within the quotes the causal link between collaborative design and quality. Furthermore, a summary table will highlight the encountered relationships at the end of each project section.

5.1.1 Project P

5.1.1.1 Idea generation

Requirements - Idea Specificity and workability

Within this case, an interrelation between the dimension specificity and workability of the idea quality and completeness of information was identified alongside IG. Collaboration between actors took place by means of artefacts (Blyth & Worthington, 2001; Eckert, 2001). There was no joint assessment of the presented requirements, therefore the owner and designer in this case solely assessed the information transmitted as complete (Strong & Wang, 1997).

Nevertheless, each actor had different needs when it came to receiving specific information to be able to accomplish tasks during the process (requirements). So, whether information was complete and congruent with the transmitter's intentions (owner) and the receiver’s perception (designer) to use the information

(Weiskopf et al. 2013). Requirements were seen as a guiding point in the process to align between different actors, what the purpose of the information was in the collaborative process, which fed into the idea being feasible (workability) in regards to implementation (Dean et al., 2006). Additionally, it tied into specificity, since it depended on how individuals transformed informal declarations into explicit specifications (Dean et al, 2006).

'*I don't think it was that difficult. Usually that first briefing is pretty straightforward." (2P)*
"Well as soon as the problem is defined then I just need a timeline
to know how much time I have to work on it." (1P)

"I tried to make it as detailed as possible so everyone involved can understand
what the purpose is with the product and how to execute it" (1P)

"We don't want it to be too clear because we want to have that or
let her do her creative approach as well to our idea." (2P)

Mutual understanding - Idea Relevance

The owner aimed to discuss the opportunity with the designer to solve the identified problem and the objective, to fulfill customer needs. Furthermore, the designer aimed to get an understanding of what the owner exactly wanted, in order to live up to his expectations. The need for a mutual understanding related with the 'relevance' dimension, hence it refers to the level to which an idea can be used in the needed context and conversation (Dean et al., 2006). It is also related to how appropriate the idea was to the present issue and how doable to fix the issue (Dean et al. 2006). The activity 'framing' in this context was paramount, since individuals operating in collaborative design needed to be able to show goal-directed behavior and shared rationality referring to mutual understanding (Valkenburg & Dorst, 1998). Both actors were involved in face-to-face collaborative interactions, in which they attempted to reach mutual goal-directed behavior.

"I probably talked about it in the way I asked I answered your first question just to describe who we are targeting in this case and what kind of solutions we think we would need to have to, to fulfill these customer's needs" (2P)
"So from the first meeting, my purpose with this meeting is to understand him more about
what he wants to do with his portfolio because in the end, he is the one owning the portfolio." (1P)

"It met all the requirements that we set also in the initial stages of the project." (2P)
"So I think we really incorporated the problems that we identified or he identified in the beginning." (1P)

5.1.1.2 Idea Selection

Requirements - Specificity & Relevance

A causality is identified between the 'requirements' of information and 'relevance' of the idea. The owner (receiver) expected from the designer (transmitter) that the conceptualization of the idea presented is aligned with initial requirements. The project designer held the perception he/she adhered to the requirements in regards to the concept design. Requirements are seen as 'what' the actor needs to solve the problem and the understanding why it is needed to solve the identified problem (Clarkson & Eckert, 2005). The requirements related to specificity of the idea, hence the idea was well conceptualized as it was understandable, clear and contained all the necessary information to further proceed with. Subsequently, the initial set requirements resulted in an effective idea, by virtue of the appropriateness of the idea in relation to the identified problem (Dean et al. 2006).

"So, this was his identified need that he needed a product family for. And in doing that, I wanted to add a lot of flexibility in the concept so it could be used not only together with the product range machine." (1P)

"I think they fulfill them in a good way. Mostly a matter of I mean design versions or different designs fulfilling still the same purpose and meeting the same requirements" (2P)

"I tried to make it as detailed as possible so everyone involved can understand what the purpose is with the product and how to execute it" (1P)

Individual Comprehension - Specificity

Individual understanding of the designer is congruent with its own formed interpretation, related to prior knowledge (Nonaka, 1991). Due to a lack of prior experience, the designer based her design on interpretation of what the owner expected to see. The designers' idiosyncrasies can mismatch with the owners' expectations, resulting in miscommunication later in the innovation process (Bucciarelli, 1996; Eckert & Stacey, 2000; Yus, 1999). As prior mentioned, designers' interpretation of the initial set

requirements were paramount to make the idea relevant to solve the problem. Thus, individuals' comprehension of the other actors' expectation had an effect on idea specificity, hence it affected the specificities visualized in the idea's conceptualization presented by the designer to the owner.

"So, she will probably have her own preference as well even though she made all the concepts and I can have my preference. So we discussed that (...) the requirements that we put forward in the beginning are quite important or very important and so obviously they have to steer our decisions later on" (2P)

"Since it was the first time it was kind of, I was unsure how the results, how the reaction would be. So it was my interpretation of what I think they want to see." (1P)

"We don't want it to be too clear because we want to have that or let her do her creative approach as well to our idea." (2P)

Mutual Understanding - Workability

It is identified that the designer and owner formed a mutual understanding with regards to the selection of concepts. The project designer has pointed the discussion into a direction to assure the idea will become feasible. The idea had to be unique and simultaneously technically feasible. The designer executed the 'reflecting' activity within a collaborative design, which refers to the ability to mutually reflect upon current activities to adhere to goal-directed behavior and shared rationality, with the aim to accomplish a 'feasible' idea (Kleinsmann et al., 2012; Schön, 1987; Dean et al.,2006).

"So we evaluated the four concepts by looking into what we had in the portfolio already, finding something that wouldn't stick out super much but still stick out looking into the possibilities that we have with the production" (1P)

"Because even though she makes a pretty thorough, let's say drawing of the product and the concept, we are all aware that that needs to be translated into a technical drawing as well in later stages to make it feasible." (2P)

"And that all depends on the suppliers because we don't have our own factories." (1P)

Mutual Understanding - Relevance

An interrelationship was identified between mutual understanding of the actors involved and the 'relevance' of the idea. Again, the owner mentioned the importance of having mutual understanding of the initial requirements. Moreover, the designer acknowledged to have preferences of the conceptualization of the design, nevertheless he/she tries to fulfill the desires of the owner. So how the owner comprehended the idea impacted how the designer conceptualized it, which influenced the relevance of the idea (Dean et al.,2006).

"So, if there are certain or if there are concepts that we are being presented with that are not really fulfilling the requirements stated in the beginning, then they become less interesting"(2P)

"Of course, I always have my favorites, that's for sure. But that's not really anything that I put a value in because it's not me that is supposed to like it. It's the customer that's supposed to like it." (1P)

"it met all the requirements that we set also in the initial stages of the project." (2P)

"So I think we really incorporated the problems that we identified or he identified in the beginning." (1P)

Quality dimension **Collaborative design dimension**	Workability	Relevance	Specificity
Requirements	IG	IS	IG + IS
Expectations			
Individual comprehension		IG	IS
Mutual understanding	IS	IS	

Table 8: Identified relationships project P

5.1.2 Project T

5.1.2.1 Idea Generation

Expectations - Specificity

The owner (transmitter) was not familiar with this type of collaboration before, resulting in a lack of knowledge background. The designer (receiver) expected that the owner obtained the same level of knowledge with regards to the NPD project (Cohen & Levinthal, 1990). Nevertheless, the opposite was true. As a result, miscommunication arose. Unless the different expectations, the quality of the idea achieved a certain degree of specificity, due to a thorough established preparation and task division among the owner and designer. So, aligning specific expectations among actors was beneficial to specify the idea and enhance the quality.

'No, as this was new, I haven't worked with this before, we haven't done any collaboration of this kind before, neither from me with the owner or neither from the whole team that I work behind. So, based on that we didn't have any formal templates or processes before. I would say we, the owner, did a tremendously good job in preparing everything.' (3T)

'I think, I assumed that she actually had the same information that her manager, who was the other product manager. But her boss, or her boss's boss, I should say. I thought he had given her a lot more information. She didn't tell me she didn't know. So, we sort of bumbled through this together' (4T)

Individual comprehension - Workability

The responsibility of the owner (transmitter) was to send specific information to the consultant, so they were able to continue with the development of the prototype. However, the owner tried to individually comprehend what kind of information the designer (external consultant) needed. Consequently, it is confirmed by Taifa, Hayes & Stalker (2020) that individuals create conventional assumptions on information when information of an initial idea is not specified by means of interactive negotiation. The owner's individual comprehension influenced the workability of an idea, since it refers to the degree of the implementation of an idea (Dean et al., 2006).

'*But then you come into the technical data how do we calculate stuff like that. so I would say my hesitation to: can I find all this information that is needed for the tool and I might need more help*

outside the owner and me, So that was probably my personal journey in getting all the information we needed.' (3T)

'But I think it helps that this idea was already set, you know, from the beginning' (4T)

Mutual understanding - Specificity

The case company and consultant organized weekly meetings to reach a mutual understanding of the process and requirements needed to accomplish certain tasks. Even though both parties held diverse object worlds, they were able to apply a transactive memory system, in which they weighed each other's knowledge capacity to discern the most applicable knowledge, to jointly solve the problem (Buijs & Kleinsmann, 2006; Austin, 2003). This led to higher specificity of the idea generated as mutual common understanding of knowledge was achieved during collaborative design (Calsamiglia & Van Dijk, 2004; Yoshimura & Yoshikawa, 1998)

'*Well, all the Skype meetings, like the Skype conversations were always meetings and the meetings had agendas, where it was very clear, like a checklist. Have we done this? Have we done this? So as soon as we felt on the checklist that yeah, this has not been ticked off. Who's responsible? When can we get it? Do we need another week? So the weekly meetings had agendas all the time. And that is why we definitely managed to keep within the deadline that we had, which was January.' (3T)*

'*I would say in meetings, we had weekly check in. So I was always working on it in between, and then we checked in. Basically, checking on status of open topics, as well as possible new feedback. And then at some point, we realized that we no longer need a weekly check in, but rather can speak as it comes. But that was basically when no longer so many things happened and changed, we decided that it's no longer needed that we have weekly series. And then it went to email conversation' (5T)*

5.1.2.2 Idea Selection

Requirements - Specificity

In the beginning of idea selection, a requirement list was compiled between the consultant and the case company. Back and forth conversations continuously occurred to discuss what and why certain requirements are followed through (Weiskopf et al. 2013). Feedback is seen as an integral requirement to reach mutual understanding and point the project in the direction of the set frame (Kleinsmann et al., 2012;

Schön, 1987). The frame, set to live up to certain requirements alongside the process, has resulted in a specified idea, hence the idea has achieved the set objective (Dean et al, 2006).

'*What did I expect? I mean, the list of requirements that were then made together with the sustainability manager and also the project manager.' (4T)*

'*I would say when I had the meetings with them at the beginning, it was quite a lot on how they wanted to have things displayed. So it was a lot about which numbers we want to display, in which way we want to display the numbers. All of these details when it comes to the tool and the pages of the tool. The meetings with them were basically always going through, whether they have some feedback on the latest version, or whether we have some news from our side in regards to some open topics which were layout topics or also that they wanted to have some articles added or others deleted.' (5T)*

"The initial problem was to take a great step in the market of being an environmental company doing choosing better material before other non so good products and unhealthy or being an environmental ambassador. That was definitely the aim for this tool and that we achieved. The response and the help the tool have done for the guys has been great." (3T)

Individual Comprehension - Workability

Individuals' perceived understanding whether the tool will become a success was contingent with the feedback received from the end-users. The owner and designer's understanding had a result on the workability of the idea. Workability referred to the probability of the idea becoming effective the moment it is launched (Dean et al., 2006). Since it was a service, the owner and designer needed to understand the end-users to deliver customer-centric solutions.

'*We would sit afterwards and we would say this is how we feel; it does looks good or, we are quite happy now, it's a relief to hear that it's been taken quite positively and people seem to understand, because we were quite concerned is this still too complex for you our sales to use' (4T)*

Mutual understanding - Relevance

The consultant and case company established a mutual set checklist in the beginning of the project, which resulted in a smooth process. As identified by (Eckert, 2001; Eckert & Stacey, 2001; Yus, 1999), when information is not prior discussed, individuals will unconsciously put the emphasis on information they

believe is the most important. Since an iterative feedback approach was applied, participants knew how a present issue should be resolved by generated ideas.

'We discuss what could be improved or this could not be improved. I mean, we typically agreed with each other. So there were never any problems there. And then we would go back to them and say; this is what we needed. It was a fairly smooth process.' (3T)

'But from our perspective, yes, we have hit the checkmarks of what we sought to do. I think to say that if it's actually working, I mean, this is how it is with everything right? You don't need to do a more thorough analysis. So this checklist, I mean, that was quite important to have' (4T)

Quality dimension **Collaborative design dimension**	Workability	Relevance	Specificity
Requirements			IS
Expectations			IG
Individual comprehension	IG + IS		
Mutual understanding		IS	IG

Table 9: Identified relationships project T

5.1.3 Project V

5.1.3.1 Idea generation

Mutual understanding - relevance

The first link between collaboration and quality was identified from the beginning of the idea generation phase, where the owner explains that the development of the project would have not been undertaken, without the involvement of the designer. This in turn can be seen as an advantage to create an idea, appropriate for the context and which would fix the issue discovered by the owner (Dean et al., 2006).

However, mutual understanding between actors was considered key, yet also a challenge in idea generation due to the need of matching the owner's commercial objectives regarding the opportunity with the designer's technical abilities (Eckert, Clarkson & Stacey, 2001).

"Yeah, I sent the hypo. went out to look for different providers who had worked with augmented reality technology, because we knew that that was the technology we wanted to use. And then I talked with a bunch of different players to get an understanding of, you know, how they can support us." (8V)

"I said; I need a partner that can help me succeed with this. This is an important investment for the company and we want to try this. Also for me in my role, so I need someone I can trust, and that can guide me through this from the development point of view. We had a very open discussion, and it's stupid questions." (8V)

5.1.3.2 Idea selection

Requirements - specificity

The owner's individual necessities were fulfilled by the designer's work and informational declarations were successfully transferred into specifications for the idea (Clarkson & Eckert, 2005). Furthermore, the designer's deliverables coincided with the purpose of the idea, therefore contributing to the level of detail and surpassing the owner's requirements (Dean et al., 2006).

"So proof of concept was the period when I tested the web app. If we take the question if I was expecting more from the web app, then I was not. That was just what I needed and that's what it delivered and even better. " (8V)

Expectations - relevance

Since the owner proposed the opportunity to the designer, there were several expectations regarding the project's outcome during idea selection. The owner's expectations were formed based on prior experience and knowledge (Nonaka, 1991). Therefore the evaluation of the idea was influenced by the actors' prior experience and how the information's context was understood. Also, based on the evaluation, the owner was confident the collaboration will contribute to creating a solution that will solve the identified problem (Dean et al., 2006).

"I expected something I could test for real. My expectation was that I would get a web link and then when I went in there, I could go in with my phone and then visualize a product on my table." (8V)

"I also looked at for example, if we would implement an application like this, could we reach more potential customers, because this is an online tool that will be sent out and provided?" (8V)

Mutual understanding- relevance & specificity

The discussion between the actors looked at how the chosen idea solves the problem (Dean et al., 2006). This related to the process of framing, where actors led the collaboration towards a shared direction to fix the issue (Schön, 1987). Nevertheless, the owner recalled how essential it was to reflect on how to mutually find new features for the idea, in line with prior set objectives (Kleinsmann et al., 2012). Therefore, the collaborative design also contributed to the specificity of an idea and added on its level of detail (Dean et al. 2006)

"I think it was more, we proved in the proof of concept that visualizing something with AR is a benefit. And then with him, I then discussed, you know, what more things can we add in the future application to generate statistics or better communication with a customer or even establish a sales and marketing channel." (8V)

In conclusion, the owner confirmed once more that working together with the consultant had a tremendous impact on the overall quality of the idea, from the level of detail to how well the idea matches the initial need.

"The tool would not be what it is today and what will be now in the future releases if I didn't have a collaboration with him. I would have done it in different ways. So it was a good mix" (8V).

Quality dimension **Collaborative design dimension**	Workability	Relevance	Specificity
Requirements			IS
Expectations		IS	
Individual comprehension			
Mutual understanding		IG + IS	IS

Table 10: Identified relationships project V

5.1.4 Project A

5.1.4.1 Idea generation

Requirements - specificity

In this project, the collaborative design was initiated by using briefs to capture the necessary knowledge, for the designer (receiver) to start generating ideas (Clarkson & Eckert, 2005). The inclusion of the owner's (transmitter) inspirational sources within the requirements allowed the designer to understand how the information was derived from the owner's tacit knowledge (Nonaka, 1991, Eckert & Stacey, 2000).

Essentially, these requirements triggered the comprehension of the designer and allowed to create ideas. As a result, the designer's understanding allowed for a clear process on how to reach the objective and the inclusion of the required details (Dean et al., 2006)

"He showed me mood boards that he made with different feelings that he wanted to add. So he was instantly drawn into the beach, Hawaii feeling, sand, beach wood. So he had already stated the feeling that he wanted to have when he was eating from this bowl. So my job was to find a product that could simulate this mood." (6A)

Requirements - relevance

The project's requirements seemed to also have an influence on how ideas can become relevant to the stated objective (Dean et al., 2006). The requirements were clearly presented by the owner, then they became guiding points of what is the purpose of the information received (Clarkson & Eckert, 2005). Consequently, the designer could generate ideas, which fall in line with the owner's objective and were appropriate to the presented issue (Dean et al., 2006).

"I need to know what it is he wants me to do. And I also need to know all relevant research that he has already done in the sector (...) it's not necessary for me but it's more easy for me to get into the type of idea that he is imagining himself that he wants to present." (6A)

Expectations - workability

The designer's expectations were based primarily on the information needed from the owner, to start the research process. The expectations were also related to the designer's prior knowledge and experience in the field (Nonaka, 1991). The feasibility aspect was obviously influenced by how the expectations were formed, as it was relevant for the designer to look at whether the opportunity imposed restrictions and could be easily integrated into the case company's objectives (Dean et al., 2006).

"I expect to get a description of his problem that he needs a physical product to resolve. I expect to get some background information on how he came up with this problem (...) I also have to take in consideration how many items we are actually able to realistically develop and also the level of innovation that he wants to add in the products." (6A)

Individual comprehension - relevance

The owner's requirements come once more into play when it comes to understanding the opportunity. The designer's interpretation was positively influenced by the specificity of the received information, which did not create a gap between the intentions of the sender and the perception of the receiver (Daft & Macintosh, 1981; Eckert & Stacey, 2000). The level of detail of the requirements allowed the designer to generate ideas which added upon the need to solve the specific problem (Dean et al., 2006).

"The first impression was very positive, because it was so specified into one thing and the more specified something is, the easier for me it is to resolve his problem." (6A)

Mutual understanding - specificity

As a result, the correct interpretation of the information and also the discussions between actors allowed for an effective collaborative design. Comprehending each other's interpretation was dependent on how well each individual reflected upon the situation and complied with the set objectives, in order to deliver new subsequent tasks (Kleinsmann et al., 2012; Schön, 1987, Boos, 2007). Consequently, the focus was on how the idea can achieve the required level of clarity and detail, to match the initial requirements (Dean et al, 2006).

"I think those initial talks enabled the designer to do her research in both an efficient way but also in the right way to find the right I would say both strong points and weak points of the concept." (7A)

5.1.4.2 Idea selection

Requirements & expectations - relevance

For the owner, it was essential the generated ideas follow strictly the initial guidelines, in order to not derail from the project's objective. Requirements were perceived as a guiding point into how the designer should perceive the problem (Clarkson & Eckert, 2005). A reason for failure would have been if the ideas proposed would have not matched the project's scope and not solved the problem (Dean et al., 2006).

The same applies for the owner's (receiver) expectations, which were formed based on the requirements and the individuals' tacit knowledge (Nonaka, 1991). It was expected the designer (transmitter) presented the research and its results (individual interpretation) and several options on how to reach the clarified objective (Kleinsmann & Valkenburg, 2008, Dean et al., 2006).

"It matched almost perfectly, because those requirements are also the scope of the project. If we set, for instance, a cost image already in the beginning, that needs to be incorporated already in the early design stages. Because otherwise, we're exploring paths that are not within scope" (7A)

"Depends on what stage you're at, but in the initial phases I expect to get the research and the results because often there's a multitude of different ways to reach the objective those need to be clarified in the early stages." (7A)

Individual comprehension - workability

Furthermore, the interpretation of the designer was influenced by the willingness of the owner to pursue a presented idea. This meant the owner's preference impacted how the designer integrated the information received into the course of the project (Minneman, 1991).

"I also have to read what the owner is willing to do, of course in terms of innovation and news, so it's always adapting to the person that orders a product from me" (6A)

Individual comprehension - workability & relevance

Consequently, the owner's preferences were based on experience and were pushed through communication, influencing the view on the feasibility of the idea (Eckert & Stacey, 2000; Ostergaard & Summers, 2003).

"From experience, you can judge if a certain concept will appeal to a broad audience or to a narrow audience, for instance, and in this case, we know that it will probably appeal to a more narrow audience than our mainstream products. So then you've set kind of the commercial limitations of the product already from the beginning." (7A)

Furthermore, the owner based his/her preference on the evaluation of requirements and the project's scope. This might have led to focusing on the information, which seems more important for the receiver, yet missing to understand the objective of the transmitter (Eckert, 2001; Eckert & Stacey, 2001; Yus, 1999). The relevance aspect of the idea was also influenced, as the owner pursued to direct the communication towards his/her interpretation (Dean et al. 2006).

"Yeah. Because that is the initial need that we try to capture. And if we don't capture that need within the concept and it's a failure, then we're missing the target we can, then we can do something else. "There might be great ideas coming out of a concept like this, but the delivery within the project is to deliver on the need that was initially stated. If we answer a different need, then it's a different project, and then we need to scope that and have that go through the process in a different way." (7A)

Mutual understanding - workability

The employees involved in the collaborative design were aware from the start on certain feasibility issues of the project. There was a similarity in their individual perceptions about how the design would be conceptualized (Kleinsmann & Valkenburg ,2008). Not taking action around these problems obviously influenced how feasible the idea would be to implement in the later stages of development (Dean et al., 2006).

"No, we were quite aware of challenges in the start of the project. So that that will of course, affect the timing of it. We knew it would take longer to get this project from start to finish." (7A)

Mutual understanding - relevance & specificity

The understanding between actors seemed to have a positive impact on the quality of the selected idea. The close collaboration allowed the individuals to understand and comply with the intended objective (Boos, 2007). If the actors did not share a similar understanding, the relevance of the idea would be affected (Kleinsmann & Valkenburg, 2008). Nevertheless, the objective of the project was achieved, the idea matched with the intended scope and it also included the level of detail, necessary for the later stage of development (Dean et al., 2006).

"It solves it really well. From the point of view that the main objective was to have a really good or the ultimate bowl eating experience. We were convinced that this was a concept that would do that." (7A)

"It's central. If you want a result that actually answers to the to the initial objective, you need to have a tight collaboration between the designer and the product owner, because otherwise you will end up : you won't share the same objective maybe or how to get there and there is a clear risk because the decision maker is the product owner and if the designer isn't really clear on what the product owner is expecting, it will be a longer process because you will ping pong, a lot of things. " (7A)

"It was quite detailed. We knew the things that we wanted to have the number of articles and so on, but we didn't know exactly the materials" (7A)

Quality dimension **Collaborative design dimension**	Workability	Relevance	Specificity
Requirements		IG + IS	IG
Expectations	IG	IS	
Individual comprehension	IS	IG + IS	
Mutual understanding	IS	IS	IG + IS

Table 11: Identified relationships project A

5.2 Cross-Case Analysis

An inductive structure was conducted, whereby emergent concepts arose from data analysis of new data in combination with existing literature. It was a highly iterative process, meaning researchers continuously analysed emergent relationships between variables and existing theory (Bryman & Bell, 2011).

Nevertheless, in order to avoid becoming trapped in overburden of qualitative data, mainly consisting of detailed descriptions of social phenomena, a reductivist method within the cross-case comparison was adopted (Weed, 2005; Bruscia, 2019). This implied the appraisal of qualitative data, with the aim to look at how frequent a specific collaborative design-quality interrelationship occurs within the different cases (Weed, 2005; Bruscia, 2019). As described by Bryman & Bell (2011), researchers who try to substantiate too many emergent themes with existing theory, thus covering too many interrelationships, mostly arrive at superficial findings or end up with violation of generalizable inferences. For this reason, the collaborative design-quality relationships that have been identified in three or more projects, in which 12 combinations were distilled into two interrelationships and further analysed by means of existing theory. The two prevalent interrelationships identified consist of Requirement-Specificity and Mutual Understanding-Relevance, appertaining to the idea selection phase.

	Workability		Relevance		Specificity	
	Idea Generation	**Idea Selection**	**Idea Generation**	**Idea Selection**	**Idea Generation**	**Idea Selection**
Requirements	P		A	P + A	P + A	P + T + V
Expectations	A			V + A	T	
Individual comprehension	T	T + A	A	A		P
Mutual understanding		P + A	P + V	P + T + V + A	T + A	V + A

Table 12: Cross-Case Analysis

5.2.1 Requirements - Specificity

As mentioned in project P, the project owner expected that the designer obeyed to initially established requirements. The owner compiled those requirements and expected from the designer to transfer them within the conceptualization of the idea. The requirements refer to what individuals need, in order to resolve an identified problem and transform informal declarations into explicit specifications (Clarkson & Eckert, 2005). The owners' perception on what was required to solve a problem and why it was needed to pursue certain tasks, had an influence on the design process in the idea selection phase of FEI.

This is primarily substantiated by the fact that perceived requirement values anchored by the project owner had an influence on how the designer will continue the design process (Chiu, 2002). The designer formed their own interpretation of the owner's requirements, which led to creating assumptions on the information of higher value (Eckert, 2001; Eckert & Stacey, 2001; Yus, 1999). Consecutively, a lack of clarity on the received information with regards to the initial requirements could lead into miscommunications and have constraints for further development (Bly, 1988; Daft & Macintosh, 1981; Gransberg & Molenaar, 2004; Kobayashi & Higashi, 2009). Nevertheless, the designer managed to clearly interpret the information and showcase possible concepts in a presentation to the owner.

A similar phenomenon was identified in project T, where requirements are formulated by the owner and

expected to be obeyed alongside the process. However, differences were identified between project P and T**.** In project T, continuous back and forth conversations took place, to reach mutual understanding of initial requirements. The actors reflected alongside the process, to see what and why certain information was required to solve the initial problem. Considering project T involved developing a new to the market service, which was initially considered intricate by CC to develop by itself, the feedback managed to reduce the complexity of information and the chance for error during collaboration (Cover, 1988). Additionally, the continuous feedback loop in between involved participants benefited the collaboration process in general. *'The reflective conversations with the situation'* was paramount to point the participants in the same direction throughout the design process (Schön, 1987, p. 251). It is about reflecting upon retrospective activities and how to pursue from that point onwards (Schön, 1987)

This phenomenon occurred to be inadequate in Project P, hence the designer tried to comprehend the initial requirements set by the owner through showcasing several conceptualizations of the idea. Specification of the idea was reached by delivering various options of the ideas with the aim to live up to the requirements. Consecutive feedback sessions were however omitted in Project P.

The collaborative structure, which occurred in Project T was also identified in Project V, as both cases worked with an external consultant to launch a service-oriented idea. Within Project V, the owner provided the designer with intended requirements, which were jointly assessed during the outset of the process, similar to Project T. Nevertheless, the owner in project V placed the emphasis on trust in the initial stage. Building trust was an essential part within the collaborative process. As a consequence, the level of specificity, mentioned in the initial requirements, was reached and the frame, composed in the beginning of the project, obeyed.

Path Dependency Requirement-Specificity

It was identified that initial set requirements within IG influence the actors' actions in IS, leading to a path-dependent process, which ultimately had an influence on specificity. In project P, the owner expected various design conceptualizations within IS, which had to be aligned with the initial transmitted requirements in IG. A similar phenomenon took place in Project T. The owner and designer established a list of requirements that had to be obeyed by the consultant (designer) throughout IG and IS, to enhance the specificity of the idea at the end of FEI. Finally, for project V, the actors also commonly agreed-upon requirements in IG, which were followed through in the later stage and determined the final outcome of the idea.

5.2.2 Mutual Understanding - Relevance

The common thread among the four projects was the actors mutually agreeing that the ideas generated should apply to the problem and expect to also solve the problem (Dean et al., 2006). All projects showcased that the created ideas have to follow the objective presented at the start of collaborative design.

Arriving at a common understanding of the objective was however influenced by having requirements, to guide the development process (Clarkson & Eckert, 2005). For project P and A, there can be noticed that the requirements, established by the owner when requesting the collaborative design, determined the objective of the project. Therefore, the discussion between actors followed and was influenced by a one-sided perception of an objective.

This decisive role of the owner in the conversation led to a lack of negotiation between actors (Eckert, 2001). Particularly, there was no negotiation for jointly agreeing upon the final idea, which could lead to potential compromise from the actors (Eckert, 2001). The owner unconsciously put the emphasis on what was believed to be important, based on own perception (Eckert, 2001; Eckert & Stacey, 2001; Yus, 1999). This falls in line with Gibson (2001), who mentions that during the examination of information, actors' perceptions are incorporated to a greater or lesser extent, to lead to a final decision. The designer could have challenged the owner's choices only if he/she would have had another authority and the collaboration process would have a different structure (Stacey & Eckert, 2001).

Consequently, there was no mutual contribution to the decision process and even though the designer contributed with information, the relevance aspect of the idea was primarily influenced by the interpretation of the owner.

This decision pattern did not apply to the other two cases. Firstly, for projects T and V, the actors jointly brought meaning to the requirements, which allowed for accomplishing a mutual perspective on what was needed to solve the problem (Gibson, 2001). Secondly, the communication was based on a 'checklist', which allowed the actors to contribute on an equal level to the accomplishment of the objective. This strategy avoided one actor to acquire a higher status during the collaborative design and one's perception to weigh more and achieve a certain bias of how the project should continue (Gibson, 2001).

Path Dependency Mutual Understanding-Relevance

As confirmed in all the projects, mutual understanding was needed among actors regarding the initial identified problem, in order to select a relevant idea. Specifically, a mutual objective derived by the formulation of initial requirements guided the development process. As described in project P and A, the owners mentioned they would consider an idea as irrelevant within the IS phase if it was not fulfilling the requirements stated in IG. Moreover, mutual understanding among owner and designer regarding initial requirements was needed to accomplish a relevant idea within IS. Additionally, for project V and T, an initial set checklist and the identified problem within the outset of the project was paramount to enhance a smooth collaboration process for the subsequent stages, confirming the path-dependency in between IG and IS. Again, the relevancy of the idea was dependent on whether the actors held a shared understanding with regards to the initial set requirements.

The importance of Idea Selection

In collaborative design, idea generation is without a doubt relevant, nevertheless, selecting the ideas for later development (NPD) is essential. From a business perspective, it is essential to select the best idea, since further resources and time is invested to develop the idea into a product (Faure, 2004).

One of the determining factors in selecting qualified ideas is decision-making within collaborative design, which was also encountered in all analyzed projects (Kijkuit & van den Ende, 2007). Decisions hinged on the owner's personal interpretation of the generated ideas, complemented by the designer’s expertise. Subsequently, initial requirements played a significant role in the decision of the actors during idea selection, as they influenced how the owners formed their interpretation.

Another contributor to decision-making was the mutual understanding between actors, as the designer’s ideas had to be understood and accepted by other actors, in order to successfully select the most suitable idea (Kijkuit & van den Ende, 2007, Dean et al. 2006). In idea generation, mutual understanding was vital to understand the owner’s requirements. In idea selection, the designer had to acquire the comprehension of the owner, to reach a common sense of which ideas are worth choosing. Sense making can be achieved if the designer can translate complex information into user-friendly concepts (Kijkuit & van den Ende, 2007; Larsson, 2003). Therefore, idea selection was very important for the collaboration and tied into quality, due to the role of the owner in selecting the most suitable idea that was later developed in the development phase.

5.3 Theoretical framework

The findings showcased that the actors' interpretation of what was required of a project determined the specificity level of an idea during collaborative design. An owner submitted an opportunity, to create a baseline for the development process and to guide the designer in the creation of suitable ideas (Clarkson & Eckert, 2005; Koen, Bertels & Kleinschmidt, 2014). The requirements were further processed by the designers and certain interpretations were formed, in order to present possible concepts that match the owner's expectations (Hannola & Ovaska, 2015).

However, it was also revealed that mutual understanding had a significant influence on the requirements' function in relation to idea quality. For a designer to clearly understand and interpret the opportunity, all actors have to jointly assess the requirements (Kleinsmann, Valkenburg & Buijs, 2007; Schön, 1987). The owner presented an objective by using prior acquired knowledge and expertise (Nonaka, 1991). In some projects, it was essential to assess potential comprehension gaps between actors, in order to create and qualitatively evaluate ideas.

Furthermore, mutual understanding in the selection process revolved around the use of information between actors. As showcased, in idea generation, designers will filter and apply the received information to further present potential concepts to the owner in the idea selection (Gibson, 2001). Nevertheless, as these concepts entered the collaborative context, each actor acquired a different perception, depending on their decision-making position. Each actor had a different objective and interest in the project, which was highlighted in the evaluation of ideas (Hannola & Ovaska, 2015).
Their different interests were impacted by the usage of requirements throughout the collaborative design. As identified in project P and A, the owner presented the requirements at the start of idea generation, which were perceived as most important, and urged the designer to follow them in the evaluation and selection process. Contrarily, for project T and V, clarifying the actors' interpretations of the proposed requirements in idea generation, allowed the actors to have equally divided control over the qualitative aspect of the idea (Coughlan & Macredie, 2002).

As a final thought, this study revealed that there exists a relationship between collaborative design and the qualitative aspect of radical ideas. In fact, it appeared that Dean et al. (2006)'s quality dimensions, specificity and relevance, were influenced by the actors' interpretation of requirements and the process of reaching a common understanding during the selection procedure. Furthermore, this research confirms

Suhkov’s (2018) theory that individuals' assessment of the information’s completeness functions in conjunction with understanding each other’s interpretation of the information.

To conclude the discussion, figure 11 captures the influence of individuals' behavioural actions within collaborative design in relation to the relevance and specificity of ideas and the complementary relation between completeness and comprehension of information.

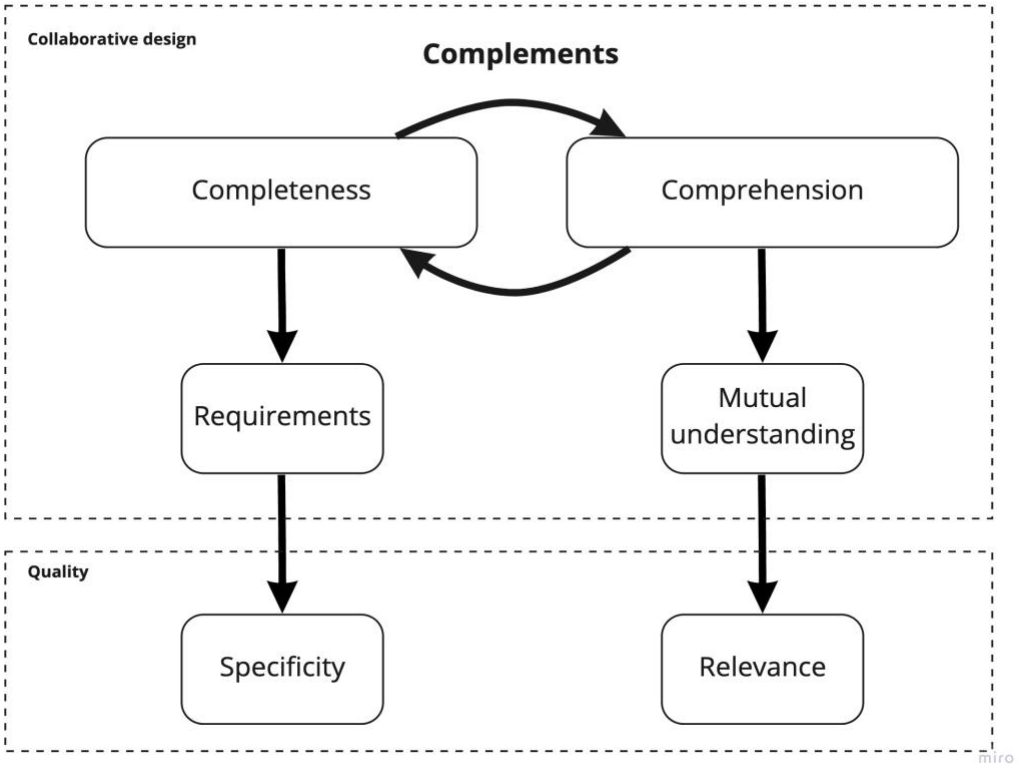

Figure 11: Theoretical framework, Collaborative design - Quality

6. Conclusion & Implication

6.1 Conclusion

A higher degree of idea radicalness coincides with higher information processing uncertainty. Uncertainty of information refers to the gap between the available and needed information to resolve an identified problem, hence companies are not familiar with technicalities behind radical innovation. Individual equivocality becomes a fundamental aspect, to reduce uncertainty, and prevails a role within the collaborative design between actors in FEI.

Moreover, prior research primarily shed light on how to forge volume of generated ideas within a corporation rather than looking at how individuals can foster high quality of ideas within FEI. Since ideas stem and are managed by individuals, this study revealed how the individual's role in collaborative design has an influence on quality of ideas.

For collaborative design, there were selected two variables: completeness and comprehension. The study revealed two sub-dimensions, which came across as most prevalent during analysis. For the dimension 'Requirements', part of completeness, it was discovered that each consumer of information had different interests, which resulted in contrasting assessments of the requirements' purpose in the design process. Additionally, the dimension 'Mutual understanding', part of comprehension, had the aim to reach shared understanding among individuals.

On the other hand, idea quality was classified by the dimensions 'Workability' 'Specificity' and 'Relevance'. Nevertheless, the study revealed that only two dimensions had been significantly influenced by requirements and mutual understanding. Specificity, referring to idea clarity and its detailed level, was impacted by how actors understood and processed requirements in the collaborative design. Whereas, relevance was influenced by how well the actors understood and used their interests to select an idea relevant to the initial problem.

Furthermore, the study revealed that the interrelation between the behavioral factors of collaborative design with idea quality in FEI was path dependent by nature, hence the compiled requirements within IG influenced individual's actions within the IS. Mutual understanding of initial set requirements among

actors positively impacted the specificity of an idea in the selection stage. Specifically, reflective discussions between actors concerning the individual's understanding of the requirement seed into specific, clear and understandable ideas. Moreover, the decisive role of the owner led to one-sided perception of the objective of the requirements. Therefore, joint comprehension of the meaning behind the established requirements was crucial to conceive into relevant ideas. As a result, mutual understanding and completeness of requirements both went in conjunction within collaborative design, to discern the best qualified ideas in the Idea Selection stage of FEI.

In conclusion, this study accomplished to answer the proposed research question, showing how collaborative design indeed influences idea quality and confirmed that the evaluation of the completeness of information and the comprehension of individuals' interests are complementary.

6.2 Managerial Implications

Decision-makers at firms running innovation projects are under pressure to maintain a competitive advantage and come up with new ideas to their customers. Therefore, putting emphasis on having a structured evaluation process for the idea quality would greatly benefit innovation, as it would enhance decision-making capabilities. It would enable them to better select ideas, which would be easily integrated in the development phase of innovation.

Fostering novel innovations has been acknowledged as crucial by many organizations to stay at the forefront of their rivalries. Nevertheless, launching a successful radical innovation requires focusing on the idea quality within the Front End of Innovation. Since individuals generate and select the best qualified ideas, it is recommended for an organization to understand how individuals comprehend the established requirements and how that has an influence on the generation and selection of a qualified idea. Additionally, how individuals comprehend each other can deteriorate or enhance the process of collaborative design, meaning misunderstandings can derive from lack of comprehension in between actors. As a result, an individual's role of collaborative design is prevalent for the selection of a specific and relevant idea before it continues into the development stage.

Collaborative design is a process, where information is shared and ideas are generated and selected. Nevertheless, it is essential to consider what are the factors that trigger certain behaviours and actions throughout the cooperation between individuals. As investigated in this study, requirements and mutual

understanding have proven to complement each other in their relationship with idea quality. Therefore, it is recommended that organizations dedicate time on the core of collaborative design to foster qualified radical innovations.

6.3 Limitations

The conducted research presents advantages and disadvantages. One of the most important steps in organizational ethnography is exposure to the social context (Bryman & Bell, 2011). Accessing necessary data was a major concern for the study, since only a limited number of participants were eligible, hence the emphasis was placed on the owner and designer of the selected projects.

Another limitation was that during the sampling process, it was identified that one participant was the designer for two distinct projects. Considering the type of CC, selected for the research, it is very common that there is one person responsible for the design aspect of collaborative design. This disadvantage might have led to a bias in answers, as for the second interview, the participant was already familiar with the structure and style of questions addressed.

The approach used to interview the participants might have also had an influence in the collection of data. Due to unforeseen circumstances, the researchers were not able to conduct interviews in the desired situation, face to face, at the headquarters of CC. Consequently, the conversations were moved to an online setting, where in some cases, it was not possible to see the participants' reaction to questions from the point of body language. This disadvantage might have led to not obtaining a complete picture of the participant’s view on the collaborative design.

Furthermore, for one of the projects it led to having to compile data, where only the owner’s view could be collected. This disproportion may have caused misrepresentations between projects and a potential risk for the data analysis. Nevertheless, the researchers’ decision was to carry-on the analysis and hold a positive view over the collected information.

The encountered results present a strong argument how two collaborative design dimensions influence several aspects of idea quality. Nevertheless, the in-depth exploration of the selected collaborative design-quality relationships in a cross-case setting across projects, rather than analyzing them all, might also become faulty. Particularly, one downside could arise from having neglected relationships, present in a

sole project, which could have changed the overall outcome of the study. Yet, the chosen strategy was still preferred over a general presentation of all relationships, to capture the dominant elements of collaborative design and quality.

6.4 Future research

This study sheds light on how individuals evaluate information and how their mutual understanding influences the idea quality. Within several projects (project P and A), the degree of decision-making authority proved to have an influence on behavioral processes within collaborative design and thus indirectly influence the quality of the selected idea (Gibson, 2001). Due to insufficient collected data, the researchers could not internally validate the claim across the studied projects. As a result, it is highly recommended to investigate whether different levels of decision-making power among actors involved in collaborative design influence idea quality. It is further recommended to investigate how the degree of hierarchy affects individuals' behavior within collaborative design and whether it violates or enhances idea quality in FEI.

Moreover, as this study aimed to look at the behavioral processes driven by individuals within collaborative design, it is recommended to dig deeper into how individuals' collaborative skills can enhance the dimensions of collaborative design and thus quality. As prior research acknowledged some techniques and skills that can be used to enhance mutual understanding within collaborative design, it is recommended to look whether requirement elucidation techniques, selective biasing and framing skills can be used among actors to complement idea quality in FEI (Hannola & Ovaska, 2015; Kleinsmann et al., 2012).

As confirmed in this study, completeness and comprehension are complementary variables, hence individuals' perception on initial set requirements needs to be jointly discussed and mutual understanding about requirements is a prerequisite to facilitate high quality of ideas in FEI. Hence, the various actors involved in collaborative design assign different meanings to the initial set requirements, which directly and indirectly impacts quality of ideas. Even though the relationship collaborative design - quality has been confirmed in this research, attention still needs to be drawn by conducting a similar study within another industry to strengthen the generalizability of the subject.

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Appendices

Appendix 1A - Interview Guide, Owner

1. Interview guidelines
Question type: introducing questions (Bryman & Bell, 2011, p.477)
● Present to the participant the objective of the interview ● Explain that the interview could be recorded and transcribed ● Ask for permission to record and transcribe ● Give a short summary of the agenda for the interview
2. Project background
Question type: variety (Bryman & Bell, 2011, p.478)
Transition to the topic of background
Product/ Service developed ○ Can you describe the product/service developed within the project? *(introducing question)* Participants in the 'idea' phase ○ Who were the employees involved in the idea phase? *(direct question)* ○ What was your role during the idea phase? *(follow-up question)*
3. Collaborative design in idea generation
Question type: structuring question (Bryman & Bell, 2011, p.478)
Transition to Collaborative design
Question type: variety (Bryman & Bell, 2011, p.478)
Completeness

- How did you come up with the initial idea for this project? (specifying question) *(Koen, Bertels & Kleinschmidt, 2014)*
- What was your objective with sending this information to the designer? *(direct question) (Eckert & Stacey, 2000)*
- Can you describe to us what did you include in the initial information you sent? *(specifying question) (Blyth & Worthington, 2001; Parkman & Malkewitz, 2019)*
- How did you send the information to the designer? *(specifying question) (Eckert, Maier & McMahon, 2005)*
    - What format did you obey for arranging this information? (*follow-up question) (Eckert & Stacey, 2001)*
    - What difficulties did you encounter when arranging the information? (*follow-up question) (Stacey & Eckert, 2003)*

Comprehension

Individual comprehension

- If you could summarize the opportunity, how would you describe it? *(probing question) (Kobayashi & Higashi, 2009)*

Mutual understanding

- Once you send/receive the initial information about the opportunity, how do you talk between each other about it? *(specifying question) (Kobayashi & Higashi, 2009; Kleinsmann et al., 2012; Schön, 1987)*
- Have you talked about your own interpretation/understanding of the opportunity? *(specifying question) (Kleinsmann & Valkenburg, 2008; Minneman, 1991)*
    - If yes, how do you see your understanding of the opportunity influencing the outcome of your discussion? *(follow-up question)*
    - If not, how does not talking about it influence the later generated ideas? *(follow-up question) (Bucciarelli, 1996; Eckert & Stacey, 2000; Yus, 1999)*

Transition between idea generation and selection

Question type: variety (Bryman & Bell, 2011, p.478)

- How is the process continued? (*structuring question) (Koen, Bertels & Kleinschmidt, 2014; Minneman, 1991; Reid & de Brentani, 2004)*
- How do you see your own understanding of the opportunity influencing the process? *(direct question) (Koen, Bertels & Kleinschmidt, 2014; Minneman, 1991; Reid & de Brentani, 2004)*

4. Collaborative design in idea selection

Question type: Structuring question (Bryman & Bell, 2011, p.479)

Transition to the second phase of collaborative design

Question type: variety (Bryman & Bell, 2011, p.478-479)

Completeness

- How were potential ideas from the designer conveyed to you? *(direct question)*
  - What format was used to send you information about the generated ideas? (*follow-up question) (Eckert & Stacey, 2001)*
- What do you expect from the designer when you receive these ideas? *(specifying question) (Gkorezs & Kastritsi, 2016; Lin et al., 2005)*
  - How did the received ideas fulfil your expectations? (*follow-up question)*
- What kind of information do you usually need to continue this project? *(specifying question) (Mylopoulos et al., 2007; Coughlan & Macredie, 2002)*
  - How did the suggested ideas provide you with the needed information to continue your work? (*follow-up question) (Hannola & Ovaska, 2015)*

Comprehension

Individual comprehension

- How did you personally evaluate the likelihood of success of generated ideas? *(specifying question) (Oliveira et al., 2015; Girotra, Terwiesch & Ulrich, 2010, Terwiesch & Ulrich, 2010; Sukhov, 2018)*
  - Did your previous interpretation of the initial opportunity play a role in this assessment? *(follow-up question)*

Mutual understanding

- How did you evaluate the generated ideas? *(specifying questions) (Kijkuit & van den Ende, 2007*
  - Did you follow a specific evaluation process? *(follow-up question)*
- Before you evaluated the ideas, did you bring to the discussion your own assessment of the generated ideas? *(probing question) (Kijkuit & van den Ende, 2007; Kobayashi & Higashi, 2009)*
  - If no, how does not discussing the assessment influence the evaluation process? *(follow-up question) (Kobayashi & Higashi, 2009)*
- How do you select the final idea? *(direct question) (Forde & Fox, 2016)*

5. Idea quality (10 min)

Question type: Structuring question (Bryman & Bell, 2011, p.479)

Transition to idea quality

Question type: Introducing question (Bryman & Bell, 2011, p.477)

Presentation of the criteria for evaluating idea quality (Dean et al., 2006)

- Workability refers to the degree of implementation of an idea.
  - Feasibility refers to how simple/difficult an idea is to implement.
  - Acceptability refers to whether an idea fits company objectives
- Relevance refers to the efficiency of an idea in relation to the problem/need.

• Specificity refers to the clarity of an idea, to be submitted for development.

• **Workability**
  ○ Can you describe to us your understanding of the level of feasibility of the selected idea? *(specifying question)*
  ○ In your view, how does the selected idea fit existing company objectives? *(specifying question)*
 	
• **Relevance**
  ○ How does the chosen idea solve the initial problem? *(specifying question)*
  ■ How is the idea different from what is initially requested? *(follow-up question)*
• **Specificity**
  ○ As the idea was submitted for further development, how would you assess its level of detail at the end of the idea phase? *(specifying question)*

Effect collaborative design- Idea Quality • In your opinion, how did the collaboration between each other influence the quality of the final idea? *(specifying question)*
6. Conclusion (2 min)
Question type: Structuring question (Bryman & Bell, 2011, p.479)
Coming to the end of the interview
Question type: variety(Bryman & Bell, 2011, p.478-479)
• The researchers check if all questions have been answered • Thank the participants for his time and the insights provided. • Wish a pleasant day forward.

Appendix 1B - Interview Guide, Designer

1. Interview guidelines
Question type: introducing questions (Bryman & Bell, 2011, p.477)
• Present to the participant the objective of the interview • Explain that the interview could be recorded and transcribed • Ask for permission to record and transcribe • Give a short summary of the agenda for the interview
2. Project background

Question type: variety (Bryman & Bell, 2011, p.478)
Transition to the topic of background
Product/ Service developed ○ Can you describe the product/service developed within the project? *(introducing question)* Participants in the 'idea' phase ○ Who were the employees involved in the idea phase? *(direct question)* ○ What was your role during the idea phase? *(follow-up question)*
3. Collaborative design in idea generation
Question type: structuring question (Bryman & Bell, 2011, p.478)
Transition to collaborative design
Question type: variety (Bryman & Bell, 2011, p.478)
Completeness
● How were you approached by the owner to start collaborating on this project? *(direct question)* ○ What format was used to send you information about the generated ideas? (*follow-up question) (Eckert & Stacey, 2001)* ● What do you expect from the owner when you receive an opportunity? *(specifying question) (Gkorezs & Kastritsi, 2016; Lin et al., 2005)* ○ How did the received ideas fulfil your expectations? (*follow-up question)* ● What kind of information do you usually need to continue this project? *(specifying question)* (Mylopoulos et al., 2007) ○ How did the information provide you with the needed information to continue your work? (*follow-up question) (Hannola & Ovaska, 2015)*
Comprehension
<u>Individual comprehension</u> ● Can you describe to us how you understood the information received from the project owner ?*(probing question) (Kobayashi & Higashi, 2009)*
<u>Mutual understanding</u> ● Once you send/receive the initial information about the opportunity, how do you talk between each other about it? *(specifying question) (Kobayashi & Higashi, 2009; Kleinsmann et al., 2012; Schön, 1987)* ● Have you talked about your own interpretation/understanding of the opportunity? *(specifying question) (Kleinsmann & Valkenburg, 2008; Minneman, 1991)* ○ If yes, how do you see your understanding of the opportunity influencing the

outcome of your discussion? *(follow-up question)* ○ If not, how does not talking about it influence the later generated ideas? *(follow-up question) (Bucciarelli, 1996; Eckert & Stacey, 2000; Yus, 1999)*
Transition between idea generation and selection
Question type: variety (Bryman & Bell, 2011, p.478)
● How is the process continued? (*structuring question) (Koen, Bertels & Kleinschmidt, 2014; Minneman, 1991; Reid & de Brentani, 2004)* ● How do you see your own understanding of the opportunity influencing the process? *(direct question) (Koen, Bertels & Kleinschmidt, 2014; Minneman, 1991; Reid & de Brentani, 2004)*
4. Collaborative design in idea selection
Question type: Structuring question (Bryman & Bell, 2011, p.479)
Transition to the second phase of collaborative design
Question type: variety (Bryman & Bell, 2011, p.478-479)
Completeness
● How did you come up with the generated ideas, based on the initial opportunity? *(specifying question) (Koen, Bertels & Kleinschmidt, 2014)* ● What was the objective behind sending these ideas back to the owner? *(direct question) (Eckert & Stacey, 2000)* ● Can you describe to us what did you include in the information you sent? *(specifying question) (Blyth & Worthington, 2001; Parkman & Malkewitz, 2019)* ● What method did you use to send this information? *(specifying question) (Eckert, Maier & McMahon, 2005)* ○ Did you obey a specific format for arranging this information? (*follow-up question) (Eckert & Stacey, 2001)* ○ What difficulties did you encounter when arranging the information? (*follow-up question) (Stacey & Eckert, 2003)*
Comprehension
Individual comprehension ● How did you personally evaluate the likelihood of success of generated ideas? *(specifying question) (de Oliveira et al., 2015; Girotra, Terwiesch & Ulrich, 2010, Terwiesch & Ulrich, 2010; Sukhov, 2018)* ○ Did your previous interpretation of the initial opportunity play a role in this assessment? *(follow-up question)*
Mutual understanding

- How did you evaluate the generated ideas? *(specifying questions) (Kijkuit & van den Ende, 2007)*
    - Did you follow a specific evaluation process? *(follow-up question)*
- Before you evaluated the ideas, did you bring to the discussion your own assessment of the generated ideas? *(probing question) (Kijkuit & van den Ende, 2007; Kobayashi & Higashi, 2009)*
    - If no, how does not discussing the assessment influence the evaluation process? *(follow-up question) (Kobayashi & Higashi, 2009)*
- How do you select the final idea? *(direct question) (Forde & Fox, 2016)*

5. Idea quality

Question type: Structuring question (Bryman & Bell, 2011, p.479)

Transition to idea quality

Question type: Introducing question (Bryman & Bell, 2011, p.477)

Presentation of the criteria for evaluating idea quality (Dean et al., 2006)

- Workability refers to the degree of implementation of an idea.
    - Feasibility refers to how simple/difficult an idea is to implement.
    - Acceptability refers to whether an idea fits company objectives
- Relevance refers to the efficiency of an idea in relation to the problem/need.
- Specificity refers to the clarity of an idea, to be submitted for development.

- **Workability**
    - Can you describe to us your understanding of the level of feasibility of the selected idea? *(specifying question)*
    - In your view, how does the selected idea fit existing company objectives? *(specifying question)*

- **Relevance**
    - How does the chosen idea solve the initial problem? *(specifying question)*
        - How is the idea different from what is initially requested? *(follow-up question)*
- **Specificity**
    - As the idea was submitted for further development, how would you assess its level of detail at the end of the idea phase? *(specifying question)*

Effect Collaborative design- Idea Quality

- In your opinion, how did the collaboration between each other influence the quality of the final idea? *(specifying question)*

6. Conclusion

Question type: Structuring question (Bryman & Bell, 2011, p.479)
Coming to the end of the interview
Question type: variety(Bryman & Bell, 2011, p.478-479)
● The researchers check if all questions have been answered ● Thank the participants for his time and the insights provided. ● Wish a pleasant day forward.

Appendix 2 - Findings Quotes

Interviewee	Code	Project Code	Product owner / Product designer
1	1P	Project P	Project Designer
2	2P	Project P	Project Owner
3	3T	Project T	Project Designer
4	4T	Project T	Project Owner
5	5T	Project T	Project Designer
6	6A	Project A	Project Designer
7	7A	Project A	Project Owner
8	8V	Project V	Project Owner

Project P

Idea Generation (IG)	
ID	**Background**
1P	*"The project brief came to me with a need of creating smaller sizes for delis"*
1P	*"He wanted to create a range of products in smaller sizes in terms of millimeter"*
2P	*"Yes, and the starting point for the project was, it was several things that we saw it was going on in the market. First of all, we had, you know, the sustainability movement, which had started."*
2P	*"So everything combined, that was the inputs mainly for the project before we actually started and then of course, she took over and did her investigation and based on these criterias."*
1P	*"I believe it was only me and him "*
Completeness - Requirements	
2P	*"If there were any difficulties I don't know if I remember them. I don't think it was that difficult. Usually that first briefing is pretty straightforward."*

1P	*"Well as soon as the problem is defined then I just need a timeline to know how much time I have to work on it."*
Completeness - Expectations	
2P	*"Well it depends but normally as a designer, and especially she likes to get let's say the rough idea of what we are aiming for. So not necessarily a specific brief on exactly how the product should look like"*
1P	*"He approached me with the defining problem that he wanted to resolve"*
Comprehension - Individual Comprehension	
2P	*"Well, we saw a potential within the segments that we were targeting with the 'product range' that we should do something smaller portions and something sustainable.*
1P	*"At first sight it was interesting because it was a new type of as far as I remember it was also the first project that I did together with the product range."*
Comprehension - Mutual Understanding	
2P	*"I probably talked about it in the way I asked. I answered your first question just to describe who we are targeting in this case and what kind of solutions we think we would need to have, to fulfill these customers needs."*
1P	*"So from the first meeting, my purpose with this meeting is to understand him more about what he wants to do with his portfolio because in the end, he i s the one owning the portfolio."*

Idea Selection (IS)	
ID	**Completeness - Requirements**
1P	*"So, this was his identified need that he needed a product family for. And in doing that, I wanted to add a lot of flexibility in the concept so it could be used not only together with the product range machine." (1P)*
2P	*"I expect something which is of course based on the brief that we made initially, so it should meet all those must have requirements that we specified. I do expect maybe a couple of different options "*
Completeness - Expectations	
1P	*"The purpose was to get more understanding about what he actually wanted in terms of design. So that was probably the purpose for me showing four concepts because otherwise I might just show one if I'm 100% sure that I know what the customer wants, which is very seldom, because it's difficult, because I see him as a customer because he orders from me so he is my customer."*
1P	*"Always difficulties. I think it's more the suffering of trying to make something look simple. You'd have to explain something in a clear and simple way and leave out all the*

	unnecessary information and just focus on the core requirements and that also depends on how well I have interpreted the information I received from the customer, in this case."
Comprehension - Individual understanding	
2P	*'I mean, usually it's a joint discussion of course. So, she will probably have her own preference as well even though she made all the concepts and I can have my preference. So we discussed that. And usually we agree on one or two concepts that we both like to continue with. Usually there can be maybe some technical issues maybe with one solution, which is maybe good from a design perspective, but which we already see in that meeting could cause production problems or production complications later on'*
1P	*"Since it was the first time it was kind of, I was unsure how the results, how the reaction would be.* *So it was my interpretation of what I think they want to see."*
Comprehension - Mutual Understanding	
1P	*"So we evaluated the four concepts by looking into what we had in the portfolio already, finding something that wouldn't stick out super much but still stick out looking into the possibilities that we have with the production."*
2P	*"So, if there are certain or if there are concepts that we are being presented with that are not really fulfilling the requirements stated in the beginning, then they become less interesting"*
1P	*"Of course, I always have my favorites, that's for sure. But that's not really anything that I put a value in because it's not me that is supposed to like it. It's the customer that's supposed to like it."*
2P	*"I think It comes out of the discussion that we have together in those meetings. So there's no, let's say, strict process of selecting one out of two concepts. I would say it's more based on subjective considerations. But of course, in our discussion together with her in this case."*
2P	*"As long as that one fulfilled our initial requirements and still looked interesting as she presented the full ranges and the full concepts then that was probably the concept that we would then move into development I would say."*
1P	*"It's interactive, but it's also a lot of me presenting things and they comment on it."*

Evaluation of Quality	
Workability (W)	
2P	*"Because even though she makes a pretty thorough, let's say drawing of the product and the concept, we are all aware that that needs to be translated into a technical drawing as well in later stages to make it feasible."*
1P	*"And that all depends on the suppliers because we don't have our own factories."*
Relevance (R)	

2P	*"So I think, yeah, with that, it was definitely in line with the overall strategy of the business area at least."*
2P	*"it met all the requirements that we set also in the initial stages of the project."*
1P	*"So I think we really incorporated the problems that we identified or he identified in the beginning.*
Specificity (S)	
1P	*"I tried to make it as detailed as possible so everyone involved can understand what the purpose is with the product and how to execute it"*
2P	*"We don't want it to be too clear because we want to have that or let her do her creative approach as well to our idea."*
Effect Collaborative design - Quality	
2P	*"So, it is very much a two persons thing in that sense. So, if that collaboration is not really successful, I think the end result is not going to be good either."*
1P	*"His opinions influence, of course, because he is the product owner. He is the one who starts the project, and he is the one that owns the product. But his ideas obviously influence my work, but I try to always be most influenced by the user"*
1P	*"Obviously, I have to translate the general design view on the company into the products as well as his opinions. So it's very interactive with a lot of different players."*

Project T

Idea Generation (IG)	
ID	**Background**
5T	*'The company wanted to have a tool where they can compare their products and the salespeople can use it. The beginning of the project was a collaboration between normative and South Pole, because South Pole is another sustainability consultancy, which basically got us all the hard numbers in terms of the lifecycle assessment of products. Our main businesses is assessing mostly co2, the co2 emissions off supplier transactions. But in this case, it was specifically the entire lifecycle of a product and that means from getting the resources to production, to usage, to how you throw it in the end and whatsoever'*
4T	*'So the first part of it was, an idea had already been formed that the company needed some type of tool or something to help sales go to customers and then look at our carbon footprint'*
5T	*'I also think both the owner and designer, but the owner signed the contract with us. So definitely. The owner from the beginning'*
4T	*'So as soon as we got approval, and as soon as we signed a contract, then it was the designer. So I was still working, from the inception of the idea, and then also from the sustainability side, so the calculations. That was my part, and then her part was just sort of,*

	working with the product. So to make sure that we had the right products that we wanted to fit in there and also the right data of the products we want to fit in there'
Completeness - Requirements	
4T	*'But we weren't really happy with these solutions. So that's where I came in. So I was asked to investigate more to see if there was more like this. And then, the more I investigated, the more I thought, we're not going to get anything close to what we really want'*
3T	*'I was told to be involved and then the owner was told to be involved, now the designer is involved, she will be the one responsible for the category of what's going to be in the tool. You two get it done'*
Completeness - Expectations	
3T	*'No, as this was new, I haven't worked with this before, we haven't done any collaboration of this kind before, neither from me with the owner or neither from the whole team that I work behind. So based on that we didn't have any formal templates or processes before. I would say we, the owner, did a tremendously good job in preparing everything.'*
Comprehension - Individual Understanding	
4T	*'I think, I assumed that she actually had the same information that her manager, who was the other product manager. But her boss, or her boss's boss, I should say. I thought he had given her a lot more information. She didn't tell me she didn't know. So we sort of bumbled through this together'*
4T	*'It wasn't very clear to me what her role would be in this. I was just told that she would be taking care of the product side of it. So we had to sort of find it out our own way.'*
3T	*'But then you come into the technical data how do we calculate stuff like that. so I would say my hesitation to: can I find all this information that is needed for the tool and I might need more help outside the owner and me, So that was probably my personal journey in getting all the information we needed.' (3T)*
4T	*'I mean, there was never any expectation that I would keep this that I would be Project Leader. There was never any defined space for this. None of us sort of set the structure naturally.'*
4T	*'So, looking back at it now, I wish I would have actually been given some space for that.Because if I was the one, doing all this work and developing it, I would have liked to own that space of that title. And I think it's the same for her because she ended up taking that title and then I had to go to her and say, wait a second, what's going on here? And that created some confusion and you know, we talked about it's fine.'*
Comprehension - Mutual Understanding	
4T	*'We had a lot of conversations around that and meetings with them. We're always quite equal, and discussing. If we had a problem, then we would talk about it first with each other, and then we would go to them together and say, we would like this done, or not.'*
4T	*'No, I don't think so. I just think it was, it was more or less preparing her for a meeting that we were having with the company that we had hired to do this. That information at the time was enough. And then I think she just more or less learned along the way. So I never felt like, she didn't know a lot.'*

3T	*'Well, all the Skype meetings, like the Skype conversations were always meetings and the meetings had agendas, where it was very clear, like a checklist. Have we done this? Have we done this? So as soon as we felt on the checklist that yeah, this has not been ticked off. Who's responsible? When can we get it? Do we need another week? So the weekly meetings had agendas all the time. And that is why we definitely managed to keep within the deadline that we had, which was January.'*
5T	*'I would say in meetings, we had weekly check in. So I was always working on it in between, and then we checked in. Basically checking on status of open topics, as well as possible new feedback. And then at some point, we realized that we no longer need a weekly check in, but rather can speak as it comes. But that was basically when no longer so many things happened and changed, we decided that it's no longer needed that we have weekly series. And then it went to email conversation'*
3T	*'The third party in this, our consultants in this case, we had almost weekly meetings by Skype because they're sitting in Stockholm. I initially gave him the idea of, okay, this is the data that we have today. This is our database, do we have everything in this database and he started to look through the database and see what kind of information, he did kind of an interview about the data. And then from there on, I set him up with more info along that he needed.'*

Idea Selection (IS)	
Completeness - Requirements	
4T	*'What did I expect? I mean, the list of requirements that were then made together with the sustainability manager and also the project manager.'*
5T	*'I would say when I had the meetings with them at the beginning, it was quite a lot on how they wanted to have things displayed. So it was a lot about which numbers we want to display, in which way we want to display the numbers. All of these details when it comes to the tool and the pages of the tool. The meetings with them were basically always going through, whether they have some feedback on the latest version, or whether we have some news from our side in regards to some open topics which were layout topics or also that they wanted to have some articles added or others deleted.'*
Completeness - Expectations	
3T	*'I believe we have had situations where we have been in need of more people and more resources, for example IT where I still believe that me and the owner we're standing together and trying to get more resources, which we didn't get. But we were in the same team at that point and saying we need more resources and this is something that neither me or the owner can do. We are not IT. We need someone from IT. We get no. They are not interested in helping us or involved in this project. And yeah, that between us there was fully understanding. We just have to deal with it'*
5T	*'Sometimes when it came to that they wanted to have something displayed in this sort of way. Then we were maybe advising them to not do that or to do it a little bit differently. Moreover, they gave feedback and we incorporated.'*
5T	*'Exactly so basically, I presented what has changed as of now due to their feedback or because I thought that's better the way I just changed it. So I was presenting that to them.*

	And then subsequently they were either giving direct feedback or they had other things that they bumped into'.
Comprehension - Individual comprehension	
4T	*'We would sit afterwards and we would say this is how we feel; it does looks good or, we are quite happy now, it's a relief to hear that it's been taken quite positively and people seem to understand, because we were quite concerned is this still too complex for you our sales to use'*
4T	*'But I think to know exactly if the tool is succeeding, and doing what we set out to do, I don't think we can answer that question right now, because it's still so new. So there needs to be sort of another needs-based assessment to see if it's actually fulfilling what it was meant to do'*
3T	*'I would say that the likelihood of success felt very strong and very good and I would say that is some very high percentage like hundred percent because of a very, very professional consultant. And they were on, on top of stuff the whole time they gave us what we needed. They were in time they did very professional presentations, agendas in meetings. Very, very good collaboration with that consultant.'*
3T	*'I would say we, the owner did a tremendous good job in preparing everything'*
Comprehension - Mutual Understanding	
3T	*'We discuss what could be improved or this could not be improved. I mean, we typically agreed with each other. So there were never any problems there. And then we would go back to them and say; this is what we needed. It was a fairly smooth process.'*
4T	*'But from our perspective, yes, we have hit the checkmarks of what we sought to do. I think to say that if it's actually working, I mean, this is how it is with everything right? You don't need to do a more thorough analysis. So this checklist, I mean, that was quite important to have'*
Workability	
3T	*'The data and the setup behind it has been difficult and that's why we needed the consultant because this couldn't have been done by any within the company. And so they were the major part of getting it done'*
4T	*'I think it's, it's still quite complex, and it will still take a lot of time to do this. So I think as soon there's a push from upper management's and of course, it's feasible because then it's just about resources and budget'*
4T	*'But I think it helps that this idea was already set, you know, from the beginning'*
Relevance (R)	
4T	*"Own designed with a consultant doing it, then I think it's much easier to tailor it to tackle the initial problem. So, in that regard, I think it's done. I think it's really hard to be able to assess now because I don't know how sales are using it. And if they are using it, I would like to see a lot more input analysis from them. Because it could be that we have this tool and you know, only 20% of the sales are using it because they're the ones that understand it*

	and feel comfortable working with it. Well, maybe 80% don't feel comfortable with working with it because maybe it's too advanced for them."
3T	*"The initial problem was to take a great step in the market of being an environmental company doing choosing better material before other non so good products and unhealthy or being an environmental ambassador. That was definitely the aim for this tool and that we achieved. The response and the help the tool have done for the guys has been great."*
Specificity (S)	
3T	'As soon as we got understanding of what data the consultant needed to do this tool. It was very, it was very easy. But again, it's not that hard to just send out data. If I'm trying to make an example if you know what, what you need, you need to know.'
Effect Collaborative design - Quality	
3T	*'But it's also a three or four man show. It's quite easy, everyone knows their part in the group and what they were supposed to contribute.'*
4T	*'We more or less agreed that we had this sort of structure in the beginning and this is our checklist and this is what we needed. Yeah, but I think overall, it went very well. We were aligned on just about everything. Then we didn't really have any problems'*
5T	*"I mean, it would have not been possible without the cooperation. Basically, the tool would never be there, if not the case company and us would have collaborated on how they want it and how we can make it feasible to basically bring ideas to paper. That was only possible because the case company shared their views with us and gave us feedback through enable, and the integration process and whatever."*

Project V

Idea Generation (IG)	
ID	**Background**
8V	"This idea came from a work innovation session that we held, two years ago in Copenhagen. We were 15 different people from doing it from different departments; sales, corporate development, marketing, and so on. And also five external people that we invited to the session. So those were the people that were involved."
8V	"It's an application that uses augmented reality technology to visualize part of our products in the environment of our end customers. "
8V	"It was the product owners. So the ones responsible for what products should be in the system. But mainly I worked alone but with an external consultant."
Completeness - Requirements	
8V	*"Yeah, I sent the hypo. went out to look for different providers who had worked with augmented reality technology, because we knew that that was the technology we wanted to use. And then I talked with a bunch of different players to get an understanding of, you know, how they can support us."*
Completeness - Expectations	

8V	*"I sent what type of products we have. So they can look at the products and see how hard it would be to make those in 3d. And then I also gave him my service blueprint? It's a map that shows a little bit what you want to do."*
8V	*"From my side, I had a lot of things. So it was like, am I asking the right questions? Do I really understand the technology? When you go to consultants or partners that are working with technology and are experts within that area, you can feel quite naked and if you have an understandable picture. There I had some problems understanding if they understood what I wanted to achieve."*
Comprehension - Individual comprehension	
8V	*"When I looked at this idea, it was something I've reflected on before I started. Because I felt you know, that there must be smarter ways with new technology to visualize how a table could be set. If that will be AR, photo or VR. So that's why I also thought it was so interesting."*
Comprehension - Mutual understanding	
8V	*"I said; I need a partner that can help me succeed with this. This is an important investment for the company and we want to try this. Also for me in my role, so I need someone I can trust, and that can guide me through this from the development point of view. We had a very open discussion, and it's stupid questions."*

Idea Selection (IS)	
Completeness - Requirements	
8V	*"So proof of concept was the period when I tested the web app. If we take the question if I was expecting more from the web app, then I was not. That was just what I needed and that's what it delivered and even better"*
Completeness - Expectations	
8V	*"I expected something I could test for real. My expectation was that I would get a web link and then when I went in there, I could go in with my phone and then visualize a product on my table."*
8V	*"Very good. They delivered what they should and even better than I thought, because I was quite impressed actually. And so I was very pleased."*
Comprehension - Individual comprehension	
8V	*"I also looked at for example, if we would implement an application like this, could we reach more potential customers, because this is an online tool that will be sent out and provided?"*
Comprehension - Mutual understanding	
8V	*"I didn't follow a specific process. I had the criterias that I looked into, to see if this was a successful proof of concept. I did not work on a specific model or stuff like that. It was more, you know, if we got so many of our customers really positive to this and it helped them, there were some additional benefits then we would take it to the next level."*

8V	*"I think it was more, we proved in the proof of concept that visualizing something with AR is a benefit. And then with him, I then discussed, you know, what more things can we add in the future application to generate statistics or better communication with a customer or even establish a sales and marketing channel."*
8V	*"That I did based on recommendations from the department I was working with. I created a pitch. And then with this pitch, I went to the CEO and the chief. I pitched this, this said This is what I believe, this is the feedback we have received. I want to go ahead and they said yes."*
Workability (W)	
8V	*"Okay. From a technical perspective, it was 100% sure that we could make this. That was no problem. So technically hundred percent. But implementing and really getting it out there much tougher. "*
8V	*"So it fits in what we wanted to bring out to the market. And it could both have a selling perspective, brand building perspective and marketing perspective."*
Relevance (R)	
8V	*"The time it takes for a customer to see how those products look on the table and in your environment goes from two weeks to seconds."*
Specificity (S)	
8V	*"It was not hundred percent clear.Let's say it took a couple of rounds. "*
Effect Collaborative design - Quality	
8V	*"The tool would not be what it is today and what will be now in the future releases if I didn't have a collaboration with him. I would have done it in different ways. So it was a good mix"*
8V	*"If you want to work with new things and you're alone in an organization of driving them. You need to have partners that are 10 times better than you in that, so they can help you forward. Not just you know, sel their technology, but feel the trust that they want to help"*
8V	*"He helped me a lot to make this a good app. So not just an app, what things we need to gather, how we should plan the implementation phase. There were so many things. So, it was my right hand. And I think that's the really important thing to have"*

Project A

Idea Generation (IG)	
ID	**Background**
6A	*"So, the starting point was to create a product family or a concept revolving around a bowl eating which was poke bowls and this type of food and also to add an element of emotion into the bowling."*

7A	*"Yeah, well the whole project is a full concept for take away bowl, bowl type of food eating. That was a project from the beginning. In the initial briefs we actually use the term the ultimate bowl experience."*
6A	*"It was me and the product owner."*
7A	*"So that was the background and then it ended up in you know, concept of articles around bowl eating, from the research that was done by the designer. "*
Completeness - Requirements	
6A	*"He showed me mood boards that he made with different feelings that he wanted to add. So he was instantly drawn into the beach, Hawaii feeling, sand, beach wood. So he had already stated the feeling that he wanted to have when he was eating from this bowl. So my job was to find a product that could simulate this mood. "*
6A	*"I need to know what it is he wants me to do. And I also need to know all relevant research that he has already done in the sector and in this case bowl eating sector, in order to not do the same work twice. He already gives me the package of what the different types of conclusions that he drew to come to this conclusion and definition of the problem and it's great to have this mood board as he had, it's not necessary for me but it's more easy for me to get into the type of idea that he is imagining himself that he wants to present."*
Completeness - Expectations	
6A	*"I expect to get a description of his problem that he needs a physical product to resolve. I expect to get some background information on how he came up with this problem. And I also would like to know if there are any limitations in the products that I need to think of. For instance, if he only has available one type of supplier then I have to take in consideration the technical knowledge of that supplier. I also have to take in consideration how many items we are actually able to realistically develop and also the level of innovation that he wants to add in the products."*
6A	*"Well, as far as I can remember, say it was quite good because it was quite open, which is positive for me because then it's more room for the designer to think out of the box, think out of the brief to find new alternatives. I think it was good. As far as I remember."*
7A	*"No and and also where we were in tight collaboration, with the designer So it's not like a really big company where you have to be really specific in your briefs in this company where we're in close proximity to the designer as well. So any questions we can deal with, informally and directly."*
Comprehension - Individual comprehension	
6A	*"The first impression was very positive, because it was so specified into one thing and the more specified something is, the easier for me it is to resolve his problem. If you have a general problem, it's difficult to understand, where to start and which way to start. In this case, I knew from the beginning that it was a bowl, so it was very positive to get such a narrow problem. It makes it much easier for me to resolve."*
7A	*"The information I gathered and the analysis that was done. It was basically if you sum it up, the trend is increased bowl eating and the company lacked a good concept for that."*
Comprehension - Mutual understanding	

6A	*"Obviously, it influences and I bring my experience to the table and together with his experience, we need to find a middle way. I tried to see it from the end users perspective. While he usually looks from the industry perspective, and also the buyer perspective. So it's important to add also, the neutrality in the discussions and that's what I bring in, as well as the shape and the form and discussion."*
7A	*"I think those initial talks enabled the designer to do her research in both an efficient way but also in the right way to find the right I would say both strong points and weak points of the concept."*

Idea Selection (IS)	
Completeness - Requirements	
6A	*"I present the backgrounds. I present the research. I present the different functionality aspects, different possibilities in the items. I present suggestions for types of material if that was not already stated in the brief. I present the pros and cons on each item and each functionality."*
7A	*"It matched almost perfectly, because those requirements are also the scope of the project. If we set for instance, a cost image already in the beginning, that needs to be incorporated already in the early design stages. Because otherwise, we're exploring paths that are not within scope. In this particular case, we didn't have any cost boundaries for the project, so it was quite open."*
Completeness - Expectations	
6A	*"The object is to get as close to a final product as possible to materialize his idea in items of three dimensions."*
6A	*"The difficulties that I encountered were more in terms of can we do this type of concept family that we haven't done before? I think it was four different materials. That means working with four different factories that don't know each other. Can we get them to collaborate in order to get everything in place? Can we get them to deliver? So it was more this type of problem because the brief was so good that it was not difficult for me to satisfy the brief."*
7A	*"Depends on what stage you're at, but in the initial phases I expect to get the research and the results because often there's a multitude of different ways to reach the objective those need to be clarified in the early stages."*
7A	*"Yeah, but in the beginning, you need to identify different routes that are available. Because there's different routes to reach the objective. The objective in this case was the ultimate bowl experience. So how can we reach that? And we explored that in three main concepts I think the designer presented in the beginning."*
Comprehension - Individual comprehension	
6A	*"I was pretty confident that it will satisfy his needs. In terms of the cutleries that I added, I was not so sure because the cutlery, it was not something that we had discussed in detail. It was something that I added on. My expectations was, I mean when you introduce something Innovative that hasn't been there before that no one has seen before. It's always a risk. Because if you find the right person that is interested in applying innovation he says yes of course. But if you find another person that is a little bit more conservative, he*

	says no, I have not seen that before I cannot calculate anything based on this because it's new. Do for the cutlery, it was gambling"
6A	*"I have to tone it down a little bit to make the innovation less frightening for the users, because obviously we want our products to sell."*
6A	*"I also have to read what the owner is willing to do, of course in terms of innovation and news, so it's always adapting to the person that orders a product from me, because I'm not in charge of the shape. I just form something visually for a person in an area of business, obviously. So it's also a matter of adapting to their willingness of experimentation."*
7A	*"From experience, you can judge if a certain concept will appeal to a broad audience or to a narrow audience, for instance, and in this case, we know that it will probably appeal to a more narrow audience than our mainstream products. So then you've set kind of the commercial limitations of the product already from the beginning."*
7A	*"Yeah. Because that is the initial need that we try to capture. And if we don't capture that need within the concept and it's a failure, then we're missing the target we can, then we can do something else. "There might be great ideas coming out of a concept like this, but the delivery within the project is to deliver on the need that was initially stated. If we answer a different need, then it's a different project, and then we need to scope that and have that go through the process in a different way."*
Comprehension - Mutual understanding	
6A	*"I also had a neutral discussion with the poker bowl restaurant owners. And just to test some of my ideas on them to understand if this could be something that they are interested in. And that's also a part of why I involve the other players and why I went to speak to the poker bowl restaurant owners, in order to have a backup for my ideas. In order to be able to say I have tried this on three or four external restaurant owners. Because if I didn't do that, then me and him would have the discussion. I don't think it's gonna work. I think it's gonna work and I have no meat on my bones in order to convince."*
6A	*"The process is dialogue at this stage, because it's a very organic discussion, weighing pros and cons, looking at different things, thinking, just chatting. So it's not really a protocol that you follow. It's more of an organic discussion.*
7A	*"The designer was contributing in actually explaining the concept for those evaluations. Because no one can do it better than the designer, to explain the thinking behind the articles or the parts of the concept?"*
7A	*"Yes, together with the designer, of course, but she's pretty clear that she is not the decision maker of it. She presents ideas and concepts and then the decision is taken by the product owner."*
Idea Quality (IQ)	
Workability	
6A	*"A big problem which we didn't expect was to find a rubber band. Because the bowls are closed together with the help of rubber bands on the waist. And it was extremely difficult*

	for the sourcing team to find a rubber band. And, we were all very surprised, because we thought that was the easiest part."
7A	*"For this specific product, we knew that we're feasibility Issues, or difficulties that we would like to challenge. You have to judge stuff every time, every project because there's different hurdles to get to the final product. "*
7A	*"No, we were quite aware of challenges in the start of the project. So that that will of course, affect the timing of it. We knew it would take longer to get this project from start to finish."*
6A	*"I think it fits extremely well apart from the rubber band, because we couldn't manage to find a rubber band, which was plastic free."*
7A	*"It fits really well because that is the basis of it. We wanted to have a concept where the individual parts are great together. The concept is greater than the individual parts that are in it."*
Relevance (R)	
6A	*"Well, in my opinion, it solves the problem almost to 90%, I would say. Because what's lacking is having a carry solution together with the bowls. But since we couldn't really add it, it is still a very successful product."*
7A	*"It solves it really well. From the point of view that the main objective was to have a really good or the ultimate bowl eating experience. We were convinced that this was a concept that would do that."*
Specificity (S)	
6A	*"The level of detail was it was very good, because I have to say that the bowl does not differ. I think it differs maybe 5% from my original drawings. So that was really good. And the cutlery, obviously, because we had to change the material halfway into the product, it differs maybe 70% from the original."*
7A	*"It was quite detailed. We knew the things that we wanted to have the number of articles and so on, but we didn't know exactly the materials. For instance, we didn't know if we were going to use a bio plastic or wooden cutlery in the beginning because we didn't know the availability of certain materials, and we didn't know the production methods of other materials. So that that was set along the way, basically on availability cost on and so on."*
Effect Collaboration - Quality	
6A	*"He was already with a very well defined idea, what he wanted to achieve, or a very well defined problem that he wanted to solve. And he's also very good at handing over the responsibility to the designer. And he's also very creative himself. So I would say it was really good collaboration, because we created a mutual understanding and mutual*

	passion about making this product be something that would stand out. So it was a very good collaboration.”
7A	*“It's central. If you want a result that actually answers to the to the initial objective, you need to have a tight collaboration between the designer and the product owner, because otherwise you will end up : you won't share the same objective maybe or how to get there and there is a clear risk because the decision maker is the product owner and if the designer isn't really clear on what the product owner is expecting, it will be a longer process because you will ping pong, a lot of things. So to save time, I think the collaboration between the product owner and the designer is crucial. And also, of course, a clear brief and expectations and scope of the project in the initial phase.”*