Impact
Creative
Toolkit

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Nowadays, a common approach to cope with the inherent uncertainty in innovation is the use of multidisciplinary teams following a Design Thinking (DT) process. However this strategy has its pitfalls, such as the lack of experience with DT or the communication issues underlying a group of people with completely opposed backgrounds.

In order to better understand the context of the problem, a series of interviews and two workshops with practitioners were conducted. The insights, together with the literature review helped to frame a design challenge and eventually to arrive at a design solution. After several iterations, the Impact Creative Toolkit took shape.

The Impact Creative Toolkit aims at mitigating the struggles of such a team-settings that follow a DT process. More concretely, it supports multidisciplinary teams in the ideation process. It assures a constant reflection around what are the benefits, emotions and consequences for the end-user behind the ideas that come up during the creative session.

The toolkit is composed of three tools: Impact Designer — where the problem statement and the desired impact are defined — , Impact Analogies — an idea generation using analogies of the pursued impact — , and Impact Detective — a roleplaying exercise where the impact is assured.

An evaluation of the tools took place, from two perspectives: from the practitioners and from the HEC framework for creative tools. A number of changes were implemented and recommendations for future use suggested.
Abbreviations used

IP: Internship Program organised by NORDIK. It takes place twice a year: from September to December and from February to May.

DT: Design Thinking

BA: Business analyst

SME: Subject matter expert

IDE: Industrial Design Engineering faculty at TU Delft

CPS: creative problem solving

HPI. Hasso Plattner Institute of Design.

Terms

Consumer and end-user and user are used indistinctly, having the same meaning.

Finally, the company where this thesis has been written requested that a pseudonym is used instead of its real name. The pseudonym for the company is NORDIK.
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1

Introduction

This first chapter contains the introduction of the thesis. It covers the company hosting the project, the project scope, the design process and the explanation of the thesis structure.
1. INTRODUCTION

The idea of the present thesis was born while I was an intern at NORDIK in Stockholm. NORDIK is a consultancy based in the Nordic region that supplies services related to computing, including operation, outsourcing and online banking. It is headquartered in Oslo, but the second biggest office is in Stockholm.

NORDIK’s innovation department, the Innovation Hub, focuses in concept development with disruptive technologies or new regulations that shape the market. The Hub organises twice a year the Internship Program (IP), which takes place from September to December and from February to May. The IP aims at developing a series of concepts in multidisciplinary teams following a Design Thinking (DT) process in a four-month period. I participated in the program that started in September 2018.

Project Scope
The interns that participate in the IP are not familiar with the technology of their project or with DT. The multidisciplinary approach is a deliberate decision from the Hub, as people from different disciplines would bring a variety of approaches to a problem solving (Alves et al., 2007). On the other hand, following a DT process is an strategy for producing concepts that are catered he user needs (Brown & Katz, 2011) and therefore more likely to succeed.

From my personal experience I could observe how interns struggle with the uncertainty of working with a technology they are not familiar and with following the DT methodology. Although the innovation approach of the Hub has granted them good results, I saw myself an opportunity on reducing the struggle of interns in order for them to produce a better outcome.

After convincing the head of the IP and my two supervisors from TU Delft — Giulia Calabretta and Milene Gonçalves — to embark in this project, the initial design challenge was defined:

“to mitigate the struggle that interns—who are not familiar with the technology involved in their project or with the design process— may experience”

Design process
The double diamond (British Design Council, 2005) is the design process that has been followed in this thesis (Figure 1).

The first diamond started from the general design challenge stated in the previous section. The exploratory study — of the process of former and current interns of the IP — and the literature review composed the research phase. They took place simultaneously (visual) , which means that they were adjusted along they were happening. The insights from the research were synthesised and they pieced together the specific design challenge and three design guidelines.

The second diamond consisted of the ideation of the Impact Creative Toolkit and building the prototype, which was tested by design students from Umeå Institute of Design and evaluated by current interns of the IP.
Structure of the thesis
The present thesis has an unusual setting. As the exploratory study and the literature review happened at the same time, they are built on each other; therefore telling the story of one without mentioning the other one has been a challenge. For the purpose of the narrative of the thesis, the exploratory research is presented first. This is due to the fact that the final shape of the literature review cannot be understood without previously introducing the research on former and current interns.

The thesis starts with the exploratory research (chapter 2), a primary data collection in which former interns of the program were interviewed, and a couple of workshops were organised with current interns.

Next, the literature review (chapter 3) is presented. It started with five keywords: multidisciplinarity, uncertainty, design thinking, ideation, and creative facilitation. The aim of the literature review was to better understand the problem statement by building a Theoretical framework that would support the design process. In order to do so, four Research questions are phrased at the beginning of the chapter, which are answered after all the literature is presented.

Once the research is described, the synthesis of the insights and conclusions (chapter 4) of the research helped to define a specific design challenge and three design guidelines.

After a series of individual ideation sessions and a workshop with Umeå Institute of Design, a creative tool for ideation that focuses on the impact on the user was designed, the Impact Creative Toolkit (chapter 5). It is meant for multidisciplinary teams unexperienced in DT and it guides interns through a workshop of three steps: problem definition, idea generation and idea development.

Finally, the evaluation of the toolkit (chapter 6) and the final conclusions (chapter 7) close the thesis.
2

Exploratory Study

This second chapter contains the exploratory study. It consists of a series of interviews to former interns of the IP and two workshops facilitated to current interns. At the end the new design challenge is presented.
2. EXPLORATORY RESEARCH

At the same time that the Theoretical framework was taking shape, an exploratory research of the process of the interns in the Internship Program (IP) was conducted. In order to understand their process, a set of semi-structured interviews were conducted to former interns, and two workshops were facilitated with current interns.

This chapter starts with the general design challenge:

“to mitigate the struggle that interns—who are not familiar with the technology involved in their project or with the design process—may experience”

The end goal of this chapter is to arrive at a more precise design challenge, in which “the struggle” of interns is more specific, so the outcome of the thesis is a solution catered for the needs of NORDIK. The design challenge is redefined at the conclusions of the interviews and at the conclusions of the workshops. This is due to the fact that they took place sequentially, and the design of workshops took into account the redefinition of the design challenge from the interviews.

For the purpose of preserving the anonymity of the participants of this research, all the names have been changed.

2.1 Exploring the process of former interns

Former interns were interviewed aiming at exploring their journey in the IP in terms of digging into the process they had followed, as their project outcome was not relevant for this research. The former interns had already experienced the programme, therefore they were a valuable source of insights for understanding the challenges of participating in the IP.
2.1.1 The interviews

Sample selection
The sample consisted of five interns of the September 2018 program. For this purpose the following requirements were in the selection criteria:
· Having participated in the latest edition of the program – in order to have a sharp memory of the process.
· Being an NORDIK employee at the moment of being interviewed – so no confidentiality issues would arise.
· Not having worked closely with the interviewer – aiming at avoiding biased answers.

Three pilot interviews took place for shaping the selection criteria. They provided either biased answers because they are too close to the thesis or not deep enough information because they were interns more than six months ago.

The final sample had five participants which in total comprised three projects. This three projects had a concept as an outcome and their topics were AI, debt registry and loyalty to banks.

Interview guide
The interviews had a duration of 30 minutes approximately and were divided in three sections:
· Understanding the overall process and the main challenges during the project.
· Understanding the struggle with technology and how they cope with it.
· Understanding the struggle with Design Thinking and how they dealt with it.

The complete interview guide can be found in appendix A.

Conducting the interviews
The five interviews took place between the 4th and the 6th of February and were conducted over Skype, as the five former interns worked in Norway. Notes were taken during the interview and the audio was recorded.

During the first section of the interview, they were asked to sketch their process in Microsoft Paint while sharing their screen. This was done with two main objectives: help them to recall better their experience by means of visualisation; and use their sketch as a support for the communication, as by video call there is less information exchanged than in a in–person interview.

Before starting the analysis of the data, two sketches from the interviews are presented. The linearity of the sketch from Peter (Figure 2) whose role is BA, contrasts with the one from Natalie (Figure 3) who is a designer). She perceived her project with freedom of movement that goes back and forward as many times as needed in a constant iteration. On the contrary, Peter understood the project as set of linear steps. It is important to note that after following a DT process, the Business Analyst still looked retrospectively at the project as a straight progress from one stage to another.
2. EXPLORATORY RESEARCH

2.1.2 Analysis of the interviews

All the interviews were taped and the most relevant parts were transcribed. From the transcripts quotes were extracted and written down on sticky notes. As the quotes were obtained from a series of interviews about the process of the projects, for the first round, the post its were clustered in the timeline of the project.

The clusters of the timeline were: before the program, topic research, conducting user research, ideating, prototyping, or quotes about the project in general. Some quotes were in the define step of DT, but as they were not abundant, they were sticked between user research and ideation.

Pain points (PP) – moments where interns struggled – and strategies (S) – how they dealt with the struggles – were pointed out. Pain points were all put together in a different board and the strategies in another board. In the separate boards different themes or categories were found.

In the next sections the most relevant categories of the pain points and strategies are explained. The complete analysis of the insights from the interviews can be found in appendix B.
2.1.3 Pain points during the project

The analysis of the pain points started from the steps of Design Thinking, but this left some insights outside. Then the ones that did not belong to any step were organized in new clusters.

At the end, the pain points were clustered into ten different categories. The most relevant categories of the pain points were:

Lack of knowledge of the project topic
The sample interviewed consisted of a total of three different projects. None of the participants were familiar with their topic project before the program. A team worked with debt registry, a new system that got approved by the Norwegian government just before the program started. Apart from the text of the law that was passed, the only other source of information was the group of experts behind the new regulation.

“We were working on a topic that didn’t exist, we basically had to rely on people.” —N.

Intern’s previous experience with researching about a project topic involved secondary research, as they were used to finding relevant information on the internet or in academic papers. However, they had to grasp the knowledge about the topic with a completely new approach that they had to figure out while doing the actual research.

Another team’s project that revolved around AI applied to a reference project. The information regarding this reference project was not easy to access, as it was partly confidential. They had knowledge gaps that needed to be fixed. At the same time, their sources of information were using a technical knowledge that required previous knowledge about the topic itself.

“If we don’t know about what the other person is saying there is no added value” —R.

Even though the interns struggled when getting to know about their project topic, it is due to that fresh perspective from their own discipline which brings value to the project (Fay et al., 2006). However, providing interns with some support to deal with the uncertainty of their project topic without mitigating the positive effect of multidisciplinarity could be helpful.

Consequences of the assumptions on the unknown
The interns received a lecture on DT at the beginning of the programme in which the process was explained and right after they started working on their projects. Most of the interns had never followed a DT process.

In such an environment surrounded with uncertainty, some assumptions were made by the participants regarding the process and approach. In the case of the designer interviewed, she assumed from the beginning that her teammates knew what a concept was. During the empathising phase, she realised that her teammates were having a narrow approach and at
some point she realised they had a different understanding of what a concept was.

“BAs thought a concept means a product. I had to explain it can be a service, a strategy or a brand identity. This opened more doors” —N.

In the same team, while the designer wanted to keep the exploration open, the BAs kept on complaining about finding uncomfortable having such an open process. They wanted to have a set duration for the research phase, independently of what was the outcome of it.

“BAs had the preconceived idea that DT is about doing things quickly, but I wanted to focus on research. I tried to keep it open” —N.

In this case the designer struggled trying to translate the importance of taking a non-defined time for the exploratory phase, because her teammates found uncomfortable dealing with the uncertainty of just conducting research without a clear horizon.

On the one hand it could be beneficial to provide a more thorough learning of the DT process. On the other hand, there is a need to reduce in order to check assumptions and align team mates expectations at the start of the project

**Mistakes when conducting user research for the first time**

For several teams, talking to the end-users of their projects was challenging, mainly due to the research approach. They were novel to user-centred design and had never conducted user research. They prepared interview guides for their research, and after some unsuccessful attempts, they realised that the duration of the interviews were putting people off.

“It was hard to recruit people because the interviews were too long” —V.

Another team, due to their lack of experience in conducting research, they recruited only employees from the company as a representation of a standard user. The team realised over time that their sample was unusually tech savvy and had to conduct a second round outside the company, which delayed their project.

“It was incredible the difference between NORDIK people and general people” —K.

In both cases the fact that teams were not versed in user research delayed their project and made them felt they were not doing a good job, even though they were trying their best.

On another level, another interviewee explained that it was at the end of the project when her fellow interns realised how valuable was to understand the user in order to find needs that can lead to a solution.

**Coming up with a problem definition**

Once the projects had moved from the empathize step of DT, they started to define the problem to solve. Defining
a problem statement is usually a difficult task for already experienced practitioners, and for a team that had never done it before it was definitely a big challenge.

“We spent two months seeing how could we narrow than the problem statement” —R.

As a consequence, the process resulted a little fuzzy and made them question in many occasions if they were properly following the DT process.

Another team had a different experience in the problem definition, as they would not find a problem to solve. They had some early ideas, but when they tried to validate them, they realised that they were actually not a problem. They had to return twice to the research phase in order to look for other directions.

“We got to a point where nothing was possible, until we heard about a new concept” —N.

Besides that problem definition is tricky by itself, interns were struggling with the fact that DT is not a linear process. A better understanding of the process could be helpful for the interns to feel more comfortable during their project. This could be done by having a more detailed explanation of DT.

The need of support for ideation
When writing this section, a short conversation took place with the junior designers in the Innovation Hub, who are former interns of the IP. They have seen three editions of the IP taking place since they were hired. They expressed their point of view of the program based on their experience. They both felt there is a need of guidance during the ideation, as the teams without a designer struggle during this phase.

Teams are provided with the Google Sprint book and they are also handed a list of different online sources. The issue arises when they have to choose a method to move forward. As they lack any previous experience in design, they have no criteria for making a decision.

“A challenge was to decide what method to use and focus on” —P

In the case of the team of this interviewee, they decided to use the two methods which they were doubting on. Part of their attention was focused on choosing the right technique and making sure they were following it correctly, therefore their performance was lower. Besides they kept on questioning the process during the whole ideation, because they were not completely sure of their decision.

DT tackles open problems that do not have a predefined solution. Creative Problem Solving is used in order to solve those problems, because it allows for generating innovative ideas. However, CPS is not present in the disciplines that are not creativity related. The role of the [creative] facilitator has been developed to help ameliorate the experience of using creative problem solving techniques, and to work with groups towards an
agreed end, such as an open problem (Cruickshank & Evans, 2012).

In spite of the support that an initial crash-course on DT could bring, the ideation phase needs additional guidance while it is actually taking place. In this way, interns would not struggle as much due to their lack of experience in CPS.

**Testing (and validating) that value was not being created**

During one of the interviews, an intern explained that she felt they had made a mistake upon arriving to the testing phase. They had defined the problem statement based on the need they have discovered from their research, and ideated from that problem statement. However, when testing their prototype, the feedback they received was that other features of their solution were reducing the value for the user.

“When testing our solution we realised it was causing struggle to the user” —K.

They ideated around a problem statement that would only take into account a need of the user, and no other requirement was part of the statement. A better definition of the problem to solve would have lead to a better solution with less iterations.

**Miscommunication in multidisciplinary teams**

One of the main challenges of multidisciplinary teams is working on a common language between the team members (Alves et al., 2007). One of the interviewed teams had big troubles with communication throughout the overall process. The struggle showed up early in the project, but they did not pay too much attention to it. At the last stage of the project it caused big problems that created a lot of tension between the teammates.

“Biggest pain point was communication in the team because of cultural differences, background and personality (...) It became a big problem. I would have gone earlier to the manager” —V.

An early alignment of expectations of the project and some communication dynamics could have reduced the consequences of their communication issue. There is a need for improving communication among team members.
2.1.4 Strategies adopted during the project

During the interviews, former interns talked about different strategies they followed in order to cope with the challenges they encountered. The most relevant categories were:

**Learning project topic**
In order to learn about the project topic the teams of interns adopted different strategies. They obtained information from looking for articles online, watching videos, going to events organised by people working on the topic field or talking with SMEs inside or outside the company. All the knowledge they gathered individually was summarised and presented to each other sharing their conclusions.

“It was a lot of mutual learning” —R.

Some teams structured their research by writing down the questions which they felt they had to answer in order to understand the topic. They would seek the answers in their meetings or interviews. At some point they arrived to a level of uncertainty which was manageable and that allowed them to carry on with their project, even though they had not found all the answers.

“At the end we didn’t answer all the questions but we got to a point in which we felt comfortable. There were questions we needed and answer and there were other things that would be great to know” —N.

They had reached the threshold of uncertainty that allowed them to innovate, sparking their imagination (Madsen, 2007) without causing them any struggle.

When gathering information about the project topic, there were different types of knowledge that interns needed to research on such as the technicalities or the functionalities of their topics (Jalonen, 2012). Participants went in different directions in an natural way, depending on their backgrounds.

In one of the teams BAs focused on technicalities and the financial side of the topic while the designer focused on what it would mean for people and the impact on consumers. Each intern put the focus of the project on the elements that belong to their own discipline.

**Designerly approach**
When it comes to dealing with the Design Thinking process, an intern unfamiliar with the design field took a couple of courses in DT and in Interaction Design before starting the program. As he explained, it helped him immensely in understanding the user-centred approach.

Designing for the user by co-designing with the end user was particularly successful in one of the teams. They invited end users to their meetings and had regular checkups with them after the brainstorming sessions, to verify the solution made sense also for them.

However, novel practitioners of DT have preconceived ideas of what the process should look like. One of the teams encountered difficulties with this issue – as explained in the pain points section – and during the interview the designer of the team said she would have made sure they were all aligned in this sense.
2. EXPLORATORY RESEARCH

2.1.5 Connecting pain points with strategies

There are some links between the pain points and the strategies extracted from the interviews:

- Interns found their own ways to solve the lack of knowledge of the project topic that struggled them at the beginning. Listing the questions that would come up along the process was a useful strategy. Even though they were not able to get all the answers, the arrived to a comfort level in which the could carry on with their project, which eventually made them stop questioning their role in the project.

- Knowledge about Design Thinking is not a requirement to enter the IP, and interns that felt the curiosity or the need to know about it were able to find the means to learn about the process.

- The initial assumptions whose consequences arose later in the project can be tackled by aligning the team members’ expectations perspectives about the project.

- Conducting user research was a challenge for some teams due to their inexperience and they managed to learn it by trial and error, which ended up delaying their project.

- Problem definition was also a difficult milestone for some participants, that either took extra effort to narrow down the scope, or just had a hard time finding the right problem to solve. In both cases their struggle took time out of their project, but they ended up with a problem definition they believed in.

- Communication was a big issue for one of the teams. As a future strategy it could have been reported earlier to the manager in order to find a way to tackle the problem sooner in the process.

- Ideation phase was challenging to the interns without any knowledge on design. They followed their intuition and were able to evaluate their decisions regarding the ideation process once the project was delivered.

On top of this, the way the problem statements were defined was poor, in terms that it was only addressing the detected need and not taking into account the impact on the user.

However, there were some pain points which do not have a clear strategy, and caused difficulties along the project:

- Knowledge about Design Thinking is not a requirement to enter the IP, and interns that felt the curiosity or the need to know about it were able to find the means to learn about the process.

- The initial assumptions whose consequences arose later in the project can be tackled by aligning the team members’ expectations perspectives about the project.
2.1.6 Conclusions from the interviews to former interns

**Project topic instead of technology**

At this stage of the thesis, the focus is narrowing down the main goal of the project from “mitigate the struggle that interns—who are not familiar with the technology involved in their project or with the design process—may experience” to a more specific design challenge. The new design challenge has to better describe what “technology involved in their project” and “design process” are, generating a thesis outcome more concrete and specific to the needs of the Innovation department, instead of being a generic toolkit.

The first insight of the interviews is that the term “technology involved in their project” has to be changed to “project topic” as some of the IP projects do not deal directly with a disruptive technology, but a new topic that is disrupting the market (i.e. the brand new national debt registry in Norway).

Even though at the beginning interns were unfamiliar with the project topic, they managed to rapidly gather the knowledge to cover the understanding of their topic per se, as they could access to this knowledge inside of NORDIK or they could reach out to SMEs outside the company.

As a suggestion, in the case any team wants some extra help in dealing with the uncertainty, they could use a framework (e.g. Skunkworks) to map the uncertainties they need to tackle.

**The importance of understanding the relationship between the user and the project topic**

The end goal of the IP is to design user-centered concepts in disrupting project topics. However, the relationship between the user and the project topic is an area that interns: 1) are not used to approach because it is not present in their backgrounds; 2) do not feel comfortable conducting an open research on; 3) are not familiar with the techniques; and 4) do not see the added value of understanding it until the project is finished. There is a need for putting an extra focus on supporting them to understand how the user relates to the project topic.

When searching for the information of their project topic, the non-designers naturally set the scope of their research in the technicalities of the topic. However, the designers, due to the nature of their field, tried to expand the scope in order to explore the relationship between the user and the project topic.

The relationship between the users and the technology or project topic, is born from a user need being met by the technology or project topic. The most common technique to discover this need is by conducting user research (Kumar & Whitney, 2003). However, the interns not familiar with design had no experience in user research, which caused struggle and extra work. Besides, the lack of experience usually goes hand in hand with distrusting a technique whose benefits can only be seeing with the final outcomes.
Providing some introductory knowledge about user research could be helpful for future editions of the IP.

Focus on the impact of the solution on the user
In the define step, DT aims at defining a problem statement based on the detected need(s) from the user. This problem statement is the seed from which the team will ideate a solution. Whatever is defined would serve as the boundary conditions for the next step.

However, a solution has to fulfill a series of requirements that are not always part of the problem statement. Being aware of this fact comes with experience. Interns not versed in design would just ideate a solution that would meet the need(s) from the problem statement, and then prototype it and test it. It would be in the testing step where they would realise it has unintended effects on the users that they could have foreseen. In the case this happen, it is very likely that the user will end up not using the solution as it is not convenient for them.

In this sense, interns could benefit from a support in better understanding the impact on the user before they are testing an already designed solution. Impact means: what are the effects on the user? What benefits for the user produces the solution? What emotions does the solution produce on the user? What are the consequences for the user if choosing the solution? If the interns take into account the impact on the user as an extra boundary condition, on top of the problem statement, they reassure that the solution they design adds value to the user. Therefore it is more likely that it would be a successful solution.

Focusing on a creative tool for ideation
During the interviews, the identified pain points—points where interns struggled—that did not have a matching strategy emerged in: user research, problem definition, ideation, prototyping, testing and communication in general.

In all the phases, the pain points could be mitigated partly by introducing a crash-course in DT at the beginning of the program. However, regardless of an initial introduction, ideation phase may need additional guidance at the moment while it is actually taking place, as CPS is a very specific approach and interns should be focusing on producing ideas rather than if they are using the right technique.

All in all, there is evidence from this set of interviews that interns struggle when they are in the ideate step and that they need guidance while it is actually happening. Therefore the outcome of this thesis could be a creative tool for ideation.

Redefined design challenge
Taking all of the above into account, the design challenge can be rephrased into:

“design a creative tool for ideation for multidisciplinary teams unexperienced in design in order to support them envisioning the impact of their disruptive innovative concept on their user.”
2.2 Exploring the process of current interns

In the previous section, after 5 interviews to former interns, the design challenge was rephrased into “mitigate the struggle of ideating around the relationship between the user and the project topic”.

In order to make the design challenge more specific and better understand the needs of the interns, a new intervention for data collection is designed and conducted. The intervention is a workshop that is designed with two main goals:

· Gaining a better understanding of the intern’s process by observing them in their working environment. This is expected to provide new insights for making a more specific design challenge that is better catered to the needs of the IP.

· Trying out techniques that lead them to think about the relationship of the user and the project topic. Besides, it will serve current interns to have new directions to explore further in their projects and therefore they will be more implicated during the workshop as they may see some benefits for themselves.

The starting point of the workshop is the problem statement “how can we better understand our target group and their relationship with the project topic?”. The interns were at the empathising phase of their projects and they needed to start planning their user research. The problem statement was proposed by Astrid, head of the IP, as it was the task that she had always given at this very stage to the teams in the program. Therefore the workshop was meant to be an ideation session for them to further organise their research.

Initially, instead of having a creative facilitator, the workshop was thought of as the interns interacting with an early toolkit prototype as a guide for the session. This would be followed by interviews to all the participants in the experiment. In total, two workshops took place with teams of current interns. The toolkit prototype was iterated in between the two sessions with the data collected from the interventions. In the next section the two workshops are explained and the data collected is presented.
2. EXPLORATORY RESEARCH

2.2.1 First workshop

The first workshop was divided in two main sections, the first one the interns would solve the problem statement in their own means, and in the latter one they would be facilitated with a toolkit. The toolkit prototype was a Powerpoint presentation that guided through a creative session aimed at solving the problem statement. This prototype would be used as a guide along the process (the prototype can be found in Appendix C). It was designed focusing on understanding the user perspective. They were discussed and agreed with Katrina Heijne, course director of Creative Facilitation at IDE faculty.

However, while the workshop was happening, one of the participants reacted negatively to the activity and expressed he was feeling used and did not like the idea of the observation. As the approach of this exploratory phase of the thesis is research through design (Stappers, 2007) taking into account this reaction, the planning was readjusted and I decided to facilitate the session myself, instead of just giving them a toolkit. This decision was made because there was starting to be a negative mood among the participants and I believed they were not going to put enough interest in continuing with the workshop and therefore data collected would not have been representative of their performance. It is important to acknowledge that my interaction provoked that the data collected was contaminated and could not be completely trusted, but it still gave insights about their process.

A summarised version of the structure is presented below, the full version can be found in appendix D. The session had a duration of about 5 hours and started at 9:30 am. Structure:

1) Observation of the interns solving the problem statement in their own. Objective: understanding the working process and if there is a structure or methodology behind, and understanding their struggles and challenges in the project.

2) Individual interviews. Objective: understanding their perception of the session and their process, and understanding any challenges that did not emerge or were not expressed during the session.

3) Facilitated session for solving the problem statement. Objective: understanding the working process when following a methodology and validating the suitability of the chosen structure; what are the new challenges they encounter along the way and if the is structure useful for solving such a problem statement?

4) Group interviews. Objective: understanding if the interns felt the session was useful and if they perceived any added value.

The sample

The team was composed of three interns:

· Richard, Swedish, background in business and communication, interested in change in change management, IT and digitalisation.
· Christina, Slovenian, background in computer science and data
visualisation, interested in graphic design and interface design.
· David, Thailandese, background in branding and international marketing, interested in computer science.

The aim of their project is to design a digital experience for the young customers of one of Sweden’s largest banks.

2.2.2 Second workshop

Based on the literature review, and the interviews and observations from the first workshop, the third step of the workshop, the facilitated one, was iterated. It was redesigned focusing on enhancing the understanding of how the user relates to the technology and how the technology impacts the user life. A detailed description of the iteration can be found in appendix D.

The sample

The team was composed of three interns:
· Lena, Slovakian, background in physics.
· Vincent, Thailandese, background in computer science.
· Hank, Swedish, background in applied maths.

Project: a solution that will help banks lending to small and medium enterprises using fintechs. What can the banks learn/reuse/gain from fintechs that are already offering loans?
2.2.3 Insights from the workshops

The complete analysis of the insights from the workshops can be found in appendices E and F. In this section the most relevant insights are presented below.

Unstructured process
During the observation of the two workshops, it became evident that the interns were working without any kind of structure, as they were deciding on-the-go what to do next. When being asked about their feelings of the session, everyone stated that they were going in circles without any clear direction. This unplanned process implies that team members have unaligned expectations on what is going to happen during the working session. For example, in the first workshop: as they narrowed down quite early in the process because one of them suggested to do so, and the others did not disagree, some interns felt the process should have been more open.

When asking the interns about their normal process, they all explained it was usually like the one that it was observed.

“Maybe it is a bit awkward because it is the natural flow of what we would do, maybe we don’t know how to turn” —C.

By “we don’t know how to turn” the interviewee meant that they just follow a natural process of discussion that they do not steer or intervene on. There is certainly a lack of preparation for this kind of sessions. This can be due to their lack of experience in any kind of creative workshops, as they were all experiencing it for the first time. In future sessions it would be important to make sure they have an structured process.

Some diverging, kind of reverging & no converging
The non-facilitated session of the first workshop started by diverging from the problem statement. Immediately they started writing their ideas individually. This process lasted over 5 minutes, and in total they produced 19 ideas to solve the problem statement. This was the end of their diverging state.

Then they explained each others’ ideas and stuck the post its on the whiteboard. Figure 4 is an image of the board with their ideas.

Once they finished explaining, they started commenting on them without any clear purpose of clustering or selecting the best ideas. Richard was leading the session standing up with his hand in the whiteboard while holding the marker. He was the one stirring the conversation. After 30 minutes of discussing the post its on the wall with no clear direction, I stopped the session.

In the individual interviews the interns explained their feelings about the session.

“My mind is more and more closed because at the beginning I would think of all the options but now we are focusing on ideas and letting others go [...] Once you start going in one direction it is very difficult to come up with others (directions)” —D.
As they stopped their diverging state too early, he was not able to give all his ideas and did not have a pleasant experience during the rest of the workshop.

A clear division between diverging, reverging and converging phase could ensure they maximise the outcome of each of them. This division should include guidance on how long or what should be the outcome of each phase.

**Following the golden rules**

Even though they had been introduced to the golden rules of creative facilitation in none of the sessions they were followed properly. Participants were extremely influenced by any comment from others. I insisted a couple of times on the need of postponing judgement, but they hardly follow that suggestion.

This connects with the previous insight. It is necessary to translate them the golden rules properly, so they can properly go through the different states of the creative session. It is also important to change their mindsets during the different phases, as converging, reverging and diverging require different states of mind (Heijne & van der Meer, 2019).

**The questions that structures the process**

In the second workshop, Lena started writing the questions that their discussion was arriving at, or others she would think of. These set of questions articulated the session, by
them trying to find an answer. They were mostly “how” questions. They can be observed in the right side of Figure 5.

On the other hand, since the beginning of the session, Hank kept asking “why?” whenever someone made a new assumption. He explained in the individual interview that this other enquiry approach has been very useful for him during his university studies.

Even though they did not have an structured process, by using this list of questions, they entered in an enquiry based framework (Cardoso et al., 2016). They all said it was their normal process when working together. These “how” and “why” questions are high-level questions that help diverging and converging respectively when they are asked (Eris, 2004).

To conclude, posing high-level questions helped them to move forward with the project and to deal with the uncertainty that otherwise would affect the group dynamics (Slappendel, 1996).

2. EXPLORATORY RESEARCH

Figure 5. Picture of the board, questions are on the right (second workshop).
2.2.4 Conclusions from the workshops

The workshops started with the design challenge: “design a creative tool for ideation for multidisciplinary teams unexperienced in design in order to support them envisioning the impact of their disruptive innovative concept on their user”. During the interventions I aimed at understanding their natural creative process in order to make a more concrete design challenge.

After exploring their process, which has proved to lack a structure, the creative tool must have a structure but they should not need to think constantly of it. It has to be able to give them the confidence not to think about the process themselves, so they can focus fully on the ideation. Besides, an accurate estimation of the time needed and expected outcomes is key for them to trust the tool.

This structure or backbone of the tool could make use of the inquiry based framework and force them to ask high-level questions. Besides, question-asking could be a strategy to cope with the inherent uncertainty that exists in creativity. It could be great to support interns in the different phases of the creative diamond, ensuring they follow the golden rules of each of them and helping them to change mindset. The tool could encourage them to align expectations and define a problem statement together. And in any case the toolkit should have clear instructions in an understandable language for non-designers and also provide examples.

The outcome of this thesis is meant to guide the teams of interns in the ideation phase. It is meant to help them understand the relationship between the user and the project topic within the concept they are creating. This concept is a disruptive innovation that implies a change in the reality of the user. Therefore it is essential to connect them at a personal level and foresee the future impact of the concept in the user: what benefits, consequences and emotions it will provide the person that purchases or uses the designed solution with.

Taking all this into account, the design challenge remains “design a creative tool for ideation for multidisciplinary teams unexperienced in design in order to support them envisioning the impact of their disruptive innovative concept on their user”. The challenge contains the essence of the creative tool, which is the attitude of reflecting on the impact on the user.

On top of this three design guidelines are included. They aim at shaping a creative tool that is catered to the needs of the interns:
- The interns must feel guided in a seamless process that they do not need to keep track of in their minds.
- The different phases of the creative tool must be clearly differentiated, making sure the requirements for each phase are respected.
- The creative tool can be used regardless of the intern background or working experience.
This chapter contains the literature review that was conducted during the In this chapter, first, the theoretical framework is illustrated. Secondly, the process of the literature is introduced. Then, the different topics explored in the literature review are explained further. Finally, the conclusions presented.
3. LITERATURE REVIEW

3.1 Theoretical framework

In an uncertain economy where emerging technologies are ready to disrupt the current market, companies need to innovate with new products and services that will create value for the end-user. In this scenario, companies concerned about their survival have wondered: “how to innovate with products or services based on the emerging disruptive technologies that will create value to the consumer?”

The Theoretical framework represents an approach that aims at answering this question, by integrating the different themes explored during the literature review.

The approach is to put together multidisciplinary teams following a DT process as a way for dealing with the inherent uncertainty of innovation. By constantly reflecting on the relationship between the user and the project topic — meaning the impact that the product or service will have on the user — they will achieve value creation.

Figure 6 is the visualisation of the Theoretical framework.

![Figure 6. Theoretical framework.](image-url)
3.2 Research questions

The scope of this thesis regarding the literature has been broad in terms of the topics that it has covered. It started by doing research on the five starting topics defined in the thesis challenge: **multidisciplinarity, uncertainty, design thinking (DT), ideation, and facilitation.** Multidisciplinarity is the approach in which NORDIK relies its innovation projects. Uncertainty was a term connected from the beginning with the struggles of interns, and DT is the process that interns followed. Finally, the focus on ideation and creative facilitation is due to the insights from the exploratory research, which led to narrow down the scope of the research.

When studying the topics further, value creation became present in the literature, although it was not one of the initial keywords. The reason for including value creation on the literature review is that it is the goal of innovation, the outcome of DT, what multidisciplinary teams work towards to, and what is created out of uncertainty.

All in all, the literature review has tried to answer the following Research questions:

1) What is the connection between uncertainty and innovation? How can innovators deal with uncertainty?

2) Why do companies rely on multidisciplinarity for innovation purposes? What are the challenges of multidisciplinary teams?

3) Why do companies adopt DT in innovation practices? Why are multidisciplinary teams challenged in ideation? How can those challenges be tackled?

4) What is value creation? How can it be explained for non-designers what a solution brings to the user?

The present literature review starts by examining uncertainty as the realm where innovation occurs, introduces two uncertainty theories and presents three different tools for dealing with uncertainty. Secondly, it explores innovation within multidisciplinary teams and the challenges they may encounter. Later, it focuses on the DT process as an innovation approach, and digs deeper in exploring the challenges of multidisciplinary teams in the ideation phase and how are they tackled with creative facilitation. Finally, it looks into value creation as the end goal of innovation and goes through the types of value for the user.
3.3 Uncertainty in innovation

“Given that the future entails uncertainty, it is reasonable to expect that uncertainty is inherent in every innovation process” (Jalonen, 2012).

The starting point of this section is the Research questions about uncertainty: What is the connection between uncertainty and innovation? And how can innovators deal with uncertainty?

Uncertainty is essential to generate novelty and change. Dwelling with uncertainty is what sparks innovative ideas in a designer’s mind. However, innovation projects can have other layers of uncertainty due to other factors which are not intrinsic to the design process.

In the next section, two theories of uncertainty and three approaches to cope with it in innovation are presented, aiming at piecing together different views on the topic in order to build a better understanding of uncertainty in the context of this project.

3.3.1 Theories of uncertainty

In this section two theories to understand the concept of uncertainty within in innovation are presented. The first one relates to the experience of someone when working on an innovation project (social uncertainty), while the second one refers to the lack of knowledge about the topic of the project (technological uncertainty).

Social uncertainty

Madsen (2007) defines uncertainty in innovation as “the individual’s and/or group of individuals perceived level of not knowing the appropriate course of action and/or its outcome at a given point in time”.

From a social action point of view, she presented a Theoretical framework of uncertainty connected to the three perspectives delineated by Slappendel (1996) to analyse innovation research:

- Structuralist perspective: uncertainty increases when innovators are unable to make sense of the situation for a period of time due to situational characteristics or events.
- Individualist perspective: although uncertainty is necessary to generate novelty and change, each individual has an uncertainty threshold over which the effects can be counterproductive.
- Interactive perspective: the group dynamics that emerge when the situational characteristics that cause uncertainty are extended for a period of time (basic assumption behaviour, groupthink, and/or competitive rivalry).
From this we can conclude that each person has an individual threshold of uncertainty that exceeding it can be detrimental. At the same time, there is a group uncertainty that is connected to the way of working and the interaction between team members.

**Technological uncertainty**

In a literature review performed by Jalonen (2012) on research on uncertainty, eight factors responsible for uncertainty in innovation projects were identified, being one of them technological uncertainty. Taking into account the character of the innovation projects of the present thesis, this literature review digs deeper on this type of uncertainty.

Jalonen (2012) summarized that technological uncertainty in the innovation processes arises due to two factors: a lack of knowledge of the details of the new technology and a lack of knowledge required to use the new technology.

For the purpose of this theoretical framework, the two main uncertainties described by Jalonen (2012) are adjusted into:

- Uncertainty caused by technicalities: the lack of knowledge of the details of the technology causes incertitude among innovators who miss the expertise for understanding the way in which the technology functions.
- Uncertainty caused by functionalities: as a consequence of the unawareness on how to use the technology, innovators experience incertitude because they are not able to think of possible ways to use the new technology.

In order to come up with new possible uses of the technology, innovators need to deal with both uncertainties. A better understanding of the technical details of the technologies and the way it functions will help to overcome some of the barriers that uncertainty causes in the innovation process.
3.3.2 Coping with uncertainty

Some uncertainty is unavoidable and an essential source for creativity. This is because a new idea is the solution for a problem, and the answer of that problem was in the realm of uncertainty before the idea came to place (see abduction thinking in section 3.5.1). However, a high level of it can be detrimental in an innovation project, as the working team could get to feel lost and unmotivated (Mathiassen & Stage, 1992). Moreover, technically it cannot be completely eliminated, but coping strategies can help with managing it flexibly (Dönmez & Grote, 2018).

After having introduced the theories of uncertainty in innovation, three frameworks to cope with uncertainty are explored. This overview helps to understand three different perspectives on how to deal with uncertainty in innovation and decision making, and aims at exploring which one applies better to the case of NORDIK. Next in this section one ignorance map and two frameworks for dealing with uncertainty—in decision making and in innovation projects—are presented.

The ignorance map gives a canvas to acknowledge what is unknown, while the two frameworks offer a canvas and several guidelines for dealing with the uncertainty.
The Map of the Domains of Ignorance
When working on an innovation project, there are many unknowns. Some need to fully answered in order to be able to understand the project topic (technological uncertainty) and others require to be answered at least until a certain threshold (social uncertainty) from which it is possible to function properly.

In order to map the unknowns Kerwin (1992) defined six domains of ignorance, in which the unknown knowledge can be located in “the Map of the Domains of Ignorance” (Figure 7):

- **Known Unknowns**: what you know that you do not know
- **Unknown Unknowns**: what you do not know that you do not know
- **Errors**: what you think you know but you actually do not know
- **Unknown Knowns**: what you know but you do not know you know
- **Taboos**: Dangerous, polluting or forbidden knowledge
- **Denials**: what is too painful to know, so you do not know it

The Map of the Domains of Ignorance helps to establish what knowledge needs to be known, but it does not provide the tools for realising that something is unknown. It can be useful to classify the unknown, but before one needs to be aware of that lack of knowledge.

The next framework for coping with uncertainty in innovation includes a series of steps that allow to spot the lack of knowledge.

Skunkworks: a framework for dealing with uncertainty in innovation
Skunkworks (Harris & Woolley, 2009) is a cognitive mapping technique to reduce the uncertainty at the early stages of an innovation project. The aim of the framework is to spot the areas or items that are causing the uncertainty in order to rapidly acquire the needed knowledge.

Cognitive mapping is a representation of mental models – patterns in which humans organize their knowledge in order to engage effectively with their environment (Rouse & Morris, 1986). Mental models are very relevant to multidisciplinary teams as they typically struggle to establish a common ground (Smulders, 2007). Building on this concept, a shared cognition is the intersection of two or more mental models, which represents the shared knowledge of a group of individuals.

As opposed to cognitive mapping, Skunkworks maps uncertainty instead of knowledge. The technique followed for plotting the uncertainties is “oval mapping technique” (Eden, Ackermann & Cropper, 1992) in which innovation teams write each concept in an oval-shaped card and later organize them in clusters. The cluster are built into a map. This uncertainty maps are dynamic, as they are meant to evolve when the team covers each gap of knowledge, which is done by researching on the spotted concepts. Figure 8 shows the evolution of Skunkworks maps when the knowledge gaps are covered.
After testing and iterating their framework with a series of innovation teams, Harris and Woolley (2009) proposed seven steps:

1. Capturing the task. Aligning every team’s member understanding the problem statement of the innovation project.

2. Generating uncertainties. Individually brainstorming on the concepts that are causing uncertainty in oval-shaped cards.

3. Grouping uncertainties into operating concepts. Sharing the uncertainties, eliminating duplicate cards, making new uncertainties to arise.

Figure 8. Two Skunkworks maps showing the evolution of the maps when covering the knowledge gaps (Harris & Wooley, 2009).

5. Wider searching for uncertainties. Laddering the uncertainties in order to arrive to a more specific concept to research on.

6. Growing the team task-relevant knowledge. Researching on the concepts that are causing uncertainty.

7. Updating the team map. Removing the concepts that are no longer creating uncertainty.

All in all, Skunkworks is a framework that allows innovation teams to focus their research activities in the concepts that will help them fill the knowledge gaps that are causing uncertainty. In a series of seven steps it speeds up the research phase of an innovation project. However, it does not help with making the decision on how to approach what is not known yet. The framework that is introduced next assists with decision making process.
Cynefin: framework for decision making
Cynefin (Snowden & Boone, 2007) is an analytical and decision framework that presents four types of systems where any project or problem can be placed: simple, complicated, complex and chaotic (Figure 9). It recognises the causal differences that exist between the different types of systems and supports practitioners flipping between them so they can use the appropriate method for the appropriate domain. It is meant to be used in a wide range of fields, such as decision theory, knowledge management or project management.

Conclusion
In essence, the Map of the Domains of Ignorance serves for classifying what is not known but does not give a tool to firstly identify the lack of knowledge. Skunkworks helps to trace the lack of knowledge in order to tackle it and transform it from unknown into knowledge. Finally, Cynefin enables the understanding of the complexity of a problem and gives tools to deal with it.

For NORDIK’s case, the introduction of Skunkworks framework at the beginning of the projects would be advisable as a support tool, as it can be very useful in the research phase of an innovation project for speeding up the process. Even though the exploratory study has shown that all the teams eventually manage to deal with their project topic, it would be valuable to suggest it as a tool in case a team feels they are in need of some help.
3.4 Innovation in multidisciplinary teams

The aim of this section is to answer the Research questions about multidisciplinarity: Why do companies rely on multidisciplinarity for innovation purposes? What are the challenges of multidisciplinary teams?

In this section, first the different terms regarding the combination of disciplines are defined. Second, multidisciplinarity is explained further and the challenges that it implies are presented.

Innovation is the application of better solutions that meet new requirements, unarticulated needs, or existing market needs (Maranville, 1992). In an increasingly complex world, organizations have understood the value of collaboration between disciplines (Collin, 2009) and have adopted different approaches. Different terms defining the strategy in terms of disciplines have emerged (Jensenius, 2012):

- Intradisciplinary: working within a single discipline.
- Crossdisciplinary: viewing one discipline from the perspective of another.
- Multidisciplinary: people from different disciplines working together, each drawing on their disciplinary knowledge.
- Interdisciplinary: integrating knowledge and methods from different disciplines, using a real synthesis of approaches.
- Transdisciplinary: creating a unity of intellectual frameworks beyond the disciplinary perspectives.

These different strategies or approaches to innovation are more and more frequent within organizations. When solving complex problems, that do not belong to only one discipline, multidisciplinarity is the best approach, as it provides with a panoramic view from the different perspectives of a group. On the other hand, NORDIK’s Innovation Hub introduced multidisciplinary team settings in the innovation process since its foundation in 2014, and therefore this is the strategy explored by this research.

Multidisciplinary teams are those composed by members from different disciplines that contribute with their particular point of view to the project (Alves et al., 2007). The main benefit of multidisciplinary teams is the breadth of knowledge, skills and abilities offered when solving a problem, due to the different backgrounds of each of the team members (Seidel & Fixon, 2013).

Companies believe in the multidisciplinary approach as a strategy for generating more innovative solutions for new products and services (Jackson, 1996). Hence, organizations frequently rely on multidisciplinary teams expecting them to provide a greater variety of perspectives in order to increase performance regarding quality of decision-making or the degree of innovativeness of problem-solving (Fay et al., 2006).

Nevertheless, multidisciplinary teams experience several challenges. They need to put an extra effort on communication in order to efficiently perform in their task work, as their
functional diversity entails different ways of sharing their thoughts and ideas (Pelled, Eisenhardt & Xin, 1999). Besides, in case the team members are not well versed in their project topic, they also need to deal with the subsequent uncertainty of working with an unfamiliar topic.

In essence, multidisciplinary teams are composed by members from a variety of disciplines. Each member’s perspective of a complex problem allows for a richer solution. Meanwhile teams formed in such a way require extra work on communication, in order to establish a common language that will be used throughout their collaboration.
3.5 Design Thinking

In this section, Design Thinking, the process behind the innovation projects at NORDIK is examined. The starting point is the Research questions: Why do companies adopt DT in innovation practices? Why are multidisciplinary teams challenged in ideation? How can those challenges be tackled?

Design Thinking (DT) enables the traditional approach of industrial designers for problem solving to any other discipline willing to innovate (Brown & Katz, 2011). DT is a means to construct new solutions to complex problems, rather than pure analytical, problem identification thinking (Body, Terrey & Tergas, 2010). At the same time DT is a dynamic interplay between “analytical thinking” which revolves around logic and certainty, and “intuitive thinking” which relates to raw creativity (Martin, 2010). It brings new models of processes and toolkits which contributes to work on the creative process, not only carried out by designers, but also in multidisciplinary teams within any kind of organisation (Tschimmel, 2012).

The added value of DT is that it works at the intersection of human needs, the technical resources, and the constraints and opportunities of the project or business (Tschimmel, 2012). This is a characteristic of the design discipline, as well as the constant reflection in the impact of the products and services on the users (Buchanan, 2001).

There are several models of the DT process, where the best known models are: the 3 I (Inspiration, Ideation and Implementation) model (Brown & Wyatt, 2010), the HCD (Hearing, Creating and Delivering) model (IDEO, 2010), the Double Diamond model from the British Design Council (Discover, Define, Design and Deliver) (2005), and the Design Thinking model of the Hasso Plattner Institute of Design (Empathize, Define, Ideate, Prototype and Test) (2010).

All the methods above have in common that they make the DT process more accessible and applicable in organisations and business (Seidel & Fixon, 2013). The main difference is that they guide practitioners in three, four or five steps, and use different tools and techniques in them. Regardless of the chosen model to follow, a project will always: conduct initial research to gather insights and understand the context; define a clear problem statement that represents the complex problem of the project – in the shape of an open question; ideate a new solution; make a prototype, test and iterate the solution (Tschimmel, 2012). In order to choose the most appropriate model for a project, different factors should be taken into account: type of project, context, team set up and timeframe.

It is the Hasso Plattner Institute of Design model (Figure 10) where this literature review sets the focus on as it is the one followed in the IP.

According to Thoring and Müller (2011), the main goal of the first step of the HPI model, empathize, is to understand the user in the context of the project through primary and secondary
research approaches. The outcome of this step is one or some needs from the end-user. In the second step, define, the team proposes a design challenge based on the need(s) from the previous step. Next, in the ideate step, the focus is on idea generation over the design challenge, which leads to new solutions. The last steps, prototype and test, go together in a loop, in which the best solutions are quickly prototyped, tested, iterated and improved (Brown and Wyatt, 2010).

Projects following a DT process do not need to have a designer in their team (Minder & Heidemann Lassen, 2018). However, there is a correlation between the success of the project and the presence of a designer in it, as the team tends to see more and to see it differently (Barry & Meisiek, 2010). This is mainly due to the fact that designers think always of the user first, encourage creative thinking and foster quick prototyping of ideas (Jo & Kim, 2019). When not having a designer as part of a project —that follows a DT process—, team members may experience struggles that can hinder the final outcome, but this effect can be mitigated with the use of creative or DT toolkits (Minder & Heidemann Lassen, 2018).
3.5.1 The reasoning pattern behind Design Thinking

After exploring the process of Design Thinking, the following section through the reasoning pattern of design thinking: abduction, aiming at understanding how design thinkers actually think. First different reasoning patterns are presented arrive at the way designers reason when doing creative problem solving.

The basic formula of formal logic starts from a what (the thing) and a how (the working principle of the thing) which leads to an observed result (Roozenburg & Eekels, 1995).

\[
\text{WHAT} + \text{HOW} \rightarrow \text{RESULT} \\
\text{(thing)} \quad \text{(working principle)} \quad \text{(observed)}
\]

Basic formula of formal logic (Dorst, 2011).

According to Roozenburg and Eekels (1995), depending on what is unknown in this formula, there are two different reasoning patterns:

· Deduction: arriving to the result from a known what and a known how or working principle. It is they way an explanation is made, the reasoning pattern that leads to a justification.

\[
\text{WHAT} + \text{HOW} \rightarrow \text{???} \\
\text{(thing)} \quad \text{(working principle)} \quad \text{(observed)}
\]

Deductive reasoning (Dorst, 2011).

· Induction: from a known what and a known result build and hypothesis on the how or working principle. It is the way an hypothesis is made, the reasoning pattern that leads to a discovery.

\[
\text{???} + \text{???} \rightarrow \text{VALUE} \\
\text{(thing)} \quad \text{(working principle)} \quad \text{(aspired)}
\]

Value logic formula (Dorst, 2011).

However, in design and other productive disciplines, the outcome of the process is to create value for others (Dorst, 2011). Therefore the logic formula consists of a what (the thing) and a how (the working principle of the thing) that leads to an aspired value.

\[
\text{WHAT} + \text{HOW} \rightarrow \text{VALUE} \\
\text{(thing)} \quad \text{(working principle)} \quad \text{(aspired)}
\]

Abductive reasoning (Dorst, 2011).

The main objective of design reasoning is the complex creative achievement of the parallel creation of the “thing” and its way of working (Dorst, 2011). Therefore, in order to take place the design process needs to be fueled with the uncertainty of the what and the how still to define.

Dorst (2011) explains that abduction is supported by the use of frames: viewpoints from which a design problem can be tackled. Schön (1984) defines a frame as a certain
perception of a problem that is combined with a terminology and a manner of reasoning that enables the ‘framer’ to create possible solutions. They can take the shape of simple metaphors or analogies, in which the solution can be found.

Frame reasoning (Dorst, 2011).

To conclude, abduction is the reasoning pattern behind all design processes. It makes use of frames in order to reduce the level of uncertainty from a “complete uncertainty” to a “frame uncertainty” in which there is an interpretation of the context is made.

Abduction is a completely different reasoning pattern as opposed to the deduction and induction. This is why design thinking, based on abduction reasoning, can be challenging to practitioners not versed in design, as they may feel uncertainty when following a process that is not natural to the way they are used to reasoning (Dorst, 2015).
3.5.2 Ideate Step

After having introduced the reasoning pattern of DT and the challenges that it presents to new practitioners, this section focuses on the ideate step. This step is the one in the new scope that came out of the analysis of the insights of the exploratory study. Those insights pointed that the interns had struggled in the ideate step. The goal of this section is to better understand the ideate step and challenges that multidisciplinary teams experience in this step and how they can be tackled.

The ideate step of the HPI model corresponds to the phase of the design process in which the focus is on idea generation and idea selection. The goal of the ideate step is to find a solution after phrasing the initial problem statement in the define step (Tschimmel, 2012). Mentally it constitutes a process of “going wide” regarding concepts and outcomes (Hasso Plattner Institute of Design, 2010).

In some literature, the ideate step is also referred as a “brainstorming” process (Brown & Wyatt, 2010), which is entitling that Osborn’s brainstorming (1957) is the technique being used in the step. However, brainstorming is not necessarily the ultimate technique for ideation (Brown, 2009, p.79). Other ideation techniques can be used in the ideate step to come up with solutions to the problem. In this study “brainstorming” only makes reference to Osborn’s technique and it is not used as a synonym of ideation.

In the next paragraphs, a natural behaviour of design practitioners during ideation is explained. After talking about uncertainty in innovation, it is important to see how it affects creativity.

**Question asking**

During a creative session, team members interact with each other by means of posing a questions that are answered along the session takes place. This inquiry based process (Eris, 2004, p. 11) sets the creative pace, as the questions trigger the reasoning that eventually leads to the solution. Questions in the inquiry based process are low-level questions, and high–level questions, which divides in two: generative design questions (how questions) and deep–reasoning questions (why questions). They respectively generate more ideas and validate the produced ideas.

As Martin (2010) explained, DT is an interplay between the analytical thinking and the intuitive thinking. Connecting this statement with the inquiry based process: the deep–reasoning questions trigger the analytical thinking of understanding the rationale behind an idea, while generative design questions trigger the intuitive thinking that sparks new ideas.

**Many creative techniques use question asking to move creativity along.** According to Cardoso, Badke-Schaub and Eris (2016) a large number of creativity methods either implicitly or explicitly apply questioning as a mechanism to spark people’s imagination and free them from routine behaviour and regular ways of thinking.
3. LITERATURE REVIEW

3.5.3 Creative facilitation

In the previous sections Design Thinking has been introduced, and the ideate step has been explained further. This ideation step is sometimes supported with creative facilitation, which is the main focus of this section.

Creative facilitation is a subject area within the design field that aims at solving an open problem with a group of participants or resource group leaded by a facilitator and using creativity techniques; all of it framed in a creative session.

In the next paragraphs Guilford’s creative diamond is introduced in order to arrive at the Integrated Creative Problems Solving process that will be used as the model for creative facilitation in this thesis.

Integrated Creative Problem Solving model

In order to understand the process of ideation, Guilford (1950) proposed the creative diamond model for problem solving, introducing the concepts of divergent thinking –producing as many ideas as possible– and convergent thinking –selecting the best ideas.

This model was the start of Creative Problem Solving (CPS), which literally means solving a problem in a creative manner. In order to ameliorate the experience of using CPS techniques by non-designers, the role of creative facilitator emerged in multidisciplinary contexts (Cruickshank & Evans, 2012).

Guilford’s diamond has been extended over the years with the development of research on creativity resulting in different approaches to CPS. The present thesis focuses on the Integrated Creative Problem Solving (iCPS) model by Buijs and van der Meer (2013).

As the traditional CPS model from Buffalo remained challenging for european practitioners, the iCPS model (Buijs & van der Meer, 2013) emerged as an attempt to deal with those challenges (Heijne & van der Meer, 2019).

As opposed to the linearity of the five Buffalo CPS stages, the iCPS model consists of four interdependent sub-processes: Project Management, Information Finding, Acceptance Finding and Content Finding (Buijs & van der Meer, 2013). The relevant one for this thesis is the latter.

Content Finding (Figure 11) is a process that consists of three stages or creative diamonds. The aim of the first diamond is to define the problem in a way that all the participants understand the goal of the session. The second diamond consists on idea generation and idea selection. Finally, the third diamond revolves around improving the chosen idea.

Besides, in the iCPS model the traditional two-step creative diamond from Guilford is extended with the reverging step. This new step is a mental pause after the divergent thinking in order to have an overview of the generated options, and move to an adequate mindset to start selecting the best options in the convergent phase (Heijne et al., 2019).

As Heijne and Smit (2018) explained: one of the challenges of inexperienced
teams during a creative session is to understand and respect the requirements of each of the states – diverging, reverging and converging –, as the lack of familiarity leads to pay more attention to the first one. **There are no fixed rules on how to conduct a creative session, but researchers and practitioners have developed many guidelines for successful sessions** (Buijs & van der Meer, 2013). For the purpose of this thesis, the following rules are used in the Theoretical framework.

The diverging phase aims at producing as many ideas as possible, maintaining the creative flow and avoiding dynamics that could cut down the production of ideas. The golden rules for diverging (Isaksen, Dorval & Treffinger, 2010, p. 38), which align to Osborn’s rules for brainstorming are: **quantity breeds quality, produce as many ideas as possible; postpone judgement, do not evaluate the ideas yet; hitchhike on other’s ideas, build on what others come up with; and encourage crazy ideas.**

In the phase of reverging the goal is to develop an shared overall understanding of all the ideas that have been produced. **The golden rules for diverging are: use the inquiring mind, ask for clarification in order to understand the ideas; active participation, all the participants need to be part of the process; responsive listening, intent on understanding rather than quickly replying; and move circular, the reverging state does not have a specific starting point, but make sure to cover all the ideas generated previously** (Heijne & Smith, 2018).

Finally, the converging phase aims at choosing an idea out of all the produced ones. The golden rules for converging are: use affirmative judgement, by focusing on the ideas’ positive characteristics; protect originality, treat with care the unfamiliar ideas; trust the hedonic response, by following your intuition; and have action in mind, by select the options you would like to work with (Heijne & van der Meer, 2019).
3.5.4 Recommendations during ideation

In this section a series of recommendations to take into account while doing idea generation in multidisciplinary teams are presented. They intent to keep the creative flow, use the best creative stimuli and involve the participants in the ideation. They have been gathered from different sources that either studied ideation in multidisciplinary teams or in teams of designers.

Most of the studies presented in this section have used brainstorming as the experiment technique, as it is the most used one in practice (Nijstad & Stroebe, 2006; Paulus et al., 2002; Seidel & Fixon, 2013; Stroebe, Diehl and Abakoumkin, 1992). Only one study did not use brainstorming (Gonçalves, Cardoso & Badke-Schaub, 2014). All in all, the presented conclusions of the research can be extended to any idea generation technique, as they are above the particularities of brainstorming.

Creative flow

From their research, Nijstad and Stroebe (2006) found that smaller groups work better for producing ideas. They even suggest breaking larger groups. They also remarked the importance of short breaks to keep the creative flow.

This creative flow is maintained, for example, when building on each others’ ideas, which is one of Osborn’s rules, as it increases the quality of the ideas produced. Seidel and Fixon (2013) found that this is the reason why electronic brainstorming (using electronic devices for brainstorming) and brainwriting (the written version of brainstorming) work better for idea generation, as participants have the opportunity of read other people’s ideas.

Sometimes, in the diverging phase, the creative flow is interrupted by participants judging the ideas. It should be clarified that there are phases where it is important to discuss ideas and others were the focus should be on idea generation (Nijstad & Stroebe, 2006).

In any case, an ideation session conducted by an inexperienced team can mitigate the positive effects of the creative techniques participants use. In order to prevent this situation, facilitators or creative tools can support the teams that lack experience (Paulus et al., 2002).

Creative stimuli

New ideas are triggered by creative stimuli. The distance of the stimuli to the problem has been studied, discovering that distantly related stimuli — somewhere in between closely related and external stimuli — achieve better results in idea generation (Gonçalves, Cardoso & Badke-Schaub, 2016). Hence, when looking for inspiration, the scope of the research should be set somewhere near to the project topic, but that can still be used for making analogies.

The creative stimuli can either be text or visual representations. The last ones are less effective than text as inspirational sources. Therefore
making use of texts for idea generation can be more productive than the use of images in a creative session (Gonçalves, Cardoso & Badke-Schaub, 2014).

**Involving the participants**

Finally, when ideating in groups, participants experience the illusion of group effectivity. In a study conducted by Stroebe, Diehl and Abakoumkin (1992) participants in group ideation had the perception that around 60% of the ideas were proposed by themselves, even though it was not the case. This illusion produces high levels of satisfaction and ownership of the ideas that increases the interest of the participants in the activity. Playing with this illusion could help to make the participants more involved in the process of ideation.
3. LITERATURE REVIEW

3.6 Value Creation

“Design Innovation aims at harnessing human creativity for value creation” (Lokku, Onkar & Mathew, 2019).

In this section, value creation for the user, the end goal of any design project, is explored. The starting point is the Research questions: What is value creation? How can it be easily explained to non-designers what a solution brings to the user?

In order to answer the Research questions, the value for the user is challengely discussed and three new categories to understand the user value are defined – with the aim of using them later in the thesis.

The end goal of design is creating value for the user (Brown & Katz, 2011). Value can be defined as all the advantages someone can obtain by purchasing and/or using a product or service (Dobiegała-Korona, Doligalski 2010).

Boztepe’s classification of value to customer (2007) divides it into four categories of user value (Figure 12).

The first type of value to customer is utility value. This value is associated with convenience (time management, accessibility, appropriateness, physical compatibility and avoidance of sensory unpleasantness) provided by the product, the feeling of safety that grants to the user as well as to the factors related to the product’s quality and performance, and to the economy of its purchase and use.

The second one is social significance value. It applies to attaining social prestige by the purchase or use of the product or service; and to fulfilment of the need to develop an identity by distinguish oneself from other users by using the product or service.

The third type of value is emotional value. It refers to pleasure and fun associated with the product or service, including the product or service’s influence on the user’s sensory experiences and emotions.

The last category in Boztepe’s classification is spiritual value. It relates to obtaining spiritual benefits from using or owning the product or service.

However, design not only brings value to the user in terms of advantages. It also has consequences that affect the user. For instance, it changes the behaviour of the users, as they replace their previous habit for the new one that represents using the product or service (Tromp & Hekkert, 2017). In the bottom line this behavioural change can improve or worsen the users life (Lokku, Onkar & Mathew, 2019).
3. LITERATURE REVIEW

Figure 12. Categories of user value [Boztepe, 2007].
3. LITERATURE REVIEW

Impact on the user
All in all, value has a positive connotation while solutions can also have pitfalls for the user. In order to translate what a solution brings to the user –including the positive and the negative “value”–, a new concept is proposed: impact. In this thesis impact means what the user is getting out of the design solution, the advantages and the disadvantages.

For the purpose of this Theoretical framework three categories of impact are established: benefits, emotions and consequences. Benefits corresponds to the utility value of Boztepe; emotions aggregates the social significance, emotional and spiritual value of Boztepe; and consequences represents the negative benefits and emotions that the product or service induce on the user.

The categories of benefits, emotions and consequences of this literature review aims at having three concepts that non-designers can easily grasp, in order to understand the concept of impact. They are words that try to evoke personal experiences so the impact is perceived from a personal perspective.

- **benefits**
  the convenience provided by the product or service to the end–user.

- **emotions**
  the positive feelings caused by the product or service to the end–user.

- **consequences**
  the negative benefits and emotions produced by the product or service on the end–user.
3.7 Conclusions from literature review

In this section the initial Research questions are answered with the conclusions from the literature review.

1) What is the connection between uncertainty and innovation? How can innovators deal with uncertainty?

Uncertainty is the environment that triggers innovation and where novel ideas grow. However, each individual has an uncertainty threshold over which the effects can be counterproductive. At the same technological uncertainty is produced by the lack of knowledge about the project topic—it can be due either to the functionalities or to the technicalities of the project topic.

There are different ways of dealing with uncertainty. At the early stage of an innovation project, uncertainty can be tackled by following the Skunkworks framework. If there is decision making involved, the Cynefin framework could be of use. Lastly, a general overview of the uncertainties can be visualised with The Map of the Domains of Ignorance.

2) Why do companies rely on multidisciplinarity for innovation purposes? What are the challenges of multidisciplinary teams?

Companies believe that teams composed of members from a variety of disciplines would bring diverse perspectives when solving a complex problem (Alves et al., 2007). This is because each discipline has a different approach to problem solving.

The main challenge of multidisciplinary teams is communication. Each team member comes from a different background, which brings to the project different mental models. As a consequence, each team member shares their ideas in their own manner. This is why arriving at a common language for the project is the biggest challenge of multidisciplinary teams.

3) Why do companies adopt DT in innovation practices? Why do multidisciplinary teams struggle in ideation? How can teams deal with those challenges?

DT enables companies to approach complex problems that can not be tackled with traditional analytical thinking. DT is adopted for innovation purposes as its outcomes are products and services that are catered to the end user needs.

Multidisciplinary teams composed of non-designers are challenged in ideation because they are not used to working with a creative problem solving approach. At the same time, team members with a non-design background, struggle with abductive thinking, which is not present in non-productive disciplines.

A successful ideation session of a multidisciplinary team must follow the golden rules on the different phases, apply a series of recommendations (section 3.5.4) and could be supported with a creative toolkit.
4) What is value creation? How can it be easily explained to non-designers what a solution brings to the user?

Value creation is the goal of a design project. It means providing a new solution to the user that offers advantages by purchasing and/or using the designed product or service.

In order for non-designers to understand what a solution produces on the user—the positive and the negative aspects—the concept of impact is introduced. It is divided in three categories: benefits, the convenience offered to the user; emotions, the positive feelings experienced by the user; and consequences, the negative impact, the disadvantages of the solution.
This chapter is a reflection on the research phase before jumping into the design solution.
Before moving forward to the design solution, it is time for a reflection on the research.

During the presentation of the research, the reader may have realised some sentences or section titles were underlined in colour. The reason for this is because those sentences describe the most valuable insights of the research.

They are divided into three categories: challenge, direction and inspiration. Challenge applies to the insights that have helped to redefine the design challenge, either to arrive at a more concrete definition or to discard focus areas. Direction comprises the insights that have supported the design solution. Finally, inspiration groups the insights that did not play a major role, but that they have shaped the ideation sessions or workshops, or as an inspirational source.

The colour codes for the insights are:

- **Challenge**
- **Direction**
- **Inspiration**
28.01.19
- Analyze the questions they are not asking in a CS so we can push them there with the toolkit.
- Mapping the session to see what it missing
- Avoid fixation: there is an alarm that asks if they are fixated and if yes it poses questions → digital

05.02.19
- In order to cope with cultural differences, during brainstorming ask questions like “how would it be for a Spaniard?”

06.02.19
- Posing questions to solve and move from uncertainty to ideas. Digital support

25.02.19
- A toolkit to guide them a bit in the process as well (teambuilding, learning how to draw, coming up with novel ideas, showing them the possibilities of using creative thinking)

25.02.19
- Another idea could be developing something for the future CF of the program, like a toolkit for a future facilitator

05.03.19
- Technicalities, functionalities & possibilities combined with persona

12.04.19
- Toolkit for finding spots where there can be opportunities

12.04.19
- Creative session about how the project topic can solve a pain point of the user

14.04.19
- Toolkit that creates the future scenario of the user, with the technology. Is like prototyping: when is she/he going to use it? How do we want them to feel about it?

24.04.19
- Include the generativity dimension of innovation

25.04.19
- Metaphorical ideation for framing

26.04.19
- Roleplaying for idea development

28.04.19
- Activity for first diamond about common syntax

01.05.19
- Impact Creative Toolkit

14.05.19
- Kill Impact Metaphors

21.05.19
- Impact Metaphors changes to Impact Analogies
In this chapter the solution to the design challenge is presented: a creative toolkit for supporting multidisciplinary teams in ideation. At the end the toolkit is explain in a fictional scenario.

On the left, the evolution of the idea during the project.
5. IMPACT CREATIVE TOOLKIT

The present thesis started with the goal of mitigating “the struggle that interns — who are not familiar with the technology involved in their project or with the design process — may experience”. After the exploratory study and the literature review, it was narrowed down to “design a creative tool for ideation for multidisciplinary teams unexperienced in design in order to support them envisioning the impact of their disruptive innovative concept on their user”. Accompanied but three design guidelines:

- The interns must feel guided in a seamless process that they do not need to keep track of in their minds.
- The different phases of the creative tool must be clearly differentiated, making sure the requirements for each phase are respected.
- The creative tool can be used regardless of the intern background or working experience.

The Impact Creative Toolkit is designed to solve this challenge. It introduces a new variable in the ideation step, impact, which challenges the solution designed, in terms of what is the holistic value that it is adding to the user.

Impact Creative Toolkit consists on three tools that together compose a workshop for a creative session, in which there is a constant reflection on how the solution is impacting on the user. It follows the iCPS model and each of the tools revolves around one of the diamonds. Besides it continuously encourages the practitioners to follow the golden rules of creative facilitation, as it is designed for multidisciplinary teams not versed in design.

The main goals of each of the tools are:

- Tool #1. Impact Designer, where the problem to solve and the impact on the user are defined.
- Tool #2. Impact Analogies, an idea generation exercise where the impact on the user is induced in the ideas generated.
- Tool #3. Impact Detective, where the idea is developed further while the impact is being assured.

As explained in the literature review (chapter 3) The impact that it is made on the user is divided in three categories: benefits, consequences and emotions. The impact designed at tool #1 is used in the other tools as the boundary conditions that the solutions is designed around. In the tool #2 it is used as stimuli for inspiration while at tool #3 it is used as the requirements that the solution has to fulfill.

Impact Creative Toolkit is meant for new-to-design practitioners. It makes sure the solution that is designed takes into account more variables rather than the need addressed in the problem statement. As a consequence, by using the toolkit practitioners will connect with their user at a personal level.

In the next sections, the tools are described more in detail.
5.1 Impact Designer (Problem Definition)

Impact Designer is a tool for starting a creative session. It aims at covering the lack of presence of the user centeredness once the problem is defined at the define step of DT. By setting additional boundaries that take into account the impact on the end user: benefits, emotions and consequences. In this way, a more constrained problem is defined in the sweet spot within the intersection of benefits and emotions, minus consequences.

The inspiration of this tool is the challenge of multidisciplinary teams to land at a common language (Pelld, Eisenhardt & Xin, 1999). The impact designer serves to define both problem statement and desired impact of the solution on the end user, and at the same time establish a common ground for the ideation session. It helps the team members to align their understanding of the case and the desired outcomes. Besides, the tool seeks to stimulate the illusion of group effectivity (Stroebe et al., 1992) in order to enhance the cohesion of the team and the communication.

The tool guides the team in setting up a creative session by supporting them to (1) align expectations of the session and the project (2) define the problem statement and stakeholders involved, and (3) describe the desired impact of the concept on the user. The group effectivity is stimulated by doing quick brainstorming exercises in sections (2) and (3).

Impact designer aligns the whole team at the start of the creative process. Using this tool meets three detected in the exploratory research:

· Need to improve communication among team members, as they will be sharing their ideas and agreeing on statements in order to move forward.

· Need of aligning team mates expectations and reducing assumptions at the beginning of the project. They will share what they expect out of the project and the session, and they will explain how they see the project from their perspective.

· Need of starting the ideation with a clear problem statement that everyone understands. The Impact Designer aims at defining a clear problem statement that is defined and agreed by the whole team.

The tool consists of three templates: Impact Design Canvas, Individual Problem Statement and Group Problem Statement. They can be found in appendix I.

In the Impact Design Canvas, there is an initial brainstorming on the stakeholders that can be involved in the solution, as well as on the benefits, emotions and consequences on the user.
5. IMPACT CREATIVE TOOLKIT

Then, the Individual Problem Statement is an individual exercise of framing a more concrete problem statement based on what it has been discussed before.

Finally, in the Group Problem Statement, the team agrees on a problem statement and defines the desired benefits, emotions and consequences.

Impact Designer is thought to be used in the first diamond of the iCPS model, while defining the problem. It is meant for at least two people, but it is suggested to be used by the whole team, in order to align expectations and define a problem statement that everyone agrees upon.

On a side note, both Impact Designer and Impact Analogies, make constant use of the Golden Rules of Diverging, Reversing and Converging, which are three posters containing the golden rules as they are explained by Heijne and van der Meer (2019). They can be found in appendix H.
5.2 Impact Analogies (Idea generation)

Impact analogies is an idea generation exercise. This tool is inspired in the ‘frame’ concept of Dorst (2011). It is based on the notion of abductive thinking, and the use of analogies as standpoints to tackle the problem statement. Using this tool allows design practitioners to (1) find analogies that represent the future impact they aim for the user to have when experiencing the solution; and to (2) generate ideas with the analogies. Besides the tool supports in the selection of the impact analogies that are more suitable for idea generation, assuring they are distant related stimuli –somewhere in between closely related and external stimuli– as research has shown that it enhances the creative process (Gonçalves et al., 2016).

The tool has two templates: the Impact Analogies Generator and the Impact Analogies Operator (can be found in appendix J).

The first step is the Impact Analogies Generator, where the design practitioners are guided through an initial diamond whose final outcome will be the impact analogy. First, in the diverging phase the design practitioners produce a series of analogies ideas using the desired impact as an starting point. Then, in the reverging phase the analogies are clustered depending on their proximity to the problem statement. Finally in the converging phase, the team chooses one of the analogies within the distantly related ones.

Then, it is time for the Impact Analogies Operator. This template guides through an idea generation exercise based on the impact analogy. First, in the diverging phase, ideas are generated using the chosen impact analogy as stimul. In the reverging phase, the ideas are put into categories in a spontaneous clustering. Finally, in the converging phase, the team ends with an idea to solve the problem statement, which is the final outcome of this tool.

Impact Analogies is designed for the second diamond of the iCPS model, in idea generation. It is suggested to be used at least in duos because it allows for quick discussions and a diverging phase in which practitioners could build on each other ideas.
5. IMPACT CREATIVE TOOLKIT

5.3 Impact Detective (Idea development)

Impact detective is a role-playing tool whose aim is to envision and experience the impact that an idea in the making would have in the user and use this to improve the design. This tool is based on the concept of the inquiry based process that sets the pace of the ideation process (Cardoso et al., 2016). By acting out the experience of the user and reflecting on the impact at the same time, design practitioners experience the implications of their idea themselves and get to further detail the design. The outcome of the tool is a more developed idea described in a paragraph and represented in a user journey.

The Impact Detective consists of the Impact Detective Canvas, which can be found in appendix K.

First the team members divide the roles of the user and other stakeholders involved in the idea among them, leaving one of the team members the impact detective role. In the next step, the idea is enacted, while at the same time the detective takes notes of what is happening. At any time, the detective can pose the questions provided in the template. These questions are high level questions that foster a conversation that helps to develop the idea (Eris, 2004): generative design or how questions that promote diverging and developing the idea taking into account the impact; and deep–reasoning or why questions that help converging to a specific solution, assuring that it has the desired impact.

Impact Detective is designed for the third diamond of the iCPS model, in idea development. It is suggested to use it in teams of at least three people, in order to have two people enacting and one person with the role of the detective.
5.4 Example of a workshop using the toolkit

In order to illustrate how the toolkit would work and make it come alive, a fictive workshop is explained.

Kim, Troye, Carlota and David are working together in a project for NORDIK. They are multidisciplinary team composed of half developers, half business analysts. Their initial problem statement is “how can we improve the experience of going in the metro to work in Stockholm by using AR?”

They are given the toolkit so they can organise a one day workshop. First, they read the instructions which explains what templates consists of and how are they distributed in the tools.

Tool #1 — Impact Designer

When having a clear idea they start with the Impact Designer (tool #1) and put an Impact Design Canvas (Figure 13) on a wall. They start by sharing what are their expectations of the project and of the day in general. In this way, everyone is aware of how the others understand what is coming next. Then they write their problem statement on the top of the template. This is the only time they will write on the sheet. As the goal is that they speak up everything they think of, they will use sticky notes from now onwards, so they are not discouraged to share their ideas thinking it would be set on stone. Each of them gets four blocks of sticky notes of different colours.

First, they start by reading the Golden Rules of Diverging and sticking them on the wall. This will set the diverging phase mindset. Then they begin brainstorming the stakeholders that could participate in the program, among others they say “user”, “other passengers” and “metro staff”. All of them are written down on sticky notes that are put in the corresponding section in the Impact Design Canvas. Repeating the same process, they move to the benefits they want for the user when using their solution, two examples are: “guide through the station”, and “feel oriented”. Next, it is time to come up with emotions for the user to experience, some of what they propose are: “comfortable”, “safe” and “connected”. Last, they have to think of the possible consequences of their solution, one of them is “looking too much at the phone”.

Now is time to move to the reverging phase. They read the Golden Rules of Reverging and stick them on the wall. They start reviewing all the sticky notes they have on the template. When going through the consequence, they all agree that is a pitfall. Then Kim suggests that “looking too much on the phone” could be transformed in the benefit “not looking at the phone” if the user would have AR glasses instead. They all agree. Therefore, they get rid of the consequence and put the new benefit on the template.

Next step is going into the converging phase. In the same manner as before, they read the Golden Rules of Converging and stick them on the wall. Each of them gets a marker and draws a small dot on their favourite stakeholder, benefit, emotion and...
Each participant gets an “Individual Problem Statement” and based on their favourite impact elements, they frame their own problem statement. When everyone is ready, they share their statements and agree on a common one. This problem statement is written in the “Group Problem Statement” (Figure 14), along with a series of sticky notes with the benefits, emotions and consequences desired in the solution.

Their final problem statement is “how can we guide the user in the metro using AR glasses”. They have chosen “feel oriented” and “guide through the station” as benefits, and “comfortable” and “connected” as emotions.

The Impact Designer tool has fulfilled its mission: the problem statement is defined, as well as the intended impact on the user. At the same time the expectations of the team members have been aligned. Besides a common language for the problem has been established, as they have been explaining their own views on the problem and the impact, and agreeing on the final form of it.
The next tool is the Impact Analogies (tool #2). Each of the participants gets an Impact Analogies Generator and sticks on the top of it, two sticky notes: one of their favourite benefit and one of their favourite emotion. As in tool #1, participants are told to look at the Golden Rules of Diverging. Now is time for 5 minutes of brainwriting. They are thinking of analogies of the desired benefit and emotion: objects, experiences or situations that produce the benefit or emotion on the user. After five minutes, they swap the sheet to the person next to them clockwise. They repeat this procedure until all the sheets have passed by everyone.

Moving to the reverging state, participants read the Golden Rules of Reverging. They cluster the analogies in the stimuli distance line (Figure 15), depending on the distance with the problem statement.

Before starting to converge, participants read the Golden Rules of Converging. Now each of them draws a little dot on their favourite analogy. They have to select one among the most voted, the criteria for it is: everyone understands what it means, it is inspiring and everyone agrees to move forward with it. They decide to move forward with “guide dog”, which means that an analogy of the problem
they are trying to solve is to guide someone in the metro using AR as a guide dog would.

The first diamond has finished, now the team has a picked analogy that contains the desired impact on the user: “guide dog”. Each of them members gets a Impact Analogies Operator and sticks on top of it a sticky note with the analogy: “guide dog”. The same brainwriting technique is repeated, but this each round is 10 minutes. Again, they are told to read the golden rules of each phase, before starting it.

In the reverging state they organise the produced ideas using spontaneous clustering. In the converging state they choose a final idea which is a combination of different ideas: “An app on the AR glasses that guides you with arrows until your destination and that lets you know when there is someone you know around”.

The Impact Analogies tool has achieved its goal: generating an idea that takes into account both the problem statement and the desired impact. Is not only solving the problem of “guiding the user using AR glasses” but it is also making the user more comfortable by just showing arrows, and feel more connected by notifying when someone known is close by.

**Tool #3 — Impact Detective**
The last tool is the Impact Detective

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Figure 15. Stimuli Distance Line
[tool #3], where the idea is developed further by means of roleplaying. As them has four members, Kim will be the detective, Troye the user, and Carlota and David would be other passengers in the metro.

Kim takes the Impact Detective Canvas (Figure 16) and writes sticks on top a sticky note with the idea from the previous exercise “an app on the AR glasses that guides you with arrows until your destination and that lets you know when there is someone you know around”.

Troye starts imitating the user while Kim takes notes of the actions. Carlota and David start a commenting on what Troye is doing while Kim starts posing one of the questions that she has on her canvas: “how can we better include the emotion of feeling connected in the solution?”. This question stirs the conversation in order to diverge and develop further the idea. Carlota suggests that “the app could offer the option of a new journey that maximises the time spent with the known person”. They discuss the benefits, emotions and consequences of this new feature, Kim writes them down. Later, she asks questions such as “why is this solution better than the way the user currently goes to work”, to validate that the

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**Figure 16. Impact Detective Canvas**

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**Impact Creative Toolkit**

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solution adds value.

After a long discussion they end with a user journey of their solution, in which the impact on the user is mapped.

They finish the exercise by writing in two sentences their developed idea: “an app of AR glasses that enhances the experience of commuting to work. It guides through the station by using arrows; it advises what wagon is less crowded; it notifies when someone known is around; and it recalculates the journey if you want to travel as long as possible with the person you know”

The Impact Detective tool has accomplished its goal: developing the idea while keeping a constant reflection on the impact on the user. The team has been able to grow the idea in a roleplay exercise while Kim has mapped the actions and the impact on the user journey.
5. IMPACT CREATIVE TOOLKIT
In this chapter the results from the evaluation of the creative toolkit are presented. Two types of evaluations took place: with interns from the IP and with a specific framework for creative facilitation tools.
Once the toolkit had been designed, it was evaluated in two different assessments.

The first one was a testing session with current interns with the goal of evaluating if the toolkit was meeting the design challenge of the thesis, and to test three critical points that had been spotted. None of the five interns had a design background. Three of them were developers and two business analysts.

The second assessment was carried out by a current intern who is also a designer and a SPD fellow student. It aimed at evaluating the toolkit with the HEC framework (Aguirre, Agudelo & Romm, 2017), which will be introduced in its corresponding section.

This chapter finishes with a discussion of the results of both evaluations.

6. EVALUATION

6.1 Evaluation by current interns

6.1.1 Procedure

The experiment with the interns consisted in five individual sessions of an hour in which first they went through the critical points of the toolkit and later they were interviewed about it and asked a set of questions.

The three critical points were:

- Coming up with analogies. At the beginning of the Impact Analogies, participants are expected to start producing analogies of a benefit and of an emotion. The process of coming up with analogies about a problem to solve can be quite exhausting (Heijne & van der Meer, 2019, p.95). The tool is trying to mitigate that struggle by producing analogies on the benefit and emotion and then translating them to the problem. However this way of going apart from the problem and then bringing the analogy back needed to be validated.

- Arranging analogies on the stimuli distance line. Once the analogies are produced, participants are told to arrange them on a line that represents the distance to the problem statement, in order to choose the ones in the middle to move forward. This activity was found conflictive when the toolkit was tested with Umeå Institute of Design. Back then it was just a line with no separations. The iterated version had three sections corresponding to the distance of the stimuli or analogies: too near, in the middle and too far. This new version of the distance line was tested also as a critical point.
6. EVALUATION

6.1.2 Critical Points

The critical points were evaluated by organising a 45 minutes session in which they experience briefly the toolkit and passed through all of them. They were not told which were the critical points to prevent biases.

Coming up with analogies
Interns did not find the exercise of producing analogies especially difficult. Some explained that it was a little more tricky when relating it to an emotion at the beginning.

“At the start I was a little confused... After a couple of minutes, I was able to picture myself with that feeling and where I experienced it.” – Business Analyst

However, it was suggested to include more examples on the template and to incorporate the inspirational questions as part of the main text – at the moment they are just a recommendation and placed on a side. They thought they could be even more helpful if the inspirational questions are read before starting producing analogies.

Arranging analogies on the stimuli distance line
The stimuli distance line the analogies are arranged in three categories depending on their distance to the problem statement: “too near”, “in the middle” or “too far”. This was a little challenging for some interns. They explained their doubt about the meaning of distance, as it can mean physical distance or it can also represent different conceptual associations.
6. EVALUATION

“(the stimuli distance line) is very subjective, so more examples could help” –Developer

At the moment there is only one set of examples in the instructions of the template, but two more could cover the different possible interpretations of the word distance.

Another recommendation that was suggested by three out of the five interns, is to have a video explaining the whole toolkit.

Starting the role-playing
The critical point of changing from converging into the idea to starting a role-playing only felt awkward to one of the interns.

“I was wondering how to do it, should I change my voice?...Eventually I managed to cross that bridge” –Developer

But in general, they all managed without difficulties to represent the idea.

“I was basically just explaining the idea, it is just how do you visually see the concept in real life. How you see it working in real life.” –Business Analyst

A way to prevent any of the participants feeling uncomfortable, it could be suggested that if a team member does not enjoy role-playing, that person could get the role of the detective.

6.1.3 Assessment questions
The assessment questions were answered on a scale from 1 (low) to 5 (high), and then the reasons for the rating were provided. In this section each of the questions is presented with its rating and some relevant quotes.

(1) How much did the toolkit support you in ideation?
Average rating: 4/5

“In our own process we didn’t feel guided during ideation. This would have been very helpful and to get back to think about the users. We thought about the users until problem statement. We tried to go back to it, but did not. This toolkit would have been great for that purpose.” –Business Analyst (rated 4/5)

“It is a little hard to know what is the answer (the toolkit) wants from you. It would be nice to have a video with it.” –Developer (rated 4/5)

(2) How much did the toolkit support you envisioning the impact on the user?
Average rating: 5/5

“It made me think of the user in each activity, which I think we forgot ourselves in our own project.” –Business Analyst (rated 5/5)

“I really liked the fact that you could narrow the problem down and add not only the functionality but the impact, how the user would feel.” –Developer (rated 5/5)
(3) How guided did you feel when using the toolkit?
Average rating 4.2/5

“If you read the instructions very carefully they are more than enough to understand.” – Business Analyst (rated 5/5)

“I would have liked to watch what to do first on a video. Like this is where we are going, how we will get there.” – Developer (rated 4/5)

(4) How clearly differentiated were the different phases (diverging, reverging, converging)?
Average rating: 4.7/5

“It is clear because it is written in all the instructions and you have to stop and look at the golden rules. It is very good to have them on the wall.” – Developer (rated 4.5/5)

“It was very clear, we did not have this kind of reflection in our [previous] project.” – Business Analyst (rated 5/5)

(5) How easy is to use the toolkit by someone regardless of their background?
Average rating: 4.3

“I felt very supported, and I can tell you that as particle physicist. Just found a little difficult the stimuli distance line.” – Business Analyst (rated 4.5/5)

“It is very easy and I would have as many examples as possible.” – Developer (rated 4/5)

“I think people in this program are scouted to be open to new things, so they would be able to do it for sure.” – Business Analyst (rated 5/5)
6. Evaluation with the HEC framework

In this section the assessment with a framework for evaluating creative facilitation tools is presented. First the framework is introduced, then the procedure for the assessment is explained and finally the results are presented.

6.2.1 HEC framework

There is a big variety of tools which are used during a creative session. Aguirre, Agudelo and Romm (2017) divided them in three groups: readymade (i.e., sticky notes), templated (i.e., business model canvas), and contextually designed (i.e., uniquely tailor-made activities which take into account the context of the participants in time and space).

Within the contextually designed tools, Aguirre et al. (2017) made a distinction between core facilitation (operational and functional logistics) and designerly facilitation (creating contextual experiences in order to enhance the participant’s creative potential). The HEC framework focuses on the latter.

In their framework, Aguirre et al. (2017) exposed that designerly facilitation tools have three dimensions: human-perspective (H), experiential (E), and creative (C). They proposed a criteria to evaluate the degree to which a dimension is exploited by designerly facilitation tools (the criteria can be found in appendix L).

Last, using their framework, a design facilitation flow can be visualised by plotting sequentially the designerly facilitation tools dimensions of each contextually designed facilitation tool.
6.2.2 Procedure
During the last session of the evaluation of the toolkit by current interns, a design intern who is also studying in the SPD program was observing the session. She was able to watch how the toolkit is used. Later, she went through the tools and she received a through explanation of the goal of each of the tools and how they were conceived. Last, she was given the assessment of the HEC dimensions (Aguirre et al., 2017) for the purpose of evaluating the toolkit.

6.2.3 Results

Impact Designer
The Impact Designer scored high on the human dimension, as it is designing the impact on the user. The experimental dimension scored low, as it is not particularly experimental, it is purely defining the problem statement and the desired impact. In the creative dimension it scored medium, this is due to the fact that the tool is containing a creative diamond for problem definition.

Impact Analogies
The Impact Analogies scored medium on the human dimension. This is due to the fact that the impact on the user is not present continuously in the tool, as part of the exercise is an excursion out of the problem statement. In the experimental dimension it scored high as it is using an immersion in another scenario based on the analogy. Last, in the creative dimension it scores high as it prompts abductive thinking and creates new ideas.

Impact Detective
The Impact Detective scored high on the human dimension, as there is a constant reflection on the impact on the user. It also scored high on the experimental dimension as it is using role-playing to produce an immersion in the idea. Finally, in the creative dimension it scores medium, because it is building on the existing idea from the previous tool.
6. EVALUATION

HEC dimensions
human
experimental
creative

Figure 17. Creative facilitation flow: overview of the assessment of the HEC dimensions of the three tools of the Impact Creative Toolkit.
6.3 Discussion

This study has evaluated the toolkit from two perspectives: from the interns' point of view (target users of the toolkit) and from a theoretical perspective. In this last section of the evaluation, the results from the evaluation are discussed in the same order as they have been presented before. To conclude, a final reflection on the evaluation is made.

Evaluation by current interns

In general, the interns had a positive reaction to the toolkit. They were able to go through the critical points without too much struggle. Adding more examples to support the understanding of the stimuli distance line and including the inspirational questions for coming up with analogies in the main text should be sufficient. On the other hand, the answers to the assessment questions proved that the toolkit meets the design challenge, especially when it comes to envisioning the impact. By introducing the minor changes mentioned before, the overall rating should improve.

One comment that was repeated by three of the five interviewees was the suggestion to include an explanatory video of the toolkit. In a culture where videos are replacing text, even images, it is not surprising that people prefer that kind of support rather than reading written instructions. This could be done in the future, by representing a fictive session and recording it.

Evaluation with the HEC framework

The three tools that compose the toolkit obtained good results on the evaluation with the HEC framework. From the creative facilitation flow (Figure 17), it can be observed that three tools differentiate from each other by focusing more in the one of the three dimensions. This illustrates that after experiencing the whole toolkit, practitioners visit each of the three HEC dimensions. Therefore the toolkit provides a very complete and rounded ideation session to the practitioners.

Final reflection

The evaluation has shown that the toolkit is guiding an ideation session that supports envisioning the impact of a solution on the end user. It has also proved that the three design guidelines are met: guiding in a seamless process, differentiating the (diverging, reverging, converging) phases and allowing its use regardless of the practitioners’ background.

Besides, the HEC framework has illustrated that the toolkit provides with a rounded ideation session that in the different tools focuses on one of the dimensions: human dimension, experimental dimension and creative dimension.
7

Conclusion & Discussion

In this chapter the final conclusions of the thesis are presented, along with a discussion about the limitations, implications, and recommendations. The chapter ends with a personal reflection.
7. CONCLUSIONS & DISCUSSION

7.1 Conclusion

The purpose of this project was to “to mitigate the struggle that interns — who are not familiar with the technology involved in their project or with the design process — may experience”.

After the an extensive literature review (chapter X) and an exploratory research (chapter X), the design challenge was narrowed down to “design a creative tool for ideation for multidisciplinary teams unexperienced in design in order to support them envisioning the impact of their disruptive innovative concept on their user” and three design guidelines were also formulated (chapter 4).

As a design solution an ideation toolkit, the Impact Creative Toolkit, was developed (chapter 5). It is built on the idea that impact can be divided in three categories: benefits, emotions and consequences. Formally the toolkit consisted in three tools, framed each of them in one of the creative diamonds of the iCPS model: Impact Designer or tool #1 — where the problem and the desired impact are defined —, Impact Analogies or tool #2 — where ideas are generated using analogies of the desired impact, and one final idea is chosen —, and Impact Detective or tool #3 — where the final idea is developed using role-playing and question-asking techniques.

After a testing session with students from Umeå Institute of Design, a series of iterations were included. The most notable ones were: introducing tool #0, where a short introduction of the toolkit and an overview of the different tools are presented; and restructuring tool #2, which initially was called Impact Metaphors and had a different approach.

The toolkit was successfully evaluated (chapter 6) from two perspectives: the target users and a theoretical evaluation framework. As an outcome some changes were proposed in order to improve the current version.
7.2 Limitations, Implications & Recommendations

The toolkit has been developed taking into account the experience of previous interns and observing current interns, and it has been iterated taking into account the feedback of design students. However it has not been tested in a real scenario, due to logistic issues, therefore some iterations would be necessary to obtain optimal results.

One of the reasons for this, is that the toolkit is meant to be used by multidisciplinary teams not versed in design that would use it without any facilitator. This means that if they do not understand properly the instructions, the final outcome could be different than expected.

As a recommendation, the first sessions using the toolkit should be monitored — at least the final outcome — in order to verify that it is producing the expected results. In that sense, it is possible that the toolkit may need some iterations after its first uses. In any case, creative sessions are about generating ideas and developing them. As long as there are some creative stimuli, new ideas will emerge and there will be a discussion around them. The quality and the presence of the impact is what it could be affected.
7. CONCLUSIONS & DISCUSSION

7.3 Personal Reflection

I set up this project because I was an intern at NORDIK. I observed at first hand the struggles of fellow interns not versed in design. This experience is what led me to the idea for this thesis.

The first challenge I expected and experience was the difficulties of working on such a long project on my own, without teammates actively involved in the project. This has developed my skills of self-planning and my working discipline.

The biggest challenge was synthesising all the research into the design challenge [chapter 4]. I wanted to produce a toolkit that was not generic and really targeted the needs of the interns. Narrowing down the scope to the impact on the end user took longer than expected and delayed the project two weeks. Now with the perspective of the whole process, I believe it was the right decision not to move forward with a non specific challenge. If so, the essence of the toolkit would have been missed, which is the constant reflection on the impact.

On a personal level, in the course of the project, I have felt many times a connection between the uncertainty that I experienced while working on my thesis, and the uncertainty of the interns that I have tried to help with. I have lingered in the uncertainty while at the same time, I have designed for people that linger in the uncertainty.

Finally, I have opened myself up to the field of creative facilitation, which I have really enjoyed. The block course by Katrina Heijne and Han van der Meer was fundamental for this thesis, as what I learnt in it is at the core of the toolkit.

The overall experience of this thesis has been very positive and I could not think of a better way to finish my masters on Strategic Product Design at TU Delft.
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