A routine design strategy to change organisational processes in the front end of radical innovation

TU Delft

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BARCO

A routine design strategy to change organisational processes in the front end of radical innovation

Master Thesis

Delft, October 2019

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Preface

In front of you lies a graduation report which is a summary of the last five months of my life. This is the final deliverable of the Strategic Design Master and it contains much of what I learned in the past couple of years during my bachelors and my masters at the Industrial Design Engineering faculty. But also, what I learned from the internships during this time. Actually, one of the internships sparked the idea for this thesis.

During my internship at Innovation Booster, I observed the approach of many management consultants that tried to transform large organisations in order to start new business innovation. They were trying to transform teams to embed new ways of working that were going through an innovation process. This spared my interest in organisational change. The main instruments they used to activate change were workshops, flowcharts or other visuals and many, many, many PowerPoint slides. Clearly, these consultants were struggling with their approach, because teams were resisting towards new ways of working. A great example to illustrate this is the story of consultant Mieke. Her team had to change the way they used their Kanban. A Kanban is a management system that provides a visual overview of the work that needs to be done and who is working on what topic. A team of six that she coached had to change their routine from the use of a digital Kanban “Trello” to a physical one on a big wall. But they refused, because they did not saw the added value and in their opinion, things were going just fine. Her solution to this issue was making presentations of all the advantages of the physical Kanban over the digital one. But her efforts were not working, time after time, and the routine remained unchanged and this situation even escalated up to senior leadership because of the continuous resistance of the team.

Therefore, the goal of this thesis was to understand how to change organisational routines. At the beginning of this project routines seemed to be rigid things that were untouchable and definitely not something that could be designed. However, while writing this preface, a couple of days before the deadline, I can proudly present a routine design strategy that helps consultants and organisation designers in their efforts to change organisational routines.

I could not have completed this graduation project on my own. Therefore, I would like to thank some people who were actively involved in the project

Ellis, thank you for giving me the freedom in approaching this project, even though this field of design does not have your biggest preference. I appreciate your straightforwardness in our conversations and that you are giving clear and concrete feedback during our milestone meetings. Your input helped me in improving the thesis.

Frithjof, thank you for the frequent skype calls during my time in Belgium and always helping me with when I got stuck. I received lots of feedback during our meetings and always in combination with different papers you shared with me. They always helped me to make a next step forward. I appreciate your enthusiasm, close involvement and the way you challenged me, this really improved the thesis. I wish you all the best with your PhD.

Guy, thank you for giving me the opportunity to start this graduation project at Barco and always connecting me with the right people within the organisation. I admire the way you challenge the people within Barco, and it is nice to hear from you that things are actually changing. You and Blanca are a good team. O, and I will never drink a Leffe Blond again.

Boaz, thank you for all the rides back and forth between Rottedam and Kortrijk.

Mama, papa and Roos, thanks for always supporting me during my time in Delft and especially during my graduation. I look forward spending more time at the TV-straat with you.

All my friends from Fletiomare, Utrecht and the people I met in Delft, I’m not going to thank you, but I look forward seeing you guys again more often after graduation.

Enjoy my master thesis!

Kees

Executive Summary

This thesis report represents the results of a case study conducted at Barco N.V., a Belgium technology firm well known for its superior way of developing new technologies into high-quality projection and display products. However, their competitive environment is increasing, competitors, like Samsung with hundred times more capacity of resources to invest in technical research and R&D.

For technology firms like Barco, radical innovation a way to escape intense competition, but also crucial for long-term survival as they provide the foundations on which future generations of products are created (McDermott & O'Connor, 2002; Sandberg & Aarikk-Stenroos, 2014). However, a required mature radical innovation capability in the front end of the process was lacking (O'Connor & DeMartino, 2006). Therefore, they have to change their internal processes and organisational routines that are regarded as the building blocks for this organisational capability (Junginger, 2008; Salvato & Rerup, 2011). Understanding organisational change is one of the great endeavours of many researchers and management consultants in the field of organisation design. A way to understand organisational change is by looking at organisational routines (Becker, 2005). Organisational routines are important to organisational change, but easier to study (Feldman & Pentland, 2003). However, an understanding how routines are designed or come to life is still a key question in the field of organisation design (Howard-Grenvile, 2005; Wegener et al., 2019). The approach of many managers and consultants of carefully designing PowerPoints and checklists while hoping for routines to change is a mistake (Pentland & Feldman, 2008). This leads to the following research question:

How to design an organisational routine that develops a radical innovation capability within a technology firm?

To answer this question and to provide organisation designers or organisational researchers empirical insights on how to design a routine in a performative way I developed and executed a routine design strategy. This strategy is based on existing routine design literature (Pentland & Feldman, 2008) and the double diamond approach (Design Council, 2005).

This study shows that using a routine design strategy consisting of three interdependent phases are critical to routine design. First, emphasize with routine actors, conduct activities to discover and define the challenges and needs the actors face in their patterns of action. Second, lock in desired performance, prototype in collaboration with the routine actors the desired performances and lock them in a physical artefact. Third, build the ostensive, perform the designed performances in design experiments within a reflective and experimental space to practice the routine in safe but realistic boundaries.

The findings of the first phase show that within Barco there is no formal process in place to support technology and business managers in their exploration meetings to create new radical opportunities. Furthermore, a conflict in interests created a political boundary and their two specialisations created a knowledge boundary, which challenges them to collaborate.

The result of the second phase is a "radical innovation discovery canvas" developed in collaboration with both technology and business managers to capture the activities and exercises that are desired during their exploration meetings to create new opportunities.

The findings of the third phase show that during one experiment the routine actors managed to translate knowledge across their interpretive boundary to create a new shared meaning of two new technologies. In the other experiment the routine actors managed to transform knowledge across their political boundary to create a new radical innovation opportunity. Which in both cases could not be achieved in earlier exploration meetings.

The key findings that emerged from the two design experiments were significantly important for this research that based on these findings I proposed an iteration of the routine design strategy. In this new version of the strategy, routine performance and reflection on performance within design experiments are central activities that I consider to be crucial in routine design. I hope that this thesis and the proposed iteration helps other organisations designers in their efforts to change routines in order to build new organisational capabilities.

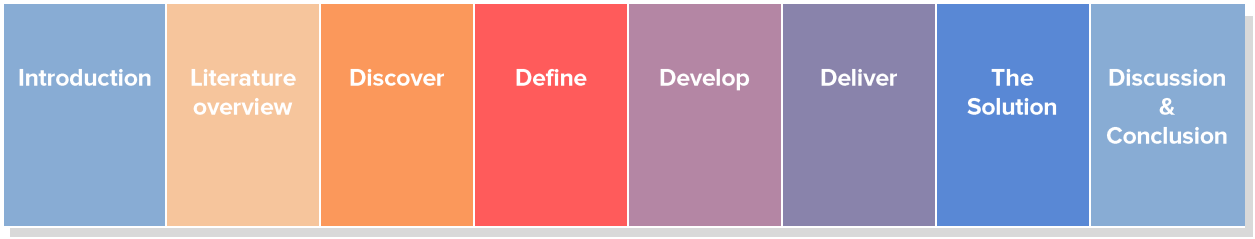
Table of contents

Reading Guide

This reading guide provides an overview to assist the reader while reading. Each chapter or subchapter starts with an introduction to introduce the topics of the chapter and states the main findings of that chapter. At the end of each chapter, a conclusion is given that highlights the main findings and what is how these conclusions will be used in the rest of the project.

Structure

All chapters in the report are structured to the phases and steps that are taken in order to complete the graduation project in a successful manner. These phases include, introduction, literature overview, discover, define, develop, deliver, the solution, and discussion and conclusion. Each of these phases are indicated with a specific colour per chapter. More detailed information about these phases is located in 1.4 Project approach.



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Definitions from literature or concepts that have direct relevance to answering the reseach question are presented like this.

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Conclusion
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Chapter 1 | Introduction

This first chapter gives an introduction of the thesis to show the relevance of this graduation project. Firstly, the research subject and the research question will be introduced. Secondly, the case company Barco N.V. will be introduced and the initial problem they have. Thirdly, the approach that is developed and executed during this project will be explained. Lastly, this chapter closes with an overview of the report structure.

Chapter 1 | Introduction

1.1 Research subject

Over the past few decades, the scope of design has steadily increased from the design of physical products, to (digital) interactions and services to complex systems and strategies (Buchanan, 2015). This project aims to take the field of design one step further and explores the use of strategic design not on the output of an organisation, but on the organisation itself.

Because, every day, organisations face some kind of new challenge: increasing international competition, emerging new technologies call for implementation, and customers' needs change. Therefore, these organisations have to change unless they want to become irrelevant, or worse, extinct and this is the paradox of an organisation: it needs stability to function well, but it needs change to survive (Junginger, 2008). It is easy to come up with some examples of famous and large organisations that failed to change quickly enough to survive in the long-term: Nokia and Kodak are just a few examples that did not change and were defeated by competitors who did.

A way to escape this intense competition and to differentiate from competitors is radical innovation, and especially technology firms acknowledge its importance (Sandberg & Aarikka-Stenroos, 2014). Radical innovations are perceived to be crucial to the long-term survival of many technology firms as they provide the foundations on which future generations of products are created (McDermott & O'Connor, 2002). Furthermore, managers in those organisations need to better understand how to address complexity and high uncertainty, both technological and market, inherent in radical innovations (Cooper, 2011). Therefore, development of radically new products requires management practices that differ substantially from those required for incremental innovation (McDermott & O'Connor, 2002). Especially when looking at the front end of radical innovation. The front end is one of the greatest areas of weakness of the process and fundamentally determines the later innovation success (Koen et al., 2001). Effectively managing the front end is one of the most important, difficult challenges facing managers (Kim, 2002). It will come as no surprise, then, that effective management of the front-end results is a sustainable competitive advantage (Brem & Voigt, 2009). For many firms this means that they have to change their organisational routines and solve internal challenges they face when it comes to managing radical innovation in the front end of the process. In order to be able to innovate radical new products organisations need to develop a mature radical innovation capability and therefore the organisation needs to change (O'Connor & DeMartino, 2006).

Understanding organisational change is one of the great endeavours of many scholars and practitioners in the field of organisational design. A proposition to tackle this challenge is to understand organisational change by looking at organisational routines (Becker, 2005). Organisational routines are empirical phenomena that are closely related to organisational change, but empirically easier to grasp (Feldman & Pentland, 2003). The concept of routines and organisational capabilities are central concepts in management studies as they are closely related. This conceptualization helps to understand an organisational capability, since routines are regards as the building blocks of capabilities (Salvato & Rerup, 2011). However, studies of designing organisational routines are still relatively nascent, more descriptive and less performative (Wegener & Smulders, 2019). An understanding of how routines come to life or how are they born is still a key question in the field of routine design (Howard-Grenville, 2005). According to Wegener et al. (2019), other studies have introduced different aspects and challenges of intentionally changing routines, but these studies lack a detailed description of actual designing the routine and thus how routine design builds up towards an organisational capability. Throughout this thesis I attempt to find an answer to this question in the context of a technology firm that is trying to change its internal processes and routines in order to develop a mature radical innovation capability.

Therefore, the main research question of this thesis is:

How to design an organisational routine that develops a radical innovation capability within a technology firm?

The answer to this question will provide organisation designers or organisational researchers new insights on a detailed and descriptive design process of routine design in a performative way. In order to answer the main research question, I developed and executed a design strategy to design a routine of which the approach and use will be discussed throughout the thesis. The project was conducted in an empirical case study within a technology firm: Barco N.V.

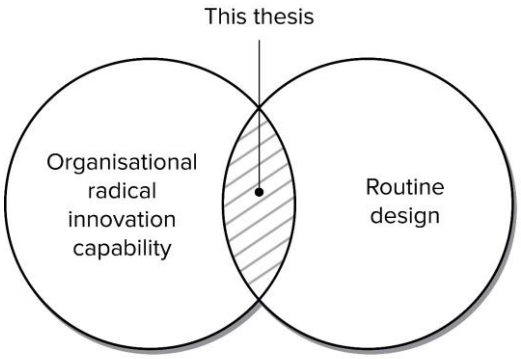


Figure 1-1 Focus of thesis

1.2 Case Company: Barco N.V.

Barco is a Belgium technology firm that is active in the following three business areas: Entertainment, Enterprise and Healthcare. In those three-business area's they offer different types of technology for different markets, but they mainly serve them with display, projection, collaboration and image processing technology. They are market leader in cinemas with their projectors, deliver projectors, LED walls and products that processes all the content towards the audience at the biggest festivals in the world like Tomorrowland and Barco's Clickshare is a well-known product in the meeting room that allows people to easily share their content on the screen without the use of any cable. And this is just a fraction of the products they are offering to their markets.

In the entire industry, Barco is well-known for its superior way of developing new technologies into state-of-the-art high-quality products. However, promising new technologies are not magically transformed into products; they need to be developed to the point where they are ready for commercialisation. This requires a management process to efficiently evaluate and choose among new emerging technologies and prepare them for new product development (Eldred & Mcgrath, 1997). Ten years ago, Barco introduced a pre-development process, a process that precedes to a deeply routinized new product development process that R&D engineers of the business units follow. Due to the high risks in radical innovation projects of, whether the new technology is feasible within a new product, there was a need for researchers to first deal with these uncertainties before going into new product development. This pre-development process, called new technology introduction, was renewed six years ago and is followed by technology managers and researchers from the technology centre. The technology centre is a corporate department that focusses on radical innovations for the divisional business units. For example, within the technology centre a group of researchers develops a display technology L into a technical proof of concept which will be handed over to business unit LED after which the R&D of the business unit L develops a product out of the proof of concept for its customers. A part of the profit of the business units fund the technology centre to research new emerging technologies.

Their competitive environment is increasing, competitors (e.g. Samsung, LG, Christie, Dolby) with sometimes 10 to 100 times more resources to invest in research and R&D compared to Barco. This forces Barco to make well considered decisions about which new technologies should be invested in, to differentiate themselves in this competitive market place and also for Barco radical innovation is therefore a way to escape from competition. While writing this thesis Barco's mission was "to enable bright outcomes by transforming content into insight and emotion. In order to achieve that mission, they want to offer best-in-class, networked visualization solutions (hardware and software) and related services." To achieve this mission Barco's strategy is built on four strategic pillars: Lead by Innovation, Focus on Performance, Offer Outcome-based Solutions and Sustainable Impact. These strategic pillars are further translated into different programs executed throughout the organisation.

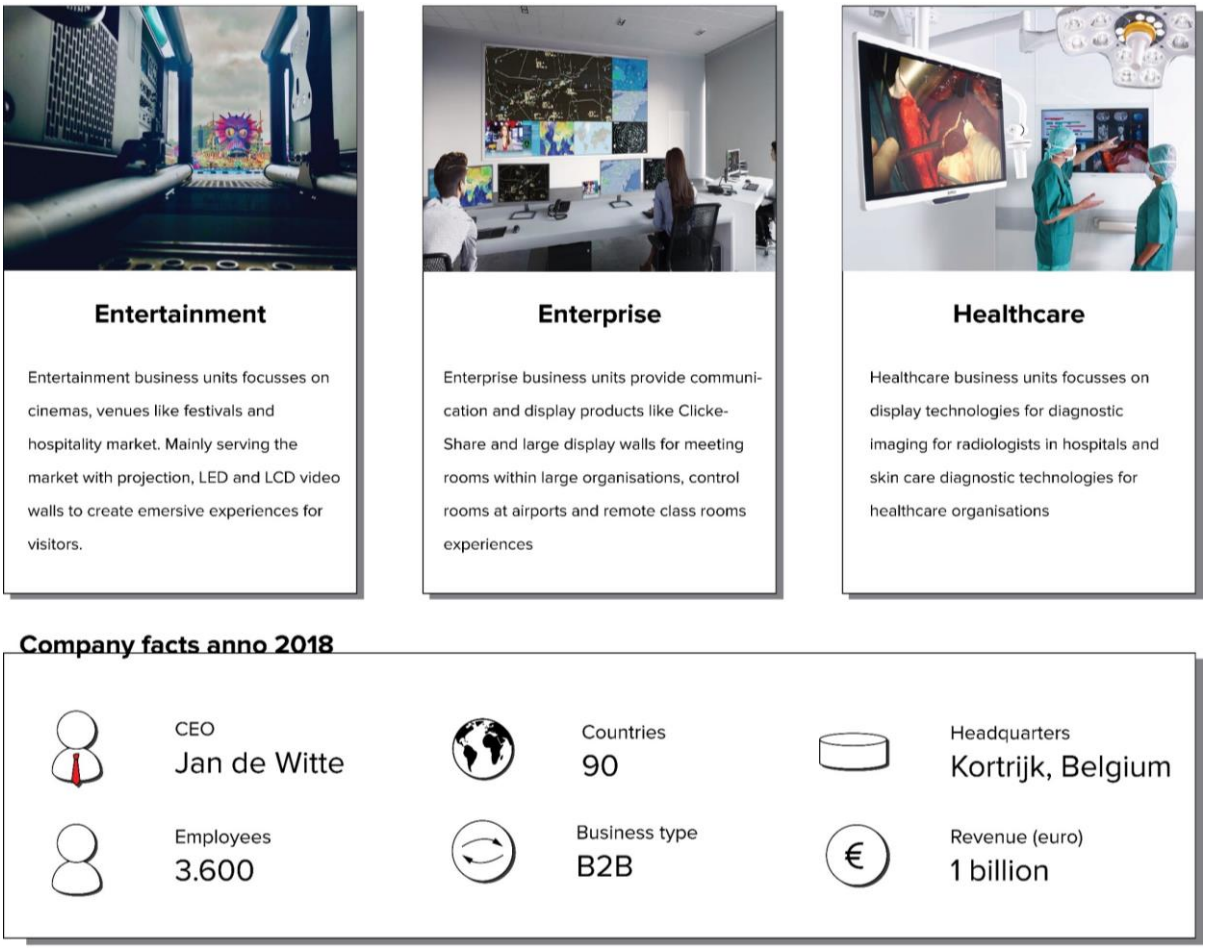


Figure 1-2 Company facts

Project scope

The project scope for this thesis is the front end of the radical innovation process within Barco. The front-end phase refers to activities prior to the formal, well-structured new product development (Koen et al., 2001). To be more specific, I focus on three parts of the front end of the process. First, ideation, in order to understand how new projects are created and how they receive approval, the process that is prior the new technology introduction process is included in the scope. Second, the new technology introduction process itself is included. Third, business handover, this is the process when project outcomes from the technology centre are handed over towards the business units to start new product development. This subdivided project scope is visualized in Figure 1-3.

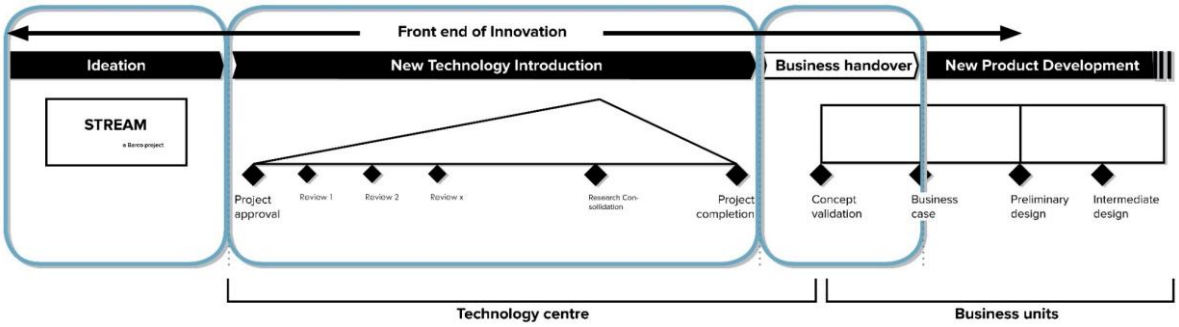


Figure 1-3 Subdivided project scope

1.3 Project Approach

The project approach derived from the double diamond approach (Design Council, 2005). This approach illustrates an iterative design process of diverging (exploring options) and converging (making decisions) based on four phases: discover, define, develop and deliver, see Figure 1-4. The left-hand diamond is key to find the problem that the design should solve, and the right-hand diamond is about solution developing by testing and refining the idea, which is essential for good design (Design Council, 2005).

However, in order to answer the main research question, I adjusted the double diamond based on an analysis of existing routine design literature and formulated a design strategy to design a routine. In the following section I describe this routine design literature, the analysis and the formulated design strategy that will be used during this project

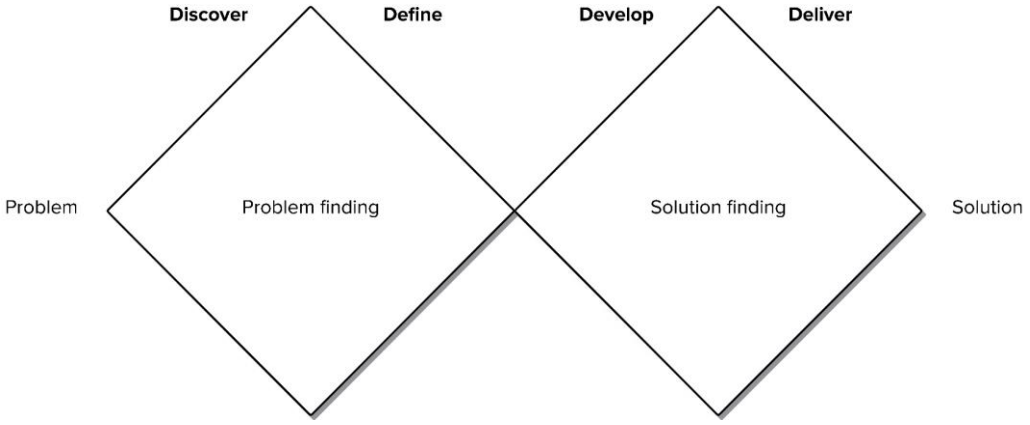


Figure 1-4 Double diamond (Design Council, 2005)

What is a routine?

A proposition to understand organisational change by looking at organisational routines (Becker, 2005). Routines are generative systems that produce, recognizable patterns of interdependent actions carried out by multiple actors (Feldman & Pentland, 2003). Feldman & Pentland (2003) proposed that a routine consist of two related aspects: the ostensive and the performative. The first aspect, the ostensive, is the ideal or schematic form of the routine. It is the abstract, generalised idea of the routine or routine in principle. These aspects are not written rules or procedures, which for many routines do not even exist. They consist of the understandings, both embodied as cognitive, of the actors (Pentland & Feldman, 2008). The performative, "consists of specific actions, by specific people, in specific times and places. It is the routine in practice (Feldman & Pentland, 2003: 101)." Routine actors use the ostensive aspect to guide their actions, to account for what they are doing. The performative aspect creates, maintains, and modifies the ostensive aspect in practice. This is done in much the same way that speaking creates, maintains and alters a language. Without these two aspects the repetitive patterns of action that characterize organisational routines cannot be produced or reproduced (Pentland & Feldman, 2008). These two key aspects of a routine are conceptualized in Figure 1-5

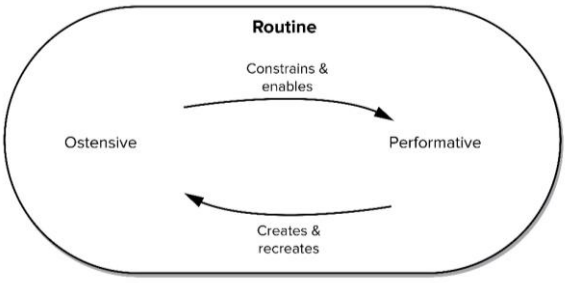


Figure 1-5 Organisational routines are generative systems

Routine design

Some organisational routines may simply emerge, but a great many routines are the product of explicit attempts to design efficient, effective work practices (Pentland & Feldman, 2008). Pentland and Feldman believe that designing artefacts while hoping for patterns of actions to happen is a mistake. Designing things like flowcharts, checklists or changing rules do not immediately result in a changed routine. No matter how carefully an artefact is designed, they just do not necessarily result in routine change. Their classic story around artefacts and organisational change is a great empirical example where organisational actors tried to change routines for scheduling and other administrative work of a departments that delivers education to adults. To achieve this, management acquired a software package to change these routines to standardize routines performances across two departments in the organisation. An implementation team was responsible to design the requirements of the software and implementation phase. The software package was carefully designed and looked promising; however, the implementation phase failed and was stalled. The implementation team envisioned to use a shared database, but the two departments were concerned with these new patterns of actions and wanted to control their own data and work practices, which is exactly the opposite of what the software package offers. This study illustrates that there was a disconnection between the artefact (software package) and the actual needs and work process of the routine actors.

Building on the insights of (Cohen, 2007), they make a distinction between 'living' and 'dead' routines. Dead routines are artefacts, they are rigid, mindless, and can be explicitly stored. Any organisational routine that involves people, who are capable of learning from experience is considered a 'live' routine. The key distinguishing factor is that live routines are generative, performing the routine gives rise to learning which gives new actions. This might explain why many managers and management consultants within large organisations put lots of effort in designing artefacts (e.g. PowerPoints, checklists, flowcharts, or other visuals) while hoping for routines to change. Through experience, routine actors naturally give rise to learning, which leads to new actions, performances and sometimes new patterns of action. Meaning that routines are constantly changing and evolving through the influence of the actors and therefore hard to control.

To conclude, just designing an artefact will not necessarily result in routine change. Feldman & Pentland (2008) suggested seven practical guidelines for designing live routines, which can be found in Table 1-1. In order to formulate a routine design strategy, I analysed these guidelines by comparing them with the double diamond approach to find commonalities and differences to include into different phases of the strategy.

Guideline	Description
#1	Prepare for continued engagement to take steps to keep the routine on track or that different set of actions are appropriate.
#2	Consider the point of view of each actor. What patterns do they produce and respond to? What are the paths leading to an event? What are their interests and alternatives?
#3	Consider the relationships between specific actions and patterns. Use narrative networks to map out different ways to move from events.
#4	Consider design points in the process rather than decision points.
#5	Lock in events that are really required. And use physical artefacts to enable and constrain that particular part of the performance.
#6	Create incentives for the behaviour you want. Design patterns of action for the routine actors.
#7	Invest in the ostensive. Train and practice together and provide feedback on collective performance.

Table 1-1 Routine design guidelines (Pentland & Feldman, 2008)

Analysis

To make sense of the routine design guidelines I combined six out of seven with the double diamond approach and included them into three interdepend phases. From a strategic design perspective, I considered all guidelines to be useful to embed in the strategy, but one guideline was not considered feasible within this project. Next to that, some guidelines had overlap with others and asked for a similar approach with regards to the double diamond, and therefore could be combined into one phase. The routine design strategy is visualized in Figure 1-6 on the next page.

Being continued engaged with the routine actors to keep the routine on track was not considered feasible within this project. First, I have to discover and define the problem, and second, develop the solution and unfortunately active involved after these phases is not feasible within the given timeframe until graduation.

Consider the point of view of each actor, consider the relationships between actions and patterns, and consider design points in the process rather than decision points are all guidelines with regards to the left-hand diamond, since this diamond is all about problem finding and emphasizing with the problem. Therefore, I combine these in the first strategic phase: Emphasize with routine actors.

Lock in the performances that are really required and create incentives for the behaviours you are complementary are linked to the first part of the right-hand diamond, which is about solution finding. Therefore, I combine these in the second phase of the strategy: Lock in desired performance.

Invest in the ostensive. Artefacts are not enough, so practising and collective feedback is key to build the ostensive aspects of the routine. Since the ostensive aspects connects the artefact (such as sheet music) to the desired performance (the actual music). From a design perspective this is about experimenting and implementation which are important in the deliver phase of the right-hand diamond. Therefore, I include this guideline in the last phase of the design strategy, phase 3: Build the ostensive.

To provide an overview of this analysis, the results are located in a table Table 1-2.

Guideline	Description	**Results**
#1	Prepare for continued engagement to take steps to keep the routine on track or that different set of actions are appropriate.	Not considered feasible until graduation
#2	Consider the point of view of each actor. What patterns do they produce and respond to? What are the paths leading to an event? What are their interests and alternatives?	Key for problem finding, included in Discover & Define phase
#3	Consider the relationships between specific actions and patterns. Use narrative networks to map out different ways to move from events.	Key for problem finding, included in Discover & Define phase
#4	Consider design points in the process rather than decision points.	Key for problem finding, included in Discover & Define phase
#5	Lock in events that are really required. And use physical artefacts to enable and constrain that particular part of the performance.	Key design principle, included in Develop phase
#6	Create incentives for the behaviour you want. Design patterns of action for the routine actors.	Key design principle, included in Develop phase
#7	Invest in the ostensive. Train and practice together and provide feedback on collective performance.	Key for implementation, included in Deliver phase

Table 1-2 Result of analysis

Routine design strategy

Phase 1: Emphasize with routine actors

I have to consider the point of view of the actors within the routine. Figure out what are their interests and what are their alternatives. To find the problem and solution space for the new routine, I have to emphasize with the actors to discover their needs and wants. Therefore, I consider the design points in the process rather than their decision points and consider the relationships between different events and actions.

Phase 2: Lock in desired performance

After defining the solution space, it is time to start developing the desired performance of the routine. To lock in the desired performance, I will use a physical artefact to enable and constrain really required parts of the performance aspect of the routine. I use feedback sessions around prototypes of the physical artefact with the target group to subtract the desired performance of the new routine.

Phase 3: Build the ostensive

The ostensive aspects connect artefacts (such as a sheet music) to the desired performances (the actual music). Therefore, I have to invest in and build the ostensive part of the routine by peforming the designed performances during phase 2.

Figure 1-6 Routine design strategy

1.4 Report structure

Literature | Chapter 2

Literature on radical innovation, challenges to radical innovation and organisation design will give me insights to analyse the data captured during phase 1 and it will enrich the design strategy with new insights that will be used during the execution of phase 2 and 3.

Routine design strategy phase 1

Discover | Chapter 3

To execute the first phase of the strategy, the third chapter is built around finding answers to two formulated sub-research questions about radical innovation management and the challenges the people within the organisation faces. This is done to find the problem and solution space for the new routine. Through literature, in-depth interviews, meeting observations and internal documents data was captured to answer these questions.

Define | Chapter 4

The challenges found during discover provide input to define the solution space and define the problem statement. Furthermore, I describe the design brief that will guide me during the develop and deliver phase.

Routine design strategy phase 2

Develop | Chapter 5

The aim of this chapter is to explain the approach taken in finding a solution that solves the problem statement. It starts with describing the design approach and the ideation phase. After choosing a specific physical artefact format, two main iterations are conducted with the use of prototypes and feedback sessions to create learnings over the desired routine performance. These learnings and then included in the next iteration of the prototype.

Routine design strategy phase 3

Deliver | Chapter 6

This chapter describes iteration 3 and 4, within each iteration a design experiment took place to build the ostensive part of the routine by practicing and testing the new routine guided by the physical artefact. Both experiments provide rich insights on both desirability and feasibility of the designed routine.

The Solution | Chapter 7

This chapter presents the latest iteration and explains the buildings blocks of the performance aspect of the routine. These building blocks are different activities and exercises that the routine actors clavately follow. Next to that, an implementation plan is presented along with directions for further improvements and recommendation

Discussion & Conclusion | Chapter 8

In this chapter I discuss and conclude on the main findings during all three routine design strategy phases in the light of the main research question. Moreover, with the insights gained during research I present a new version of the three-phase design strategy to invite other organisation researcher or design consultants to use for future research. The chapter finishes with a personal reflection

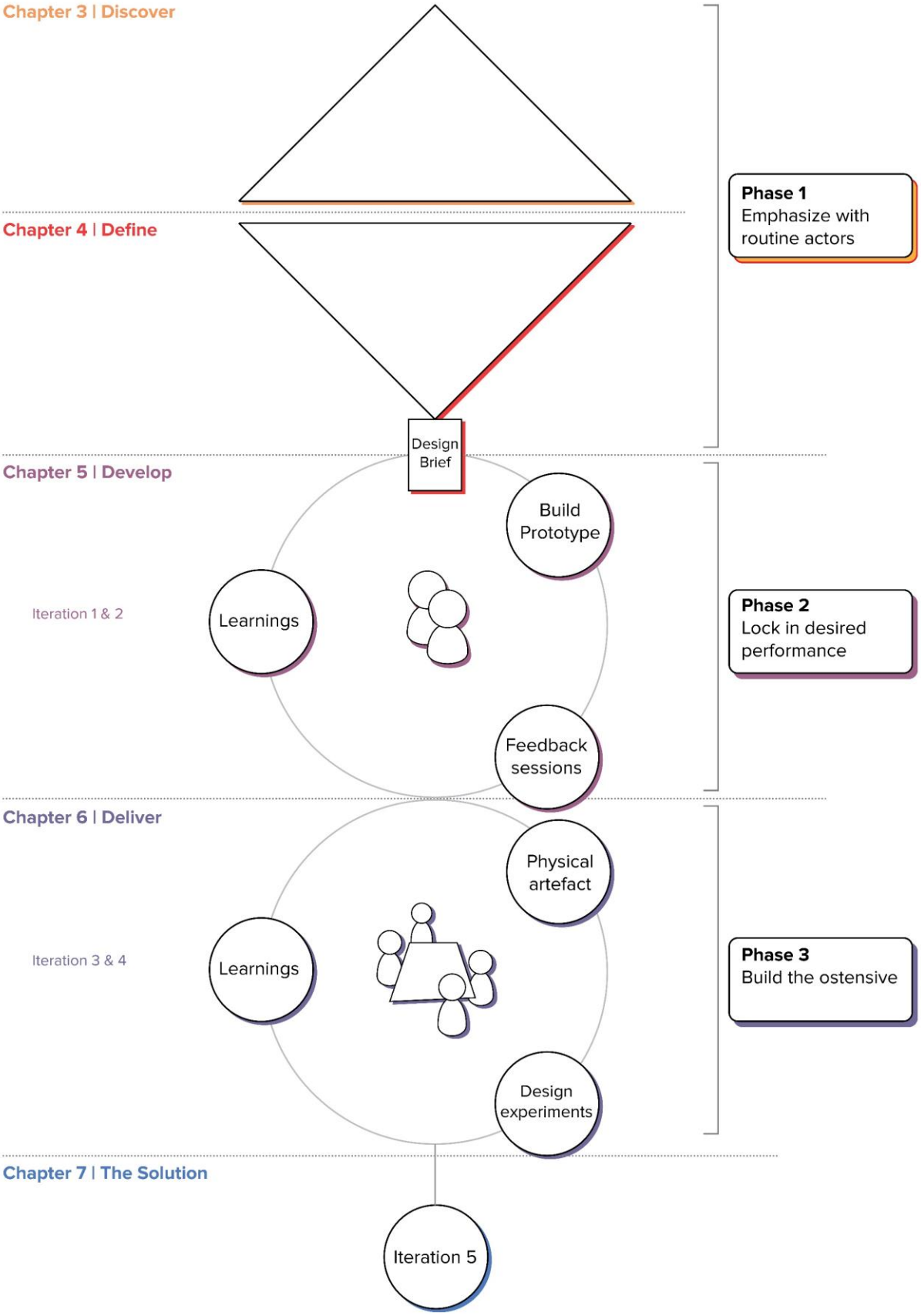


Figure 1-7 Project approach

Chapter 2 | Literature overview

The second chapter provides an overview of existing literature around radical innovation and routine design. The chapter starts with describing what radical innovation is and what are the needed organisational capabilities to innovate radically. Secondly, it provides an overview of the challenges organisations face with regards to radical innovation. Thirdly, organisation design, routine design and the use of reflective and organisational spaces will be explained. Lastly, the chapter closes with a summary of the main insights from the literature that will be used in the rest of the project.

Chapter 2 | Literature Overview

2.1 What is radical Innovation?

In order to understand what 'radical innovation' is for an organisation, I first explain meaning of 'innovation' itself. There are a multitude of definitions of "innovation" (Baregheh, Rowley, et al., 2009). Baregheh et al. (2009) performed an extensive content analysis of 60 definitions of innovation to propose a definition. Their proposed general and integrative organisational innovation is;

Innovation is a multi-stage process whereby organisations transform ideas into new/improved products, service or processes, in order to advance, compete and differentiate themselves successfully in the marketplace (Baregheh, Rowley, et al., 2009)

To define what radical innovation is, we analyse the definition of innovation depicted above. Namely, the words 'new' and 'improved' gives the impression that there is a difference between those words regarding to the innovativeness of a product. This difference between improved and new is widely accepted as incremental and radical innovation. Looking at the literature and articles on the web gives a clear impression that researchers and organisations are far from consensus regarding a definition of radical innovation. Despite differences in definitions, researchers understand that radical innovation within an organisation is very different from incremental innovation (McDermott & O'Connor, 2002). This difference can be defined using the uncertainty matrix discussed by Ansoff and Moriarty & Kosnik (Holahan, Sullivan, et al., 2014), and is visualized in Figure 2-1.

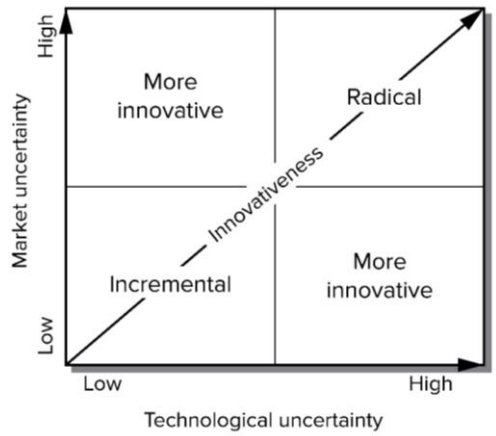


Figure 2-1 Uncertainty Matrix

Projects that fall in the lower left-hand quadrant are labelled as 'incremental' projects, those that fall in the upper left-hand or lower right-hand quadrant as 'more innovative', and projects that fall in the upper right-hand quadrant as 'radical'. Radical innovations have a high market and technological uncertainty, an example is the development of Hyperloop, a world-wide large-scale project that seeks to connect big cities far away from each other by decreasing travel time tremendously due to new technology, given his new-to-the-market status and still technological uncertainties before commercialisation. More innovative projects include products that have either high technological or market uncertainty, but not both. The construction of a new high-speed line to reach new maximum speeds for trains would be an example for these 'more innovative' innovations. Incremental innovations consist of products that have low market and technological uncertainty, and include modifications of existing products, products redesigned to achieve cost reductions, and repositioning. A train with more passenger capacity within the current dimensions is an example of incremental innovation.

According to the uncertainty matrix innovation can be categorised into incremental, more innovative and radical innovation depending on the market and technological uncertainty. Radical new products are therefore products that are new concerning the applied technology and the target market, incorporating both high technological and market uncertainties. Combining the definition of innovation described earlier with the knowledge gained from the uncertainty matrix regarding the high market and technological uncertainty of a radical innovation gives me the definition of radical innovation that will be used for this thesis:

"Radical innovation is a multi-stage process whereby organisations transform ideas into products that are new concerning the applied technology and target market, incorporating high technological and market uncertainties, in order to advance, compete and differentiate themselves successfully in the marketplace."

(Holahan, Sullivan, et al., 2014) (Baregheh, Rowley, et al., 2009)

To add another layer O'Connor et al. (2005) defined radical innovation as products that have strong impact on the market and the firm. They found that these levels are correlated with high risk and high uncertainty in the firm. This requires a firm to develop new capabilities in technology, market and organisational domains. Which I will explain in the next section.

Needed radical innovation capability

Organisational capabilities are firm level assemblages of lower-level routines (Salvato & Rerup, 2011). Therefore, organisational routines are conceptualized as the building blocks for firm-level capabilities. From a three-year, longitudinal study at 12 large established firms, O'Connor and DeMartino (2006) identified three key capabilities that are required to develop a mature radical innovation capability, these are conceptualized in a framework as discovery, incubation and acceleration. The Discovery-Incubation-Acceleration framework requires distinctive types of expertise, processes and routines per phase, the framework is visualized in Figure 2-2. First, discovery involves behaviours and activities that recognize or create opportunities for radical innovation and, importantly, that allow the actors to elaborate and/or articulate the opportunity. The skills needed are exploratory, conceptualization skills both technical scientific discovery and external hunting for opportunities. Second, incubation involves undertaking activities that mature the articulated radical opportunity into a business proposal. The skills needed are experimental skills, not only on the technical part but also for market learning and validation.

Third, acceleration is concerned with making technology ready for the market by constructing a commercially viable product and includes providing a protected space to develop production capabilities and to begin to grow sales. The skills needed are those required for managing high-growth businesses.

Discovery, incubation and acceleration capabilities are difficult to develop and in addition they do not ensure a successful radical innovation capability (O'Connor & DeMartino, 2006). However, as their research shows, organisations that changed and improved their processes and routines to develop a mature capability were having more success in those areas.

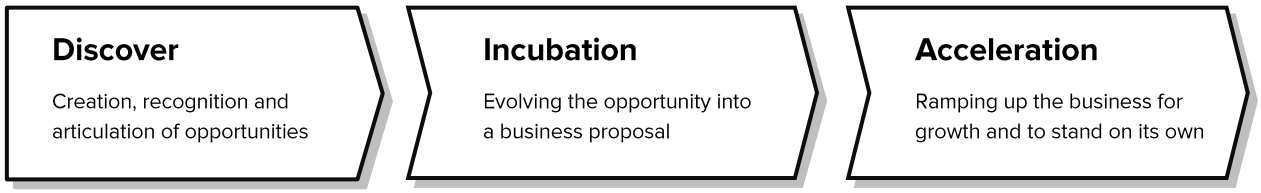


Figure 2-2 Discovery-incubation-acceleration framework

2.2 Challenges to radical innovation

As challenges hinder or diminish radical innovation activities, in order to counter these challenges, it is important to identify these challenges and understand them (D'Este et al, 2012). Throughout the process of radical innovation, organisations are forced to cope with numerous barriers, impediments, issues and obstacles. In the literature, these are often termed innovation challenges.

To identify these challenges McDermott & O'Conner (2002) conducted a longitudinal (1995-2002) multiple case study, at ten large North American firms, to explore similarities and differences in management practices applied to radical innovation projects. And they found three strategic challenge themes. The first theme, market scope, discusses the challenges associated with the pursuit of familiar versus unfamiliar markets for radical innovation. The second theme, competency management, identifies and discusses the challenges that emerge as firms stretch themselves into new and unfamiliar territory, how to manage this risk because tools and techniques associated with incremental project innovation management could not be applied in the same manner in uncertain radical innovation projects. The third theme, people issues, emerge when a sponsor (a senior management level project supporter) worked to keep a project alive and the dependency of informal networks in organisations.

Sandberg & Aarikka-Stenroos (2014) provided other researchers with an overview of challenge categories by an extensive systematic analytical review of 103 articles on challenges to radical innovation of large organisations in the B2C and B2B market. The identified challenges are grouped in internal and external challenges. This division in internal and external enables recognition of challenges that an organisation can influence, and thus closely related to its management activities and organisational processes, and challenges that are partly or completely beyond its influence. This research only focuses on the internal challenges and according to this extensive review the following classification of identified radical innovation internal challenges were found, and they are presented in order of magnitude: (1) Restrictive mindset is the fear and resistance of change or failure within the organisation, the decisions-making is highly conservative, (2) Lack of discovery capabilities to create new radical opportunities and only focusing on the needs of current customers, (3) Lack of incubation capabilities to pursue created opportunities into valid business proposals, (4) Lack of acceleration capabilities to grow the business proposal to a point where it can stand on its own, (5) Insufficient resources is the misallocation of internal skills, expertise and tools within the organisation and (6) Unsupportive organisational structure like the separation of research and development from the rest of the organisation causing communication problems. In this review the lack of capabilities were linked to the Discovery-Incubation-Acceleration framework (O'Connor & DeMartino, 2006).

Lee & Markham (2016) found in their comparative performance assessment study comparing the best with the rest firms that that using financial instruments and focusing on financial measurements results in poorer performance, however these are used in a high degree. For radical innovation conventional analytic methods are inappropriate (e.g. business case tools) because numbers in the early stage of the radical innovation process are nearly impossible to predict, especially during discovery activities in the front end. (Sandberg & Aarikka-Stenroos, 2014).

Practical and political challenges to radical innovation

Organisational competitiveness is crucially determined by a firm's capability to create new knowledge (Leiponen, 2006; Un & Cuervo-Cazurra+, 2004). Knowledge in organizations is both a source and a challenge to innovation (Carlile, 2002). Dorothy Leonard's (1995) statement that most innovation happens at the boundaries between disciplines or specialisations tells us that working across boundaries is a key ingredient of competitive advantage, but also why innovation proves so difficult to create and maintain since these different specialisations have to work together interdisciplinary (Carlile, 2004; Blackwell, 2009). The characteristics of knowledge that drive innovative problem solving within a discipline (e.g. within marketing or within R&D engineering) actually hinder knowledge creation across different disciplines (e.g. across marketing and R&D engineering). It is at these "boundaries" that we find the deep problems that specialized knowledge poses to organisations. The irony is that these boundaries are not only a critical challenge, but also an everlasting necessity because much of what organizations produce has a foundation in the specialisation of different kinds of knowledge (Carlile, 2002). Carlile (2004) conceptualizes three different boundaries and the approaches to manage these boundaries in a framework to specify the practical and political challenge categories that occur when different specialisations collaborate when innovation is desired. The three boundaries are syntactic, semantic, and pragmatic and the framework is depicted in Figure 2-3.

A Syntactic or information-processing boundary: Transferring knowledge

The primary concern of this boundary is processing or transferring knowledge between sender and receiver. The approach to manage this boundary is to establish a shared and stable language between different disciplines.

A Semantic or interpretive boundary: Translating knowledge

This boundary recognizes that if even if a common syntax or language is present, interpretations are often different which make communication and collaboration difficult (Carlile, 2002). When new requirements or new actors are present, interpretive differences in what a word means limits actors to manage knowledge between them. Nonaka (1994) suggests that it is required to generate "mutual understanding" through communities of interaction where individuals can work through these semantic differences by making tacit knowledge explicit across a boundary. Such a process would focus on the practical process of learning about and making explicit new sources of difference.

A pragmatic or political boundary: Transforming knowledge

This boundary recognizes when actors have different interests. This approach highlights the importance of understanding the consequences that exist between things that are different and dependent on each other (Carlile, 2002). It assumes the conditions of difference and dependence and novelty are all present, and so the requirement of an overall process for transforming existing knowledge to deal with the consequences that arise. Transforming knowledge refers to a process of altering current knowledge, creating new knowledge, and validating it within each discipline and collectively across disciplines (Carlile, 1997).

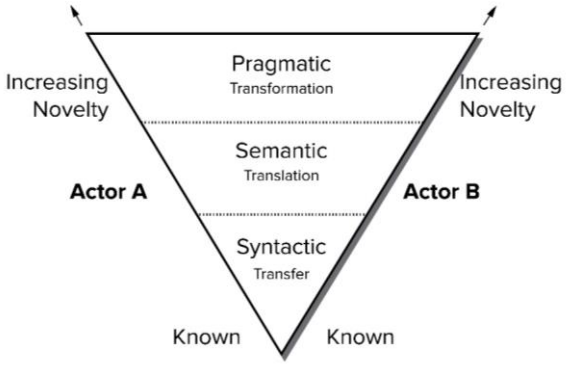


Figure 2-3 Framework for managing knowledge across boundaries

Challenges to decisions-making process

Managers have the task to balance the explorative and exploitative business efforts of the organisation in order to keep the business relevant in the short-term and in the long-term by making decisions about starting incremental or radical innovation. Investment decisions in incremental innovation are easier make, since financial tools and models are able to accurately estimate the forecasts to support these decisions. For radical innovation these financial tools are not always suitable for manager to base their decision on.

The decision making process and the role of social interactions is investigated by (Frese, Wegener, et al., 2018) in a longitudinal case study at a large food multinational company. They made use of the seminal work on decision-making by Simon (1947) which describes decision making from a three-step approach: intelligence, design and choice, see Figure 2-4. Intelligence focuses on clarifying which problematic situation one has to deal with and collecting data. Design focuses on creating alternative options. And choice is choosing amongst the alternatives. Frese et al. (2018) argues that decision makers experience the lack of design element, when they have to make choices between options, where they are left to feel that neither of the options is good, but no other options seem to be available. It can be noted that it in order to make a well-considered decision around radical innovation opportunities it is important to be able to create multiple opportunities and alternatives to choose from.

They and other researchers recognize the social nature of decision-making (Van der Ven, 1986). Frese et al. (2018) also argues the importance of the social process before actual decision-making because they saw a strong link between decision-making and long and careful discussions between decision makers before an actual decision was made. This indicates the importance of effective discussions between decision-makers in order to make a well-considered decision over time.

Figure 2-4 Decision making approach, Simon (1947)

2.3 Routine design

Organisation design

Miller, Greenwood & Prakash (2009) describe organisation design as 'the process and state of continual and deliberate alignment of the component elements of an organisation: its strategy, its structures, its human resource practices and accountabilities, and its information, control, and decision processes'. As a result, I conclude that he understands an organisation as a concept consisting of several component elements, namely: strategy, structures, human resource practices and accountabilities, and the processes in place for regarding information, control, and decisions. Junginger (2015) argues that no matter the shape, size or purpose of an organisation, design is always present within an organisation. People are busy conceiving structures, processes, procedures, products; they play, develop, realize, deliver and implement on an ongoing basis (Junginger & Junginger, 2017). Organisations are living systems (De Geus, 1997), to be a living system means to keep changing and developing. People cope with changing environments through design by changing their processes and routines. Therefore, design is a core organisational activity. If designing is a core organisational activity and if designing takes place every day somehow somewhere within organizations, the challenge here is not to introduce or embed design, but connecting to already existing design practices, approaches and methods. This presents new opportunities for transformational changes, but it also demands new thinking and new ways of going about designing for design professionals.

Reframing organisational change

Organisational change generally aims to improve organisation's internal processes (Junginger, 2008). Understanding organisational change is one of the great endeavours of many scholars and practitioners in the field of organisational design. As explained in the introduction, a proposition to understand organisational change by looking at organisational routines (Becker, 2005). Earlier work on routines emphasized their role as a source of stability, but research argued through empirical studies that routines evolve over time (Deken, Carlile, et al., 2016). Routines are generative systems that produce, recognizable patterns of interdependent actions carried out by multiple actors (Feldman & Pentland, 2003). And they developed a distinction between behavioural and cognitive aspects of the routine, known as the performative and ostensive aspects. Performative aspects are patterns of actual performances of specific actors and ostensive aspects are abstract patterns of narrative description of how to do a certain task, see Figure 2-5. Meaning that the ability for an actor to describe a routine is related to the ostensive and thus the ability to actually perform the routine is enabled by the ostensive. By performing the routine an actor builds and creates the ostensive to be able to repeat the performance. As mentioned in the introduction, there is a difference between "dead" and "live" routines. Dead routines are artefacts, they are rigid, mindless, and can be explicitly stored. Live routines are generative, performing the routine gives rise to learning which gives rise to new actions, or patterns of actions.

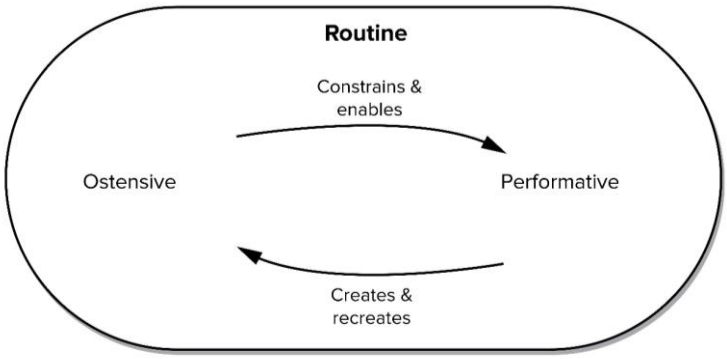


Figure 2-5 Routine consists of ostensive and performative aspects

The use of experimental and reflective spaces

Bucher and Langley (2016) argue that the notion of "spaces" can be particularly useful in understanding trajectories of intentional change in routines. They define spaces as bounded social settings in which interaction among actors are organised in distinctive ways and are characterized by social, physical, temporal, and symbolic boundaries (Bucher & Langley, 2016). There are two types of spaces where actors can deliberate put efforts to change both performative and ostensive aspects of a new routine: Reflective space and experimental space.

Reflective space

The use of reflective space are mainly activities to reflect on past experience and the current routines. In order to find new ways of working, people need to be able to take a step back to find new ways of working, reflective talk helps to achieve this (Dittrich, Guérard, et al., 2016). Reflective spaces involve actors who are maybe no usually involved in the routine to mix people and make new connections (social boundary). They are often physically distant from where routine actors normally perform the routine (physical boundary). And they need a clear beginning and ending regarding to duration, like two hours (temporal boundaries). Reflective spaces should also be marked by a label like exploration workshop (symbolic boundary)

(Dittrich, Guérard, et al., 2016) studied the role of collective reflection to change a routine and they discovered three aspects of talk that support collective reflection. When reflecting, talk supports the process of routine change by (1) name the problem or opportunity regarding to specific actions both ostensive as performative aspects, (2) explore and suggest alternatives in the enactment of the routine in the performative aspect without performing them yet, (3) evaluate and question the suggested courses of action.

Experimental space

Experimental spaces are used to bring the routine actors back into their normal workspace and safely experiment within the boundaries of their work (Bucher & Langley, 2016). Experimental spaces are related to the organisation and not physically distant from the routine subject to change. Experimental spaces are therefore related to the performance aspect of the routine, while reflective spaces are more related to the ostensive. It includes the actual actors of the routine to be as realistic as possible (social boundary) and are enacted whenever the overall routine is enacted. The interactions in the experimental spaces are of course experimental, and are suitable to test, and make iterations on the envisioned routine while performing. Experimental space also uses symbolic boundaries to be separated from its surrounding *(symbolic boundary*), just like in reflective space this can be created by labelling a workshop with "exploration workshop" . These labels indicate that the actions performed and the interactions in the experimental space are reversible, and thus are only temporally (temporal boundary). While reflective spaces are associated with the generation of new variations or ostensive patterns, experimental spaces are where "real change" in performances is seeded (Bucher & Langley, 2016).

Linking spaces to reflection

The two concepts of reflective and experimental spaces by Bucher and Langley (2016) are linked to theory of Schon (1983). He distinguishes two types of reflection: reflection-on-action and reflection-in-action. Reflection-on-action is reflecting and thinking after doing, trying to change or influence future situation and reflection-in-action is reflecting or thinking while doing and make changes in the current situation. Reflection-on-action is mostly conducted after projects are finished and reflection-in-action is mostly done intuitively, when problems occur, and they need to be solved quickly. Reflective spaces are therefore more related to reflection-on-action and experimental space to reflection-in-action. Because in reflective spaces helps to detach the routine actors from their daily work and reflect on those actions, while experimental spaces help to reflect while performing the actual routine and make changes while performing in a safe and realistic environment. Experimental space therefore is important while implementing the envisioned routine to enable the routine actors to make desirable changes while acting. But also, reflective space is useful to reflect and evaluate the old routine to make changes in the new routine.

Role playing to create experimental and reflective space

According to IDEO, role playing is a vital tool and can be used during different stages of the design process. Role playing is the practise of group physical and spatial pretend where individuals deliberately assume a character role in a constructed scene with, or without props (Simsarian, 2003). One of the key differentiating aspect of role playing is creating a 'being in the moment' for the characters, that is an individual and group state that enables vivid and focused exploration of the situation. In other words, The process of role playing entwines around the ideas of imagining and performing by pulling people out of their mundane roles, conventional ways of thinking and behaving and exploration of the possibilities and boundaries of their 'character role' in the choses situation becomes possible (Diaz, 2009), without being constrained by their fear of judgement of their 'mundane role' because role playing is asking the participants to fulfil a role that is only exists within the experimental space. By giving the participants predefined character roles, with desired performative behaviour during the experiment, the designer is able to create a space that encourages the participants to experiment safely within the situation. Roleplaying can be used to give routine actors specific roles to enable the reflective and experimental spaces.

2.4 Main literature insights

To conclude this chapter, I give an overview of the main insights derived from the literature. The insights are sorted by how they are going to be used throughout the project. Furthermore, I present a conceptual framework of how the literature relates to each other and to the main research and sub-research questions.

Required mature capabilities

In order to develop a mature organisational radical innovation capability, actors within the organisation need to develop the following three capabilities which are conceptualized in the "discovery-incubation-acceleration framework". Distinctive types of expertise and routines are needed per capability. The project scope for this thesis is the front end of radical innovation, therefore during phase 1 of the routine design strategy I only conduct research activities regarding to the first two "discovery" and "incubation" to discover the needs and challenges of the routine actors within Barco. At the end of phase 1 I define the solution space, which means scoping down the current project scope, on which capability I focus to develop for the rest of the project.

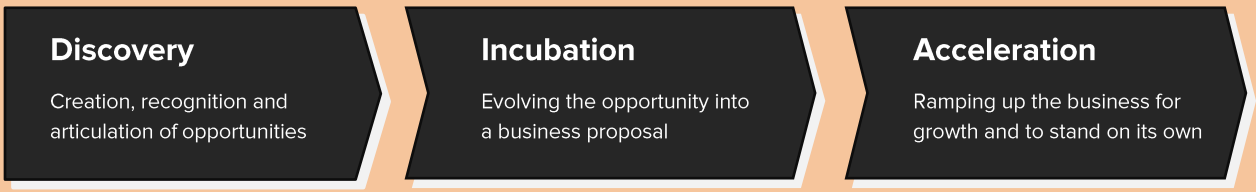


Figure 2-6 discovery - incubation - acceleration framework

Approach to move knowledge across boundaries

Most innovation happens at the boundaries between specialisations (Carlile, 2002). Barco is a technology firm that researches technologies, develops products and sales them within their markets. This asks for different domains of expertise and specialisations per phase of the radical innovation process. Working across these specialisations enables innovation but is also a challenge because of the possible knowledge or political boundary between technology and business people. There are three approaches for the three different levels of boundaries to move knowledge across a boundary: syntactic approach, semantic approach, or pragmatic approach. I will use this framework to identify these boundaries and include the approaches in phase 2 and 3 to move knowledge across these boundaries.

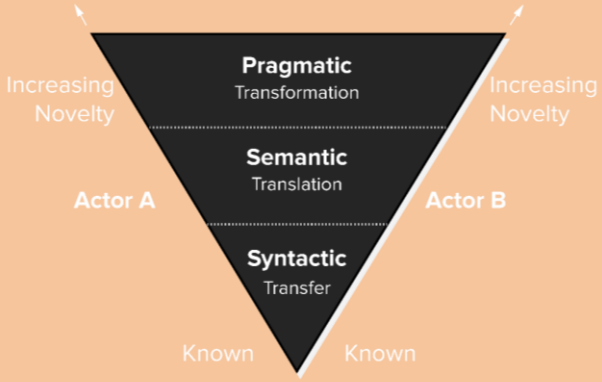


Figure 2-7 Framework for managing knowledge across boundaries

Three-step approach for decision-making

In line with Feldman & Pentland (2008) routine design guidelines, I should not only focus on the choices that are made but on the design points prior the choice. In order to make well-considered decisions in uncertain circumstances managers need to go through all three steps described by Simon (1947): intelligence, design and choice.

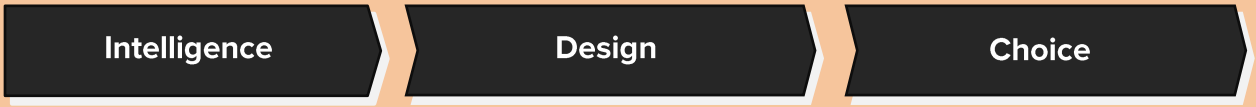


Figure 2-8 Three-step decision making (Simon, 1947)

Use of reflective and experimental spaces

Reflective and experimental spaces are useful means for reflection-on-action, reflection-in-action. Reflection-on-action set by reflective space will be used because it helps routine actors to think and evaluate their actions in the past to make changes in future situations, this helps in changing their current routine. Reflection-in-action set by experimental space will be used because it helps the routine actors to think while performing the routine and reflect on it while in action. This helps to make desirable changes in the routine, and this stimulates routine actors designing their own routines. To be able to set all the boundaries for these spaces, roleplaying is a tool to use to set the reflective mindset of the routine actors.

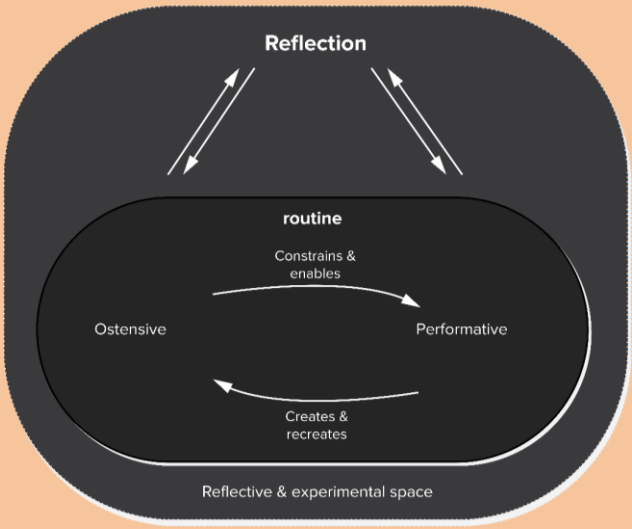


Figure 2-9 reflective and experimental space used to reflect on ostensive and performative

Chapter 3 | Discover

The third chapter describes phase 1 of the routine design strategy: emphasize with routine actors. Therefore, this chapter is all about problem finding and creates insights to be able to define the solution space and design brief in the next chapter. The chapter opens with describing the research design of routine design strategy phase 1 and introduces the two sub-research questions. The rest of the chapter contains an extensive research that identifies how radical innovation currently is organised in the front end of the process within Barco and what are the main challenges.

Chapter 3 | Discover

3.1 Routine design strategy | phase 1

The goal of the first phase of the routine design strategy is to emphasize with the routine actors and discover the needs, interest, alternatives and challenges the routine actors face in their efforts to innovate radically. To discover them, I have to focus on the design points rather than decision points and the relationships between events and actions. The approach I took is described in detail in next section 3.2 Research design.

Also, in order to start performing the new designed routine in phase 3, seen my authority position within the organisation I need to build a foundation and credibility with the potential routine actors. A former graduate design student did not succeed to perform a developed framework around foresight. The actors said that the timing was not right and was perceived as a too unknown area. It seemed that the framework was too radical and therefore seen as a heavy burden, this resulted that nobody was available to join the workshops. From the beginning, this was an important learning for me. In my project to be able to perform the routine with the actual routine actors in phase 3 I have to "hook" key routine actors and keep them hooked throughout the project. This starts in phase 1 of the design strategy with the approach for interviews, meeting observations and prioritization sessions with routine actors.

3.2 Research design

The goal of this project is to design a routine in the front end of the radical innovation process. In order to know what to design I first need to discover where the solution space is located within the front end of the process. Therefore, I conducted an in-depth qualitative research to understand Barco's radical innovation efforts and to discover challenges they face in those efforts. In order to guide this part of the research, the previous mentioned two sub-goals are formulated in two sub research questions:

1. **How is radical innovation currently organised in the front end of the process within Barco?**
2. **What are the challenges in the front end for radical innovation within Barco?**

For this research I used a single-case study approach. According to Yin (2009) case studies investigate a contemporary phenomenon within its real-life context. Moreover, case studies are trying to attribute causal relationships and are not just describing a situation. This approach is particularly useful because I attempt to discover a relationship between a phenomenon and the context in which it is occurring (Gray, 2014). As McCutcheon and Meredith (1993) argue, case studies are a powerful tool for gathering information and understanding the real conditions that are occurring in organisations.

In order to subtract radical innovation efforts and the challenges, I choose to focus on failed radical innovation projects in the past. Therefore, the focus during research methods was on actual activities and events that took place, design points and the results of these design points. This way, the collected data is empirically grounded. Collected data consisting of "ideal situations", "dream scenario's" and "future solutions" were excluded from the data analysis.

To create an in-depth understanding of Barco's radical innovation challenges, I collected detailed data from two recent radical innovation failures. With choosing two "recent" failures I ensured, as much as possible, that managers and other employees who were involved in these projects could be interviewed, internal documents were still available, and the experiences are still "fresh" in memory of the participants. To overcome participant bias (also known as subject bias), I used multiple data collection methods from a wide variety of sources. I defined failures as projects that had an initial investment in time, money and other resources but did not made it into new product development. Therefore, I used the following criteria to assess and compare different project failures: initial project investment, project duration, recency and company recourses involvement. During multiple conversations with managers throughout the organisation, the following failures were chosen:

1. Display technology L
2. Display technology R

The research design is visualized and located in Figure 3-1.

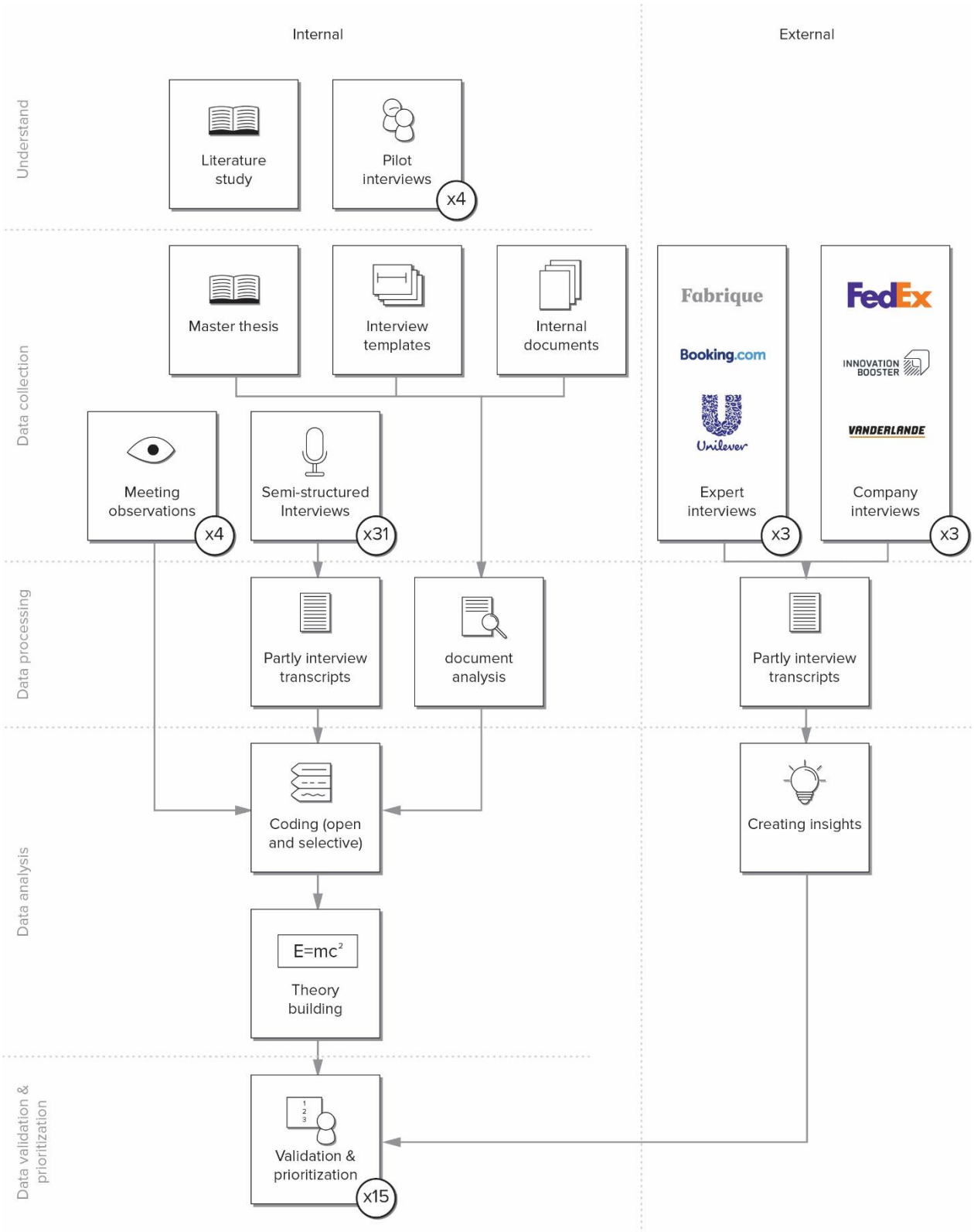


Figure 3-1 Research design

3.2.1 Methods

First, four pilot interviews were conducted to refine the interview guide. In the research, I conducted semi-structured interviews to answer both sub research questions. This approach of collecting qualitative data with semi-structured interviews provided me to word questions spontaneously, and to establish a conversational interview but within the focus of a particular subject that has been predetermined upfront (Patton, 2002). Interviews that remain fairly conversational and situational have the advantage of gathering rich stories about participants' efforts, struggles and failures. In total I conducted 30 semi-structured interviews, ranged in duration from 45 to 75 minutes.

The interview guide ensured that the same topics of inquiry would be pursued, while enabling myself to examine radical innovation management topics of interest with each of the interviewed employee in breadth and in depth (Patton, 2002). See Appendix A for the interview guide. Next to that, during the interviews paper templates of the processes were used to visualize and answer the questions. These templates help to capture and visualize these complex situations and are part of generative research (Sanders & Stappers, 2012). The templates were used as input for the results of this research, see 0 for the interview template.

For the selection of the participants I used an expert sampling technique. This technique entails selecting individuals with more knowledge on a specific topic and is known to be useful in exploratory research (Miles, Huberman, et al., 2013). The sample selection came from four different departments; Technology centre, Entertainment, Enterprise and Healthcare. Nine selected participants came from the Technology centre, a sample from this department was considered useful since the focus of this discipline is on radical innovation rather than incremental. The other twenty-two selected participants came from the three main business divisions, a sample mix of marketing managers, product managers, R&D managers and business unit VP's were chosen since these managers have the role and responsibility to collectively develop new products. Moreover, they interact and collaborate with the managers from the technology centre in the front end of the of the radical innovation process. Many of the participants were part of failed innovation projects, logically they were able to provide detailed information from their point of view on what happened during these projects. See an overview of the case study participants in Table 3-1.

The second source of data collection was non-participant meeting observation. Due to scarcity of current running radical innovation projects, it was not possible to avoid departmental and meeting bias. Therefore, since there is little variation in the observation sampling the validity of the collected data during these observations is considered marginal. Three meeting observations were conducted; two stage gate meetings and one strategic escalation meeting.

The third source of data were internal documents. In the interview e-mail invitation, participants were asked to bring materials used during failed or succeeded projects e.g. stage-gate slide-decks, idea explanation two-pagers, or project charts. When no materials were brought to the interview it was asked to provide them afterwards. Documents that were provided by interviewees where marked as validated. Other internal documents obtained from internal communication network; 'Barco zone' and 'SharePoint', were checked upon validity with interview participants and company mentor.

Case study participants

	Total interviews	VP's (Victor)	Technology managers (Teo)	Product managers (Patrick)	Marketing managers (Marion)	R&D managers (Rick)
Technology Centre	9	2	7			
Business Unit	22	5		6	5	6

Table 3-1 Case study participants

3.2.2 Data Analysis

The visualizations captured on the interview templates were used to find relationships between the environment, organisation, individual, process and idea. These insights were used to answer both research questions.

Partial transcripts from interviews, summarized insights from observations, insights from obtained and selected internal documents served as a basis for the data analysis. These transcripts can be found in Appendix C. Quotes from the partial transcripts and the summarized insights were extracted and printed on paper. The requirement to be extracted from the data was if the quote described an activity, key decision moment, routines or an event that took place. As mentioned earlier, dreams, visions and ideal situations to foster radical innovations were omitted in this part of the research, these insights will be used as input in the ideation phase later on.

The underlying logic of the research presented here is grounded theory building, which involves inducting insights from field-based, case data. Grounded theory-building approach is generating novel and accurate insights into the phenomenon under study (Glaser & Straus, 1967). The data was analysed in a paragraph by paragraph open coding approach (Saldaña, 2012). During the coding of the transcripts and the insights, the concept of constant comparison was applied. Meaning that as new codes emerged, they were checked against existing codes to either form new codes or adjust the previous ones (Birks & Mills, 2015). In parallel, selective coding was used to categorize the open codes into a coherent structure (Saldaña, 2012).

In order to answer the prior mentioned research questions the interviews, meeting observations and internal documents transcripts and codes will be analysed using spontaneous clustering and was conducted twice. To create an overview and gain first insights to check on data gaps, the first spontaneous clustering was conducted halfway through the interviews. The following two insights about the data resulted in additional expert sampling; some clusters contained little data, next to that multiple questions could not be answered during the interviews. More expert sampling was need in the following areas; product management, strategic marketing and R&D management. The second spontaneous clustering was conducted after the last interview and the coded transcripts were summarized into a set of sub challenges that served as a base for the data validation. The result from both analysis and validation can be read in full in section 2.4 Results.

3.2.3 Data Validation

In order to improve reliability and viability of the results, data validation was performed. As mentioned before, for clarity reasons, only the challenges were used in this exercise. The challenges were presented to Barco employees on challenge cards. These cards contained a title, a short subscription and to not lose its origin and uniqueness, a quote from the data was located on the back of these cards. The validation challenge cards are located in Appendix D. A technique named ‘sequencing’ was used to plot the challenges along two dimensions (Heijene & Van der Meer, 2019). The chosen dimension on the vertical axis was as follows; major block vs. minor blocker. A major blocker entails challenges that occurred frequently and has high (negative) impact on the project. Minor blocker entails the opposite, challenges that occurs infrequently and has low (negative) impact on the project. On the horizontal axis Barco’s innovation process is stated.

Representative sampling was used to recruit participants for the exercise. A total of 15 participants were used for validation of the challenges, varying in roles and positions. See Appendix E for the list of participants. In order to ensure representative sampling, potential participants were screened based on their role and position via an internal ‘who is who’ platform to check if they were part of the innovation landscape within Barco.

Each participant was asked to plot the challenge cards on the template that was provided for them, to create a first overview of clusters. The challenge cards were given in a randomized order and the participants was given the option to leave out challenges. Next to that, the participants were handed empty cards to fill in if they were missing challenges based on their experiences. This way, it was checked if there were gaps in the findings. After the exercise a picture was taken for later reference.

During the exercise, I noted comments and questions from the participants which were used later to reframe the sub-challenges and challenge areas. All the results were collected into an excel sheet for analysis. If more than half did not recognize a certain challenge, meaning that a challenge was left out, it was removed from the findings. Challenges that were added by participants were checked against existing challenges and if it could be part of an already existing challenge. If there was no fit, a new challenge was created based in its impact level and relation to the topic of the research. See Appendix F for the validation results.

The researcher conducted a final re-clustering to make sure all the cards in the respective clusters and groups fit

to the other cards. Some clusters with clear overlap or splits between the cards where either split or merged where this was suitable and applicable.

To verify the results 6 external expert interviews were conducted to improve validity. The results of these interviews are used in the discussion of the findings at the end of this chapter and are located in Appendix G. Next to external interviews, in order to improve validity of the findings, two thesis reports that focused on the innovation management efforts and challenges within Barco were checked. These reports served as a check whether to validate common findings or to discover gaps in this research findings, see Appendix H for these insights.

See Figure 3-2 for a snapshot from one of the conducted validation and prioritization sessions.

Figure 3-2 Participant during data validation session

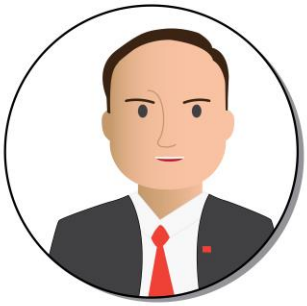
This single case study has two sub-research questions. Therefore, the insights that emerged from the data is divided in two separate sections to answer both questions. In the first section I describe how radical innovation currently is organised in the front end of the process and in the second section I describe the main challenges they face in their efforts.

3.3 How is radical innovation currently organised in the front end of the process within Barco?

In these sections I describe the findings that emerged from the study to understand how radical innovation is organised in the front end. I found four key findings. First, I created personas who represent the key managers that have an important role and responsibility in the radical innovation process. Second, I found that many different terminologies are used to label innovation projects. Third, the organisational structure shows that radical innovation is a shared responsibility between Teo and business managers. Fourth, the front end knows three phases: ideation, new technology introduction and new product development. The last two are well defined processes, however for ideation there is no formal process to create radical innovation ideas.

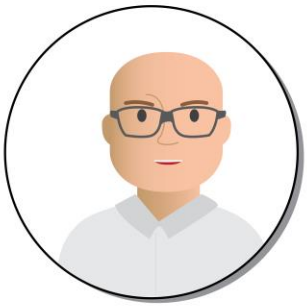
Roles and responsibilities

Radical innovation within Barco knows many stakeholders, the organisation consists out of different departments and teams who have different tasks and responsibilities regarding to the process. The following section describes the main personas of key managers that are involved. These personas are based on all conversations, observations, interviews conducted throughout the project and an analysis of interviewed people and their LinkedIn profiles. The personas can be found in in Figure 3-3, Figure 3-4, and Figure 3-5 on the following three pages.



Name:	Charlie	Years at Barco:	4
Role:	CEO	Age:	45
Department:	Core Leadership Team		
Education:	Engineering		
Experience:	Supply chain, Corporate director		

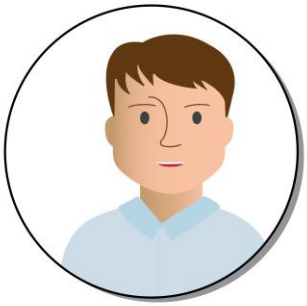
This is Charlie, 45 years old and the current CEO of Barco. Before becoming the CEO he was already CEO global performance of a large multinational called General Electric. There he was responsible for the change management programs. When Charlie became CEO of Barco 4 years ago, the organisation was looking for a man with experience in change management and a strategy to bring Barco back in the BEL 20. BEL 20 is the benchmark stock market index of Euronext Brussels. He entered Barco with a clear mission in mind: Improve the operational excellence of the organisation. Together with the Core Leadership Team he developed a program "Fit to Lead" which focusses to improve the performances of the organisation. The vision they created: Innovation that matters, also resonates with that program. And indeed last year March Barco re-entered the BEL 20. In his free time he likes to do winter sports with his family or ride on his motor with friends in the weekends.



Name:	Teo	Years at Barco:	34
Role:	Technology scout manager	Age:	54
Department:	Technology centre		
Education:	Optics Engineering, PhD		
Experience:	Research Optics Engineer		

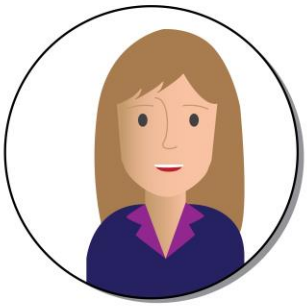
Meet Teo, a 54-year-old experienced Barco researcher. After his PhD in optics, he started working as R&D hardware engineer at Sony and after 10 years he joined Barco as hardware developer in Technology centre. Technology Centre is a research group and works cross-divisional on technologies that are typically 2-5 years on the roadmap. Their mission is to decrease technological uncertainties. After a research project, the technological proof of concept is handed over to a business unit to start new product development for commercialization. After some years he became R&D director and gained more knowledge about optics, mechanics and electronics engineering. In 2010 he became manager of technology centre, which means he is now responsible for scouting and introducing new emerging technologies in the businesses. His activities to scout new emerging technology consists of reading articles, papers, trips to suppliers, universities and many conversations with fellow technology researchers. Due to years of experience, he is able to assess and envision the impact of an emerging technology. In order to introduce these new technologies, he meets with divisional product managers to explore potential project opportunities. But does not always succeed in convincing them to sponsor a project. He weekly meets with the Chief Technology Officer to talk about progression and challenges he and his team faces. Next to that, whenever he can he will join the stage-gate and project status meetings of current running radical innovation projects. In his free time, he likes to design cars on with high performing GPU and CPU capabilities to render high quality images.

Figure 3-3 Personas: CEO Charlie and Technology manager Teo



Name:	Patrick	Years at Barco:	15
Role:	Product manager	Age:	36
Department:	Business unit		
Education:	Business Engineering		
Experience:	Boston Consulting Group		

Meet Patrick, he is 36 years old and works at Barco within a business unit as product manager. He studied business engineering and has exprience as project leader at Boston Consulting Group. In his role as product manager he defines product strategies within his markets. He is responsible for Barco's product portfolio within his market therefore also responsible to start new product developments based on user insights and has end-to-end ownership of a product; from development to introduction, and from maintaining untill retirement. He is accountable for creating and maintaining the business case and assures the market introduction of the product. He is the key integrator within the organisation regarding to new products by managing that technologies are transformed into products that customers want. Therefore, he works closely with marketeers like Marion because she provides him with market needs and customer insights strategies. Together the define new value propositions for the market. Most of his time he spends on executing the strategic plan and which is captured in targets in the profit plan. He makes sure that the targets are met, the product sells, and customer problems are fixed.



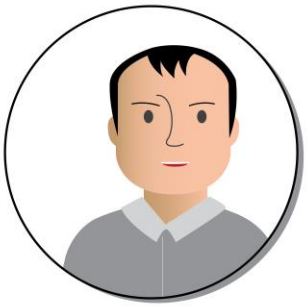
Name:	Marion	Years at Barco:	9
Role:	Marketing manager	Age:	31
Department:	Business unit		
Education:	Business Engineering		
Experience:	Brand manager		

Meet Marion, 31 years old and working 9 years at Barco. Studied business engineering and in the last couple of years also followed extra business administration courses at a local business school. After two years of experience as sales engineer at Philips she started as brand manager at Barco within the Click-Share business unit. Currently, as marketeer she is responsible for bringing outside-in market insights and uses these insights to develop strategies together with Patrick for their business unit. These strategies are based on a profound understanding of customer needs, market trends and competitive landscape. She is responsible for data-driven customer segmentation and building value propositions across the complete product offering. Also, she maintains strong relationships with key customers, regional marketers, product management, and regional sales teams. Normally she becomes involved in radical innovation projects when there is already a technical proof of concept developed by Teo. It is her responsibility to validate if this concept could be a value proposition for her market before entering new product development in the business unit.

Figure 3-4 Personas: Product manager Patrick and Marketing manager Marion

Name:	Victor	Years at Barco:	24
Role:	Vice President	Age:	44
Department:	Business unit		
Education:	Electronics		
Experience:	R&D manager, Product manager		

This is Victor, already working 24 years at Barco and is at an age of 44. He started at Barco as electronic design engineer and became after 7 years project leader during new product development projects. Before he became VP of that business unit, he had for 7 years the role as R&D manager and was 5 years product development director of business. Now he is responsible for the overall success of his business unit. He is very pragmatic and demands his employees to meet their targets. He has the overall responsible for sales, business development, key account and channel management for the entire business unit. Every month he meets with the CEO to discusses the progression and risks. Outside of work, Victor is very busy with his wife, three children and cycling. He has a master in electronic engineering.



Name:	Rick	Years at Barco:	14
Role:	R&D manager	Age:	41
Department:	Business unit		
Education:	Mechanical Engineering		
Experience:	Senior mechanical expert		

Rick is a 41-year-old R&D director. He has a technical background in electronics engineering and started as hardware developer within the business. He is mainly undertaking activities with his R&D team regarding to the new product development process. This entails achieving agreed project KPI targets (schedule, cost, quality) and ensuring the design within the given specifications and meeting the desired outputs. He develops detailed R&D project plans and make sure his team meets the targets. He is involved in the business handover to make sure the technology could be translated into a design that meets all the market and production quality, dimensions and safety requirements. In his free time, he likes to build his own cars, motors and other vehicles. On Sunday's he plays football with his friends and it is his day of the week to prepare diner for the family.

Figure 3-5 Personas: Vice President Victor and R&D manager Rick

Definition of radical innovation

All managers define their innovation efforts with the three-horizon model. They use its terminology; however, the terms are mostly expressed in time frames, which reflects the difference in 'short-term' and 'long-term' innovations. Incremental, horizon 1 innovations are considered 'short-term', where radical, horizon 3 emphasize 'long-term' innovation. The difference between the three horizons is within the timeframe, the duration of horizon 1 innovation is one year, duration of horizon 2 is two to three year and horizon 3 is three or more year. See Table 3-2 for an example.

Many labels and definitions are given towards their projects: incremental, radical, disruptive, short-term or long-term and horizon 1, 2 or 3. These managers approach innovation in different ways, Marion perceives innovation from the perspective of the market, Teo sees it more from a technical point of view, and Patrick sees it from a customer problem and solution point of view. I do not argue that these different perspectives of innovation are challenging radical innovation, however without a shared understanding of what it means for their organisation, this it is not fostering radical innovation either.

Horizon	Duration (years)	Example
Horizon 1	1	Adding features, reduce costs of or improve sustainability of current projectors in cinema
Horizon 2	2-3	HDR projection, a technology that enables the projector to steer pixels to a specific location on the screen to improve brightness and contrast.
Horizon 3	3+	LED technology in cinema

Table 3-2 Horizons with example

Organisational structure

Radical innovation is not centralized or does have a specific location within the organisation. However, Teo researches new technologies that could be radical new products on the long-term for the business units. Teo works cross-divisional on technologies that are typically 3+ years on the roadmap. Recent years, Patrick is involved in the project and after project completion the technology is handed over to the business unit for new product development. New product development takes place within the R&D's of the business units and are managed by Rick. These teams follow a new product development process to develop product updates, new features or new product releases. See Figure 3-6 for the organisational structure.

Within the organisation Teo scouts new emerging technologies that could impact the businesses of Patrick and Marion. He discusses these technologies with fellow researcher of the technology centre if there is potential value for the business units. With his deep technology knowledge, Teo is always in pursuit to start new radical innovation projects, since this it is his role and responsibility to introduce new technologies within the business units. However, it is not his responsibility to develop new products for the businesses, Teo in that sense does not have to be profitable and is seen as investment in knowledge and a pre stage-gate process prior the new product development process in the business unit.

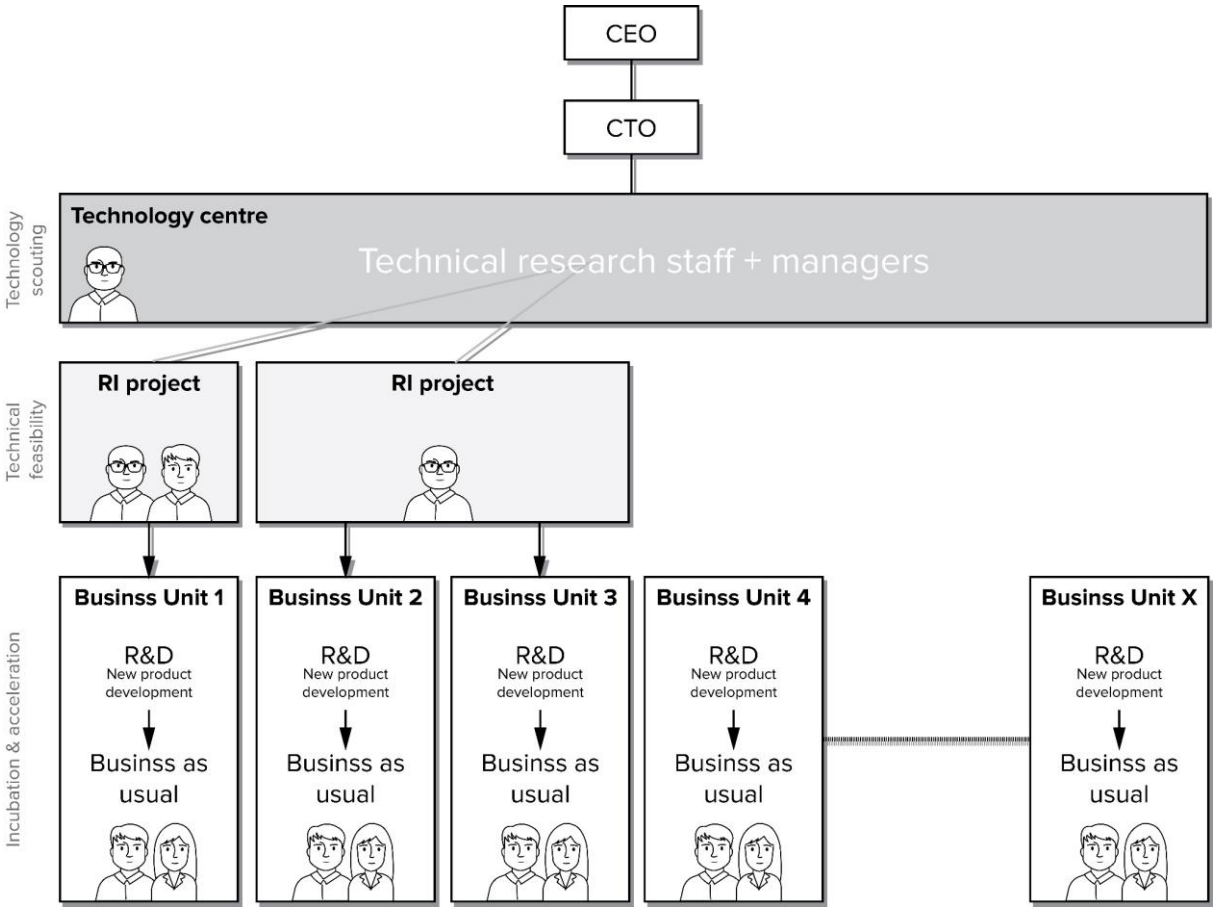


Figure 3-6 Organisational structure

Processes

In order to manage innovation, two different processes are used. Depending on the uncertainty and maturity of a technology, one of the two processes is used. Both processes follow a Stage-Gate approach, a management process that is widely used in the field by practitioners in other organisations (Cooper, 2010). In the following section I will describe new technology introduction and new product development.

New Technology Introduction

The New Technology Introduction (NTI) is a management process for research and technology de-risking projects and is used by Teo. The goal of the process is providing a framework to support and de-risk the evolution of an idea into a technical proof of concept. This management process is used when a new technology is too immature to start new product development. De-risking is widely used term within the organisation, it is rather an indication that research is needed to predict the possibilities and opportunities for the technology in dispute, than a strict methodology or process. See Figure 3-7 for an overview of this process.

Ideas for the technical proof of concept are evaluated in the 'research phase' and a basic technology is developed. Also, in the research phase a detailed description is made of what the final deliverables of the research project need to be in order to start new product development. The 'delivery phase' focuses on preparing a demonstrator or technical proof of concept. At the end of the delivery phase it is verified if all project deliverables (such as prototypes, documentation, training sessions) have been finished. Once this final gate has been passed the technology should be able to be integrated in a product and should follow the new product development process.

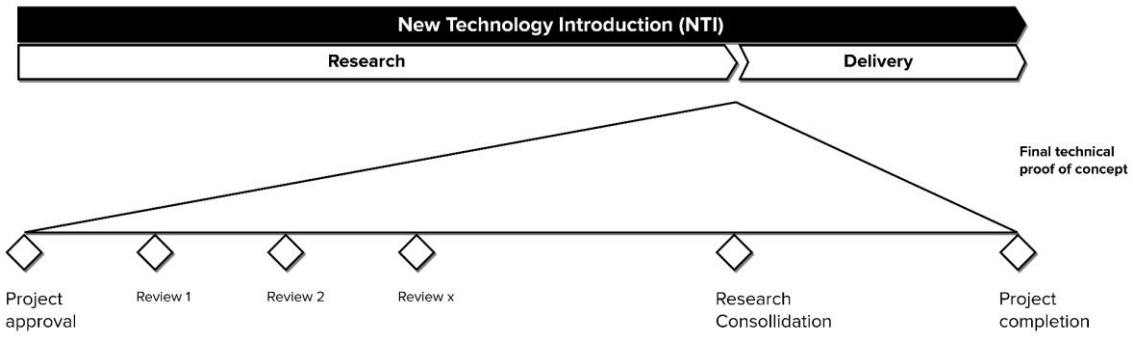


Figure 3-7 New technology introduction process

New Product Development

New product development is a management process to realize a product in a controlled way. The process is organised in different stages, each stage is concluded with a stage gate review and allows proceeding to the next stage if the review is approved. See Figure 3-8 for an overview of this stage-gate process.

The stage-gate process starts with a concept validation review, the formalization of the market and design validation to make the formal decision to invest. The deliverables in this stage are: a market and user value analysis, a technical analysis and a cost analysis. The first stage is concept validation stage, and focuses on the business case, resulting in a formal start of the new product development project. The project is defined, and both business and technological issues need to be validated. The project team is defined, and a final Go/No Go decision is made by executive management to kick-off the process. The second stage is preliminary design, where technological solutions and their risks together with the project development schedule and resources are defined. A detailed product definition is developed with final customer and product requirements. The third stage is about prototyping alpha and beta series, first it evaluates whether the alpha prototype meets the functional specifications and provides confidence towards all qualifications. Next to the requirements fulfilment, beta series provide proof that the organisation will be able to build, market and service the product. The fourth stage verifies and validates the technical solution against customer requirements and expectations. Supply chain, testing and manufacturing processes are being finalized, zero-series are being build. Based on the confidence in the project's remaining timeline towards the final review, the product's market introduction will be announced. During the last stage commercial deployment will start and thus the product will be available for customers.

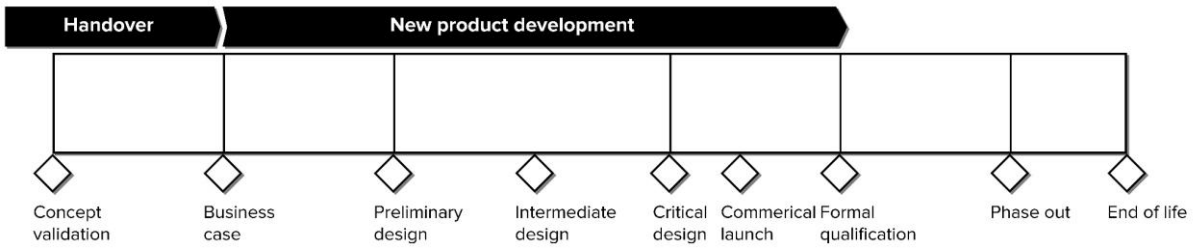


Figure 3-8 New product development process

Conclusion

In attempting to understand how radical innovation is organised in the front end, I found four key findings. First, the key stakeholders within the organisation with regards to radical innovation are CEO Charlie and the following manager from the technology centre: Teo as technology manager, and the following managers from the business units: Patrick as product manager, Marion as marketing manager, Victor as vice president and Rick as R&D manager. Seen their role in the decision-making process they are key in the front end of radical innovation.

Second, the managers use the "three-horizon model" to indicate different innovation projects. Radical innovation is seen as horizon 3, however there are many different terminologies used to label different innovation projects.

Third, the organisational structure shows that radical innovation is a shared responsibility between Teo and the managers from the business units, mainly Patrick and Marion. Teo is responsible for scouting new emerging technologies that could impact their business unit, but he is only allowed to research the technology up to a technical proof of concept, actual new product development is located in the R&D's of the business units. However, they need to collaborate to develop radical new products because both technological expertise and market or customer expertise is needed.

Fourth, the front end of radical innovation knows three phases: ideation, new technology introduction, the early stages of new product development. Little data could be captured of the ideation phase. The business managers ideate only once a year during the creation of a strategic portfolio plan. There is no formal ideation process in place to support Teo and the other managers in their collective ideation efforts. The new technology introduction is a process that precedes new product development when a new technology is still immature, and the uncertainties are too high to start product development.

3.4 Main challenges to radical innovation in the front end

In attempting to understand the challenges Teo, Patrick and Marion face I found four key findings. First, the strategy set by the CEO, and executed by senior managers result in mostly incremental innovation efforts by Patrick, rather than exploring radical innovation opportunities. Second, the responsibility for radical innovation is fragmented throughout the organisation; it is a shared responsibility of Teo and Patrick, Marion. However, they gather intelligence separately and decisions have to be made collectively, however no collective process is in place to support them in the ideation phase to design opportunities. Third, Teo, Patrick and Marion are mixing radical innovation capabilities by using business cases too soon in the process and therefore an opportunity cannot be created towards a mature level to make a well-considered Go/No Go decision. Fourth, between the two different main specialisations (technical managers and business managers) within the organisation there seems to be a knowledge boundary between Teo and Patrick - Marion.

In the following sections I describe these findings that emerged from the data analysis and data validation. From the 31 semi-structured interviews a set of 15 challenges for radical innovation within Barco were identified. Some of them share a great overlap, but this is very common in the development of new theories (Glaser, 1967). During the validation exercise in collaboration with Teo, Patrick, Marion, Victor and Rick these challenges were validated, prioritized and clustered and a total of six challenge areas were found. Individual added challenges during validation fitted in existing challenges and therefore no new ones were created. The following challenge areas were found and presented in priority order: (1) Company vision, strategy and senior leadership, (2) Lack of governance, guidance and support, (3) Knowledge barrier between technology and business, (4) Lack of entrepreneurial resources, (5) Traditional innovation cultural and mindset persistent and (6) Siloed organisation. These six challenges areas covered the total of 15 challenges, and I found a clear top 3 in these six challenge areas, this is visualized in Figure 3-9. For the purpose of clarity only the top 3 challenge area's will be presented and discussed as these challenges were the main findings of the case study as they were prioritized by the research participants as the major blockers for radical innovation. The other three challenges areas are located in Appendix I.

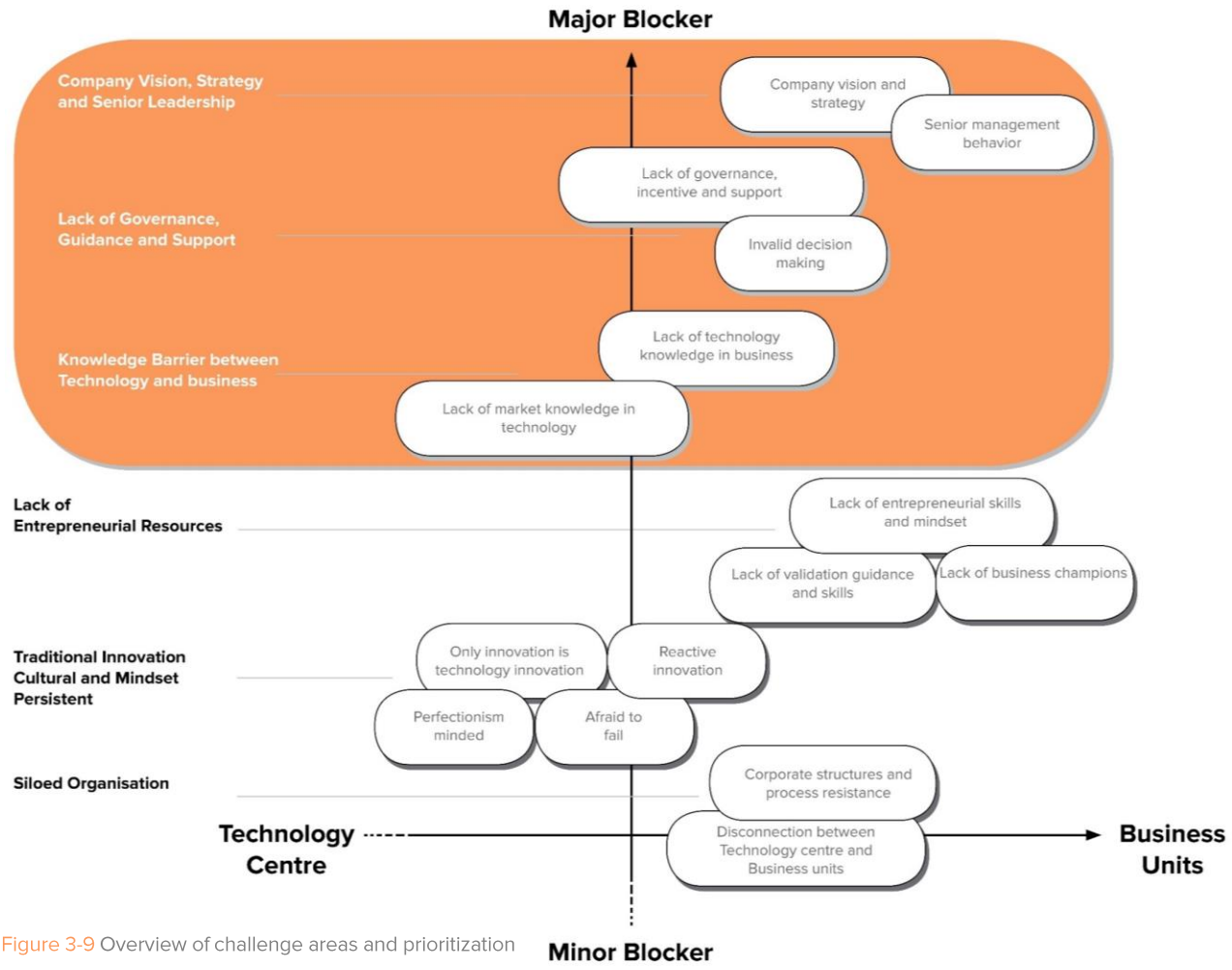


Figure 3-9 Overview of challenge areas and prioritization

3.4.1 Company Vision, Strategy and Senior Leadership

Company vision & strategy

Innovation is in the DNA of Barco for over 85 years. Because of historically successful products, there is proof they master to conceive, design and develop new technologies into desirable products. Barco's mission, set by the CEO, is to enable bright outcomes. Introduced in 2017, to make this into reality they have a strategy build around four strategic pillars: "Lead by innovation", "Focus on performance", "Offer outcome-based solutions", "Go for sustainable impact". Moreover, in 2018 11% of the sales was invested into R&D, which is more than most of their peers in the industry (Barco annual report, 2018). This may seem very promising to foster radical innovation, however almost all participants elaborated that the focus is on improving their operational excellence, which reflects mainly the second strategic pillar; Focus on performance. In the CEO, there is a senior vice president responsible for the 'fit to lead' program, aiming at making Barco a leaner, simpler and more productive organization. The results are there, stock prices are going up and profit margins are increasing.

"Currently there is a big focus on our operational excellence, and this is quite logical seen the background of the current CEO. But yes, there is little room for real innovation at the moment, because there is a big focus on short-term focus and growth of current businesses."

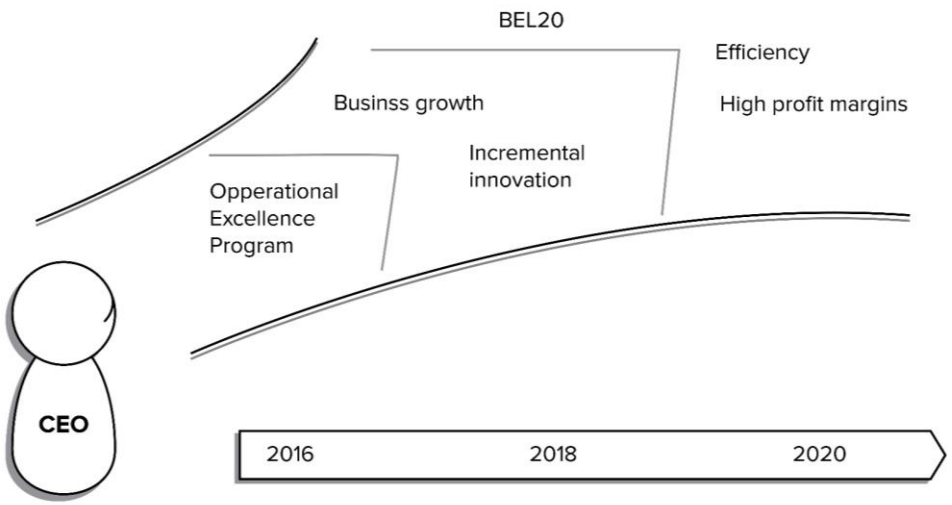
Victor (Participant 18)

During the reorganisation in 2018, there were multiple cuts conducted by the CEO of radical innovation projects, because there was no return investment yet. The CEO heavily invests in growth, efficient business units and thus demanding high revenues and profitable profit and loss statements from the businesses. This led to a forced way of spending most R&D budget to quick wins, low hanging fruit and incremental innovation, rather than starting 'radical' innovation projects.

An interview with the CEO Charlie recognizes this finding (Fernandez Hernando, 2018), while he and his team are responsible for the current overall strategy and execution of the organisation. The CEO observes that the yearly returning strategic marketing plan (SMP) developed by Patrick, Marion, Rick and Victor in the business is too close to the short-term strategy.

"I think our yearly strategic plan still is too close to our short-term strategy. [...] By default everything that is called strategic is already linked to the products that we make. We try to be strategic on top of it, but we never jump far enough. [...] What is the customer problem you are going to solve now, five years from now, ten years from now."

CEO Charlie



(Senior) Management Behaviour

Both Patrick, Marion, Rick and even Victor mentioned, that they struggle to manage their 'long-term' and 'short-term' focus of their own business. Especially how to divide budget, people and other resources between the two. This has led to perceivable frustration among them. They notice that, bottom-up there are many creative, radical ideas ready to explore. However, top-down there is an outspoken message to focus on incremental innovations, meaning that return on investment of a new project should be at max 2 years. This leaves little room for radical exploration. As Patrick puts it:

"Everything we do is incremental, but we never try to do completely different things. We have many ideas, for fundamentally new businesses, new product, new markets. But here, there is no support, no processes to explore these ideas. There are people 'looking into it this struggle', yet we have nothing for it."

Patrick (Participant 7)

And when asking Rick where the responsibility lies for radical innovation he pointed towards senior managers.

[Asking about where lies the responsibility for radical innovation] "At ourselves of course, but the leadership of the division, the VP of the business unit, they are responsible for the profit and loss statement (P&L). If it's not right, we are not meeting the targets, then they change things to improve the P&L. And everybody in the business unit is then drawn into it, the focus of leadership is leading."

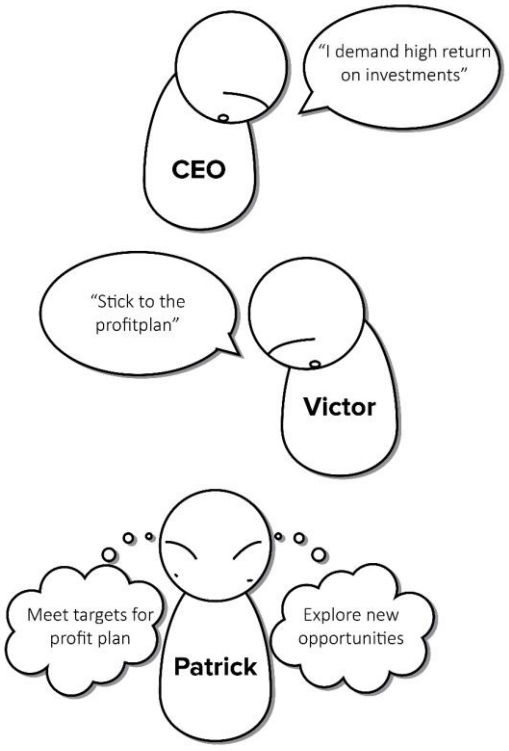
Rick (Participant 12)

Another struggle that was mentioned by Teo is the low involvement from higher management during already running radical innovation projects. I could observe this struggle by my own eyes during two radical innovation stage-gate meetings, where in both meetings only Patrick (and of course Teo) were present. Teo explains that at certain key reviews, there is a lack of involvement and important decision moments cannot be made, because Teo is not responsible to make decisions about desirability. Or stage-gate meetings, have to take place three times, leading to project slowdowns and frustrations.

"I looked very promising. We made concepts of possible solutions, but I cannot make decisions. Higher management sets out the product strategy, the people from the business make these decisions. And they need to provide resources and need to be involved. With this project this involvement decreased over time. Because they had other priorities. We tried to pull the project in the coming gates, but in another business unit there was a clear problem to work on, so I reallocated our resources.

Teo (Participant 3)

To conclude, radical innovation is seen as high risk and incremental innovation results in most cases directly to profits. Therefore, radical projects are avoided and incremental stimulated by senior managers. This current strategy set by the CEO resonates with the symptoms of a restrictive mindset for radical innovation (McDermott & O'Connor, 2002).



3.4.2 Lack of Governance, guidance and Support

Technology push led to project failures

Next to some great and important radical innovations initiated by Teo that resulted in competitive advantages, he had also project failures in the past. An important successful radical innovation developed by him was the transition of using lamps in projectors to start developing laser technology in them. However, within the organisation it is argued to some 4k or 8k laser technology projectors were too advanced for the market yet in that time. But this transition changed the entire cinema and projector market. However, as Teo explains he also received many times negative responses from Patrick and Marion towards new technologies he already started working on.

"We developed a beautiful new technology; we really thought we made improvements on the technological part. Then we tried to "sell" it internally to business people, product managers, but their reaction was: No, this is insufficient value for my market. Or, this is really good, but actually I need something else."

Teo (Participant 11)

Marion observed that she thinks it is odd that Teo develops new technologies while her market is demanding other requirements, she has the feeling the he is not always working on the "right" technologies. As she describes it:

"Sometimes you receive the question from technology centre: We are researching this piece of technology; can you do something with it? The question on itself already makes my eyebrows frown. On the other hand, we see disruptions happening in our market. Then, I have the feeling that we are not working on the right things, or that we don't understand the potential value of the technology enough to see what it could mean for our market."

Marion (Participant 26)

To add to these findings Patrick mentioned that he thinks that too many times Teo received some corporate budget and without collaboration with the businesses they were indeed developing the desired technologies for his or other business units or that he did not any budget to fund the project. As Patrick explains:

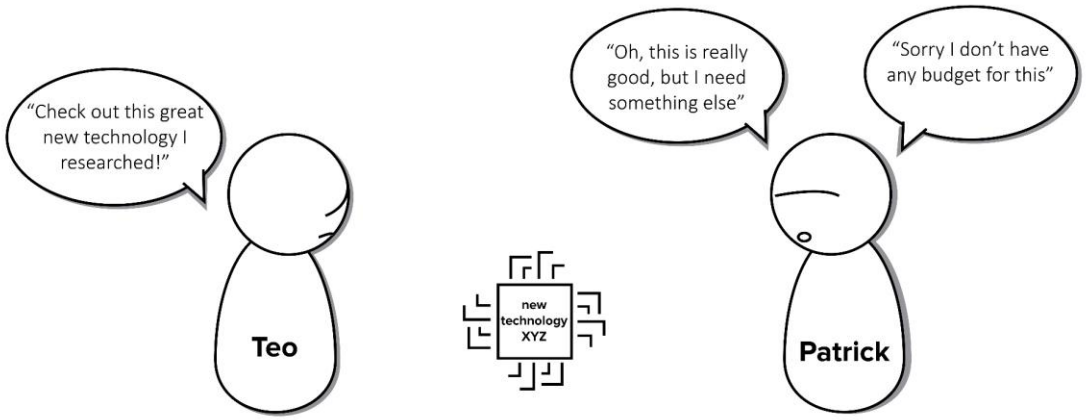
"To many times technology centre received a budget on corporate level to invent and play with their toys, too far away from the businesses. And at a certain point technology centre says: we have something. But then the reaction of the business is: we don't have any budget for this, or they developed not the things we needed. This happened to many times in the past."

Patrick (Participant 11)

To conclude, too many times Teo started innovation from a technological perspective and wanted to push the technology. However, without including Patrick or Marion the market needs were not included. Many technologies were therefore not adopted by a business unit leading to project failure. As Rick puts it:

Before, it was too many times technology push, at which the push was so heavy that market requirements were not validated, causing project failure.

Rick (Participant 25)



Radical innovation responsibility

The responsibility for radical innovation is fragmented throughout the organisation and divided among the two specialisations within the organisation: technology centre (Teo and fellow Teo's) and the business units (Patrick and Marion and fellow Patrick's and Marion's). Due to technology push failures, nowadays you need both specialisations to start new projects in the technology centre. Meaning that Teo needs the involvement of Patrick and Marion and preferable higher management in order to receive project approval to start a new technology introduction project, this way collaborating is ensured with the structure that Teo needs funding from a business unit to start a new project.

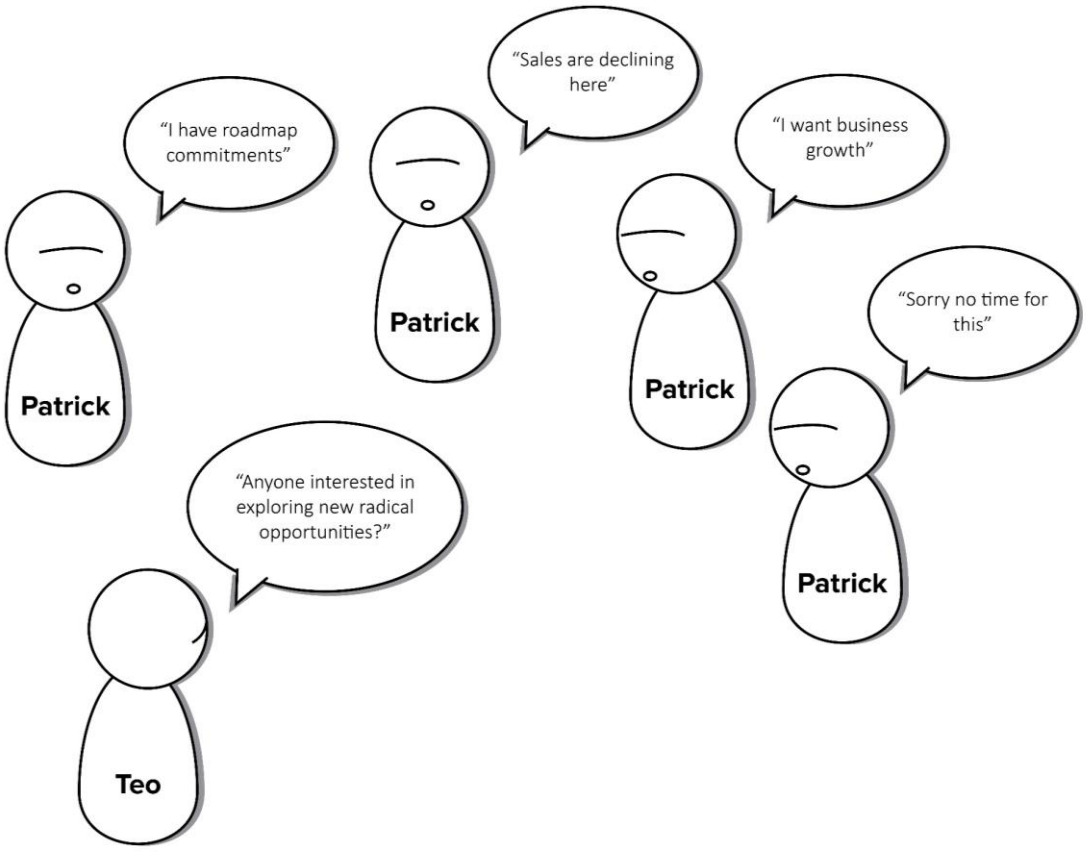
"And in technology centre we create our plan in September. Informal and formal meetings take place, and of course that is also sensing it. Because I can see the potential of a new technology and wanting to push it, that's one thing. But if I don't feel any traction from a business unit, from stakeholders that doors will open and to learn at for example customers, then it is really hard to start a project."

Teo (Participant 3)

And the responsibility for Teo is not to develop a product out of it, he is only responsible for the technical feasibility. While Patricks main focus is on incremental improvements, it can be noted that the mandate for radical innovation is not clearly defined throughout the organisation and a lack of governance arises. Patrick's short-term focus means business growth and delivering product updates in order to meet the business unit profit plan. In the profit plan decisions are made how profit will be earned the coming year, all management decisions are linked back to that plan. Victor explains that their main focus is on the commitments they made on the profit plan and therefore they have to meet their target, which is most important.

"[Asking about why there are few radical innovation projects running] Well our divisional R&D is limited with budget. And they are focused on Horizon 1 products. We have roadmap commitments and we have to deliver them."

Victor (Participant 5)



According to Marion, the moment when it seems that profit plan targets won't be met, "long-term" projects are postponed, and R&D employees will be used for urgent "short-term" product updates or customer problems. When time and resources are scarce, Victor and Patrick also puts pressure on Marion (while she does not have short-term target responsibilities) and demanding her to help achieving quarterly targets.

[Talking about the short-term focus in the division] "So the quarterly sales were declining, and Victor literally asked me to stop my current tasks to help them to develop sales strategies to increase the sales for the coming months. But that is not my responsibility! And if I stop my work, they will have a problem in the next 6 to 12 months"

Marion (Participant 8)

Marion explains that lots of bridges are not made between Teo and the business units because of the fragmented responsibility of radical innovation. As he explains:

Technology centre doesn't have the mandate for radical new products and to sell. They have objectives to develop technologies for the businesses. It happens, but nobody has the mandate. The important thing is that you create incentives and mechanisms, no the new technology introduction process is too detached. Product management is really good in looking what we should do today, but there are too few incentives and trigger to go and look beyond what we do today. Therefore, lots of bridges are not build between technology centre and the businesses.

Marion (Participant 25)

To conclude, the responsibility for radical innovation is fragmented over both technology centre and the business units. In order to receive project approval for high risky projects, Teo needs budget and involvement commitment from Patrick and Marion (and higher management). However, due to their profit plan and roadmap commitments that receives first priority.

Yearly business unit exploration

Within a business unit, Patrick, Marion, Rick and Victor conduct once a year an exercise to create a strategic plan for their product portfolio. The strategic product portfolio plan is a once a year concentrated exercise where they have to force themselves to challenge or to confirm their strategic direction and look beyond todays product portfolio. In terms of what new products should be considered, where could be differentiated and in which market. The deliverable is a final presentation to the CEO to present the plan, in a form of a slid deck, for the coming 3-5 years. Prior to this presentation is a process of multiple meetings and workshops where Patrick, Marion, Rick and Victor develop this plan. Patrick describes the strategic product portfolio plan like this:

Yes, the strategic product portfolio process. That is the only moment of the year that lots of people thinking in long-terms, but in 4 to 6 weeks' time, you don't really have the time to work something out. So, what do you get in 6 weeks of time? Lots, lots of ideas, innovative ideas, crazy ideas. Both business models as on technological level. We put it in our strategic portfolio plan, we have longlist of twenty ideas. But then… nothing really happens with those ideas.

Patrick (Participant 21)

According to Patrick and Marion this process is a heavy exercise. Because during the year limited effort is done to explore radical opportunities. During a work week there is limited time to spend on exploring or researching possible opportunities due to suddenly high priority sales problems or customer fixes. Therefore, the input during this yearly strategic around radical idea are relatively immature and poor defined. And after six weeks of meetings and workshops, a plan is created. The next step is to develop the profit plan, this plan forces them to state how to make profit the coming year, which results in more current product improvement and business growth targets. Patrick complains about this exercise:

[Talking about scarce time to spend on exploration of ideas] "Yes, because after the strategic product portfolio plan. You present it to the board, look this is our plan and then you go back to your day to day job. You spend 90% on your daily activities and responsibilities so you only have 10% left to work on your radical ideas. And with too little time, you have to present it to your manager whereby you receive the reaction: Oh… that probably won't be interesting. And the next year the same ideas come back"

Patrick (Participant 24)

Marion mentions that indeed many other colleagues of her complain about the current way of working around this process

"Yes, a comment and complainant I hear a lot is that nothing happens with those innovative plans afterwards. Because lots of people in product management and marketeers just return to their business as usual. They look 90 to 95% of the time to current products, current business. And not to innovations of the future"

Marion (Participant 26)

The priorities set in these strategic product portfolio plan and profit plan are tightly tied to resource allocations. Therefore, it seems that projects always run at least a year and are hardly killed during the year. Also, because when killing a project, not suddenly a new project is able to start because this is not included in the profit plan of that year.

Ideation phase

Teo mentioned that he is not actively involved within the yearly strategic process of the business units and therefore not able to challenge the business units on their long-term relevance or provide input for new radical innovation opportunities. Teo even must figure out himself out what are the plans of the business units the coming year. And this took them a lot of efforts.

"Yes, last year I was not even involved, and I had to ask multiple people to receive the slide decks of last year's strategic product portfolio plan, that's not how it should be"

Teo (Participant 15)

In other years, there are some meetings between Teo and Patrick but according to Patrick these meetings are not fruitful because there are too many people in the room and they just hear each other out.

"In the past too many times we had intake meetings with 20-30 people. And technology centre sits on side of the room and they ask the business: What do you need? …. Silence. And on the other side sits the business: What are you working on? Yes… uhm… [….] To many times we hear each other out, and many times only one party leads the conversation."

Participant 31 Patrick

Within this current structure of shared responsibility regarding to radical innovation Teo is not succeeding with his approach to collaboratively explore radical opportunities. Let alone being able to receive a Go decision or project approval for a new technology introduction project.

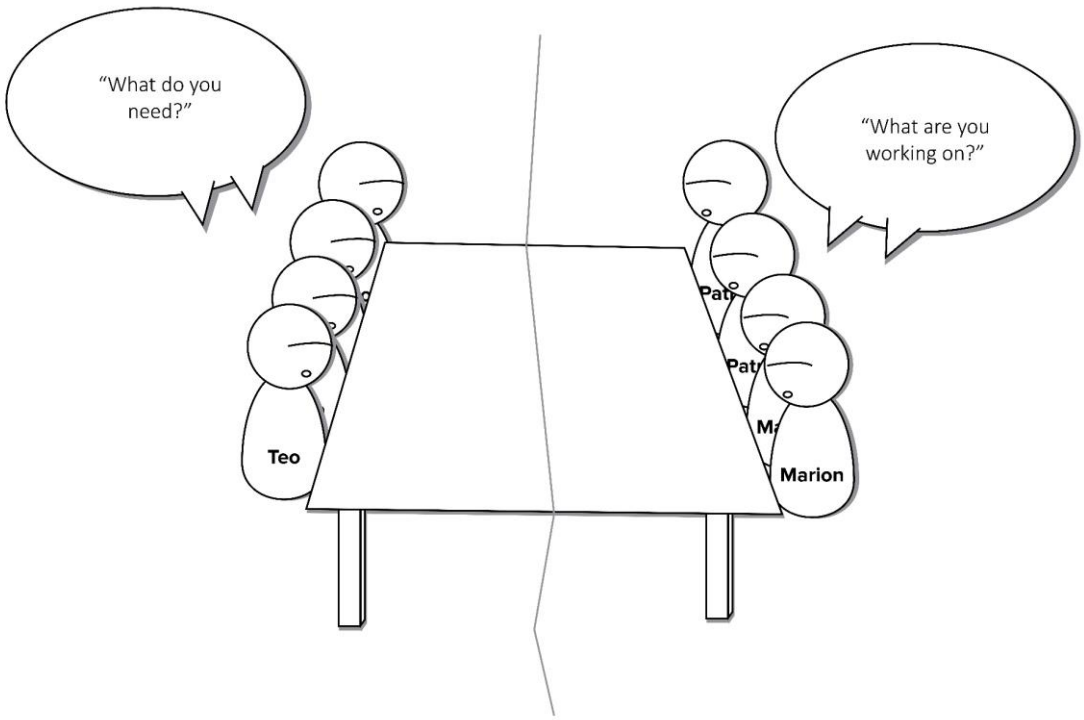
Teo experiences a hard time starting new projects in collaboration with product management from the business units since they focus limited on the long-term strategies.

As Marion puts it:

Discussions around radical innovation need time. We don't take enough time to explore opportunities around a specific framework. Many times, we don't facilitate these discussions. People speak to each other 1 on 1 in the context of Barco, if want to you continue… we have processes but quickly they become heavy and loaded because many stakeholders are involved. And these conversations only happen towards the strategic product portfolio plan.

Participant 26 Marion

To conclude, no process is in place to support Teo Patrick and Marion during the ideation phase to collaborate and create collectively radical innovation opportunities. This is giving Teo a hard time creating opportunity space for new projects with the business units.



Invalid Decision-Making process

Decisions made in the front end of radical innovation of failing products were invalid, both before a project started as during the project. They make bad choices because the "design" part of decision making is lacking. Decisions are made based on gut feeling, without or with minimal validation. Multiple participants mentioned that their business unit know its market very well. For incremental innovations it is easy to predict the next version and its viability. However, for radical new ideas this is not the case. In the past, some failed radical innovation projects seem to be pushed through the organisation by individuals, sometimes with only one customer that asked for the concept, and without valid validation with the rest of the market there was no valid data where gut feeling decisions could be based on. The consequence of this is that projects run over a long time before it comes to the realisation that the product is not desirable in the market and thus not profitable for Barco. Below Rick, Patrick and Marion describe this challenge.

"Actually, if you would have asked before the start, what are the market needs, they would have been very low. The requirements we filled in with our technology were not important to that specific market. So actually, from product management and marketing we sensed this way too late. We could have stopped the project or pivoted earlier."

Rick (Participant 25)

We talked too little with our customers. Or, when there was already a finished concept. If we went earlier to our customers, we never would have come up with this customer problem.

Patrick (Participant 27)

Looking back, we showed the customer something really attractive, whereby we received answers we wanted to hear. The questions we asked were formulated in the wrong way, we did not ask open ended questions about the problems they currently face.

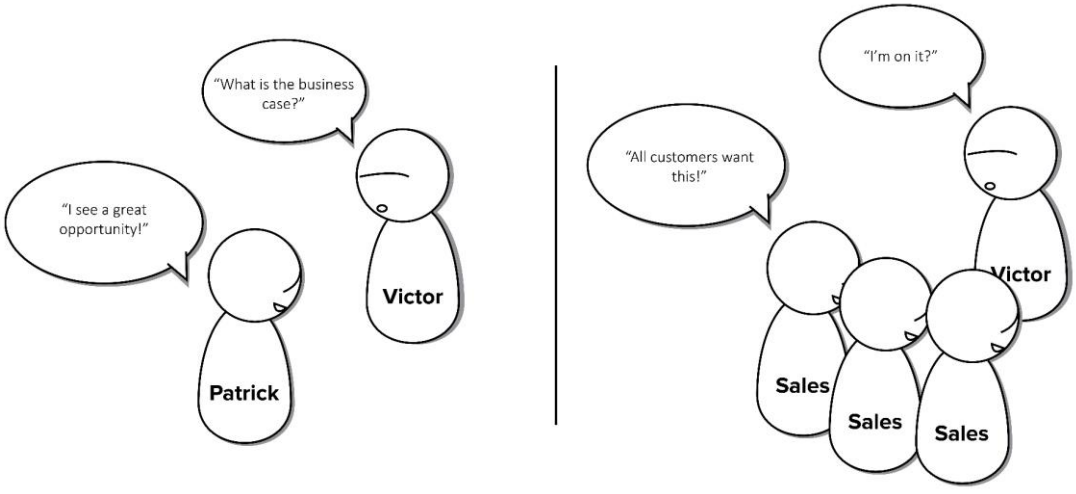
Marion (Participant 9)

There is a clear contradiction in how new projects receive approval. On one hand, still fuzzy and early ideas get killed due to the fact that management demands solid business cases and early return on investment. On the other hand, other ideas where priority seems high, they start a new project without looking at the actual problem or alternative options.

"On one side there is resistance, we should not put products to fast on the market, we really have to think this through. And lots of numbers are needed, up to the decimals. However, if there is an opportunity, and 6 sales people scream murder and fire, then immediately we act. Without any research, then there is no structure..."

Marion (Participant 14)

To conclude, the choices they made in these project failures are not good and the problems they discovered during the project could have been avoided by earlier validation prior the start of the project. This means that the intelligence and design part of the decision-making process is lacking. The collected data during intelligence was not enough to create options and alternatives.



Misusing business case tool

If I take a look at the three capabilities an organisation needs to develop in order to create a mature radical innovation capability, I observe that Patrick and Marion are misusing their incubation capability. Before project approval, in the early stage of the process, they demand a positive and solid business case while the opportunity is still immature. As Sandberg & Aarikka-Stenroos (2014) state, in their extensive review analysis, conventional analytic methods for evaluating opportunities are inappropriate and therefore business cases numbers in the early stage of the of the radical innovation process is nearly impossible to predict. Negative business cases have a huge influence on the Go/ No Go decision that has to be made by management. Exceptions are made in the past, where negative business cases resulted in project starts due to strategic choices made by the CEO and his leadership team. But normally, already before an opportunity is articulated and grown mature Patrick and Victor demand a solid business proposal. Business cases can be a useful tool, but you need to use them appropriately, now they are miss used. The following quotes from Rick, Victor and Teo support this finding.

[Asking about the reason for not starting a project?] "The price, there was no business case. The price for display technology L was too high in market C. [….] Mostly they make decision based on the business case, on senior leadership level. While sometimes that is not necessary, sometimes you have to say… Well… That's for most people here frustrating, display technology L will be introduced in the future in market C, so Barco cannot miss out. Now we fear that this suddenly will be available in the market and that we have to do a catch up to develop the product.

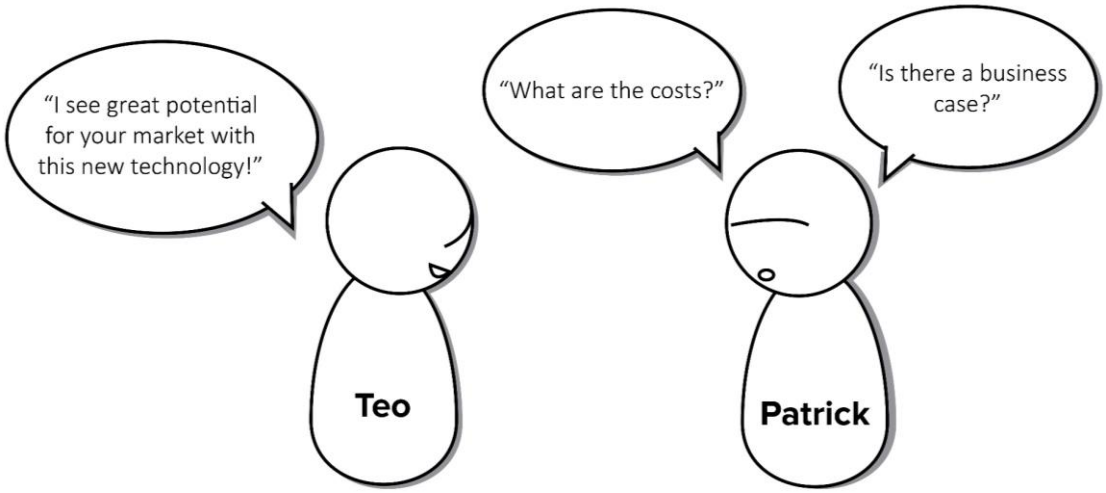
Rick (Participant 25)

[Asking how decisions are made to choose between new technologies] "That's cost, that's business case driven."

Victor (Participant 21)

[Asking about how decisions are made to choose between different technologies] Mostly, business case driven. But that's in a very early stage predicting the numbers…. Everybody can fill in an NPV sheet or spreadsheet, that's not the point. But truly estimating what the product potential is, that's hard, definitely when things are not incremental.

Teo (Participant 20)



3.4.3 Knowledge barrier between technology and business

This key finding of the study is about Teo's approach to create and explore opportunities with business managers. Because besides the formal once a year strategic exercises, there are also more informal exploration meetings going on between Teo, Patrick and Marion. Teo is experienced in scouting new emerging technologies; he reads articles, papers, blogs, goes on business trips to suppliers and speaks a lot with fellow technology scouts in his team. They discuss them during coffee breaks, during lunch or at someone's desk if someone has a hunch and thinks that a particular display technology would be interesting for potential products of the business units. When Teo developed this hunch into something which is more mature he starts to approach Patrick or Marion. The first thing he has to challenge is, and described earlier, the major focus on business growth and incremental innovation. The second challenge is that according to Teo, business managers like Patrick and Marion lack the deep technological knowledge to understand the new technology to envision the potential impact or potential value for their market.

And then, there is this person who should sell it, that person needs all of his imagination to see a product in that thing, that is hard he. Those are two different worlds [……] You need to get a product manager or business manager excited for your invention, most of the time it is just a breadboard, while you have to convince them that something is in there. Sometimes it is spectacular, and you succeed, but sometimes it is not yet that spectacular.

Teo (Participant 20)

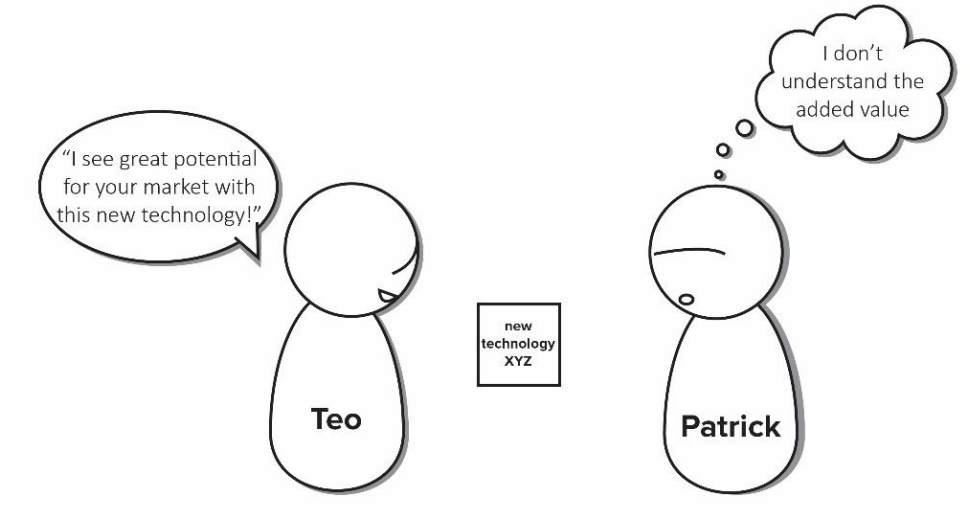
Marion also recognizes this challenge within her business unit:

"If you receive a question from Technology centre about a new technology: Do you guys see anything in new GPU accelerated capabilities in image processing? To be honest; 8 out of 10 people will drop out, just because they cannot position the question. A large part depends on the deep understanding of a technology and simple linking it to a use case. "
Marion (Participant 26)

Multiple participants from the technology centre mentioned this, due to poorly chosen experiments in the market for new technologies in the past, that business and sales managers misunderstood the technology. Creating a demonstrator is a successful tool to bridge this gap. However, in situations where the improvement is not spectacular, seen from the 'outside', business managers find it hard to use their imagination to see the value or impact of the technology. Causing that the perception that the divisions are not using new technologies to its full potential.

Look, if you have developed a reflective display technology (which needs light for energy) and product management, or someone else from the business, arranges an experiment in a metro station (without light from the environment). That is badly chosen in my opinion.

Teo (Participant 4)



3.5 Conclusion

The goal of the research in this chapter was to understand the efforts and challenges regarding radical innovation the case company Barco. Through the analysis of 31 semi-structured interviews, multiple meeting observations and internal documents, I uncovered Barco's radical innovation management efforts together with fifteen challanges. Internal sessions with research and new participants helped in establishing validity and prioritization of the challenges. From these sessions six challenge areas were created. For clarity reasons I only presented the top three: (1) Company vision, strategy and senior leadership, (2) Lack of governance, guidance and support, (3) Knowledge barrier between technology and business. External interviews with three experts and three representatives of other companies helped in establishing validity of the findings. The findings are heavily influenced by the single case study design and therefore the findings are to a limited extend replicable to other industries. There are four key findings.

First, the current strategy set by CEO Charlie and executed by senior leadership is affecting how Patrick is managing his product portfolio regarding to start incremental and radical innovation. The yearly strategic portfolio plan and quarterly profit plan targets pushes Patrick to focus on business growth and incremental innovation, leaving little room to explore radical new opportunities. On the other hand, Teo has the mandate to focus on radical innovation and puts a lot of effort to start new radical innovations with Patrick and Marion, however a conflict of different interests created a political boundary between them.

Second, a lack of governance and support for radical innovation was found to be a significant challenge. The responsibility for radical innovation is fragmented over the technology centre and business units. Due to failing new technologies that did not make it into new product development, now, in order to achieve project approval Teo needs commitment from the business managers in form of a resource investment (time and money).

They collect intelligence separately during technology scouting activities (Teo) or customer and key account visits (Patrick and Marion). Even though, they have a shared responsibility for radical innovation, no collective process is in place to support them in their efforts to collectively create new radical opportunities and guide them in this decision-making process. Currently, only once a year within a business unit, Patrick and Marion explore opportunities in a strategic product portfolio exercise after which a budget round follows to create the profit plan for the coming year. These once a year exercises are mostly focused on incremental innovation and the meetings that take place between Teo and the other business managers are not perceived to be efficient or fruitful.

Third, Patrick and Marion are misusing business case tools. Too soon in the process they demand solid business cases to assess immature opportunities. Every decision is based upon a business case while these numbers are too uncertain. Therefore, an opportunity cannot be created towards a mature level to develop eventually a proper business proposal. Sandberg & Aarikka-Stenroos (2014) state, in their extensive review analysis, conventional analytic methods for evaluating opportunities are inappropriate, because business cases numbers in the early stage is nearly impossible to predict.

Fourth, between the two different specialisations in the domain of technology and business within the organisation there seems to be a knowledge boundary between Teo and Patrick - Marion. Both arguing about the other "party" not always able understand their knowledge area enough. Therefore, lots of bridges cannot be built in their efforts to create new radical opportunities together.

Chapter 4 | Define

The fourth chapter is about defining the solution space. Based on findings from the literature in chapter 2 and the findings from the case study of chapter 3 a design brief is formulated. In this brief the problem statement and design goal are defined. Furthermore, at the end of the chapter a summary is given of these findings and the design brief. The design brief will be used to guide the design process of phase 2 and 3.

Chapter 4 | Define

4.1 Introduction

Before I scope down the project towards the solution space, I take a look at three (out of four) strategic pillars of Barco, the pillars are depicted in Figure 4-1. The three pillars are: “Lead by Innovation”, “Focus on Performance” and “Offer Outcome Based Solutions”. The fourth pillar “Go for Sustainable Impact” is not included since I considered this pillar is out of project scope: the front end of radical innovation. The CEO made a first step towards performance improvement with the ‘Fit to Lead’ program, initiated in 2017, to boost redeployment and operational efficiency. This is clearly recognizable in the way the organisation manages radical innovation on a daily basis. The major focus in the businesses on exploiting current business by exploring and executing incremental innovations to ensure growth in current markets. And to be honest if I look at the financial numbers, the focus on growth and incremental innovation is paying off, resulting in the highest company stock prices in years and higher profit margins of sold products (Barco annual report, 2018). However, I doubt if all three pillars are connected to Barco’s innovation management efforts. First, ‘Lead by Innovation’ says something about being a frontrunner in the market and leading the market with radical new products, not just randomly but repeatedly depending on the market pace. Second, ‘Focus on Performance’ implies to make high-impactful and better choices in order to perform better, make better decisions during the radical innovation process and increase return investment, both in terms of revenue and learning. And third, ‘Offer Outcome Based Solutions’ is related to move from selling just “one-time products” to selling solutions where traditionally technology specs vendor take place to combine hardware with software and services (Barco annual report, 2018). However, many challenge areas were found that withhold Teo, Patrick and Marion in becoming an innovation leader, a performance machine and offering outcome-based solutions.

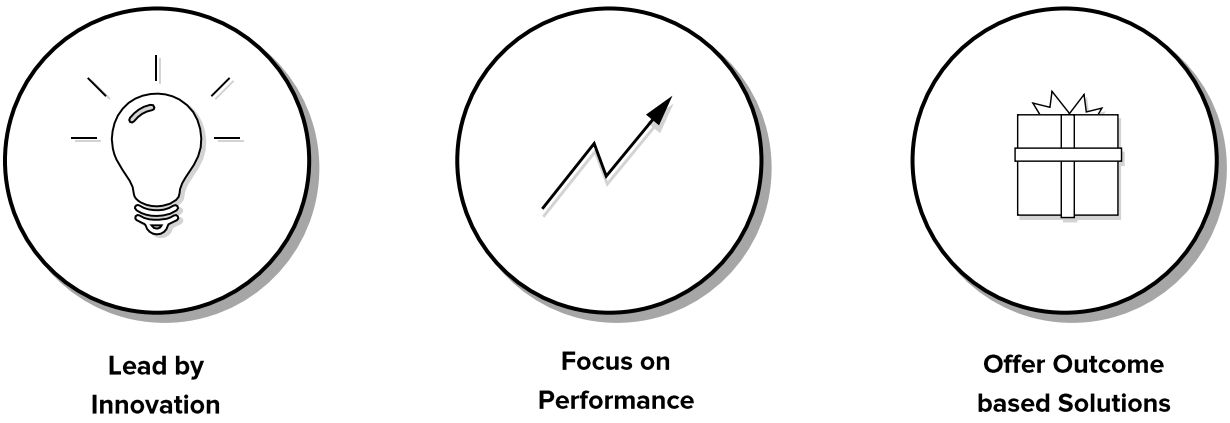


Figure 4-1 Three out of four strategic pillar of Barco

4.2 The need for change

The organisation of Barco operates in a competitive environment but is determined to lead by innovation and seeks for new businesses to grow and Teo, Patrick and Marion recognize that radical innovation is a way to escape intense competition. And as it builds foundations for new product generations for the long-term, they recognize it is crucial for longer-term survival. However, they face many challenges in their radical innovation efforts in order to develop a mature radical innovation capability and various key findings from the previous chapter prompted a need for change. Above all, the strategy set by senior leadership heavily influences Patrick and Marion as business managers to focus on incremental innovation and business growth. On the other hand, Teo, as a technology manager, focusses on radical innovation but needs the commitment from Patrick and Marion in terms of time, market knowledge and funding to start new radical innovation projects. The problem is that while Teo is trying to lobby and create new opportunities in collaboration with Patrick and Marion they mainly focus on quarterly targets, customer fixes and other short-term issues. This tension of different interests between Teo and Patrick, Marion creates a political boundary between them. Also, in attempts of both parties to collaborate there is no process in place to support them to create new radical innovation opportunities. Teo scouts new emerging technologies and has his approach to plan formal meetings and also finds ways to have informal meetings. However, without support, governance and guidance he is struggling to create these opportunities. When there are opportunities in development, Patrick and Marion make decisions based on business cases, but these tend to be inappropriate due to the high uncertainties in the early stage radical innovation. And last but not the least, the two specialisations that are present within the organisation of technology managers and business managers creates a knowledge boundary between Teo and Patrick and Marion which does not helps to collaborate efficiently.

The ongoing “fit to lead” program, initiated by the CEO Charlie in 2017, also has a specific track targeted towards Patrick and Marion to create clearer expectations, accountabilities and to build a wider diversity of skills. Its aim is to stimulate cross departmental collaboration and governance. Also, regarding radical innovation, it is described that they are allowed to spend more time on these projects. Next to that, the rhythm of budgeting only once a year is changing. The CEO wants more quarterly explorations instead of only once a year. According to my company mentor: “Normally, explorations take only place once a year in a budget rounds, these discussions set the budget for the next year. The moment that the budgets are set, the rollout of the project starts. We are changing this dynamic, instead of funding for a year, quarterly explorations are going to take place.” This is in line with the needs of Teo, Patrick and Marion. Less meetings with large amount of people groups will take place and more meetings throughout the year with decision making managers.

4.3 Solution space

The initial scope of the project was the front end of the radical innovation process and was too broad. Therefore, I will scope down in the following section. Analysing the needs for change that of Teo, Patrick and Marion show that the solution space for the rest of this project is located at the very front end of radical innovation: the ideation phase of the process, see Figure 4-2.

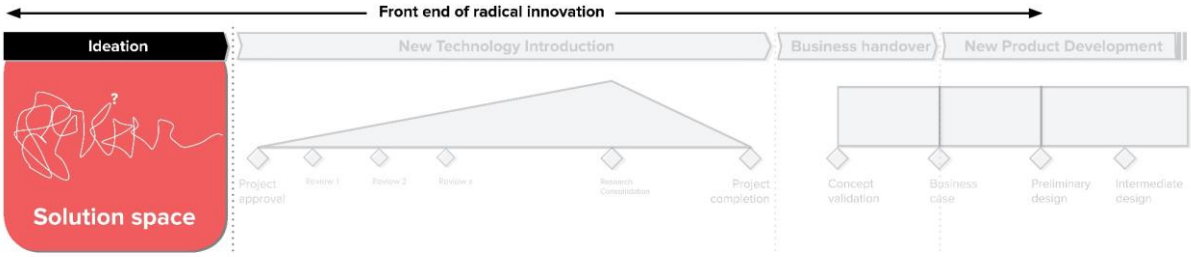


Figure 4-2 Redefined project scope

In this stage of the process opportunities should be created and Teo, Patrick and Marion are asked to collaborate in order to start a new project. However, no support or guidance is in place at this stage of the process. Their current capability to be able to collectively create, recognize and articulate new radical opportunities is challenged by not having this formal process. Moreover, their political and knowledge boundary, and decisions made based on inappropriate business cases are challenging them to develop a mature discovery capability. Therefore, I decided to focus for the rest of the project on designing a routine for Teo, Patrick and Marion that develops their discovery capability, see Figure 4-3.

Figure 4-3 Focus of the rest of the project: discovery capability (O'Connor & DeMartino, 2006).

Developing mature discovery capability is crucial in the front end of the radical innovation process in order to be able to start projects. The skills needed are exploratory, conceptualization skills and both technical scientific discovery and external hunting in order to create these opportunities (O'Connor & DeMartino, 2006). In the

context of Barco, you need the knowledge of both technical managers and business managers to develop this organisational capability. Both specialisations are needed during this phase to create the opportunity and make the Go/No Go decision. Looking at the decision-making model of Simon (1947), it makes sense to focus on the design stage.

For collecting intelligence Patrick and Marion visit their customers, key accounts and are provided with market reports and Teo actively scouts new technologies throughout the year, next to that there is already a program running around collecting intelligence for Patrick and Marion. Both specialisations collect their intelligence separately, and the solution space for this project is bringing both together and collectively design radical opportunities to be able to analyse the opportunities and choose one (Simon, 1947), see Figure 4-4.

Figure 4-4 Focus on the design stage of the decision-making model (Simon, 1947)

To visualize the solution space in more detail I created Figure 4-5. As shown, both parties separately gather their intelligence, but are asked to collectively create radical opportunities and make the decision to start a project. At is exactly this stage where the solution space is located for this project.

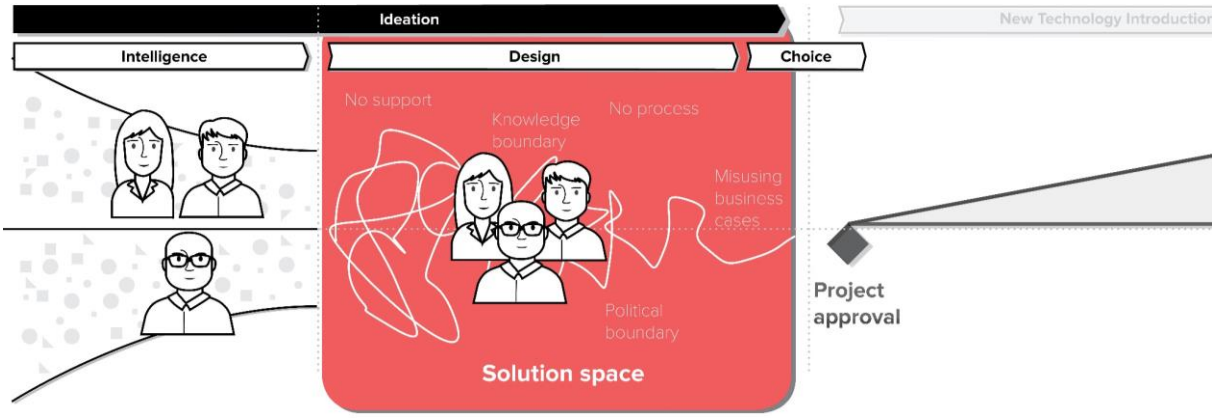


Figure 4-5 solution space in more detail

4.4 Design Brief

The main insights gained during the literature overview (chapter 2) and the main findings of the case study (chapter 3) are used to define the design brief. In this brief I describe the problem statement, and I introduce the design goal. I use this design goal to guide me during phase 2 and 3 of the routine design strategy in the chapters that follow.

The main interaction between Teo, Patrick and Marion, are meetings. Previous explorative meetings are both formal as informal and clearly embedded within their culture. Therefore, it makes sense to design in the context of these meetings (both formal and informal), fitting with their way of working and communication between both specialisations.

Problem statement & Design goal

In order to start new radical innovation projects, besides his technological knowledge Teo needs business knowledge from Patrick and Marion. They need to collaborate because Teo also needs the commitment from Patrick and Marion to receive project approval. Therefore, these two specialisations are the target group, since both technology and business managers are needed to collaborate but are failing.

First, this process is not supported by anything or anyone, while formal processes result in a higher success rate for radical ideas (Lee & Markham, 2016). Within the new routine it is important to include a process with clear steps to support their collaboration.

Second, due to the current strategy set by the CEO there is an interest conflict with regards to radical innovation between Teo operating from the technology centre and Patrick and Marion operating from their business unit, this created a political boundary between them (Carlile, 2004). Third, both specialisations have knowledge of their specific domain which results in a knowledge boundary, while at this boundary novelty creation is located which is key source to innovation (Carlile, 2002, 2004). The new routine should be able Teo, Patrick and Marion to manage to translate and transform knowledge across their political and knowledge boundary to create new opportunities (novel knowledge).

Lastly, they are misusing business case tools to evaluate their still immature opportunities (Sandberg & Aarikka-Stenroos, 2014). The new routine should include activities to create and develop an opportunity from immature to a mature one without evaluating it in the early stage with a business case.

Therefore, I formulated the following design goal:

Design a routine that supports exploration meetings between Teo, Patrick and Marion to create radical innovation opportunities.
The routine needs to create a shared language for creating, developing and assessing these opportunities in order to guide their collaborative ideation decision-making process.

4.5 Summary

In the previous two chapters I found some implications for the solution space and the new routine. In this chapter I combined findings from both chapters, described the solution space defined the problem statement and the design goal. To summarise these findings and the defined design brief, I visualized them in Table 4-1. I used the WWWWWH technique, because it is a great way to deconstruct the problems systematically (Boejen et al., 2014).

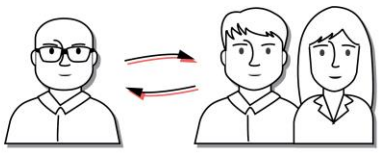
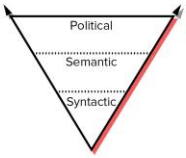
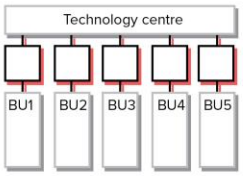
WWWWWH	Visual reference	Answer
Who?		Technology managers and business managers that try to create opportunities for new radical innovation projects but lack support in their collaborative discovery efforts.
What?		No formal shared ideation process is in place between Teo, Patrick and Marion. Moreover, duo to conflict in interest there is a political boundary and their specializations created a knowledge boundary. This challenges them to create new opportunities collectively.
Where?		As part of their shared responsibility for radical innovation this process takes place between managers from the technology centre and managers from the business units.
When?		In the very early stage of the radical innovation process, prior Go/No Go decisions to start a new project.
Why?		To be able to recognize, articulate and develop radical innovation opportunities an organisation needs develop a mature discovery capability.
How?		In order to make a well-considerd decision, during the exploration meetings the focus should be on the design stage of the decision-making process to create the radical opportunities to choose from.

Table 4-1 WWWWWH

Chapter 5 | Develop

This fifth chapter describes phase 2 of the routine design strategy: lock in desired performance. Firstly, it explains the design approach taken during this phase. Secondly, ideas and different formats for the physical artefact are generated. Thirdly, these formats are evaluated and ranked on specifc selection criteria to choose one concept to start with in iteration 1. Lastly, the two conducted iterations in order subtract and lock in the desired performances are described.

Chapter 5 | Develop

5.1 Routine design strategy | phase 2

The goal of the second phase of the routine design strategy is to lock in the desired performance. In order to reach this goal, I used prototyping and feedback sessions to subtract the desired performance from Teo, Patrick and Marion, an overview of this design approach can be found in Figure 5-2. Partner at IDEO Coughlan et al. (2007) stated that using prototypes will help me to activate organisational change through the following ways. Building helps me to think (rather than discussing and analysing before acting), I learn faster by failing early (making things tangible allows me to make many small, low impact failures early in the design process), and it gives me permission to explore new behaviours of the target group (tangible presence of a of a new thing itself stimulates new behaviours) (Coughlan, Suri, et al., 2007).

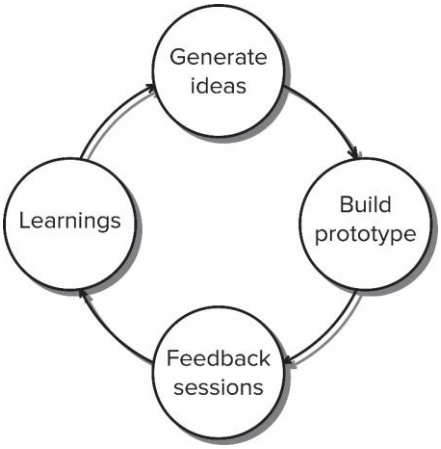


Figure 5-1 One iteration

To quickly prototype a first version, I first needed to know what I had prototype. Therefore, I organised ideation sessions, which help in generating a wide variety of different ideas during this divergent stage. This stage consisted of one external ideation session to generate many ideas, multiple individual ideation sessions and short brainstorms with Teo, Patrick and Marion to discuss the format of the physical artefact. With selection criteria I choose to use “a canvas” as physical artefact format, mainly because of the fit with the routine actors’ personalities and the fit with the routine design strategy, this process is described in section 5.2 and 5.3.

To re-state, the goal of this phase is to lock in the desired performance. However, this desired performance cannot be designed “right” at once and until know it is unknown what exactly this performance is. My design approach to tackle this derived from the Lean Start-up approach from Ries (2011) and is used during the two iterations of this phase. The approach was as follows: (1) I generated ideas with regards to the content of the prototype in a form of building blocks (the canvas), (2) From the ideas, I build a physical prototype to lock in the performances in these building blocks, (3) I conducted sessions with Teo, Patrick and Marion to receive feedback, make changes in the prototype and subtract the desired performances in the, (4) from the received feedback I create learnings and develop implications for the next iteration. After step 4 I continued with step 1 again to start generating ideas for the next iteration, this iterative approach is depicted in Figure 5-1.

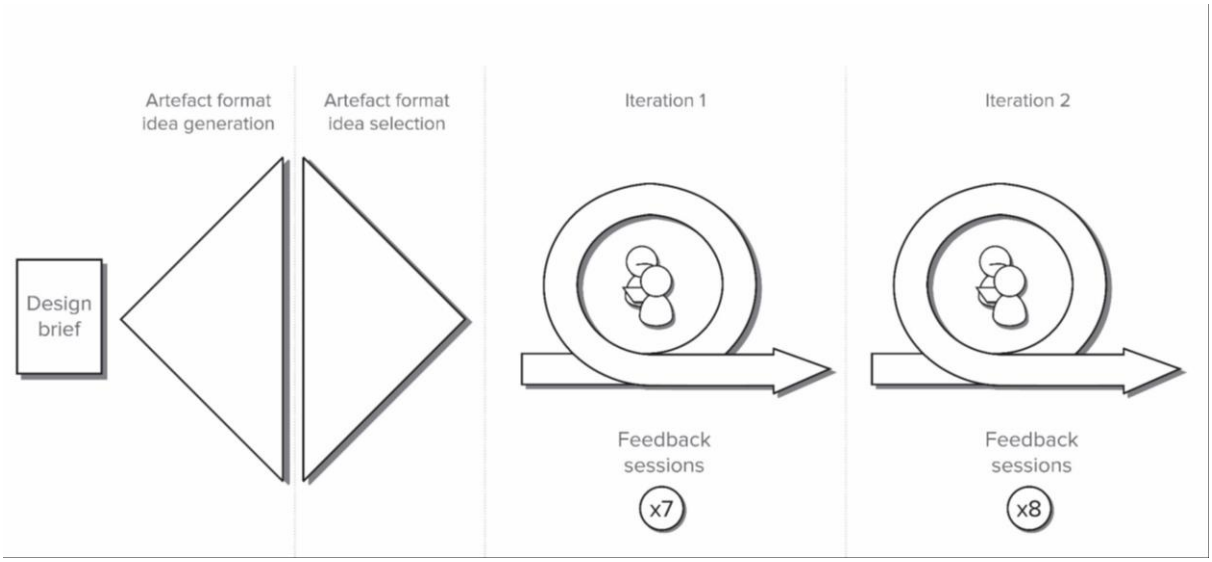


Figure 5-2 Design approach phase 2

From the first generated ideas I quickly prototyped a first version of the canvas and organised feedback sessions with Teo, Patrick and Marion. This iterative process is described in detail in section 5.4 Iteration 1 and 5.5 Iteration 2.

Also, Phase 2 of the routine design strategy is crucial for the design process to be able to test the performative aspect of the designed routine in phase 3. During the feedback session Teo, Patrick and Marion familiarize with the canvas, and by provide input to make changes and improve it also ownership of the artefact increases. By co-creating the canvas in feedback sessions will keep them “hooked” in the project and creates access to setup design experiments to perform the routine which is crucial in the next phase of the strategy.

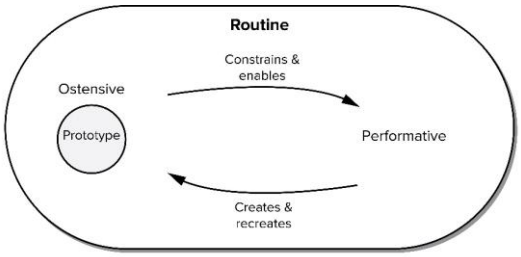


Figure 5-3 Phase 2 conceptualized

5.2 Ideation

In order to create as many as possible ideas regarding to the design brief an external ideation was organised with a mix of Integrated, Interaction and Strategic Design students in order to stimulate a broad range of idea possibilities, see Figure 5-4 for a snapshot of the session. The ideation session was facilitated by me and lasted 2 hours. The goal of the session was to come up with clusters of ideas to would serve as input for format of the physical artefact and to gain a more diverse range of possible ideas to meet the design brief. Since the external participants are not limited or biased by the graduation process, they are able to provide me fresh and new perspectives. The techniques used during the ideation came from the book of Heijene & Van Der Meer (2019) 'Road Map for Creative Problem-Solving Techniques'. The full ideation session guide and used techniques can be found in Appendix I.

I created pre-defined 'How To' statements which were drawn from the values embedded in the design brief and used them as a basis to generate ideas during the session. I predefined these statements to be able to steer the participants towards the solution space defined in the design brief. Within these statements the participants are free to explore all possible solutions and possible artefacts. The following 'How To' statements were used as input to generate ideas:

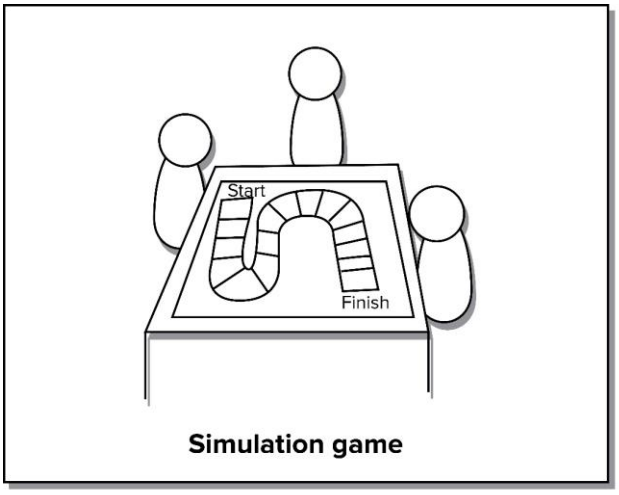
1. How to support exploration meetings between technology managers (Teo) and business managers (Patrick and Marion)
2. How to make different political interests collaborate with each other?
3. How to support a social decision-making process prior a Go/No go decision?
4. How to create a shared language between technology and business managers (Teo, Patrick and Marion)?
5. How to support decision makers in describing, articulating visualizing a radical innovation opportunity?

The ideas generated during the ideation were clustered by the participants and plotted in a C-box. This C-box indicated which ideas were original and which ideas were feasible. All results of the ideation session are located in Appendix K.

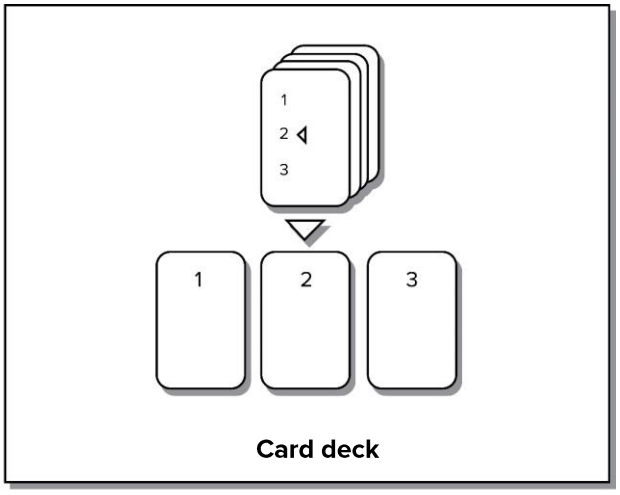
Figure 5-4 Ideation session with Integrated, Interaction and Strategic Design students

5.2.1 Artefact format concepts

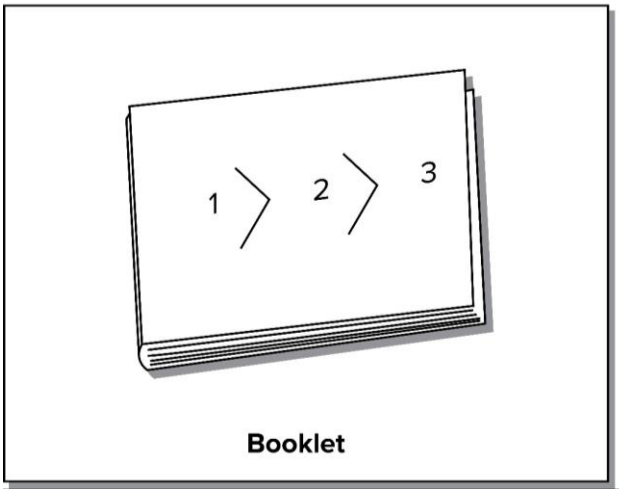
During the external session and individual session many ideas were generated. Intuitively, I choose four most promising formats for the physical artefact and developed them into a concept. The four concepts are described below.



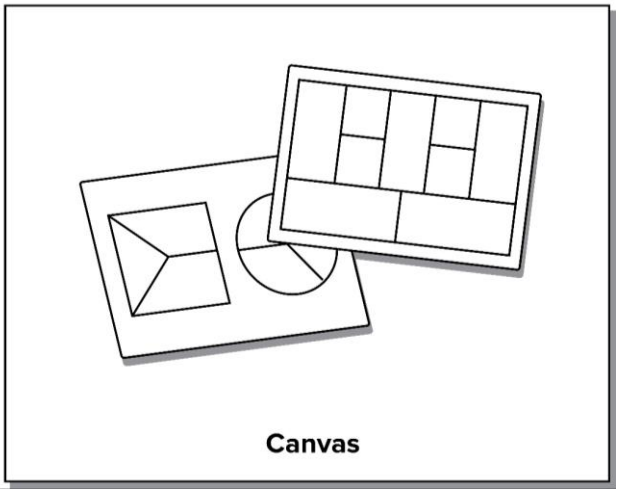
The first concept is a simulation game. This concept enables the actors literately to perform the routine. With this format I can lock the desired process and activites in the different steps of the game towards the “finish”. A great way to make the process visually and to invite people in a low-key manner to play and conduct activities and exersices.



The second concept is a card deck and consists of defferent cards with on each card a different step of the process. On these cards, different activities, exersices can be locked in. Also, the back of the cards can be used to challenge the participants or provide extra explaination.



The third concept is a booklet that locks in the process on different pages. The booklet is easy to carry and to move around or share with other actors. The book can be used to fill in the different pages throughout the meeting and that makes it easy to share the conclusions with fellow colleagues.



The fourth concept is a canvas, which is a widely used tool to visualize certain exercises or activities. On the canvas the process, its exercises and activities can be captured in one overview. The canvas can be filled in on paper during the meeting and used in digital format after the meeting to make it suitable to share.

5.3 Artefact format selection

In order to choose one of the physical artefact formats I formulated selection criteria based on a psychometric tool to categorize the personalities of Teo, Patrick and Marion and with regards to the routine design strategy. These selection criteria are evaluated by me and was validated during conversations with Teo, Patrick and Marion.

5.4.1 Formulating selection criteria

To formulate selection criteria with regards to Teo, Patrick and Marion I used a tool to categorize their personalities, I explain this in the following section. The "insights discovery wheel model", is a psychometric tool created by Andrew and Andy Lothian to help people, teams and organisations to understand themselves and understand others to improve communication and decrease conflict between people. Their work is based on a book written by (Jung, 1921) where different people were categorized into primary types of psychological function. He proposed four main functions of consciousness with two perceiving functions, which is about information gathering: (1) sensation and (2) intuition, and two judging functions, those are about decision-making: (3) thinking and (4) feeling.

The insights discovery wheel model uses the judging functions "thinking" and "feeling" and the two attitudes or temperaments someone can have, extravert or introvert. The two functions and attitudes are described below in Table 5-1and Table 5-2.

Function	Description
Thinking	Those who prefer the thinking function tend to decide things from a more detached standpoint, measuring the decision by what seems reasonable, logical, causal, consistent and matching a given set of rules.
Feeling	Those who prefer the feeling function tend to come to decisions by associating or empathizing with the situation, looking at it "from the inside" and weighing the situation to achieve, on balance, the greatest harmony, consensus and fit, considering the needs of the people involved.

Table 5-1 psychological types (Jung, 1921)

Attitude	Description
Extravert	Extravert means "outward-turning". People who prefer extraversion draw energy from action: they tend to act, then reflect, then act further. If they are inactive, their motivation tends to decline.
Introvert	Introvert means "inward-turning". People who prefer introversion expend energy through action: they prefer to reflect, then act, then reflect again. To rebuild their energy, introverts need quiet time alone, away from activity.

Table 5-2 Psychological attitudes (Jung, 1921)

The “insights discovery wheel model”, depicted in Figure 5-5, uses a simple and memorable four colour model to help people understand their style, strengths and weaknesses. These colours are a of mix of red, yellow, green and blue, which determines how and why people behave the way they do.

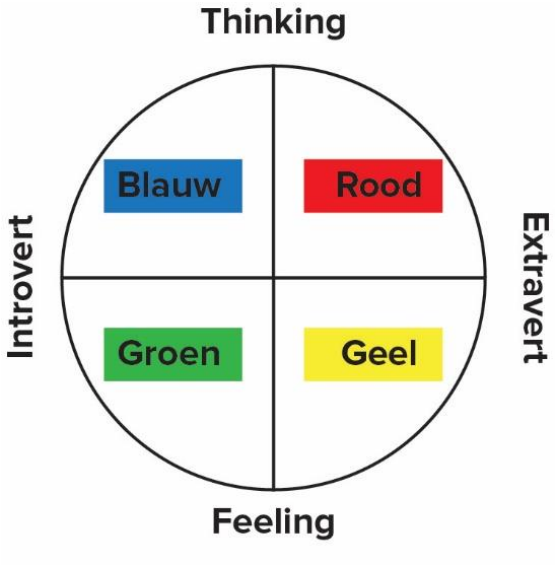


Figure 5-5 Insights discovery wheel model

According to my company mentor, Barco’s human resources is currently analysing the organisation by assessing individuals with this model. The provisional conclusions drawn from this assessment states that there are too few different colours present throughout the organisation, and blue is the most dominant one. This supports my observations noted during the interviews, meeting observations but also from observing people interacting with each other at presentations or workshops (e.g. Innovation Days event, CEO’s quarterly talk). I concluded that the organisation has a formal culture, focus on details and sometimes even overanalysing situations. Most people tend be conservative, are structured, realistic and introverted thinkers. You could argue that adding more yellow, red, or green people within the organisation would create another dynamic that can be used to change their current routines. However, seen my position as graduate student this is not considered feasible. The personality colours within the target group are blue and I suggest developing a solution that fit their culture and way of working. To avoid resistance from the Teo, Patrick and Marion, the solution should not be too new or radically different in order be able to setup design experiments during phase 3.

From these insights I formulated the following selection criteria regarding to the target group of the routine:

- To what extent does this physical artefact provide structure to Teo, Patrick and Marion (Structure)
- To what extent are for Teo, Patrick and Marion familiar with the physical artefact format (Familiarity)

Routine design strategy criteria

Moreover, I also formulated criteria with regards to the routine design strategy. The artefact will be co-created during feedback sessions and design experiments; therefore, the format of the artefact should be suitable to enable Teo, Patrick and Marion to easily delete certain undesired performances and add desired performances or make any desired change. Next to that, the artefact should also “invite” them or nudge them to perform the routine, since in order to build the ostensive aspect, performing and practicing is considered key.

From these insights I formulated the following selection criteria regarding to the routine design strategy:

- To what extent is this physical artefact easily adjustable and customizable (Customizable)
- To what extent invites this physical artefact the target group to perform (Performability)

5.4.2 Results

The Harvey balls represent the amount of points a physical artefact format can receive based on the selection criteria, see Figure 5-6. The first empty ball represents “none” (0 points), the format does not meet the criteria. The last full coloured ball represents “all” (4 points), the format fully meets the criteria. I filled in the evaluation based on the insights gained during the project.

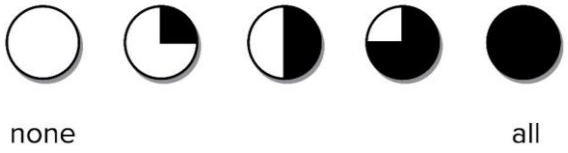


Figure 5-6 Harvey balls

The results show that canvas is the format that is most preferable with regards to the selection criteria, see Figure 5-7. During conversations with Teo, Patrick and Marion a canvas is a desirable format to work with because of the following reasons. A canvas is great artefact to visualize the desired process and provides structure to Teo, Patrick and Marion which fit their personality with a preference for structure and formality. Working with a canvas is considered not too new for the target group since they are familiar with the business model canvas and value proposition canvas to prevent resistance. Also, a canvas is suitable to create, adjust, delete or add new the elements of the canvas. Furthermore, a canvas nudges people to fill in the empty elements and thus stimulate performance, which will be useful in phase 3 of the routine design strategy. Therefore, I choose to start iteration 1 with the format of a physical canvas.

A simulation game could also be an interesting format due to its high invitation to perform and play with the process, however this format is considered too new for the actors and therefore resistance could occur amongst them. A card deck is easily customizable to work with as a prototype but just like the simulation game considered too far of the comfort zone of the routine actors. Next to that, a card deck is less suitable to provide the process in one overview for structure which is desired by the actors. A booklet is not desired because of it is not nudging the actors to perform as a format and does not provide a clear structure in one overview.

Format	Structure	Familiarity	Customizable	Performability	Total
Simulation game	◑	◔	◔	●	8
Card deck	◔	◔	◕	◑	7
Booklet	◔	◑	◑	◔	6
Canvas	◑	◕	◕	◑	10

Figure 5-7 Evaluation results

In the following two sections I describe iteration 1 and 2 of routine design strategy phase 2. These two iterations are conducted in order to lock in the desired performances of the new routine between Teo, Patrick and Marion. This is facilitated by feedback sessions with Teo, Patrick and Marion to subtract their desired performances. Their feedback is transformed into building blocks on the physical artefact: the canvas.

5.4 Iteration 1

Prototype under test

The input to generate ideas for the first version of the canvas are two meetings with Teo and Patrick from the target group to brainstorm what would be the required process to be able to collectively create new opportunities and what are the topics that should be discussed or exercises that should be conducted during the process. After these two meetings an individual brainstorm generated the first version of the canvas, seeFigure 5-8. The prototype is depicted below and can be found on A4 Appendix L. It is based on three phases of exploration: current business, emerging technology impact and future business opportunity. The canvas is envisioned to be a process to support Teo, Patrick and Marion during their collective discovery phase. The three-step approach works as follows: (1) first you explore on the status quo, where are we standing currently with our business? (2) Second, you explore an emerging technology that is scouted by Teo and see what the boundaries and possibilities of the new technology impact are. The last step is to converge and to create new radical opportunities by combining market needs with the possible impact of the emerging technology.

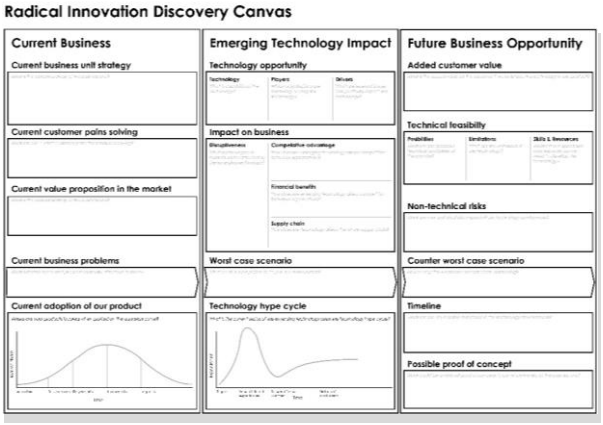


Figure 5-8 Prototype iteration 1

Goals the session

The two main goals of the experiment were to validate that Teo, Patrick and Marion were seeing value of the canvas to support their exploration meetings and collect feedback from them about desired topics, activities and exercises during the process and thus which should be included in the building blocks of the canvas. Their collected feedback is used to formulate implications for the next version of the prototype.

Approach

I invited 7 participants from the target group and asked them to provide feedback on a first prototype in a 30-minute session. The seven participants were 2 Teo's, 3 Patrick's or 2 Marion's. I printed the canvas on A3 and provided the participants with post its and markers to capture their comments. The sessions are not recorded, the feedback is noted on post-its and on the prototypes during the session. Before giving feedback, I briefed the participant with the current status of my design process, why I designed this prototype and what the goal is of the feedback session. After this short introduction, the prototype is handed over to the participants and asked to go through the process and give feedback on the building blocks. Feedback was stimulated by asking about comments, worries and what they valued or what should be added or adjusted in the building blocks. The setup of this experiment is only qualitative. A set of five of questions were asked about the desired performance within these exploration meetings but also to reflect on previous meetings and their pain points to counter these within the new routine.

Learnings

- Majority considered the canvas as valuable, especially because there is currently no structure and process for these radical innovation exploration meetings between Teo, Patrick and Marion. I can state that the challenge identified during phase 1 about not having a formal process for their collaboration is extra validated. And at least most participants of the feedback sessions understood the potential value this canvas could have. But what they also mentioned, a canvas is just a canvas unless people start using it.
- The three-step approach is clear and seems logic. However, participants mentioned that emerging technology impact on the business should not be the only angle to look at. Starting points for radical innovation could also be a business need, where it is still unclear which technology should facilitate that business need.
- Clear and challenging questions are considered very useful. Because they push you to reconsider your thoughts and to question yourself.
- The result of these conversations doesn't have to be necessarily a proof of concept, other results are also plausible; monitoring a technology, further investigation or preparing a new technology introduction project.
- Unlogic that technical feasibility is located in the opportunity space.
- Within the opportunity space it is desired to include a future scenario and room to generate ideas that could fit within this scenario
- Participants mentioned that it is important to consider strategic choices why "Barco" is the right organisation to invest in a certain technology, or that other companies would solve that problem

Implications for next iteration

- A section will be added where participant have to start; in that section the goal of the canvas will be explained, for whom the canvas is intended and when to use it.
- An element for key actions will be added in order to make sure that at the end of a discussing people act and who is responsible for that specific action
- More questions will be included in the canvas to enrich and guide the discussions better
- Add following building blocks:
    - Desired future scenario to imagine the future and what will happen with this technology. Which part does Barco wants or has or wants to play?
    - Room for ideation or applications. A result does not have to be a proof of concept, but also other ideas are possible to start experiments, or other validations.
    - Meeting conclusion and key actions to end the meeting with a mutual agreement about the conclusion. Many meetings people leave the room without key actions or a conclusion.
    - Core purpose, why is Barco the right player or what are the alternatives for this technology
    - Start section to introduce the canvas for people who are new and want to know more about the process.
- Deleted/changed building blocks:
    - Proof of concept → Key actions
    - Timeline
    - Added customer value
    - Technical feasibility → Emerging new technology phase
    - Value proposition in the market merge with product adoption curve
    - Current business problems and customer pains → Challenges, and Business needs

5.5 Iteration 2

Prototype under test: Canvas version 2.0

Based on the feedback from the previous iteration and the implications I formulated for the next iteration I made improvements in the canvas. I deleted building blocks or merged building blocks with each other to make room for building blocks that were introduced by the Teo, Patrick and Marion. Less focus on the "new technology" and the artefact is now divided in 12 building blocks. More questions were added, a starting building block was added that explain the use of the canvas and a conclusion block was added at the end of the process. Within these blocks there are different activities or exercises that have to be collectively performed by the routine actors during the exploration meetings. The prototype for iteration 2 is depicted in Figure 5-10 and can be found on A4 in Appendix M.

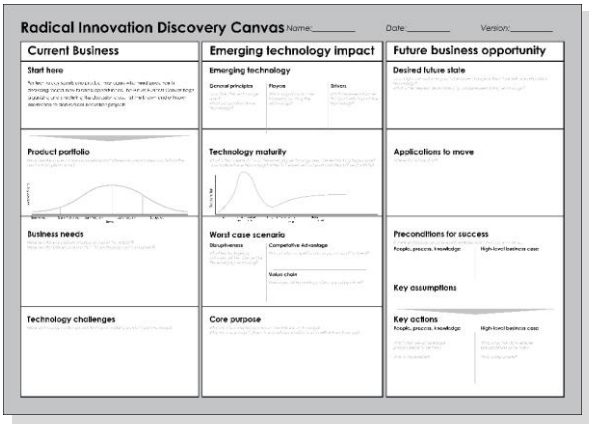


Figure 5-10 Prototype iteration 2

Goals the session

The goals of the experiment were to find out (1) if the target group would use this canvas in their meetings and why? (2) Are the building blocks the right elements and steps in the process for them, what still needs to be changed? (3) Which steps has to be taken in order to start performing and testing the new routine with Teo, Patrick and Marion?

Approach

I asked a total of 8 participants from the target group to provide feedback on the second version of the prototype. The participants were 2 Teo's, 3 Patrick's or 3 Marion's. Also, some key Teo's, Patricks and Marion's participated for a second time to keep them involved (hooked) in the project. This way I could share progression and show the improvements that were made. These sessions lasted between 30 minutes and 1 hour. I printed the canvas on A3 and brought post-its and markers to the session. The participates were asked to provide feedback while going through the process and to discuss their concerns. Within these sessions I asked them to make desired changes in the canvas. Also steps that should be taken in order to practice the performance aspect of this routine is discussed. After each session they filled in a questionnaire and answered a set of questions. The questionnaire and results can be found in Appendix N and Appendix O.

Figure 5-9 Feedback session during iteration 2

Learnings

- Most activities captured in the building blocks are discussed during previous meetings between Teo and business managers, but never captured in one overview and not presented as a process. The discussions are rather chaotic and not supported to diverge and converge during an exploration.
- To start the exploration and to steer the discussions it would be practical to set some goals at the beginning of the meeting. In many meetings the discussion starts at point A and ends somewhere random and the topic changes too many times.
- Key actions are not detailed enough to create actual actions. The meeting participants should be accounted for the key actions that have to be taken. It is important that after the meeting key actions are divided among the participants. In previous meetings too many times there was no commitment from the people in the room.
- Is this canvas intended as an exercise within one hour, half a day or used the entire process? This was not clear to all participants
- All building blocks are valuable for the target group. However, they can have some more questions or more layers within the building blocks that should be explored.
- To be able to guide the meeting it would be needed to have an objectively facilitator to (1) introduce the process of the canvas and to (2) steer the conversation towards the right direction.
- There are multiple dimensions or resolutions captured in the canvas. Participants mentioned that the canvas can be used on parts of a product, the product, market or industry level.
- It is important to consider the timeframe in which you look into the future.

Implications next iteration

- Add more exercises in the building blocks. More questions that triggers the right discussion they should have in the front end of the process.

  Changed building blocks:

- Key actions should be clearer defined what are the different options for conclusions and account the meeting participants for specific actions. And Add an exercise to indicate the amount of risk of the opportunity of the idea that is created.
- The starting building block: At the beginning the exploration meeting Teo, Patrick and Marion should set the objective of the meeting, the scope (do they explore the entire industry, a certain market or only the product or a part of a product) and the timeframe when a product needs be ready for commercialisation.
- Remove worst case scenario, but use it as a question in “potential impact”
- Technology challenges → challenges both technical and non-technical

5.6 Conclusion

At the start of routine design strategy phase 2 I organised an external ideation and individual sessions to generate many ideas and different format concepts for a physical artefact. From four concepts I choose to use “a canvas” as physical artefact format. This decision is based on the fit with the personalities and way of working of Teo, Patrick and Marion and the fit with the routine design strategy. The routine actors prefer structure and familiarity to prevent resistance. Moreover, the strategy required an artefact that is easily customizable and nudges the actors to perform the routine.

I quickly prototyped a first version of the canvas and collected insights in multiple feedback sessions with Teo, Patrick and Marion to subtract their desired exercises and activities during their exploration meetings. These insights were captured and locked in the canvas.

During these sessions I collected feedback about building blocks, that were generated during the ideation at the beginning of the iteration, that should be changed or deleted. From this I formulated implications for the next version of the canvas. This approach is repeated during iteration 2.

The result of these two iterations is a “Radical Innovation Discovery Canvas”. This canvas is the required physical artefact to enter the last and third phase of the strategy to start performing the locked in performances and build the ostensive aspect of the routine.

Chapter 6 | Deliver

This sixth chapter describes phase 3 of the routine design strategy: build the ostensive, to connect the developed canvas with the actual performance to train the ostensive aspect of the routine. This is done by two design experiments with the routine actors to also validate the desirability of the designed performances of the previous chapter. The findings of these design experiments are described and discussed at the end of the chapter.

Chapter 6 | Deliver

6.1 Routine design strategy | phase 3

The goal of the third phase of the routine design strategy is to build the ostensive. The ostensive aspect of the routine connects the physical artefact (such as sheet music) with performance aspect (the actual music) and is important to build to be able to repeat the performance. In order to reach the goal, I used design experiments with experimental and reflective spaces as mechanisms to perform the routine in a safe environment, see Figure 6-1 and Figure 6-2. I will describe in detail how I setup the experiments and how I used these spaces in section 6.2 Research design, but first I will argue why design experiments are useful in this phase of the design strategy.

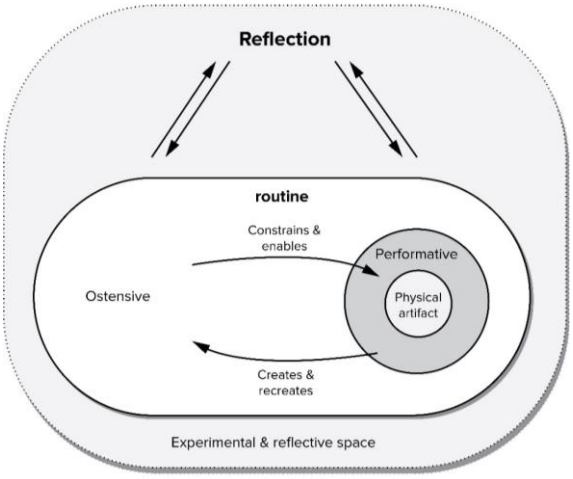


Figure 6-1 Conceptualized approach phase 3

First, I want to prevent that the canvas is perceived as a static artefact, since an artefact on itself it will not necessarily lead to desired changes of the routine actors. Therefore, I labelled the canvas as a prototype during iteration 1 and 2 and now I put this prototype under test with the actors to experience the designed actions, activities and exercises that are captured in the canvas from these previous iterations. Second, by building a design experiment with this canvas I am able to gain insights about the desirability and feasibility of the new routine. The desirability lens validates whether these designed performances are solving the challenges that were identified in phase 1. The feasibility lens validates whether if the participants of the experiment are able to perform the routine and if they reach the goal of the exploration meeting. Furthermore, design experiments with the actual actors provides me input for new learnings to make improvements on the two design thinking lenses. Third, since the aim of this strategy is to change the routine to discover new radical opportunities we might run into issues with other routines that we have not yet foreseen (Deken, Carlile, et al., 2016). It is clear that design experiments will not provide the same richness of data as in longitudinal ethnographic studies, but it is argued that experimentation within the live routine could uncover these interdependencies with other routines (Wegener & Smulders, 2019). To conclude, to build the ostensive I need to invest in the ostensive. Meaning that Teo, Patrick and Marion need to practice, just like football teams' practice and receive feedback to improve and make changes every time.

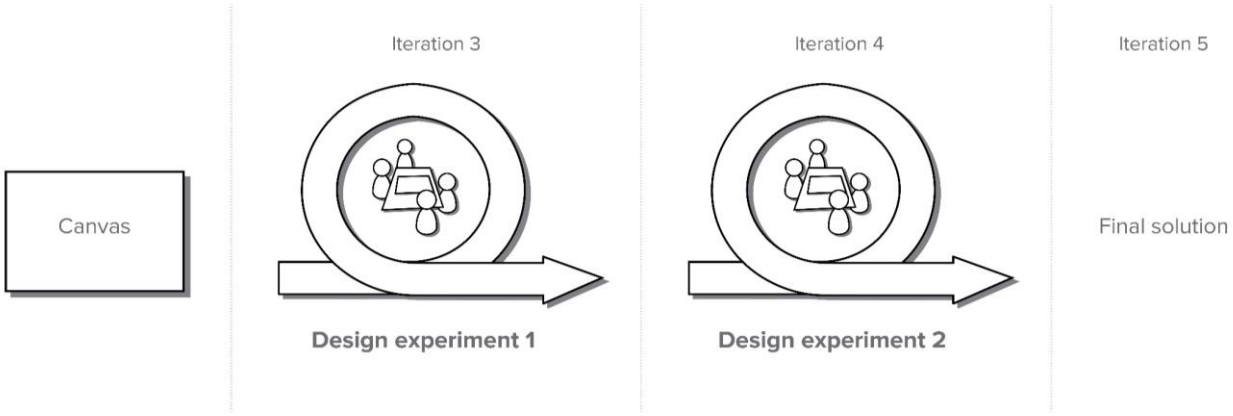


Figure 6-2 Design approach phase 3

6.2 Research design

Goals of the design experiments

- Assess feasibility of the performative aspect of the canvas by signalling usability, understandability, capability issues.
- Create experimental and reflective space to enable co-creation as a form of reflection-in-action in order to make desirable improvements in the physical artefact, and thus on the performance aspect of the routine design. This way desirability and ownership of the canvas will increase among the participants and therefore viability increases.
- Collective exploration of the potential of a new technology during the workshop, create a radical innovation opportunity and close the workshop with clear key actions within a mutual agreement amongst the participants.
- Assess desirability of the routine design, by finding moments of moving knowledge across the technology and business boundary

Hypotheses

I believe by providing Teo, Patrick and Marion a canvas with clear steps and collective exercises will move knowledge across their technology-business and political boundary. Therefore, they are able to collectively create opportunities and a make well-considered decision. I will know I have succeeded when discussions during the workshop result in mutual agreements or actionable outputs.

Methods

The design experiments are divided in two parts: A workshop labelled as “exploration workshop” and post-workshop interviews. The workshop is a design experiment with Teo, Patrick and Marion in order to test the performative aspect of the designed routine. I created an experimental and reflective space to collectively reflect-in-action on the building blocks and reflect on interesting behaviour or surprising moments regarding the process of the workshop. The experimental and reflective space set in the workshop allow the participants to co-create in form of collective reflection-in-action to change the building blocks and the process of the canvas. By performing the routine and reflecting while performing. I stimulate the participants to rethink their actions and make desired improvements in the prototype, when they collectively agree this an improvement. I record the experiment on video to reflect and evaluate the experiments.

The second part is an individual interview, where a questionnaire and recordings will be used to capture this data. This interview will be used to assess the prototype on desirability, viability and feasibility and to retrieve a deeper understanding of workshop experience of the participants. This questionnaire will be compared with the results of other participants of the design experiment to discover commonalities or differences between Teo, Patrick and Marion.

Part 1: Exploration workshop

In the following section I describe the setup of the workshop, which boundaries are used and how these are created to set the experimental and reflective space, see 0 for the workshop session guide. The reason to have initially an exploration workshop about a new emerging technology started in both experiments with a hunch from a Teo and is therefore the initiator and owner of the workshop on content level. Since Teo is operating from Technology Centre and searching for new radical innovation project possibilities he invites the Patrick and Marion from the business units and is responsible for initiating any next steps after the workshop in order to crystalize the start a new project. All participants are actors who normally also perform the routine *(social boundary).* Prior to the workshop, all participants received an invitation e-mail from the technology scout manager for the exploration workshop where is explained that a designer will take the lead as facilitator to test a prototype in a workshop named “exploration workshop of emerging technology XYZ” *(symbolic boundary).*

I am the owner of the workshop on the process level and therefore responsible for facilitation. However, since my company mentor is an experienced designer and works at Barco for many years, he is able to speak both languages he also facilitates the workshop.

Multiple boundaries and instruments are used to set the boundaries to reach the design experiment goals and test the hypotheses. One day prior the workshop to match expectations an instruction email was send to all participants about the goals and setup of the experiment, what behaviour and role is expected from them during the workshop to reach these goals, see Appendix Q for the e-mail that is used.

The workshop takes place in a large room suitable for creative explorative workshops *(physical boundary).* At the start of the workshop the designer gives a brief introduction to set the space *(temporal boundary).* First, the agenda of the workshop is shared. Second, the goals

of the experiments are explained, why the canvas is created and why we test it within this workshop. After that what behaviour is expected will be explained and what role do the participants need to take in. The designer expects that the participants not only focus on the content level, which they normally only do, but also on the process and interaction level. They are asked to signal the designer when things are unclear, not logical, something unexpected or surprisingly happens regarding to the process of the workshop. If that happen the meeting will be paused on a content level to reflect-in-action on what did they expected, what surprised and how to deal with it in order to make the desirable change in the prototype. These improvements are executed live during the workshop and markers, post-its and empty new building block templates serve as the physical co-creation tools. The canvas is presented as an unfinished and modular artefact consisting out of the different building blocks printed on A4, this invites the participants to do hands-on co-creation. The modularity of the building blocks makes it possible to rearrange the process of the canvas and empty building block templates allows the participants to create new ones themselves when this is desired. See Figure 6-4 for this workshop setup.

Based on the guidelines from (Dittrich, Guérard, et al., 2016) to support collective reflective talk, the a four-step approach is used to reflect-in-action and enable co-creation of the protype. This approach is depicted in Figure 6-3.

The workshop will close with when there is a mutual agreement of actionable output and clearly noted which participant is going to do what for the follow up or do nothing when that is the conclusion. Participants are asked to reflect on the workshop in an interview a day later for part 2 of the design experiment.

To summarize, the following instruments are used in order to set the boundaries to create the experimental and reflective space:

- An invitation email by the technology scout for an "exploration workshop of emerging technology X" to test a prototype *(symbolic boundary).*
- An instruction email by the designer towards the participants prior to the workshop to prepare them what is expected from them during the workshop *(temporal boundary).*
- An introduction by me at the start of the workshop to set the stage *(temporal boundary).*
- Explain desired behaviour of participants; focus on content and reflect on process and interaction between participants *(temporal boundary).*
- A prototype as an artefact that represents the performative parts of the routine *(temporal boundary).*
- A large room suitable for creative workshops *(physical boundary).*
- The workshop includes participants who normally perform the routine *(social boundary).*
- Visibly for the participants a camera and a microphone are installed to record the experiment *(symbolic boundary).*
- An external actor participated as second facilitator, who is usually not involved in the routine, but is well known within the organisation to challenge people both on content as process level *(social boundary).*

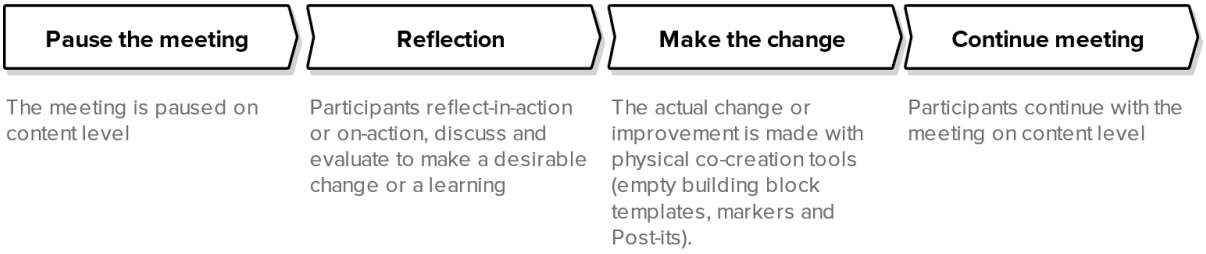


Figure 6-3 Approach during reflection moments

Part 2: Post-workshop interviews

In order to achieve the goals of the workshop and assess the routine design I conducted interviews with the workshop participants. This way a deeper understanding of their experience can be retrieved to make improvement and recommendations. Also, next steps for implementation can be discussed with the intended users. A semi-structured interview guide is used during the interviews to assess and reflect on the routine design on desirability, feasibility and viability, the interview guide is located in Appendix T. A questionnaire is used to collect quantitative answers to compare differences and commonalities in the results between participants, both questionnaire and results can be found in Appendix U and Appendix X.

Data analysis

To analyse the qualitative process data from the design experiments I followed three different analysis strategies described by Langley (1999): process mapping, temporal bracketing, and narrative. First, I created comprehensive workshop narratives in Excel per experiment. In order to create these, I followed a temporal bracketing approach to decompose the visual narratives into different “periods” in time. They are not "phases" in the sense of a predictable sequential process but, simply, a way of structuring the description of events of the workshop. If I choose a label for a certain period, it was because there is a certain continuity in the activities within each period and there are certain discontinuities at its frontiers. With this approach, a shapeless mass of process data is transformed into a series of more discrete but connected blocks (Langley, 1999). As a second step in the analysis, I distilled the key moments of collective reflection and key moments of moving knowledge across technology and business boundary. Third, in order to present these key moments in detail I created three storyboards of specific key moments that could not be included in the narratives due to their richness in raw data.

To analyse and create the narratives and storyboards I first viewed the video footage with open mind. After watching two times both experiments, I used criteria that refers to the collective reflection and knowledge boundary literature to analyse the data with more focus to subtract these key moments. The following moments where searched for:

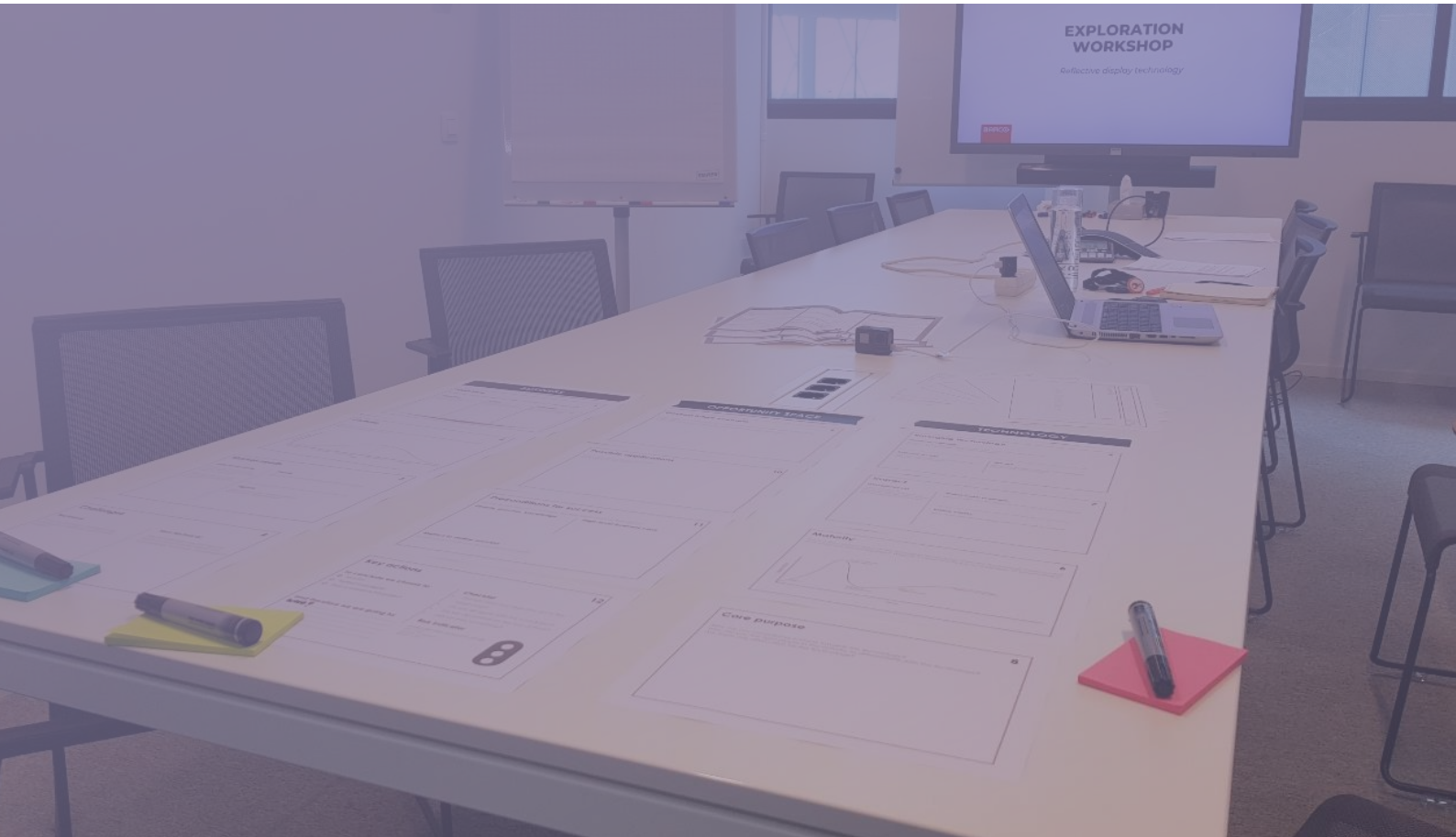
Moments of knowledge/political boundaries

- Moments of transfer
- Moments of translation
- Moments of transformation

Moments of reflection

- Moments of reflection-on-action
- Moments of reflection-in-action

Figure 6-4 Workshop setup design experiments



6.3 Iteration 3

The canvas used during iteration 3 is an improved version of the canvas from the previous iteration. This canvas is can be found in Figure 6-5 and on full scale in Appendix V. The case of design experiment is about image processing technology X.

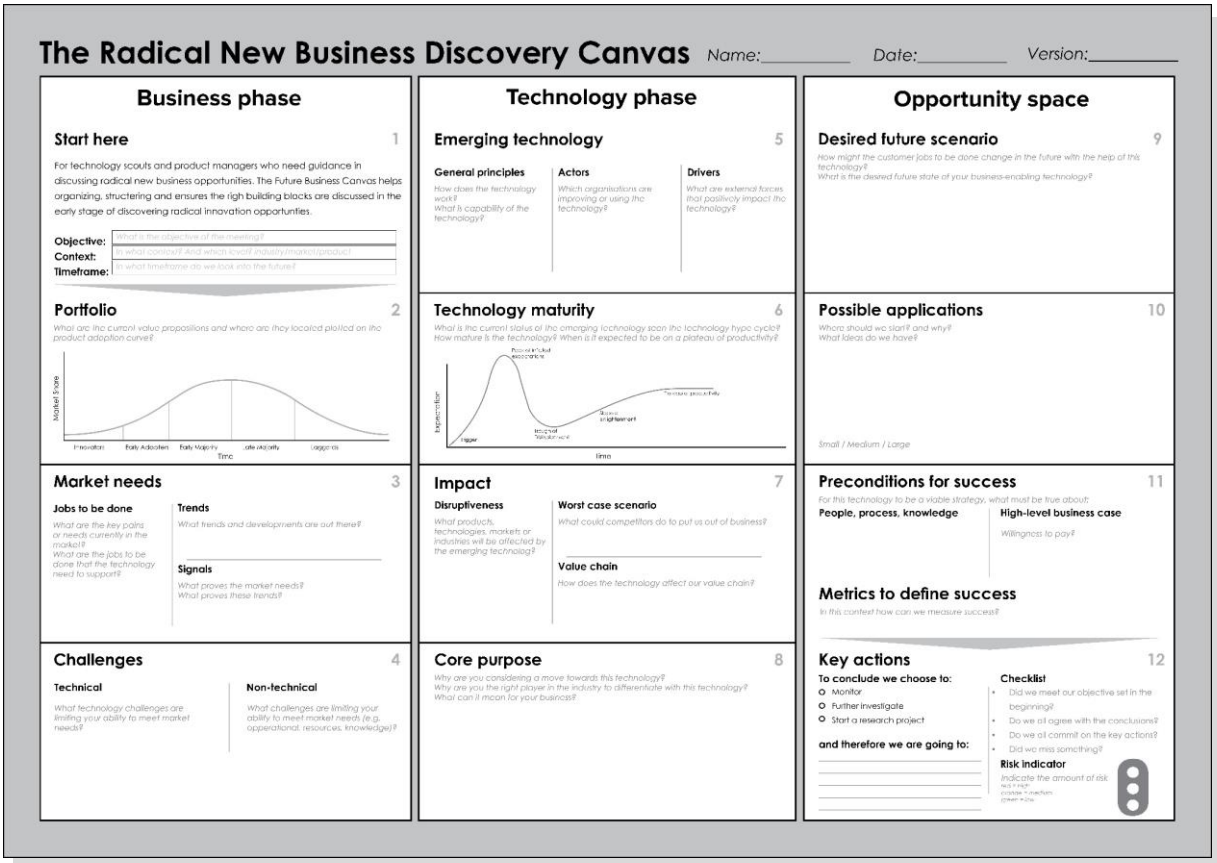


Figure 6-5 Prototype iteration 3

Figure 6-6 Teo, Patrick and Marion during design experiment 1

I will now present the narratives as a result of the analysis of design experiment 1, through visualization of the reflection moments and knowledge boundary moments. For clarity reasons I did not presented all periods, periods with fewer key moments were omitted from the narratives.

Narrative of design experiment 1: image processing technology X

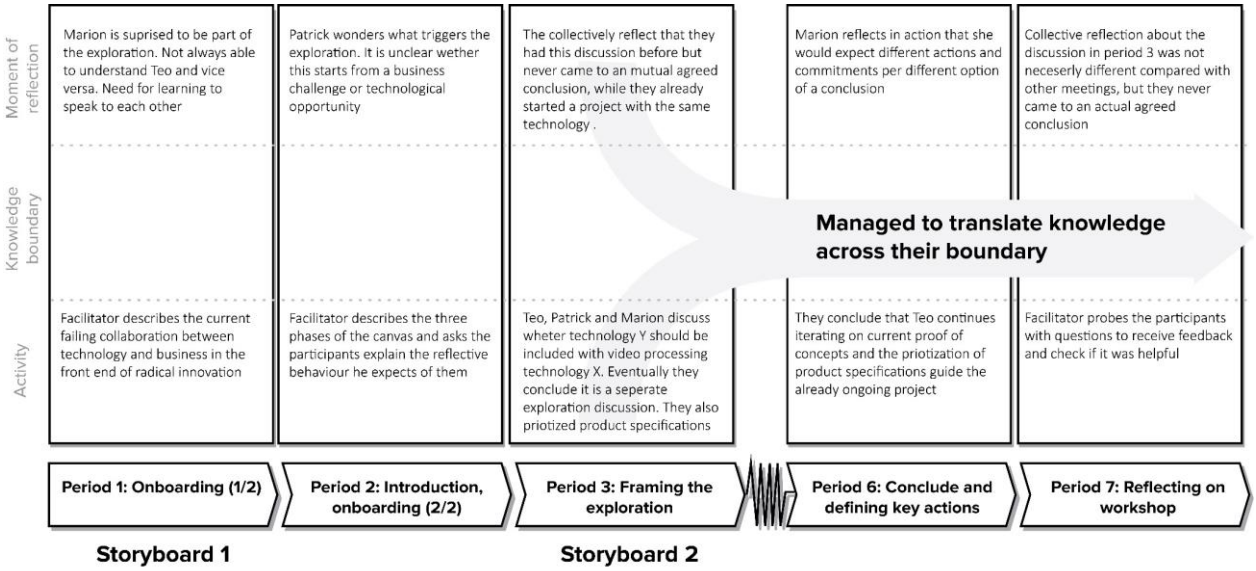


Figure 6-7 Narrative of design experiment 1

Period 1: Onboarding participants (1/2)
Facilitator gives context of the canvas and that this exploration is part of the ideation phase to start new technology introduction projects. He describes that collaboration between technology and business is still failing (to create radical innovation opportunities). Therefore, the target audience for this process is Teo, Patrick and Marion.

Moment of reflection: Marion is surprised that she is also included and thinks that for marketing this can be too far off her job description. She shares her observation that it is hard to have a conversation with Teo and to understand all technical details and for Teo to understand Marion. They collectively agree that this is indeed not her job, but she needs to understand the potential impact of the technology on the market. Marion opposes that they need to learn to speak at a certain level to understand each other. This moment is visualized in a storyboard on the next page: Figure 6-8.

Period 2: Introduction, onboarding (2/2)
Facilitator introduces the goals of the workshop, the process, explains to start with business, then technology then go to the opportunity space. And he describes the roles the participants need to take in during the workshop.

Moment of reflection: Patrick wonders what triggers this exploration. Did it started because he and Marion have business challenge or does Teo have this new technology but does not know what to do with it? They agree it can be both.

Period 3: Framing the exploration
The participants start with the first building block to set the objective and decide the context of the meeting. After an objective is written down, Teo thinks that image processing technology X goes hand in hand with technology Y and therefore should be included in the objective, Marion first agrees. However, Patrick does not agree and provides arguments with market insights to prove that should be a separate discussion. After a long discussion they all agree and Teo sums up and writes down the conclusion

Moment of reflection: After a long discussion about the objective and context of the meeting Marion deliberately stops the meeting regarding to the content and observes that in no way the process could be done in a 60 minutes

workshop. Patrick reacts that with clearer questions and without overburden statement the discussion about framing the meeting could have been significantly shorter. Marion does not agree because people could have different opinions. She reflects on action and realizes that they did not had this discussion before while they (Teo, Patrick and Marion) already started another project with this video processing technology Y. Teo adds that he thinks that they already had this discussion 6 to 7 times but never concluded wrote it down. This key moment of collective reflection is visualized in a storyboard on the next page: Figure 6-9.

Period 6: Conclusion and defining key actions

To conclude the exploration they decided that Teo continues iterating on current proof of concepts and the prioritization created during the discussion in period 3 of product features guide the project after market validation. Next to that, Teo uses this opportunity to propose customer visits.

Moment of reflection: Reflection-in-action moment of Marion, she does not understand the content of the building block: key actions. She would expect different actions and commitments per different option of a conclusion of the exploration. And to create responsibility you need an owner of the action towards the next meeting.

Period 7: Reflecting on workshop

Near to the end, due to some probing questions of the facilitator participants start reflecting on the workshop.

Moment of reflection: Participants think the structured way of discussing is desirable. Regarding to the key reflection moment at the end of period 3 they said the following: “the discussion was not necessarily different compared with other meetings, but we never came to an actual conclusion.” Teo adds: “the added value of the canvas is not filling in the canvas, but it is the discussion that takes place.”

Storyboard 1: Reflection moment Narrative 1 period 1

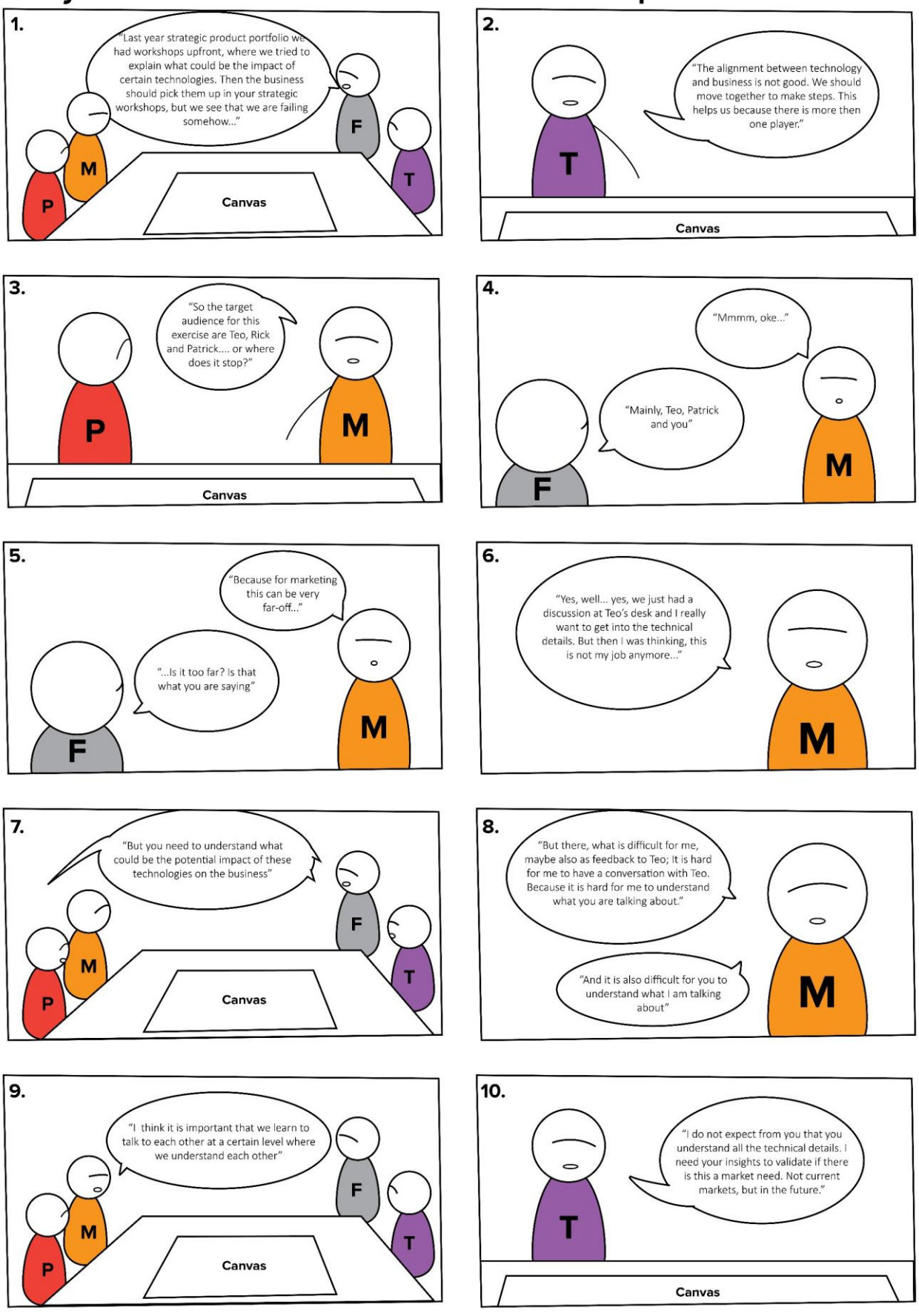
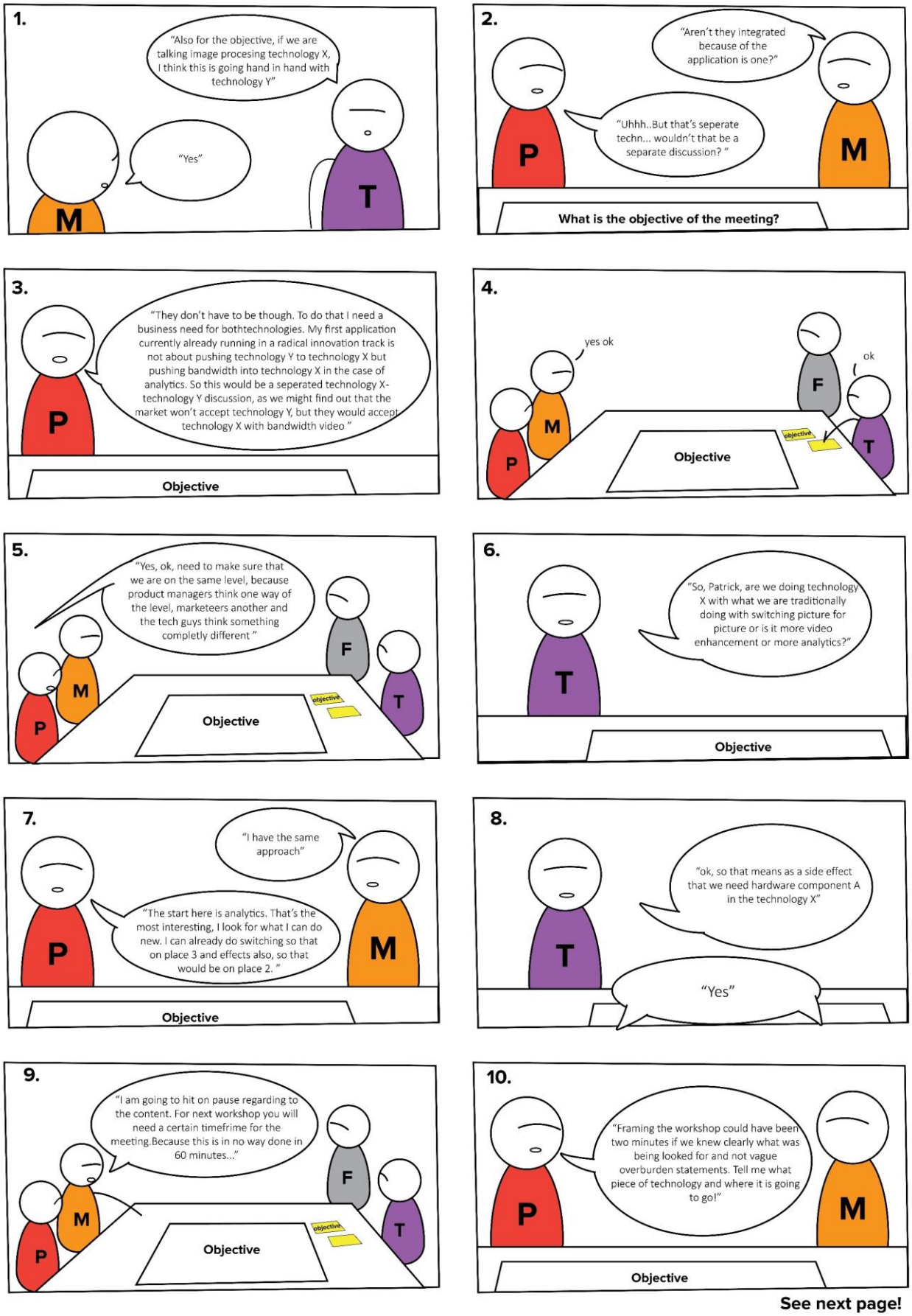


Figure 6-8 Storyboard 1 of period 1

Storyboard 2: Reflection moment Narrative 1 period 3 (1/2)



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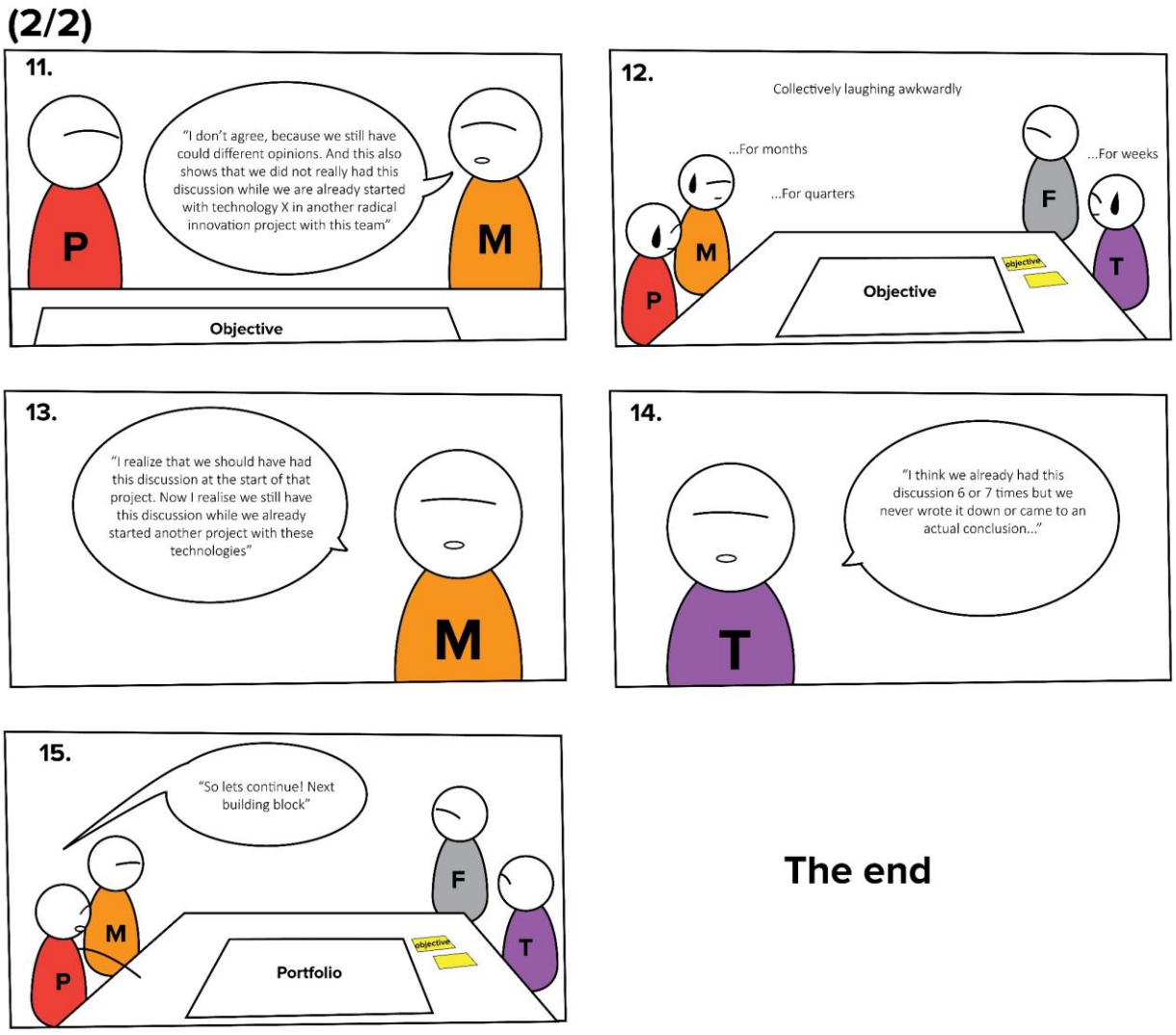


Figure 6-9 Storyboard 2 of period 3

6.4 Iteration 4

The canvas used during iteration 3 is an improved version of the canvas from the previous iteration. This canvas is can be found in Figure 6-11 and on full scale in Appendix W. The case of design experiment is about “Display technology R”

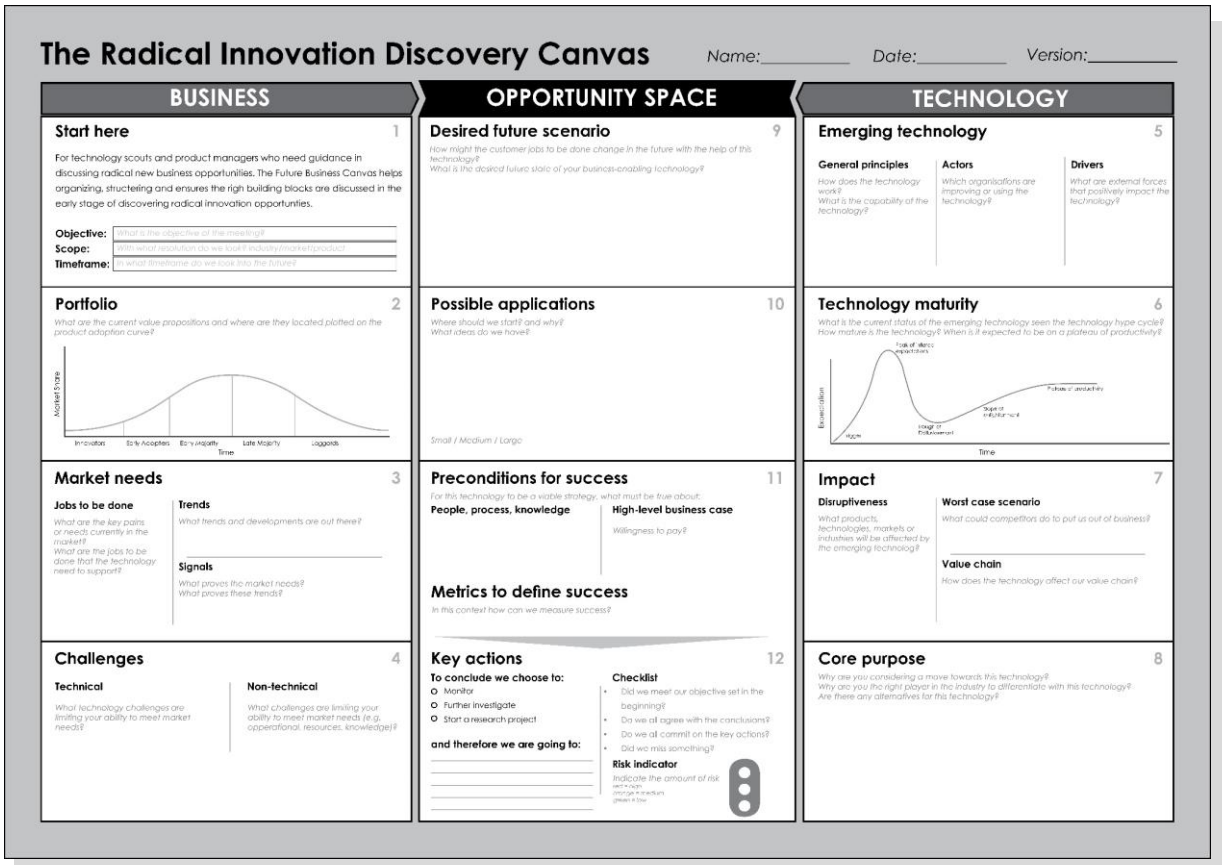


Figure 6-11 Prototype iteration 4

Figure 6-12 Teo, Patrick and Marion during design experiment 2

I will now present the narratives as a result of the analysis of design experiment 2, through visualization of the reflection moments and knowledge boundary moments.

For clarity reasons I did not presented all periods, periods with fewer key moments were omitted from the narratives.

Narrative of design experiment 2: Display technology R

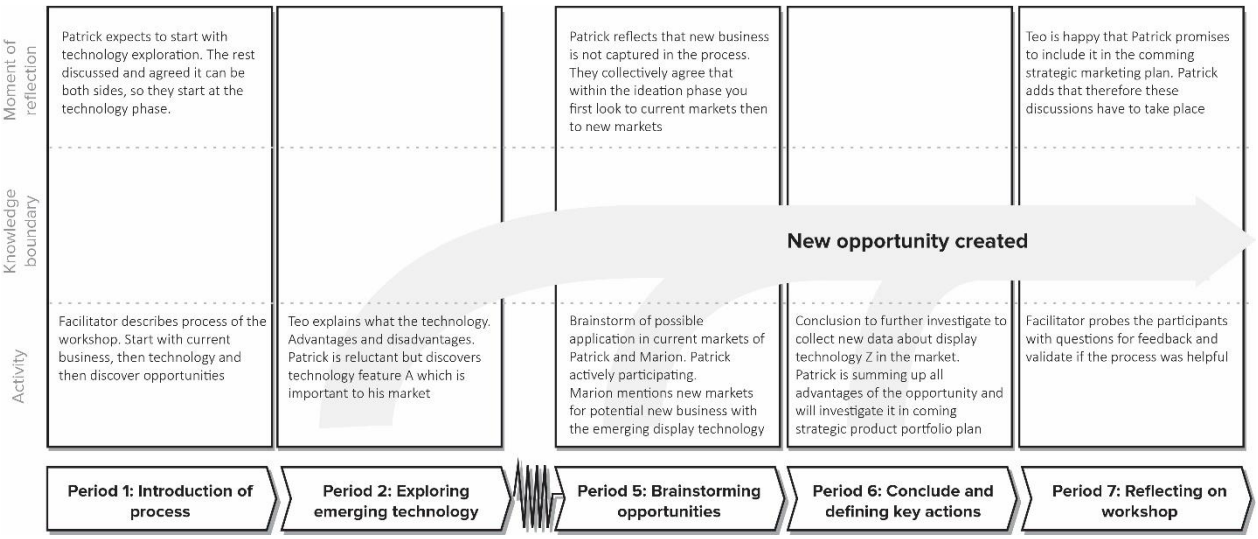


Figure 6-13 Narrative of design experiment 2

Period 1: Introduction of process
Facilitator introduces the goals of the workshop, the process, explains to start with business, then technology then go to the opportunity space. And he describes the roles the participants need to take in during the workshop.

Moment of reflection: Patrick said 'huh'. He expected to start at the technology phase. Together the participants reflected and agreed that starting these explorations could start from both sides. Within the case of display technology R, it would make more sense for them to start at the technology side.

Period 2: Exploring emerging technology
Teo elaborates on display technology R and summed up the advantages. Patrick is reluctant towards the technology. The way Teo presents looks like sales pitch. Patrick prepared many questions upfront because due to earlier meeting lots of questions arises. After a long Q&A and discussion about certain advantages, Patrick discovers technology feature A, which a great deal for him and his market. In earlier meetings between Teo and Patrick this has not been discovered.

Period 5: Brainstorming opportunities
Teo and Patrick brainstorm collectively about opportunities of display technology R in the markets both Patrick and Marion. Marion seems more absent during the brainstorm. Patrick is open minded and together with Teo he creates some possible opportunities. Marion mentions some opportunities for new markets instead of current markets

Moment of reflection: Patrick signals the facilitator, whether process wise this should be included in the process. They all agree new markets are also important to include. But they also agree that first they need to explore current markets before exploring new markets. It would be desirable to capture this somehow in the canvas.

Period 6: Conclude and defining key actions
Patrick concludes that a next step would be to include this opportunity in the coming strategic product portfolio exercise and sums up all advantages regarding the technology in his market.

Period 7: Reflecting on workshop
Near to the end, due to some probing questions of the facilitator participants start reflecting on the workshop.

Moment of reflection: Teo is happy that Patrick is (finally) including this opportunity into their coming strategic exercise in the business unit. Patrick reflects that these discussions therefore take place

6.5 Findings

From the two narratives of the design experiments I elaborate on three key findings. These key findings illustrate the value of performing the designed artefact with the routine actors within a reflective and experimental space of a design experiment.

The first key finding derived from the first case, Marion reflects that there is an interpretive knowledge boundary between her and Teo and they collectively reflect that they should learn to create a shared meaning of words in order to collaborate efficiently between their technology and business specialisation. There was a new Patrick and Marion participating in the experiment and therefore they were not familiar with the project or the artefact and its purpose. Marion started questioning the facilitator why she is included in the target group for these exploration meetings between Teo and business managers, because for marketing managers exploring the potential impact of new emerging technologies and exploring radical innovation opportunities seemed at bit far off her capability. These early stage discussions when technical details seem too complex for her. She says: "For me it is really difficult to have a conversation with Teo to understand what you are talking about, and for you it is also hard to understand what I am talking about." This clearly shows a validation that these two specialisations within the organisation have an interpretive boundary which is in line with current available literature on knowledge boundaries (Carlile, 2004) because they do not manage to have a shared meaning of words to move knowledge across their boundary in all discussion. Something that should be noted her is that Marion is new in her role as marketeer and came from a different role from a different business unit. Something that was not visible in the results, but definitely worth mentioning because from what I observed during the experiment and what she told me in the post-interview; she is still discovering her position and her role as marketeer.

The second key finding is also related to the first case. Teo, Patrick and Marion collectively reflect, after a long discussion about two technology interpretations, that they managed to translate knowledge across their interpretive boundary which could not be managed in earlier discussions. Teo proposed that image processing technology Y goes hand in hand with image processing technology X and therefore should be included in the objective of the meeting to explore. In the first place, for Marion and Teo these two technologies were interdepended, but for Patrick the second technology would be another exploration meeting. After a long discussion they came to a mutual agreement that indeed image processing technology Y would be another discussion thus another meeting. Marion reflects on this moment that they finally managed to have a shared understanding of the two processing technologies, and collectively they awkwardly laughed this moment away. However, they realize that they should have had this shared meaning of words at the start of another project that already started months ago with both these technologies. They admitted that they already had this discussion six or seven times but never came to an actual conclusion or agreement.

The third key finding derived from the second case around the exploration of display technology R during iteration 4. As literature stated that reflective spaces are associated with the generation of new variations or ostensive patterns, experimental spaces are where "real change" in performances is seeded (Bucher & Langley, 2016). After introducing the approach of the meeting, I explained to start with the business phase, then technology phase and to create new opportunities in the last phase. Patrick immediately reflected in action that it would make more sense to start with the technology phase in their specific situation. The actors discussed this proposal and collectively agreed that indeed radical innovation could start from both a business as a technological point of view, and for their situation it is more desirable to start with exploring the new technology. During post experiment interviews, Patrick explained that it surprised him that they should start at the business phase, while he had lots of questions about this new technology. Questions that derived from previous meetings between Teo and Patrick and that were still unanswered. Patrick was sceptical about this technology resulting in a reserved attitude from him at the beginning of this meeting. But after the technology exploration Patrick and Teo came more and more to a consensus about this new technology and opportunities for projects. Patrick understood the technology and discovered a key feature of this technology. Meaning that they managed to transform knowledge and created new knowledge: a new opportunity.

Moreover, based on post-experiment-interviews with Teo, Patrick and Marion, I found that the support from the canvas and a facilitator was desirable for them during their exploration meetings. They reflected on past experiences of meetings with too many stakeholders (20-30 people) already in the early stage of an immature potential project. As Patrick said: "People are just hearing each other out and this makes it sometimes chaotic." These meetings are normally not supported or guided to build towards a collective consensus. However, as they mentioned, the actions they performed, that were

captured and supported by the canvas, were not necessarily new to them. But the process and facilitation of the workshop was. They never discussed them in a structured process, guided by an objectively facilitator, to explore both sides (business and technology) and then collectively converge towards new opportunities. This approach for exploring opportunities helped them to have a formal process and increase their discovery capability because they managed to collectively create a new radical opportunity, which they did not succeeded before. This is in line with literature, where the highest idea success rate is found when the vast majority of radical ideas are selected through a formal process (Lee & Markham, 2016).

6.6 Discussion

The goal of this chapter was to build the ostensive part of the routine by performing the designed performances, developed during iteration 1 and 2, within specific boundaries of the reflective and experimental spaces of the two design experiments. In particular, I wanted to validate if Teo, Patrick and Marion managed to move knowledge across their knowledge and political boundary in order to create new (novel) knowledge. In other words, if the designed performances that were captured in the building blocks of the canvas helped the routine actors in their efforts to collectively create new radical innovation opportunities and thus if this process were desirable for them.

There are three key findings. In the first case, Marion reflects that there is an interpretive knowledge boundary between her and Teo, they collectively reflect that they should learn to create a shared meaning of words in order to collaborate efficiently between their different specialisations. Also, in the first case, Teo, Patrick and Marion collectively reflect, after a long discussion about two new technology interpretations, that they managed to translate knowledge across their interpretive boundary which could not be managed in earlier discussions. Furthermore, in the second case, Teo, Patrick and Marion reflect in action to change the process of the meeting. and managed to transform knowledge to create a new opportunity which could not be managed in earlier exploration discussions between them.

The way I designed the experiment and the results it had, there seems to be a link with the hypothesis I formulated. My hypothesis was: “I believe by providing Teo, Patrick and Marion a canvas with clear steps and collective exercises will move knowledge across their technology-business and political boundary. Therefore, they are able to collectively create opportunities and a make well-considered decision. I will know I have succeeded when discussions during the workshop result in mutual agreements or actionable outputs.” The target group managed in one case to move knowledge across their boundary and in another case, they created new knowledge by creating a new opportunity, which in both cases the actors were not able to manage in earlier meetings. It seems that this setup for these exploration meetings created the desired effect. In other words, the canvas (physical artefact) within the design experiment created the desired performance of Teo, Patrick and Marion. Something that could not be achieved in the case of Feldman & Pentland (2008), where the implementation of the carefully designed artefact (software package) failed during implementation. I argue that this is related with the different approaches to design and practice the artefact. In the case of software package, the implementation team was responsible for developing the requirements and implementation. Their implementation failed because there was a disconnection between the artefact (software package) and the actual needs and work process of the routine actors (Feldman & Pentland, 2008). To prevent this disconnection in my project, I was constantly searching for this connection, or even developing this connecting throughout the three phases of the routine design strategy. And thus, connecting the needs of Teo, Patrick and Marion with the canvas I was designing. I was translating their needs into the canvas, and therefore the canvas resonated with their needs as we saw in the experiments. I suggest, that the approach of close collaboration between routine actors and the designer of the artefact is something that the case of Feldman & Pentland (2008) missed and resulted in implementation failure.

6.6.1 Role playing for routine change

As stated in the literature, when new actors are present, interpretive differences in what a word means limits to effective manage knowledge between actors (Carlile, 2004). In order to change a routine my suggestion here would be to consider new actors, or role playing in order to stimulate collective reflection during design experiments to create a shared meaning of words. As Dionysiou and Tsoukas (2013) argue that in the initial stage of routine creation that routine actors have to develop shared understandings and definitions about their roles, means and outcomes to guide their actions. Through role playing, routine actors try to develop a mutual understanding and to align their actions (Dionysiou & Tsoukas, 2013). This might explain why in the first case Marion in her new role as marketing manager created these reflection moments. This case shows that Marion was questioning lots of things throughout the experiment and reflecting on the things that were happening and what she was observing. This attitude and reflective role she had was valuable for the rest of the group since this resulted in collective reflection and learning moments for the rest of the group. Therefore, role playing or including new actors within routines are interesting because of the naturally reflective modus it brings with it. Let actors step out of their comfort zone because it leads to questioning their own role and reflecting their actions.

6.6.2 Collective reflection to create learnings for future actions

As suggested in the literature, I see in the case narratives that it is desirable for routine actors to create space for collective reflection during design experiments in order to create learnings about their actions (Wegener, Guerreiro Gonçalves, et al., 2019). Collective reflection provided Teo, Patrick and Marion a key insight that they did not had a shared meaning of words of two technologies. Their collective reflection moment created a learning for them that a shared meaning is required to collaborate efficiently. Therefore, I suggest using collective reflection as mechanism during routine performances to reflect and learn from these reflection moments to change future situations. This is in my opinion key in routine change, because this way routine actors change their actions over time and therefore change the routine.

6.6.3 Experimental space to make desirable changes in action

As suggested in literature, the reflection-in-action moment during the second case helped the actors to reflect on the process and make changes that helped them to reach the goal of their meeting (Wegener, Guerreiro Gonçalves, et al., 2019). My suggestion here would be to use experimental space within design experiments to stimulate the actors to make desirable changes within the process if this helps them to reach the goal of the meeting. Within the experimental space actors were free to reflect on their patterns of actions and to try new patterns, which in the second case was desirable to make a change.

Future research

As described the routine actors managed to move knowledge across their boundaries within the design experiments. But what did actually cause that they managed to do so. Was is the canvas? Was it the support of the facilitation? Was it the design experiment? Was is the collective reflection? Was it the experimental or reflective space? Was it because of their earlier discussions? To answer these questions, I suggest conducting more design experiments and using different techniques in these experiments to see what the effects are on the hypotheses. If I would do another iteration and run a design experiment, I would start by not introducing the reflective and experimental space to compare these results with the results I obtained in iteration 3 and 4. Because for me it seemed that the reflection moments were key, but it would be interesting to see what behaviour occurs among the actors during their performance without stimulating their reflective attitude.

Furthermore, the goal of the third phase of the routine design strategy is not reached within two design experiments. I cannot tell of the actors developed the ostensive aspect of the routine in order to perform it again. They need to keep investing in the ostensive and keep practicing together. It would an interesting direction for future research to know when the ostensive aspect is mature enough to stop experimenting, prototyping and facilitating these meetings. Or is it even more desirable to never stop with the reflective and experimental space during their meetings in order to consciously evolve the routine over time with desirable changes? This way routine actors would become their own designers of their routine, it would be interesting to study how this could be achieved and what the role of the designer would be.

6.7 Conclusion

The goal of the two design experiments were to build the ostensive aspects by practicing the designed performances that were developed during phase 2 of the strategy. But also, to validate the desirability of the designed performances and if Teo, Patrick and Marion manage to move knowledge or create new knowledge in order to create new radical innovation opportunities. These design experiments were part of routine design strategy phase 3.

The two organised design experiments with the canvas and experimental and reflective space helped Teo, Patrick and Marion to perform the new routine and to reflect-in-action on their performance and to reflect-on-action on past performances collectively. This provided them multiple insights. In the first case they reflect that they managed to translate knowledge across their knowledge boundary and the second case that they managed to create a new radical opportunity (new knowledge), which in both cases could not be managed in earlier meetings.

Teo, Patrick and Marion mentioned in post-design experiment interviews that the exploration meetings were desirable with a smaller number of decision-makers in the room, facilitated by a formal process and a facilitator to support their ideation process.

However, in both experiments they did not manage to finish the process in the given time and the actors were questioning lots of different aspect regarding their performances in action, performances of past actions, the process and collaboration challenges between Teo representing the technology centre and Patrick and Marion from the business units. Therefore, in order to build the ostensive aspect of the routine they need to invest in it much more. They need to practice, reflect and receive feedback, just like how football teams practice together and improve their capabilities over time. This process needs to be facilitated, just like football teams have trainers and coaches. My ideas on this will be discussed in the next chapter where I present the final iteration with new ideas gained during the design experiments in iteration 3 and 4.

Figure 6-14 Teo, Patrick and Marion performing during design experiment 2

Chapter 7 | The Solution

This chapter describes the final iteration by explaining all building blocks that are captured in the canvas. Firstly, it presents the final version of the canvas. Secondly, it describes the building blocks of the canvas with regards to how they were performed during the design experiments. Lastly, this chapter closes with an evaluation based on the three lenses of Design Thinking and recommendations for further development.

Chapter 7 | The Solution

7.1 Introduction

Radical innovation is seen as a seen as crucial for long-term survival for technology firms because it sets foundations for new business and product generations. However, many of these organisations do not have mature radical innovation capability. Phase 1 of the design strategy found that radical innovation is seen as high risk for Patrick and Marion and tend to focus more on incremental innovation which results in a political boundary between them and Teo, who wants to start new radical innovation projects. Phase 1 also reveals that there is currently no formal process to support them in their efforts to create new opportunities. On top of that they misuse conventional analytical tools too early in the process to evaluate still immature radical ideas. And because of the two specific specialisations within Barco there is a knowledge barrier between technology managers (Teo) and business managers (Patrick and Marion).

In order to help them, a design brief was defined based on these findings. The solution to the design goal has to be a routine that supports collaborative exploration meetings between Teo, Patrick and Marion to create radical innovation opportunities. This routine needs to create a shared language for creating, developing and assessing these opportunities.

This chapter explains this designed routine with the use of a physical artefact named “Radical Innovation Discovery Canvas” that contains the desired and required performance aspects of the routine. These performance aspects are the result of multiple feedback sessions and two design experiments with the target group from phase 2 and 3 of the routine design strategy. This exploration meeting helps Teo, Patrick and Marion to bridge the knowledge and political gap between technology and business. Furthermore, this chapter closes with an evaluation and I propose further developments.

Figure 7-1 the Radical Innovation Discovery canvas used during iteration 4

7.2 What is it?

The Radical Innovation Discovery Canvas is a physical artefact that enables the desired performance of technology and business managers in exploration meetings. The canvas builds and combines elements of existing processes and tools to create a shared language for creating, developing and assessing new radical innovation opportunities. It bridges knowledge and political boundaries by providing concrete methods and tools that support explorative discussions between technology managers and business managers in their collective ideation phase.

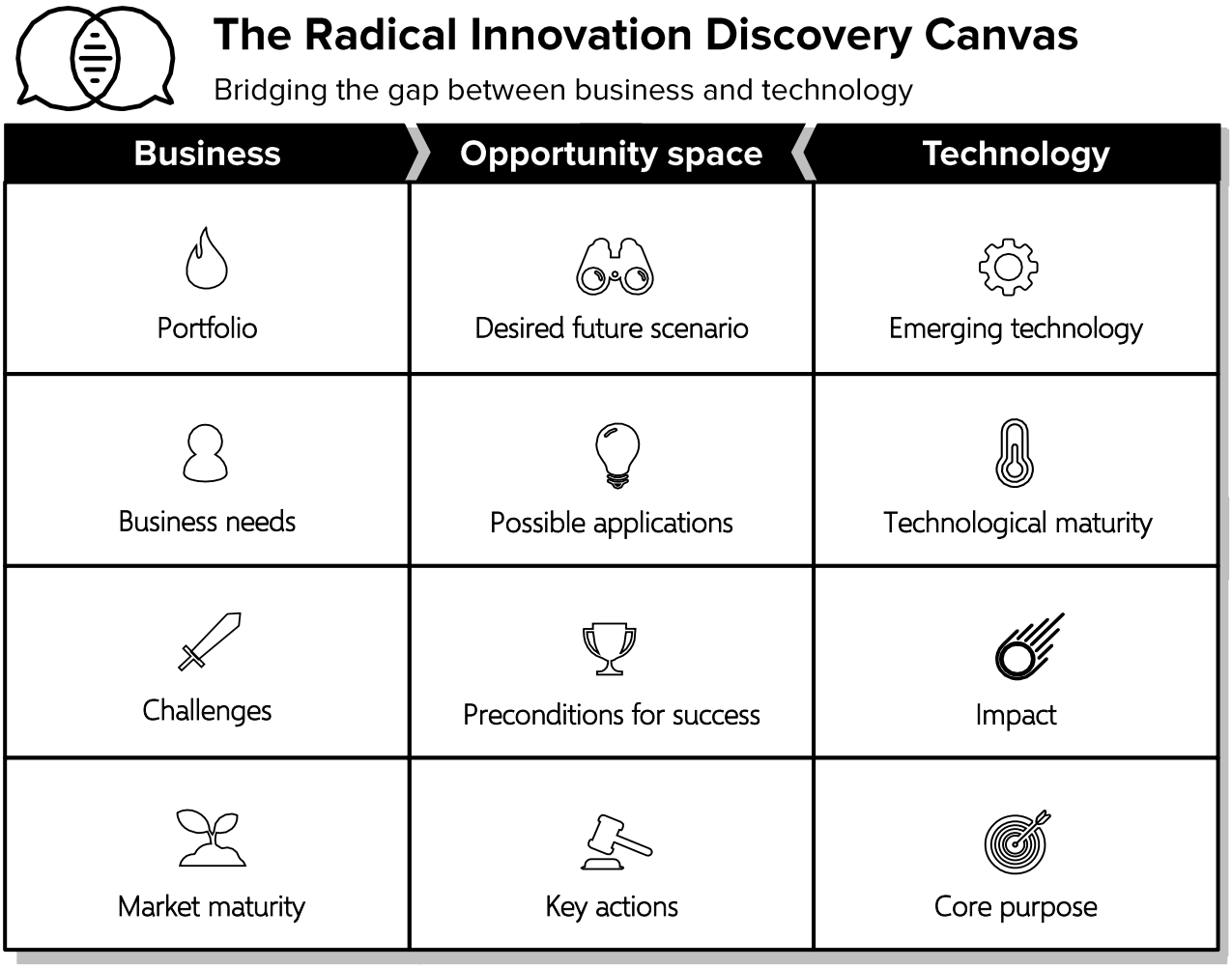


Figure 7-2 The Radical Innovation Discovery Canvas

Routine Vision Statement

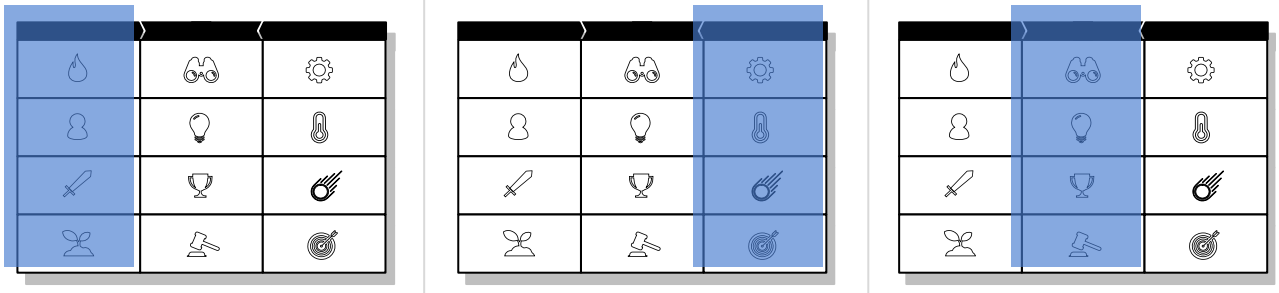
For	technology managers and business managers that aim to create and develop radical new products
Who	need guidance in their collective explorations around new emerging technologies and their potential value
The	Radical Innovation Discovery canvas is a process
That	supports exploration meetings by performing the required building blocks to create and articulate collectively new radical innovation opportunities
Unlike	existing creative processes
This	process considers that two different specialisations need to move knowledge across their boundary in order to create new novel knowledge

Figure 7-3 Routine vision statement

7.3 How does it work?

The following section describes the process how it is used during the design experiments and how it was created during the development phase. The radical innovation discovery canvas starts with framing the meeting, followed by three phases and ends with key actions for a possible next meeting. Before entering the first phase it is necessary to frame the exploration to enable the facilitator of the meeting to steer the discussion. Therefore, the participants of the meeting first set the meeting objective, scope, timeframe and describe the hunch.

The first phase "business" is the aim to find out what is happening in the business landscape, what are the needs, challenges to meet those needs and how mature the market is regarding this new emerging technology. During this phase, both Patrick and Marion are able to take the lead in the discussion. The second phase is called "technology", in which the goal is to understand how the new emerging technology works, how mature the technology is to productise and the potential impact on the business landscape. During this phase, Teo takes the lead. The third phase is called, "opportunity space", which aim is to sketch a desired future scenario and generate possible radical opportunities. This phase closes with key actions regarding to the conclusion of the meeting. Each of the phases has their own tools, methods and steps which will be described in the following sections. See Figure 7-4 for the overview of the three phases.



Business exploration | Technology exploration | Opportunity space

Figure 7-4 Phases of the process

Before you start

Set the objective, scope, timefrime and describe the hunch

Business	Opportunity space	Technology
Portfolio	Desired future scenario	New technology
Business needs	Possible applications	Technology maturity
Challenges	Preconditions for succes	Impact
Market maturity	Conclusion & Key Actions	Core purpose

Objective

What is the objective of the exploration meeting?

Scope

With which scope do we explore? On industry, market, or product level

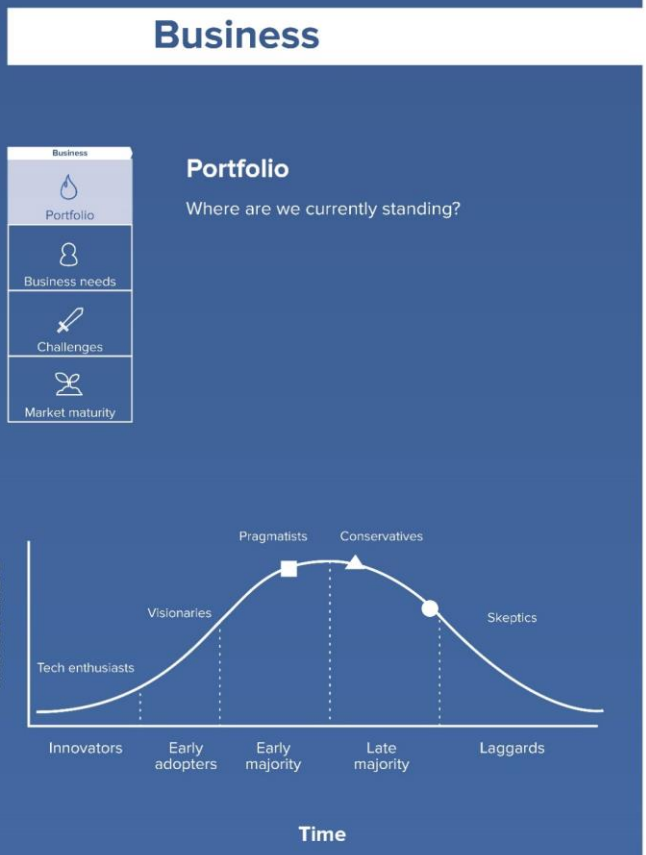
Timeframe

When should the product be on the market?

Hunch

Why is this meeting initiated?

Facilitator	Facilitator, someone with both knowledge from users, business and technology
Participants	Technology manager, Product managers, Marketing manager
Materials	Printed canvas, Post-its, Camera, Room space and wall space, Markers
Intelligence	Technology: Papers, sketches, expaination slides Business: market insights, user insights; trend reports, interview quotes
Time	2 hours



Business phase

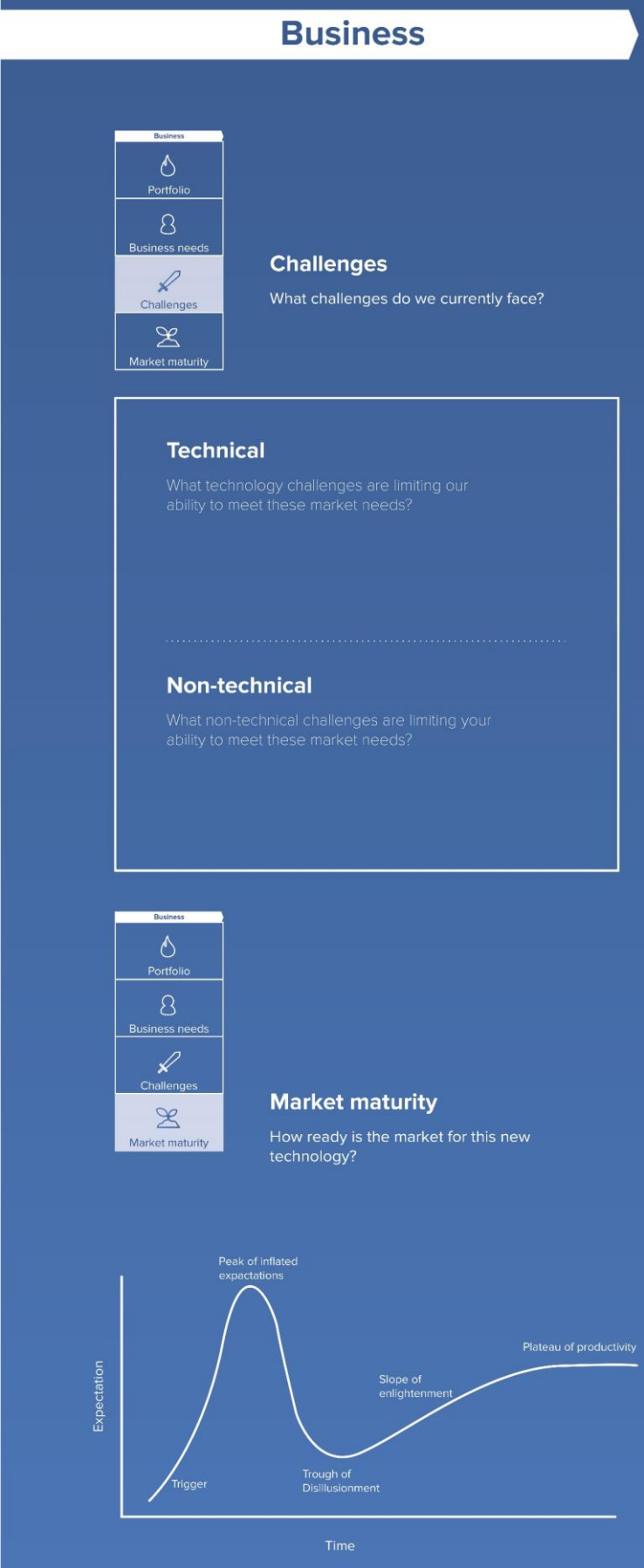
Portfolio

The business phase starts with evaluating the current product portfolio. With the use of the product adoption life cycle curve the Patrick and Marion evaluate how urgent it us to start new projects because of a possible “burning platform”. It is a widely used model by business managers that reflect who is buying their product and when. The routine actors plot the current portfolio that fit within the scope on the curve and evaluate the urgency for radical innovation. If there are lots of products on the right side of the curve the urgency is high. If the products are mainly plotted on the left side of the curve the routine actors should probably consider first to focus on growth on those businesses before starting to explore new potential radical innovations.

Business needs

The second building block of the business phase is all about diving into the business landscape and exploring what is happening in the market. Within the scope of the exploration Patrick and Marion use the signals they received during customer off-site visits, customer problems and business trips to describe the jobs to be done for their customer. Next to that, trends and developments are explored and works best if Marion prepares a trend analysis prior the exploration meeting to also share the evidence with the rest of the group. At this step of the process mainly Patrick and Marion take the lead in order to explain Teo what is happening in their market and what the customers pains and needs are. It helps if they provide visual of their evidence to transfer the knowledge to Teo and make things clear for him.

Important for the facilitator that the routine actors do not look to narrow into their own markets, but also explore marked trends, developments in other markets.



Challenges

As a next step in the process Teo, Patrick and Marion discuss which technical and non-technical challenges are limiting or disable them to meet the market needs defined in the previous step. Technical challenges are regarding to the technology that is unable to meet the market requirements. For example, certain projector technologies not able to provide the amount of brightness and color contrast for the desired cinema experience. Non-technical are challenges with regards to for example market acceptability or Barco's place in the value chain with buyers and suppliers. This step is important to Teo, Patrick and Marion because it provides them insight about potential opportunity spaces.

Market maturity

The last building block of the business phase was in earlier feedback session and the two design experiments included in the technology phase, since it seemed that this exercise was linked with technological maturity. However, in the last experiment Teo proposed to use Technology Readiness Levels (TRL) to evaluate the technological maturity. Gartner's Hype cycle is a graph that visualizes how ready the market for a specific technology and therefore indicates the market maturity regarding to the new technology. For example, Google glasses with AR technology was introduced years ago to the market. The market was not ready at the time and the project was killed somewhere between the peak of inflated expectations and trough of disillusionment. Nowadays, the first applications of AR with the Microsoft HoloLens are adopted by the market which indicates that this AR technology in some markets reached a plateau of productivity and therefore those markets are mature enough to adopt these new products. The routine actors use Gartner's Hype cycle to evaluate how mature the market is with regards to the new technology that is explored during the meeting.

Technology phase

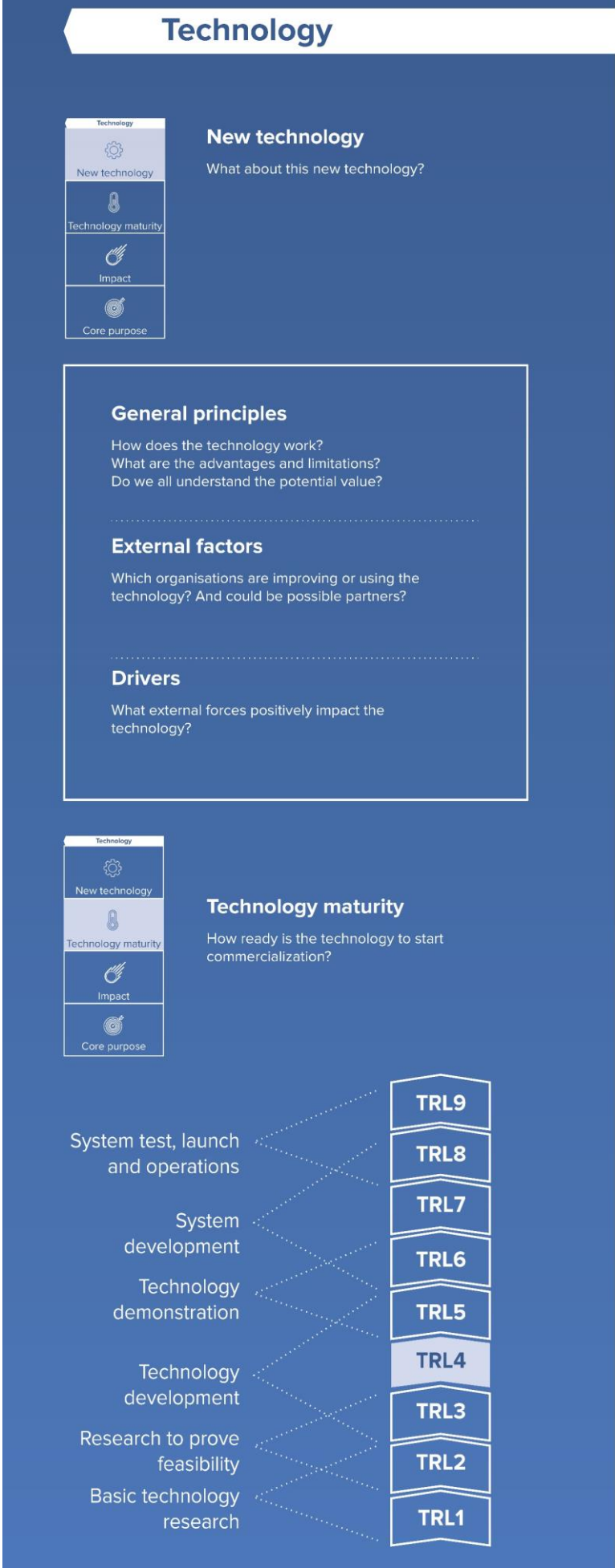
New technology

The technology phase starts with describing the new technology, if it is really new to Patrick and Marion, Teo takes the lead here to explain the general principles. Moreover, what are the potential advantages and limitations to create a clear view of the potential capabilities of the technology. Next to that, the external factors and drives will be discussed. External factors are a useful subject to indicate which organisations already work with the technology to learn from them or that could be possible partners. Also, if there are almost none other organisations researching the technology gives an indication that the technology is still too immature to develop a product out of it. Drivers indicates which external forces positively impact the technology like legislations for example.

Important for the facilitator that he instructs Teo to prepare visual material to explain the technology for Patrick and Marion, if they are unfamiliar with the technology.

Technology maturity

The next step of the technology phase uses the Technology Readiness Level (TRL) to evaluate the maturity of the technology. The scale of levels indicates the maturity of the technology, TRL 1 represents the lowest maturity; the technology probably is only researched at universities or other fundemental research labs, the technology is still unproven, and no testing has been performed. This indicates that the technology is not ready for commersialisation. TRL 9 represents the highest maturity; the technology is proven to be feasible and thus ready develop applications with it, at this level the technology is available for customers. For Teo, Patrick and Marion regarding to radical innovation the most technologies start to be interesting from TRL 4. The TRL level of the technology that is explored indicates how many and which steps have to be taken in order to increase feasibility.

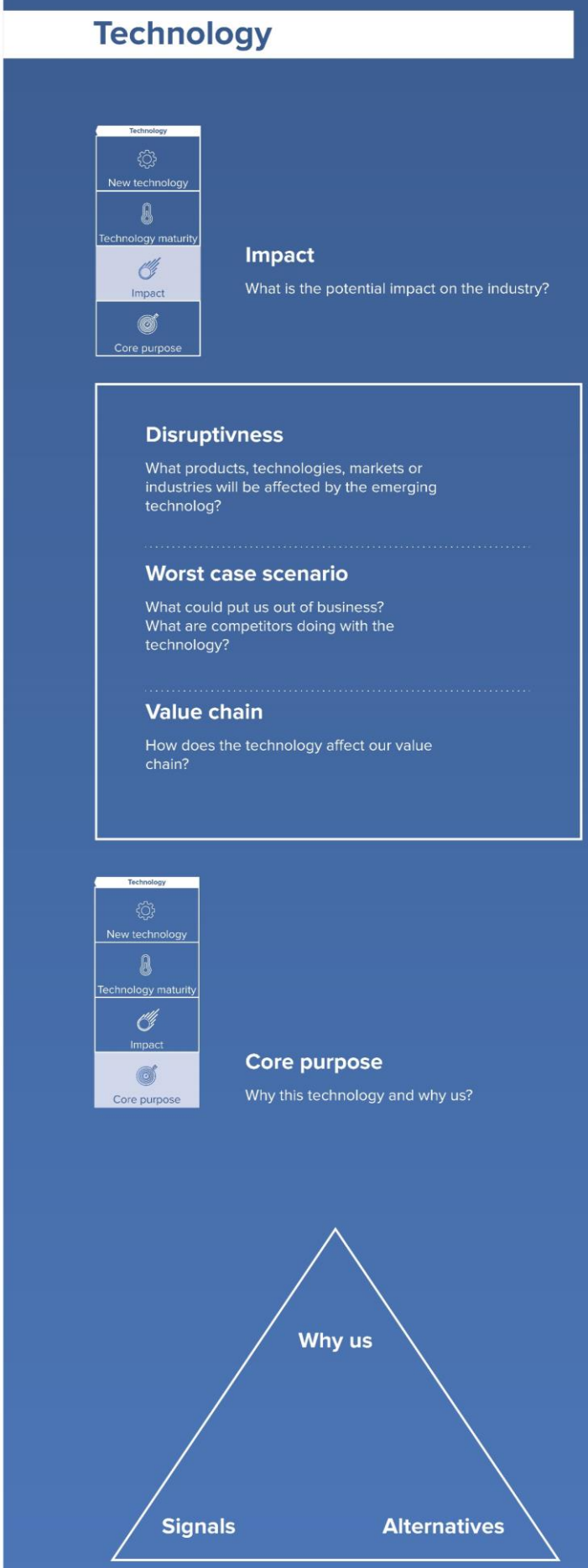


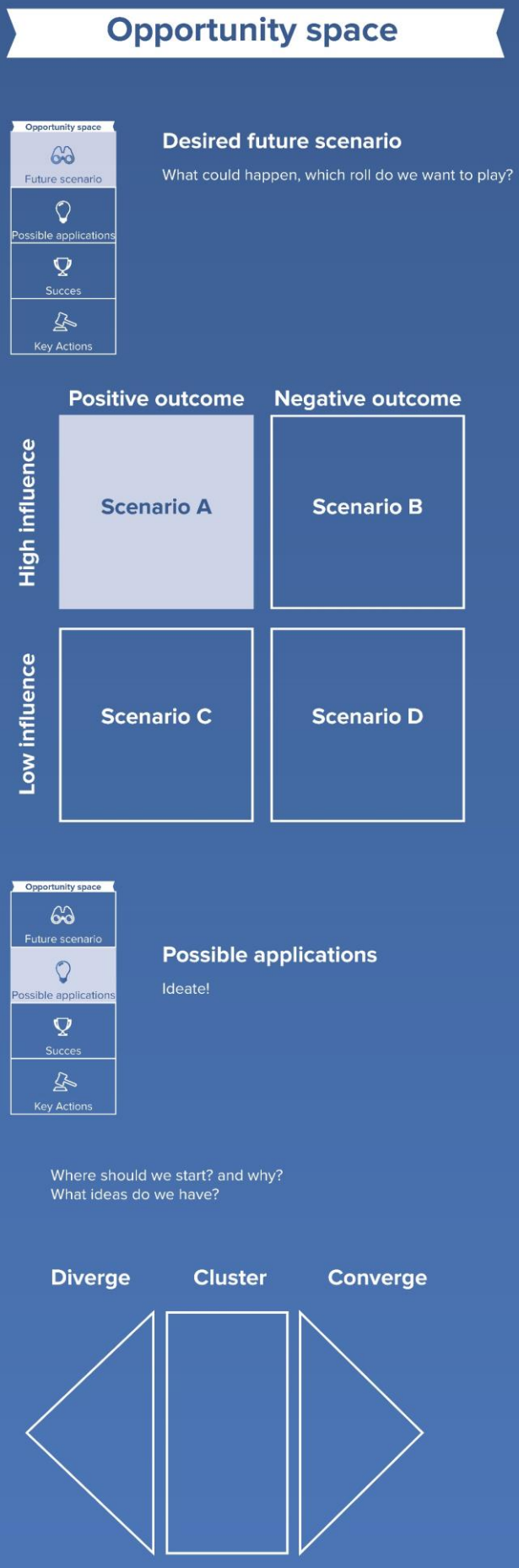
Impact

In the third building block Teo, Patrick and Marion explore the potential impact of the technology on the industry, markets or their current product portfolio. From the knowledge Teo has about this technology and the market knowledge from Patrick and Marion they try to argue how disruptive the technology can be. This is also done by looking at the worst-case scenario and discuss what other organisations could do put them out of business. Also, the value chain is analyzed to see how the new technology affects their value chain. The input that is created in this stage is important during the opportunity space when Teo, Patrick and Marion create different possible scenario's.

Core purpose

In the last step of the technology phase Teo, Patrick and Marion discuss why they are the righ player to move towards this technology or why they should start working with the new technology. Therefore, they consider the signals they have from the industry and the value chain. Are they able to start researching this technology seen their position in the value chain? Maybe there are also other alternatives to this technology that solves indicated problems, or other solutions that this technology could provide with significant value to the market?





Opportunity space

Desired future scenario

The opportunity space starts with developing scenarios. This step is important to explore multiple scenarios because of the high technological and market uncertainties at this point of the process. With the knowledge that is brought to the meeting and now that we know what we know, what will happen in the future, and what would be a desired future scenario. And seen this future scenario, which roll does Barco want to play? A model can be used to split the different outcomes of the scenario and the amount influence Teo, Patrick and Marion have on this scenario. From these scenarios, multiple assumptions could be subtracted and is used as a stepping stone for the ideation during the next step.

It is important for the facilitator to make sure that Teo, Partick and Marion not only focus on one specific scenario. It is important to challenge them that there more possible scenarios could be the truth at this point. Make sure that the explore different scenarios to be open minded towards the future.

Possible applications

Now it is time to create different opportunities with regards to the scenario's that were developed in the previous step. This can be done with creative facilitation techniqies and creative sessions to generate ideas.

Important for the facilitator to facilitate the creative process and provide Teo, Patrick and Marion the right tools to articulate their ideas.

Preconditions for success

To be able to realize the ideas and possible applications created in the previous step what are the preconditions to make a success. What has to be change internally, considering the people within the organisation, the current processes and the knowledge that is not within the organisation yet. Furthermore, a high-level business case can be formulated in order to create a feeling of viability of the opportunity. But this should be just a back of the napkin calculation, since predicting the right numbers at this point of the process is impossible.

Conclusion & Key actions

The last step of the process is to conclude the meeting and define and divide the key actions from this conclusion. The four options in the context of Barco are to: (1) monitor the technology in the following “X months” and meet again after these months, (2) investigate further and gather more intelligence to be able to create opportunities or to conclude that it is not time to dive into opportunities, (3) start a new project and certain actions have to be taken to start the project, (4) start incubation outside of the business because there is no place within the existing business units to start incubating this promising opportunity. Depending on the conclusion different key actions are divided among the participants.

It is important for the facilitator that participants give commitment to their actions and that people get de-briefed and a follow up meeting to iterate is planned. This is of course not relevant if the conclusion is to do nothing or wait a couple of months to monitor the technology.

7.4 Evaluation & recommendations

The solution I presented in this chapter was the fifth iteration on the canvas. In this section I evaluate the canvas based on all iterations of the previous chapters with the three lenses of design thinking and I propose further developments.

7.4.1 Evaluation

I evaluate the canvas based on the three lenses of Design Thinking: desirability, feasibility and viability.

The results from the two design experiments validated that the designed exploration meeting with the canvas between technology and business managers is desirable. This is indicated during the experiments and in post-interviews with the routine actors. In both design experiments with the canvas the actors managed to translate and transform knowledge across their boundary in order to create new radical innovation opportunities that could not be achieved in earlier meetings. And the ability to create, articulate new radical innovation opportunities is the main activity to develop a mature discovery capability. According to my company mentor new meetings are planned after the two experiments because people were eager to follow up their opportunities. This also validates that this approach for exploration meetings were desirable to help them with their efforts to innovate radically. Also, another exploration meeting took place with new participants and another case of display technology Q, this shows another validation for desirability.

However, much more practice is needed to make it more feasible within the given time, the actors were not able to finish the workshop in time and it took them lots of discussions in order to conclude during the exercises of the building blocks. But I consider this normal when performing new routine, you have to go through the process in order to familiarize with the routine and start building the ostensive. My recommendations here would be to invest time to build the ostensive by practicing, reflecting and giving feedback.

Designers assessing their own solution on viability and claiming their solution is viable is, in my opinion, sometimes misplaced. Validations could indicate a solution is viable because stakeholders of the project, or customers told during interviews that they see the value and want to invest/buy the product. But until the actual investment or action of the customer/stakeholders took place, that validation cannot not indicate the viability. This is better known as the mom-test, what people say and how they actually act is not always the same (Fitzpatrick, 2019) So, to be honest, I don't know if the way I designed this routine will be viable on the long-term, only time will tell. However, with my design strategy I tried the best I can to discover their actual needs and created a solution as much in collaboration with the routine actors in order to develop something that is viable. To say something useful about viability, I received signals from my company mentor that the canvas is also used in conversations between the chief technology officer and senior management of the business units, this indicates that at least something is happing after leaving the organisation. Moreover, as mentioned before follow-up meetings are planned with the actors involved during the two design experiments. To ensure viability, my company mentor is many cases involved in these meetings and seen his design background, position within the organisation, his expertise of both technology, business and user he is the right person to facilitate this process.

7.4.2 Further developments

- Although the canvas has been improved based on feedback with the routine actors and during the design experiments. The canvas should not be considered as finished. Due to time-constraints, the process could not be finished in both experiments and therefore the process is not tested in full of the routine actors. In order to further validate the process and its effectiveness, I advise Teo, Patrick and Marion to do multiple and full lengths experiments with a facilitator to guide them. And important to notice that experimental space is key here, to stimulate the actors to make desirable changes in the process in order to create radical opportunities. This means that the facilitator should organize experiments with them to validate if all the building blocks are needed, or that other are required.

- The process was focusses only on the design stage of the decision-making process (Simon, 1947) during their collective ideation phase. However, gathering intelligence and how people transform this knowledge and how they bring to the table is key in order to move knowledge across their boundaries. I advise, to also help or train the actors in the way they present their knowledge to the others that are unknown in that expertise. And the making the actual decision after these two stages is also something that should be more emphasized or supported by the process. This is currently not embedded but I recognize this is part of the ideation phase, I advise Teo, Patrick and Marion to reflect on how this is currently going, subtract the challenges and reflect how these could be solved.

- I did not create generic examples to fill in the canvas on purpose. I wanted to prevent that I was teaching how to use the canvas, I wanted to find out how the actors wanted to use it and what they needed to do so. They had to discover themselves how the process works and what is needed to successfully create new opportunities. However, some participants mentioned it would have been favourable to first show the process of the canvas before performing. My advice would be that after some more experiments more experienced actors create this example and fill in the canvas with it to be able to share it with people who are new to the exploration meeting. This way new actors can be onboarded by the other actors before the meeting starts.

- The process has been mainly designed from a technological and business perspective and does not embraces the user that much. I think this is a limitation of the canvas, but maybe this is a limitation of the Teo, Patrick and Marion in general. They tend to focus on technological aspects and business aspects of innovations and not so much on future user values. I advise to include also new user insights in the process instead only known markets and known customers.

- I approached this design process as much as I can to develop the canvas in collaboration with the actors, and I positioned myself as a designer that wanted to help them with their challenges. However, I conducted the project and designed the canvasses in between the iterations. Even though the canvas has been developed based on feedback from Teo, Patrick and Marion I advise to organize co-creation session in the future to create the process or canvas together with the facilitator. With co-creation the designer is able to subtract their pains and needs and at the same time create physical artefact. This will increase the ownership of the artefact, but also start developing the ostensive aspect of the routine together.

- As mentioned earlier, this process only focusses on the design phase of the decision-making process. The goal of this process is to create and develop ideas, but these ideas also need a follow up. Someone should facilitate this process and own the ideas and make sure that the ideas are captured and that decisions are made. I advise that someone should be the process owner of the ideation phase in the front end of radical innovation to facilitate this process.

7.5 Conclusion

This chapter explained the designed performances of the routine that are captured in the “Radical Innovation Discovery Canvas.” This canvas is designed to be used during exploration meetings between technology managers and business managers to explore both important aspects of radical innovation, but also to collectively converge towards the opportunity space in order to create new radical opportunities. The process consists of three phases: the technology phase, the business phase, and the opportunity space. It does not matter from which side the actors start exploring, but it is important that before entering the opportunity space both sides are clear and that the actors are on the same page. The process needs to be facilitated, preferable by a designer with the knowledge of both the technology, business and user. Furthermore, this chapter provided advise for further developments with regards to the exploration meetings and the canvas.

Chapter 8 | Discussion & Conclusion

The final chapter of the thesis answers the main research question. Furthermore, I discuss the developed routine, the executed design strategy throughout this project and propose a new version of this strategy. Lastly, this chapter closes with a personal reflection to discuss the process and the goals set at the beginning of this project.

Chapter 8 | Discussion & Conclusion

8.1 Discussion

The goal of this thesis was to develop and execute a routine design strategy for managing radical innovation in order to develop a more mature radical innovation capability. The study expands the scarce literature on how to design a routine to develop an organisational capability in the front end of radical innovation and to my best knowledge this is the first empirical study that connects both. In addition, these findings will help other organisation designers or management consultants in avoiding common mistakes when attempting to change organisational routines by providing a rich and detailed description of the execution of a routine design strategy.

Carefully designing an artefact while hoping for the routine to change is a mistake (Pentland & Feldman, 2008). To prevent this mistake, I developed a three-phase routine design strategy based on routine design guidelines of Pentland & Feldman (2008). However, their guidelines were only suggestions to design live routines, but they were never used deliberately in an empirical case study. From a design perspective all guidelines were considered useful, but some were not considered feasible within the project, and some had overlap with others and could be combined. After this analysis, I also concluded that there is a great overlap with the widely used double diamond (Design Council, 2005) and design thinking (Brown, 2008) approach in design projects. This allowed me to formulate three interdepend phases of the routine design strategy based on routine design guidelines, the double diamond and design thinking.

Executing the strategy, provided me new insights about how to change a routine and how to design it within an organisation. In my opinion, the developed strategy that is I used throughout this thesis is already outdated due to the insights gained during the project. Therefore, I would like to reflect on this strategy and make an iteration with regards to the gained insights and available literature. First, I reflect on the approaches taken in the strategy and argue what the most valuable activities and findings were. Second, I propose a new approach per phase of the things I would do differently if I would start a similar project after graduation. The insights gained during this project emerged from a case study where two specific specialisations within the organisation needed to collaborate together in a new routine in order to collectively create new or novel knowledge.

Routine performance and collective reflection on this performance during design experiments are key for routine design. This derived from the findings of the two experiments were the routine actors performed the designed performances that were locked in the artefact. Performing and reflecting provided key insights for the actors by reflecting on past actions, current actions that were captured in the artefact. In one design experiment reflection-on-action provided the routine actors insights about not having a shared meaning of two technologies in the first place, but finally managed to translate knowledge across their boundary, which could not be managed in earlier discussions. In the second design experiment the routine actors reflected on the added value of the new designed performance because they realised that they managed to cross a political boundary that could not be achieved in earlier meetings. Both key moments seemed to be enabled due to performing the routine within a reflective and experimental space to collectively reflect during the experiment. In this study, I only used reflection and routine performance in the last phase. However, I suggest using design experiments to perform the routine and using collective reflection iteratively in each phase of the routine design strategy. I will elaborate on this suggestion in the following sections where I describe a new proposition approach for each phase of the strategy. The propositions are also conceptualized in Figure 8-1.

8.1.1 Use collective reflection-on-action to discover challenges and needs

As proposition approach for phase 1, in order to emphasize with the routine actors and to subtract their needs, wants, political interests and alternatives (Carlile, 2004; Design Council, 2005; Feldman & Pentland, 2008). I propose to be actively involved to observe their performances and use collective reflection to reflect on routine actions and reflect while performing so that the actors create insights about their boundaries and challenges, they face in their efforts (Dittrich, Guérard, et al., 2016; Wegener, Guerreiro Gonçalves, et al., 2019). Discovering and defining these cannot be achieved within one experiment, I suggest continuing this phase until the routine actors indicate that they are ready to go to the next phase, which is about solution finding rather than problem finding (Design council, 2005). With this approach the routine actors collectively subtract their challenges from their own observations and reflections, these insights are then used as stepping stone one for next phase.

8.1.2 Co-create the physical artefact with routine actors

As proposition approach for phase 2, to subtract desired performance and lock them into a physical artefact (Pentland & Feldman, 2008). I propose to provide the routine actors with appropriate tools to express themselves and co-create the physical artefact with the designer (Sanders & Stappers, 2008). This way, the actors co-create their own desired performances, and this will increase ownership of the created artefact during these sessions. People tend to take responsibility and ownership of the things, they designed themselves. To take this even one step further it would be even more valuable to perform the routine during the co-creation session and use the experimental space for reflection-in-action while performing to pause the meeting for a moment and use these reflection moments to design the artefact(Wegener, Guerreiro Gonçalves, et al., 2019). This way the routine actors become the designers of the routine themselves and again this increases ownership of the routine design which is key in routine change.

8.1.3 Use design experiments and collective reflection-in-action to perform and change the routine

As proposition approach for phase 3, design experiments and reflecting while performing are key to build the ostensive and to test and change parts of the routine that where designed in the previous phase (Bucher & Langley, 2016; Dittrich, Guérard, et al., 2016). Prepare for many iterations, and switching between performing the routine, reflecting on the routine and changing the artefact that represents the performances of the routine.

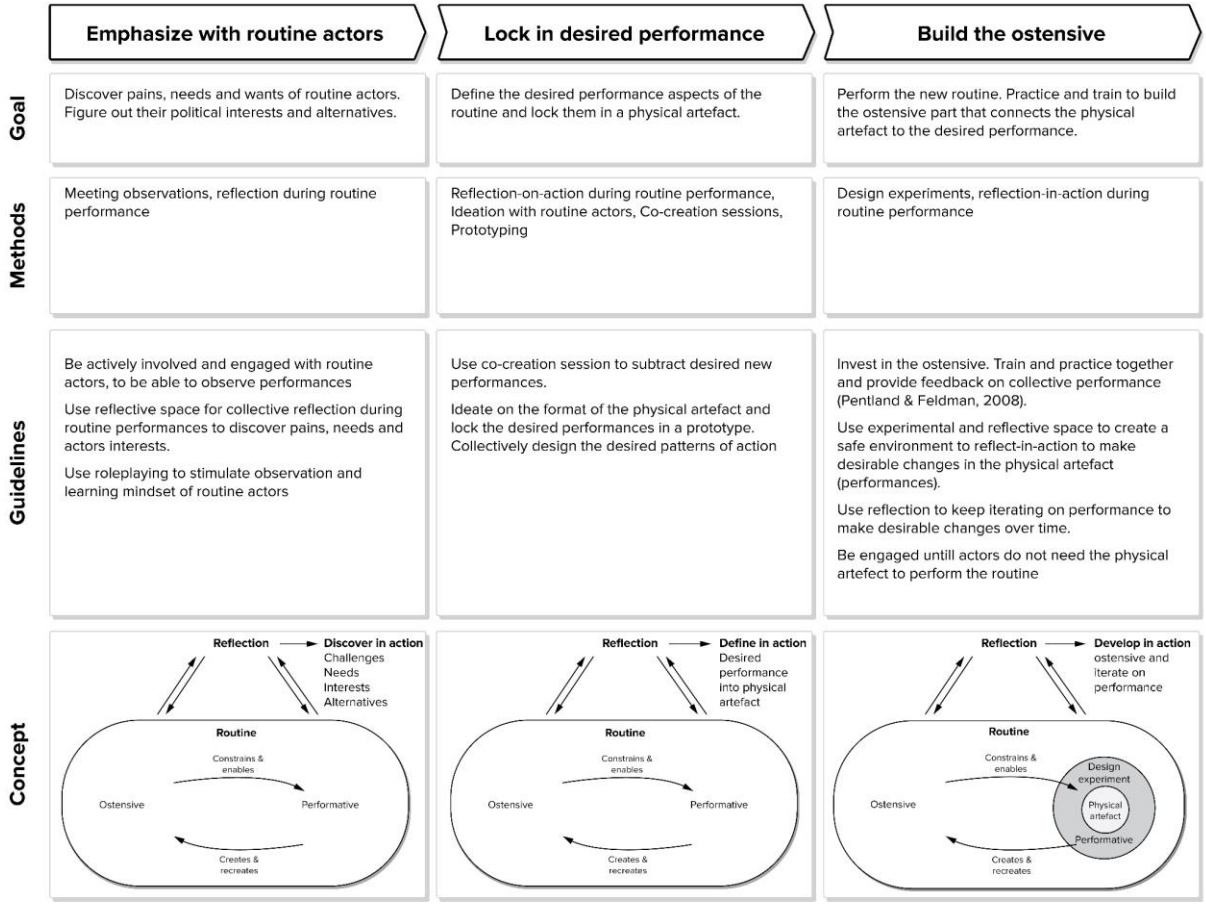


Figure 8-1 Routine design strategy with new propositions

Future research

I want to highlight two potential interesting directions for organisation researchers and designers to engage in for future research on routine design.

How is the ostensive build?

In this case study, I described the design of an organisational process. However, the project stopped at a point when the designed routine was performed by the routine actors in design experiments and the actors learned about their actions through collective reflection moments. I am aware that within two design experiments the ostensive aspect of the routine cannot be built. Onboarding the actors that were new in the project took a while and performing something new costs lots of discussions and energy from the actors. More practice and training are needed to really start building the ostensive, and as I saw in the experiments, reflection while performing stimulates this process but also raised new questions among the routine actors. I would be interesting to research what the point is that the ostensive is mature enough that experimentation and reflection is not needed anymore? Or is it needed that actors keep reflecting and experimenting to make desired changes and thus evolve the routine over time?

Another iteration of the routine design strategy

I hope that the proposed iteration of the routine design strategy invites other organisation designers to use this strategy in their practices or to compare findings of other case-studies to validate the viability of the strategy. Is this strategy generalised enough to be usable in other large organisations or even in smaller ones? Or does every initial problem demand a tailored made strategy to change the routine? I invite other organisation designer to start using the strategy and iterate on it.

8.2 Conclusion

To conclude the thesis, I answer the research question that was set at the start of the project: how to design an organisational routine that develops a radical innovation capability within a technology firm. To be able to answer this question, I developed and executed routine design strategy based on the double diamond (Design council, 2005) and routine design guidelines (Pentland & Feldman, 2008). The findings are based on an in-depth case study of Barco N.V. and the findings are therefore limited regarding to generalisability.

Every day, technology firms are under pressure, and due to external treats like increasing international competition with more resources and new emerging technologies popping up everywhere this will only continue to increase in the coming years. Radical innovation is a way to escape this intense competition and is perceived to be crucial for the long-term survival as they provide new foundations for future generations of products. Organisations without a mature radical innovation capability have to change their organisational routines in order to develop this capability.

However, carefully designing an artefact while hoping for the routines to change is a mistake (Pentland & Feldman, 2008). This study shows that using a routine design strategy consisting of three interdependent phases are critical to routine design. First, emphasize with routine actors, conduct activities to discover and define the challenges and needs the actors face in their patterns of action. Second, lock in desired performance, prototype in collaboration with the routine actors the desired performances and lock them in a physical artefact. Third, build the ostensive, perform the designed performances in a design experiment within a reflective and experimental space to practice the routine in safe but realistic boundaries.

From executing this strategy, I found that reflection and design experiments are crucial in routine change. The reflection moments provided the routine actors collective learnings about their actions and what to change in their actions in future situations. However, these reflections also raised more questions among the actors about their patterns, collaboration between the actors and current organisational processes. This observation calls for the need for more practice, experimentation and reflection in order to learn and build the ostensive aspect of the routine, which develops the organisational capability.

The key findings that emerged from the design experiments were significantly important for this project that based on these findings I proposed an iteration of the routine design strategy. In this new version of the strategy, routine performance and reflection on performance within design experiments are central activities that I consider to be key in routine design. I hope that this thesis and the proposed iteration helps other organisations designers in their efforts to change organisational routines.

8.3 Personal reflection

In this final part of the thesis, I reflect on the past five months. As stated in my project brief Appendix Y, my personal ambitions were to learn how to create a solution space and how to actually start solution implementation with regards to organisational processes, because in almost all courses during the master this is not part of the project. Secondly, I wanted to create value for the potential users of the solution, this might sound obvious, but to be honest during my masters many projects were just projects. In many cases after the final presentations the project finishes, and we never validated if the developed solution solves the problem that was defined during the project. Thirdly, I wanted to learn how change organisational processes, from my experience during my internship at Innovation Booster I saw many consultants struggling with their efforts to change processes and routines.

To be able to start the implementation with regards to Barco's internal processes I knew from the beginning that I had to develop a personal strategy to make sure I could setup experiments with the actual users of the solution. This personal strategy turned out to be so important for this project that it became the core of my thesis. However, I did not realize this at the beginning of the project, because I was busy with developing my methods and executing them in order to create the best as I can value for Teo, Patrick and Marion. I learned that I should zoom out and reflect more in order to evaluate the relevance and value of the things you are working on. Along the way I realized the strategy I developed and executed was significantly new in the field of organisation design. For me, in the first place, this is just the way designers get to work and approach these complex situations. However, now I realize that this strategy and my design process could provide organisational researchers and designers some new insights in how routines can be designed.

I also want to reflect on my approach. The analysis part was quit long, it took me 10 weeks before I defined the design brief. While the most valuable insights of this project were captured during the design experiments in the last two weeks. Problem finding took me a while because the project scope was very broad and the biggest source to understand all the different processes, routines and the challenges the routine actors face were mainly from interviews. I think it would be important in a next project to make the scope of the project a bit more specific, instead of the front end of radical innovation in total. I also would consider multiple sources of data, and especially participating in the processes to emphasize with the actors which is an important stage in Design Thinking. I think this would speed up the process of the project and also increases the validity of the data.

Looking back, during the internship I gained much experience about organisational processes and all the political games that are played within the organisation in order to make decisions about innovation. At the beginning of the project I thought people come together in a room and make the decision. But these processes take time and consists of different steps. Also, all managers with their different target have their strategy reach these targets. This is something that cannot be learned at the faculty, but it is an important insight for designers when operating in a large organisation.

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