DEALING WITH UNCERTAINTY THROUGH PROTOTYPING

GRADUATION PROJECT

J.J.L.A. in ‘t Veld
Student Strategic Product Design

Dealing with uncertainty through prototyping

Master thesis by J.J.L.A in 't Veld (4444795)
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Author

J.J.L.A. in 't Veld
jmintveld@icloud.com

Graduation committee
Chair - Prof. dr. Lloyd, P.A.
Faculty of Industrial Design Engineering
Design Organization Strategy department

Mentor- PhD Candidate Stoimenova, N.
Faculty of Industrial Design Engineering
Design Organization Strategy department

Company mentor- MSc. Geus, D.
Business Model Inc.

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Preface

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This graduation project was carried out as part of the Master program Strategic Product Design of the faculty Industrial Design Engineering at the TU Delft. This project is the final project of the master program. At the TU Delft it takes at least 7560 hours of work until you are given the opportunity to start your graduation project. I would like to thank anyone involved at some point during this journey, especially my parents, brothers, inspiring professors and fellow students.

As this project was executed in collaboration with the strategic design agency Business Models Inc. (BMI) , I would like to thank BMI for this opportunity and support during this project, especially during these uncertain times. Additionally, I would like to thank all the colleagues for their support and availability to ask questions.

Moreover, I want to especially thank my supervisor team, Peter, Niya and Daan to keep me sharp by challenging me and providing clear guidance through feedback. Also, I really appreciated the flexibility during the corona virus. I always enjoyed our digital conversations which helped me to carry on.

Finally, I would like thank those who dared to prove read my thesis, Mark and my Grandma Nel thank you for the comments to improve the report.

Summary

As the COVID-19 struck, many organizations faced the challenge to rapidly adapt in order to stay relevant. Over night consumers' needs changed, leaving the organizations in an uncertain environment. The current situation highlights that organizations need approaches that must enable them engage in search activities, in order to find out how to adapt and deal with uncertainty

This thesis was carried out in the context of a strategy design agency. They help their clients to explore how to adapt an organization by designing strategies and new business models. By a design doing approach they help their clients to engage in search activities with a focus on business model innovation. An initial business idea is considered to be a 'guess' that needs to be tested. During the search activities a prototyping process is followed to test these 'guesses', referred to as assumptions.

The prototyping process is carried out by a multidisciplinary team, consisting of employees of the organization from various departments and business designers from a strategic agency. These (validation) teams aim to use prototyping to reduce uncertainty. By carefully deciding what assumptions needs to be tested, an experiment (activity) is designed to do so. Prototypes in the form of artifacts are build to generate learnings. With the use of these learnings, teams can iterate their business model, value proposition and product designs.

Initial observations show, validation teams face difficulty to create suitable prototypes, and setups to test these assumptions while uncertainty is only addressed to a limited extent. Underlying assumptions, which are not explicit at first, are seldom considered. To enhance the current practice, a wide range of prototypes are created which are implemented within the context.

The implemented prototypes are aimed to enhance the current process, mainly through a digital manner due to the COVID-19 pandemic. Through numerous of prototypes, new ways were explored with the intention to enable teams to address uncertainty, and moreover, help to create suitable prototypes. These efforts manifested in enabling teams to utilize prototypes as a straw man within the team or use prototypes to trigger customers in an early stage. These activities helped the team to go beyond testing assumptions, and enabling them to reveal assumptions. Through the practice of revealing assumptions, the prototyping process enables to drive continuous learning, since the newly revealed assumption can influence learnings goals for the next steps.

The project also identified obstacles that could hinder a successful use of prototyping, such as a risk avoidance mindset and lacking skills of team members.

Eventually, based on the developed prototypes and generated learnings, a boundary object in the form of a digital warroom was designed and presented. So the teams are being enabled to go through the prototyping process to address uncertainty. The embodied approach of the warroom should help teams to drive changes by developing new business models, value propositions with product & services supporting these.

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1 Project

In today's world, organizations are forced to adapt to a changing environment in order to maintain a favorable competitive position. (Teece et al, 1997; Ambrosini & Bowman, 2009;Wang & Ahmed, 2007). Especially during this time period, the COVID-19 pandemic forces organizations to adapt. Consumer interest changed suddenly 'over night' and processes needed to shift to digital alternatives, since offices were closed all over the world. This situation highlights the need for organizations to have a mechanism in place to figure out what is the right thing to do, rather than doing it right (Teece, 2016).

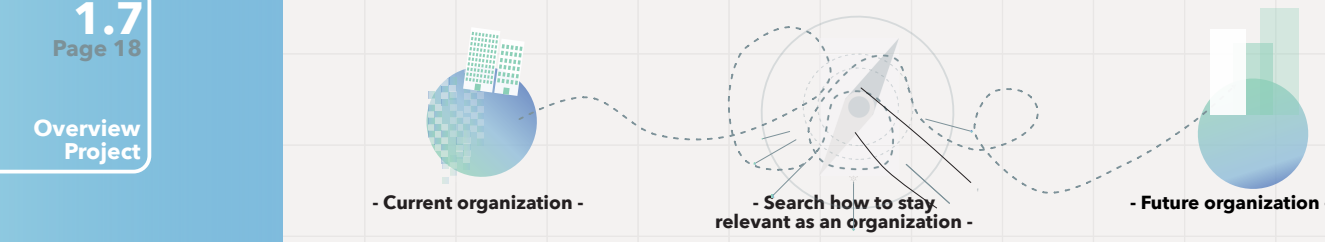
Organizations face a wall of uncertainty since the answer to these questions are unknown upfront. To stay relevant the sensing capability is often recognized as being important (Rumelt, 2011; Teece, 2016). This generative sensing capability can help to learn about possible futures by actively creating and testing hypotheses.
Rather than 'executing' and optimizing their current business models and products, generative sensing refers to a search mindset which aims to explore new alternatives. In many organizations this search mindset is lacking, therefore, external (design) agencies such as Business Models Inc. (BMI) are hired to explore the future and build this capability within the organizations.

Together with their client, BMI takes a blended approach of Design Thinking and the Lean Startup. These processes are utilized to create strategies and design new business models. To deal with uncertainty situated around these new 'ideas' to stay relevant, BMI makes use of processes such as prototyping to reduce the uncertainty.

A growing body of scientific literature from the business discipline state the importance of experimentation to reduce uncertainty (Andries et al., 2013; McGrath, 2010) and to 'de-risk' the novel business models (McDonald and Eisenhardt, 2019; McGrath, 2010).

Prototyping processes can in theory drive the experimentation of novel business ideas to address uncertainty. Recently, the prototyping practice of design is increasingly viewed as a way to help organizations address uncertainty (Dong et al., 2016; Jensen et al., 2017), Dong and colleagues (2016) recognized that design, practices such as, prototyping are a way to develop understanding by testing hypothesis. This approach of utilizing prototypes to evaluate ideas is not new (Lim et al., 2008; Seidel & Fixson, 2013; Dong et al., 2016), and is in line with the Lean Startup method and Design Thinking method (Brown, 2008; Ries, 2011 ; Müller & Thoring, 2012). However, in Design, prototypes are used beyond evaluation purposes and are also used in a generative manner for discovery (Lim et al., 2008). Therefore help to formulate hypothesis rather than test. As such, these prototypes are especially useful for early stages and can be used to reveal (new) information in a fast manner (Blomkvist & Holmlid, 2011). Thus, (process) prototyping can be regarded as a way to generate learnings during an innovation project.

As the design discipline is expanding to new fields, such as business model innovation, it is relevant to further explore how mechanisms such as prototyping could be utilized in these fields. While the prototyping practice is extensively researched from a design perspective, to date little research is carried out how prototyping can be utilized within organizations (i.e. Lauff et al.,2017; Stoimenova et al., 2019). Therefore, this project aims to explore with a research through design approach how the prototyping practice could help organizations to deal with uncertainty, in order to drive business model change to enable organizations to stay relevant.



1.2 Project: Context of this project

As organizations need to adapt to rapidly changing environments. The difficulty is that the necessary adaptions are seldom clear at first. Somehow, organizations need to address this uncertainty, and develop understanding of their context. As Organizations need approaches to face and deal with uncertainty. Agencies such as Business Models Inc. (BMI) can help organization organizations when faced with uncertainty, situated around the search to adapt the business model of an organization in order to stay relevant for consumers.

The agency BMI is a frontrunner when it comes to business model innovation and facilitating teams to design new strategies. As co-producer of the bestseller Business Model Generation (Osterwalder & Pigneur, 2010) the agency started in 2009 their journey. Today, the Business Model Canvas is popular tool, and often used during sessions. However, during this decade, BMI further developed their methodology with a strong focus on Design Thinking and Doing (Van der Pijl et al, 2016). These days, BMI helps their clients to design strategies and organize their business model innovation projects by facilitating a design doing approach (see table 1.1).

Business Models Inc. facilitates the search from a business models perspective by at first designing a strategy and creating a vision. This vision results in so called 'value spaces', which are used to design and co-create business models and value propositions. To do so, BMI uses tools like the business model canvas, that can be regarded as boundary object (e.g. Bouwman et al., 2018).

This approach enables to explore by developing initial and envisioning new business models (Athanasopoulou & de Reuver, 2020). Still, an iterative process (Sosna et al., 2010; Athanasopoulou & de Reuver, 2020) is needed to test these ideas , as it is uncertainty whether this business model would work in the new context. New knowledge needs to be acquired reduce the uncertainty (e.g. Cavalcante, 2014).

A way to address uncertainty and test ideas is by engaging in activities such as prototyping. In the third step of the process (see figure 1.1) BMI gets out of the building in order to explore, whether the designed business models works in real-life. As the business model consists of multiple 'building blocks', assumptions could be tested on multiple levels (see figure 1.1.) such as the value proposition and product & services. In contrast with the design discipline, prototyping is used beyond testing 'solutions' such as product and services. A more holistic view is taken continuously, meaning the business models are considered throughout the search process. Within the current process the prototyping processes serves as a way to test assumptions on a business model, value proposition and a product & services level.

The next paragraph further explains these 'levels' through an example case study.

	1. Understand	2. Ideate	3. Validate	4. Scale
Scope	Understand context, Understand business Understand customer	Develop ideas and explore options	Experiment and prototype to find a problem-solution or problem-market fit	Continuously experimenting to build the business model and find a solution-market fit
Design	Strategy	Business Model & Value Proposition	Business Model & Value Proposition & Product or Service	
Tools	Context canvas Business Model canvas Customer profiles Vision map Design criteria	Business Model Canvas, Value proposition canvas	Experiment canvas, Riskiest assumption canvas, Value proposition canvas, Test cards	
Output	Value spaces	Business model + Value proposition	Validated Value proposition	

Table 1.1 The design doing approach to create and build 'new businesses', where prototyping activities take place during the validation phase.

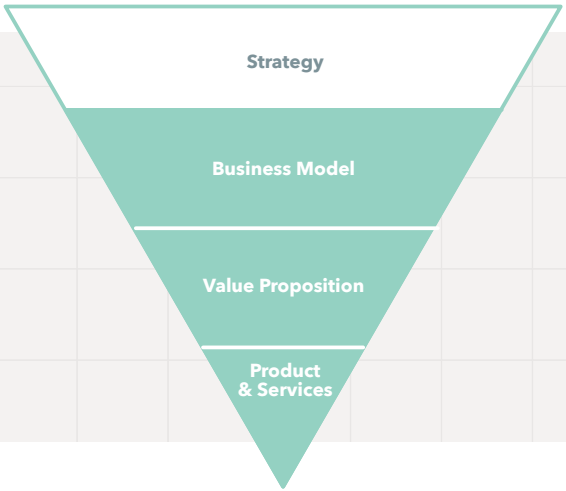


Figure 1.1 The levels BMI addresses during their search process to enable organizations stay relevant, the business model, value proposition and product & services are part of the scope when engaging in prototyping (colored green)

1.3
Project:
Business model driven innovation

In contrast with common design practices, Business Models Inc. takes a business model perspective rather than a product perspective. Based on the strategy, an initial business model is designed. To illustrate this approach, figure 1.2 shows an example case study of Gucci, who succeeded to adapt to the changing environment as an organization. Figure 1.2 presents per level what this adaption entitles and show how these levels are connected.

Strategy
As Gucci faced a decline of sales in the recent years (Dunne, 2014) they knew they needed to make a shift. The strategic shift could be described as "Counter act sales decline by targeting millennials".

Business model
This strategy was realized by adapting the current business model (see figure 1.2). Where business models refer to the architecture of the firm to create and capture value (Teece, 2010; Chesbrough & Rosenbloom, 2002, Zott & Amit, 2008). Gucci shifted to an online presence to target millennials to realize growth. To achieve this goal, they introduced new channels such as digital web shops and influencers as partners, which allowed them to target millennials. But they didn't stop there, besides making use of predictive algorithms which allowed Gucci to 'predict' demand for certain items, Gucci also introduced a new value proposition, street style fashion for millennials.

Value proposition
The value proposition (see Appendix 2) embodies the customers needs (sometimes framed as 'problem') and offering to meet those. To create value for the customer (millennials) Gucci started creating new products in the category streetwear. These products still represented the brand and Italian craftsmanship which offers quality and exclusivity. These gain creators should help the customer to look good in their clothes and be fashionable. To be fashionable, customers should also be aware of the fashion trends. To showcase the latest trends and 'how to be fashionable' influencer serve as an accessible outlet that inspires. While the web shop makes it easy for millennials to continuously buy the latest fashion.

Products
The created product is a wide range of street wear garments and accessories that can be considered of high quality and being fashionable

This example illustrates the multi-levels of a business model innovation approach and what these represent. As this example showcased a realized innovation, and thus the output of a 'search process', it should be stressed, things are not clear at first. Which means initial ideas might work on paper but not in reality, the at first designed business model and value proposition and product all consist of 'assumptions'. On a business level model one could question whether 'Gucci customers would be willing to buy such expensive items on their web shop'. Conversely, on product level it is not clear if '(high end) street style fashion is viewed by millennials as a way to build their reputation'.

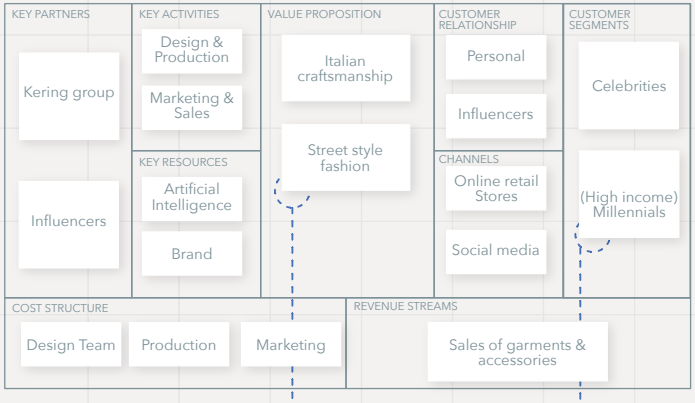
On multiple levels, assumptions could be formulated. These could be 'tested' with the use of prototypes. To illustrate this, to develop understanding if the street style fashion resonates with millennials an online 'pop up' store could be created as prototype to test interest in the fashion and willingness to buy.

This paragraph illustrated how organizations could adapt by considering innovation at multiple levels. All these levels bring a degree of uncertainty.

Example: Gucci

Based on Business Models Inc. Blogpost (2020)

STRATEGY: *Counter act sales decline by targeting millennials*



Business Model *Shifting to an online presence to target millennials*

Value Proposition *Creating value for high income millennials*

Products *Enabling the value creation through a product portfolio of street style fashion*

Figure 1.2 Gucci case study taken as an example to show what these dimensions represent and how these are connected.

1.4
Project:
Uniqueness of the context

The unique characteristics could be described as following;

1. Business model perspective
Instead of a product perspective, a business model perspective is taken by the teams. As such, the carried out projects are not merely about improving current products or extending the product portfolio, the innovation projects aim to introduce new business models within the organization.

2 Multidisciplinary teams
Rather than teams consisting of designers, teams consist of cross-silo team members. As a result many different perspectives are present 'at' the table. As a consequence the teams consist of mainly novice designers who are new to a search process.

3 Search driven
The carried out innovation efforts often do not aim to optimize the current organization through efficiency, but yet aim to create 'new value' for new or existing customers. The search includes strategy design, business model design, value proposition design and product and services design.

4 Changing environment
While environments and industries can be stable over time, due to the COVID-19 pandemic, the environment of the context could be described as a fast changing environment. The involved stakeholders therefore needed to adopt to these changing context.

The overall context is especially suited to explore how prototyping can enable organizations to deal with uncertainty when they face ever changing environments. Taking a search driven approach, with a business model perspective, enables to realize change on organization level. During this time period, these changes were rapidly needed to stay relevant.

1.5
Project: Scope
Prototyping to address uncertainty

This project aims to further explore and develop an understanding how processes such as prototyping can be used to address uncertainty around newly designed business models. More specially, enable organizations to make use of prototyping to facilitate learning in order to build and iterate upon the initial idea(s). To develop an initial understanding how prototypes could help to address uncertainty, a process perspective is taken. This means prototyping is regarded as a process of defining and considering what teams want to learn and designing the right activities and artifacts to do so. Within the context, these teams are referred to as the validation teams. These teams are multidisciplinary and consist of employees from various backgrounds who work at the clients organization. As BMI is hired to help these clients, business designers are part of these teams to facilitate the process and co-create the prototypes.

To get an initial understanding of such a process, firstly a literature review is carried out. Secondly, the current prototyping process within BMI is framed and analyzed to define initial opportunities in order to enhance their process. To enhance the process a wide range of designs are tested. Based on the developed understandings and learnings an eventual redesign of the prototyping process is proposed by the way of a design of a digital Warroom.

In short, the project aims to answer the following main research question:

How can validation teams make use of prototyping in order to address uncertainty?

1.6
Project:
Research through design approach

This thesis aims to enhance our understanding of the use of prototyping, in a (rapidly) changing environment to address uncertainty. As such, the project aims to answer the research question: ***How can validation teams make use of prototyping in order to address uncertainty?*** A research through design approach (Gaver, 2012; Wensveen & Matthews, 2015) was taken to explore how the prototyping process could be utilized to address uncertainty. An overview of the approach is presented in figure 1.3. The remainder of this paragraph further elaborates on the approach to answer the main research question.

Understand

The first chapter aims to get an initial understanding of the prototyping process. The chapter therefore aims to answer the research question, ***In what ways can prototypes enable to address uncertainty?*** To do so, a literature review was carried out that compares the Lean Startup and Design Thinking methodology, since Business Models Inc. takes a blended approach to prototyping. Moreover, prototyping dimensions are discussed to gain an initial understanding of the prototyping process, and theorizes in what ways prototypes could address uncertainty.

Define

This chapter tries to answer the sub research question, ***What are the current practices of prototyping within BMI?*** Through multiple activities such as observations and interviews, an initial prototyping process is defined as observed in practice. The materials used during this process are analyzed to gain a better understanding whether this process enables teams to deal with uncertainty. Based on this analysis opportunities are defined.

Explore

Based on the defined opportunities several prototypes are developed and implemented within the context of three case studies. This allows to explore new ways to enhance the current prototyping practice and as such aim to set an initial step to answer the question: ***How can the current prototyping process be improved to enable teams to address uncertainty?*** The prototypes are analyzed to gain an understanding of the context to redesign a develop a new process.

Develop

Based on the generated learnings from the explore phase a redesigned process is developed which is communicated through a digital warroom design. This chapter thus presents a concrete and tangible artifact to answer the the main question, ***How can validation teams make use of prototyping in order to address uncertainty?***

1.7
Project:

Overview project

This chapter described that organizations need to adapt to stay relevant. This project is executed in the context of organizations which aim to stay relevant by designing new business model, value propositions and product and services. With the use of prototyping the validation teams aim to deal with uncertainty during their search efforts. The main research question was therefore formulated as following:

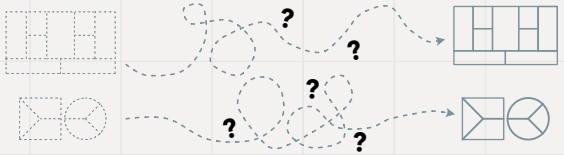
How can validation teams make use of prototyping in order to address uncertainty?

To answer this question question a research through design project was carried out. Through a double diamond approach, four phases are defined; understand, define, explore and develop. Each phase aims to answer a (sub) research question (see figure 1.3). Eventually the double diamond approach delivers a design of a boundary object that communicates and shows how validation teams could go about addressing uncertainty.

Overview

CONTEXT

SCOPE PROJECT



Enable validation teams to address **uncertainty** through **prototyping**

APPROACH

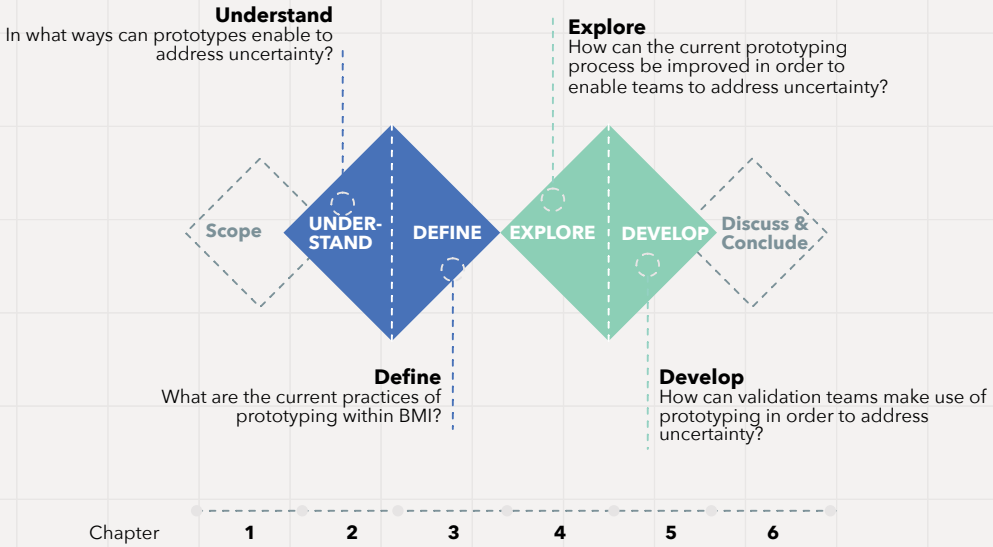


Figure 1.3 an overview of the project and taken approach for this thesis

2.1
Introduction

This chapter aims to explore current literature on the topic of the prototyping and uncertainty to answer the first research question:

In what ways can prototypes enable to address uncertainty?

First of all, this chapter initially elaborates and compares the innovation approaches as currently used within the context, to establish a first understanding. Eventually through a prototyping lens the chapter establishes a view how prototyping can help to address uncertainty.

2.2
Understand:
Innovation approaches

As described in the chapter 1, BMI aims to help organizations innovation on a business model level and therefore takes a blended approach when it comes to their process. Both Lean Startup principles and Design thinking are used to guide the teams through the search process. These methodologies are first explored and elaborated upon.

2.2.1
Lean Startup

Background

The concept of lean thinking founds its origin in lean manufacturing method developed by Toyota to optimize their production process. (Womack et al, 1990). Building on the lean thinking from Toyota, Ries (2011) developed the Lean Startup approach to embed the 'lean thinking' in the innovation process. Ries argues that lean thinking can help to increase the speed to generate so called validated learnings. To generate these learnings Ries developed the build-measure-learn process cycle to test 'hypotheses' (see figure 2.1).

Nature of the Lean Startup

To test the hypothesis, metrics need to be defined upfront and with the use of a prototype an experiment can be conducted to falsify or justify the hypothesis. The aim is to continuously go over this cycle to build a continuous 'feedback' loop with customers (Maurya, 2012). In essence, the approach is very similar to a scientific hypothesis-metric-experiment cycle, since both aim to test to validate a specific hypothesis with an experiment to learn something (Müller & Thoring, 2012).

Blank (2013) even argues that taking a lean startup approach will lead to "radically successful businesses". The central idea is to engage early with customers to produce scientific evidence to turn 'guesses' into facts. Since the central believe is, "hypothesis is just a fancy word for guess" (Blank & Dorf, 2012;37). This idea is somewhat in line with other literature, where it is suggested that entrepreneurs who stick with their original idea might be less successful than those who iterate (Zuzul & Tripsas, 2019).

Recently, more evidence is emerging that entrepreneurs can benefit from a scientific approach if they carefully frame, formulate falsifiable hypotheses and design rigorous experiments. This appears to help entrepreneurs to avoid false positives and negatives (Camuffo et al., 2019). However, Felin et al. (2019) argue the Lean Startup barely addresses how to theorize and develop a good hypothesis. Which is a critical step to come up with a truly new idea. An idea, or 'theory' is needed as these theories help us and guide us to find where to find value (Felin & Zenger, 2017). Therefore, a theory is necessary to design the right experiment to get clear signals (Felin et al., 2019).

In short, the Lean Startup enables innovators too 'validate' ideas but at the same time give little guidance to create an 'novel' business idea (e.g. Felin et al.,2019).

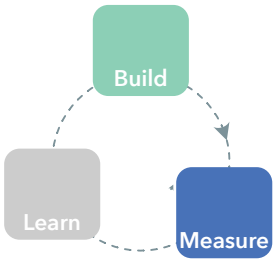


Figure 2.1 the build-measure-learn model, adopted from Ries (2011)

2.2.2
Design Thinking

Background

Design Thinking mainly popularized by Brown (2005, 2008), is recognized as a method to enable innovation, develop new products and formulate strategies (Sato, 2009; Carlgren, 2013; Liedtka, 2015; Fraser, 2007). Design Thinking can be utilized for multi-purposes, therefore it is probably not a surprise more organizations try to build a competitive advantage through Design Thinking (Martin, 2009). However, since design is a fundamental explorative non linear process (Brown, 2009) it can be sometimes difficult to pin down the way one should go about it. As stated by Cross (2001), design is largely an intuitive process and more about building creative bridges; "the sudden illumination that occurs in creative design is therefore more like building a 'creative bridge' than taking a 'creative leap' "(Cross, 1997;428). To successfully utilize Design Thinking in organizations following the 5 step IDEO approach might not be enough, due to Design's the intuitive nature.

Nature of the Design Thinking

While some believe Design is about brainstorming and writing down your brilliant ideas on a post-it, designers mostly take a more purposeful strategic approach (e.g. Dorst, 2015). Design Thinking takes a 'human centered' and user perspective during their activities (Carlopio, 2009; Beverland et al. 2015). As design is often recognized as problem driven, design aims to change existing situations into preferred ones (Simon, 1996). However, potential preferred future states can sometimes be difficult to define. For example, how does a better democracy looks like? Problems can be complex and 'wicked' (Buchanan, 1992). In complex situations defining a preferred situation is ongoing process, and by 'muddling through' one could learn and develop understandings while doing (Flach, 2011). These can be developed since Design Thinking can be recognized as an iterative approach, where constant experimentation with the use of artifacts (prototypes) can help to gain knowledge quickly (Eisenhardt & Martin, 2000). The experiments, however, do not have to succeed per se to learn, since failure is seen as a way to learn and gain knowledge rapidly (Carlgren, 2013). Through the iterative process designers develop a better understanding of the problem and the solution itself.

By it is very nature, design tends not to be evidence driven but rather explorative (Dorst, 2015) of "what might be"(Martin, 2010) "what if" (Liedtka, 2015) and "what ought to be" (Glen et al., 2014).

2.2.3
Lean Startup VS Design Thinking

As Lean Startup and the Design Thinking are outlined in 2.2.1 , 2.2.2 Design Thinking and Lean Startup have similarities and differences (table 2.1) this paragraph compares the two approaches.

	Design Thinking	Lean Startup
Goal	Innovations	Innovations
Approach	Human-Centered	Customer-oriented
Scope	Desirability, Feasibility, Viability	(Mainly) Viability
Core Reasoning	Abductive reasoning	Deductive reasoning
Research methods focus	Qualitative methods	Quantitative methods
Iterative	Yes, Iterative	Yes, Pivot
Prototyping purpose	Evaluative & Explorative	Evaluative
Prototypes	Paper prototypes, Experience prototypes, Boundary Objects etc.	Minimal Viable Product

Table 2.1, Comparing Design Thinking and Lean Startup, based on literature review and the work of Müller & Thoring (2012)

As table 2.1 shows Design Thinking and Lean Startup both aim to enable innovations, and make use of experimentation to iterate or pivot upon the idea in order to come up with a successful innovation. The focus to achieve this is somewhat different, since Lean Startup mostly uses deductive reasoning to quantify the value of an idea. On the other hand, design thinking uses abductive reasoning to explore what might be an 'valuable' idea from a human/user perspective.

Since Design Thinking (DT) is mostly intuitive and decisions are often based on qualitative data, utilizing the full potential of DT in a corporate environment might be difficult, since design skills are difficult to acquire, and the value of DT and the output is difficult to prove (Carlgren, 2016). Lean Startup provides a more clear approach aimed to use clear metrics to evaluate ideas not merely on intuition, but based on generated (quantitive) data from experiments.

To make use of the Lean Startup an idea or hypothesis is needed as a starting point. This is troublesome to some extent, since the Lean Startup only allows to test initial ideas and give little guidance to come up with a novel and useful idea (e.g. Felin et al., 2019). The only mechanism Lean Startup offers is reshaping the hypothesis through consumer feedback (pivoting). However, relying on consumers to come up with a novel idea might be a bitt naive in the light of Steve Jobs & Henry Ford (figure 2.2). In contrast, with the Lean Startup, Design Thinking methods are especially useful to explore 'what could be' through abductive reasoning.

Figure 2.2 Quotes from Jobs and Ford that illustrate relying on merely consumer feedback might not be a preferable approach to innovate.

One could argue taking a blended Lean Startup & Design Thinking approach is the best way to approach an innovation project. Work from Müller & Thoring (2012) already showed how the Design Thinking and Lean Startup approach could be blended in theory. However, as the core of every innovation approach to address uncertainty from a knowledge perspective, is the way it facilitates to learn. Both Design Thinking and the Lean Startup have a mechanism to do so, enabling learning through experimenting with the use of prototyping. Therefore, prototyping is a becoming a more important tool to generate learnings during the innovation projects to deal with uncertainty. Lean Startup & Design Thinking both make use of evaluative prototyping to test their ideas. Design however also make use of explorative prototyping in order to generate learnings.

The next paragraph 2.6 further explores and defines the use of prototyping within the Lean Startup & Design Thinking to develop an understanding how these processes can be utilized to enable learning.

2.3
Understand:
Prototyping processes

The previous paragraph shortly discussed that both Lean Startup and Design Thinking make use of prototyping to facilitate learning. These approaches, especially Design Thinking, are nowadays used beyond the context of product innovation. The role of processes such as prototyping are therefore likely to change. As this project is carried out in the context where the aim is to design new business models, prototypes are regarded as representation of a 'business design idea'. Meaning, the prototypes are not merely used to test for example functionality of a product but can also be used as (boundary) object to explore possible revenue streams or co-create together with stakeholders such as partners. The way prototypes are utilized is thus expanding beyond product testing.

In this project the prototyping process entitles framing the initial learning goal such as testing an assumption, designing the setup and make use of an artifact (prototype) to gather data which results in learnings. This chapter further elaborates on theoretical prototyping processes as seen in the Lean Startup & Design Thinking. These processes are further explored by defining the relevant sub dimensions of the process and thus frame the consideration what the process entitles to do.

2.3.1
Prototyping in Lean Startup

The lean process could be framed as a 'prototyping process'. The method explicitly (see figure 2.3) aims to test upfront formulated hypothesis by using a 'prototype' (build), and specifically aims to build light and lean prototypes (eg. Felin et al., 2019) to test the business ideas in a quantitative way (e.g. Müller & Thoring, 2012). As such, this approach can be described as an evaluative approach to specifically 'validate' ideas. However, such an approach might result in insufficient exploration of alternatives (Gans et al., 2019).

Typically, the Lean Startup aims to develop a 'minimal viable product' (MVP), where a product with a minimal set of features could help to test business hypothesis (Ries, 2011). Recently, more and more 'prototypes' variations are used to test business ideas (see table 2.2) by taking a lean startup approach. .

Prototype	Description	Purpose
Minimal Viable Product	Product with a minimal set of features	Evaluate and test hypothesis
Mockup (Brochure, Landing page, flyers)	Mockup of the initial designed Value Proposition	Evaluate if the described offering is desirable
Concierge	Manually deliver the experience of a service	Evaluate/ Explore if a solution is desired in a real life context

Table 2.2 typical prototypes used in a Lean Startup Context (Bland & Osterwalder, 2019)

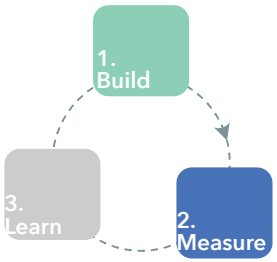


Figure 2.3 the build-measure-learn model could viewed as a prototyping process, adopted from Ries (2011)

2.3.2
Prototyping in Design

Prototyping, framed as a critical activity to create new products (Wall, Ulrich & Flowers, 1996) is often used by designers to create and design new products. Prototyping is a way for designers to generate learnings during innovation projects. As such, prototypes can be described as a learning tools (Coughlan et al, 2007; Leifer et al, 2012) that enable to explore, evaluate and communicate ideas (Blomkvist & Holmlid, 2010; Buchenau & Fulton Suri, 2000; Voss & Zomerdijk, 2007).

Prototypes aimed to evaluate ideas enable teams to test hypothesis and gain knowledge rapidly through failure (Carlgren, 2013). Moreover, through prototypes designers are able to develop deep understandings, since prototypes with a generative aim help to explore the design space and reveal new information (Blomkvist & Holmlid, 2011). Which is a crucial activity considering that during the fuzzy front end much is unknown and thus uncertain. Especially prototypes are recognized as a way to address (ontological) uncertainty (Jensen et al, 2017).

Overall, prototypes help to enable to generate user-insights, use-case understandings, create understanding of the design itself within a team and potentially boost creativity to produce more ideas and further develop the concept (Jensen et al, 2015). To test certain aspects of an idea (Lin et al, 2008), designers make use of all sorts of different prototypes

The work from Rekonen & Hassi (2018) shows how such a process could look like (figure 2.4). The prototyping process first aims to 1) identify uncertainty and then 2) design the experiment, 3) build the prototype, 4) run the experiment, 5) reflect and iterate.

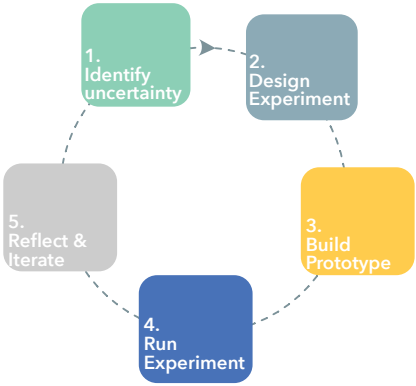


Figure 2.4 an illustrated process that shows how designers could go about prototyping, adopted from Rekonen & Hassi (2018)

2.3.3
Prototyping in Business Models Inc.

This paragraph aims to gain an initial understanding of theoretical prototyping process of BMI. BMI believes uncertainty is an important dimension to tackle during prototyping and validation, and can help to "explore the unknown" (Van der Pijl, et al., 2016). As such, prototyping is viewed as a way to explore the unknown, as phrased, "You can't figure it out in your head. Prototyping means solving (unknown) problems" (Van der Pijl, et al., 2016;178).

In their book a clear prototyping process is stated that aims to validate assumptions (see figure 2.5.) Figure 2.5 shows this step by step process, which aims to test assumptions. The assumptions to test are selected by mapping 'all' assumptions on the Jenga map (see Appendix 2) to determine the 'riskiest assumption'. Based on the gathered data the team can derive learnings and decide to either pivot, persevere or redo (the experiment).

The framed methodology mostly focusses on low fidelity prototypes as illustrated by a prototyping rule: "keep it simple", "use materials already available". (Van der Pijl, et al., 2016; Design Doing Academy, n.d.)

Figure 2.5 step-by-step approach to test assumptions, as described by Van der Pijl and colleagues (2016;202-203)

2.3.4
Prototyping processes comparison

All the described processes aim to make use of prototypes to learn something. Compared to the Lean Startup, Business Models Inc. takes a more explicit stand with the aim to reduce uncertainty by testing 'the riskiest assumption'. BMI views an idea as a Jenga tower (see Appendix 2), where each block represents an assumption. The whole tower (=idea) would collapse if specific assumptions turned out to be false. As business model ideas produce a wide range of assumptions, it seems to be a necessary step to map these to get an overview. The process as defined by Rekonen & Hassi (2018) also views uncertainty entitles breaking down an idea in chunks to make the assumptions testable. However, their work mostly takes a product/service perspective rather than a (broader) business model perspective.

Eventually the difference of the overall processes are rather slim. Figure 2.6 shows especially the defined Design Thinking process and BMI's process are similar in terms of steps. Compared to the Lean Startup approach, identifying uncertainty is not clearly embedded in the process.

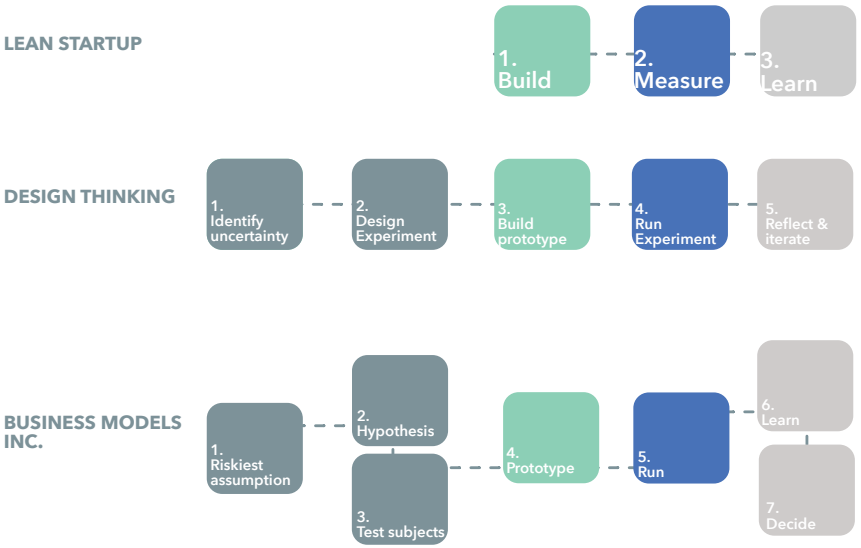


Figure 2.6 comparison between the outlined processes, the processes can be viewed as mostly similar.

2.4
Understand:
Prototyping dimensions

Paragraph 2.3.1, 2.3.2 and 2.3.3 briefly showed possible prototyping processes (figure 2.3 & 2.4) while paragraph 2.3.4 compared the processes. These processes are similar and show how teams could go about prototyping to a certain extent. These processes however, still give little guidance. In theory on could follow a process, however, in practice the end result might not be sufficient. In the analogy of a chef, when a chef doesn't know how to operate specific kitchen tools and what they could achieve, cooking a recipe becomes quite difficult. If we view prototypes as the 'kitchen tools' for designer, one should understand its tools to create a useful output.

Therefore, it is of great use to develop understandings of prototyping dimensions within the process. More specifically if teams aim to create suitable prototypes to learn and create together with stakeholders initially understanding is needed what dimensions are of importance.

During the prototyping process these dimensions should be considered. The work of Blomkvist & Holmlid (2010) shows relevant prototyping dimensions such as the purpose of the prototype, the intended stakeholders, activities and artifact (prototype) should be considered. These dimensions are illustrated in figure 2.7.

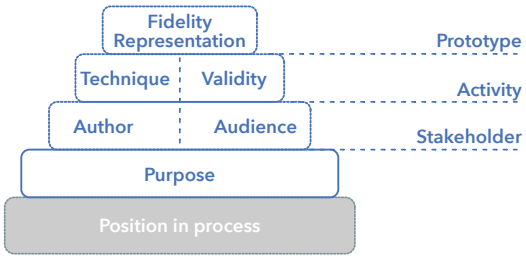


Figure 2.7, the relevant prototyping dimensions, adapted from Blomkvist & Holmlid (2011)

Prototyping dimensions in the prototyping process

Building on the prototyping process presented in figure 2.7, the dimensions from the work of Blomkvist & Holmlid (2011) could be viewed as underlying dimensions that should be addressed during the process. Figure 2.8 illustrates these dimensions. To gain a deeper understanding of these dimensions the following will be discussed in the coming paragraphs.

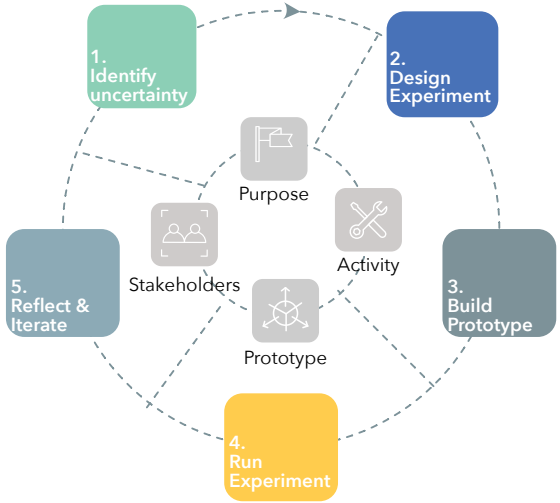


Figure 2.8, underlying dimensions that should be addressed during the step-by-step prototyping process.

Purpose

Houde & Hill (1997) stated designers should be aware what they are prototyping. A clear why should be embodied with the prototype to make an appropriate artifact. As the prototype can serve different purposes, research mainly recognized two purpose categories: exploring, evaluating, (Blomkvist & Holmlid, 2010; Buchenau & Fulton Suri, 2000; Voss & Zomerdijk, 2007).

Generative
Generative in the design field often refers to creating ideas and generating insight situated around the question such as what will be useful? what will be desirable? (Sanders & Stappers, 2012) As such, generative prototypes can be viewed as prototypes that aim to explore aspects of an idea and reveal new information. This exploration of the design space can lead to clear opportunity identification and help deal with ontological uncertainty (Jensen et al., 2017).

Explicitly, these prototypes can help develop understandings of the context, can help to develop new ideas (Kershaw et al., 2011) and aid the concept generation process (Hess & Summers, 2013). As such, generative prototypes help to formulate 'design questions', hypothesis or create ideas ('hunches').

Evaluation
To answer design questions and test more explicit ideas evaluative prototypes can be used. These prototypes enables testing somewhat explicit hypotheses and assumptions (Dong et al., 2016; Lim et al,. 2008). Using prototypes in an evaluative manner helps to evaluate and asses your ideas, concepts and business models. The central questions such as; 'is it useful', 'is it desirable' (Sanders & Stappers, 2014) This prototyping approach is also used in the Lean Startup method (Ries, 2011) where prototypes are used as a tool to test a hypothesis.

Stakeholders

As David Kelley puts it " if a picture is worth a thousand words, then a good prototype is worth a thousand pictures" (Fredman, 2002); prototypes can be regarded as artifacts that communicate information. Therefore, at first stakeholders should at least be able to understand the prototype, before they are able to respond to artifact (Blomkvist & Holmlid, 2011). As Deininger and colleagues (2019) argue a prototype sketch might work for an engineer but not for a social worker. Since prototypes aim to involve different stakeholders, designers should be aware whether the used 'medium' is understandable for the audience.

Typical audiences are; clients, users, customers, colleagues. Where colleagues can be further determined by role; designers, business strategists, brand consultants, sales manager, and so on. Moreover, the author of the prototypes should also be regarded as stakeholder (Blomkvist & Holmlid, 2011). The eventual created prototypes are also influenced by their skills (in 't Veld & Stoimenova, 2020).

Activity

To create intended learnings, different activities can be considered (Blomkvist & Holmlid, 2011). Designers could make use of activities such as sketches, foam models (e.g. Jensen et al., 2017) to experience prototypes (Buchenau & Fulton Suri 2000) or boundary objects (Holford et al., 2008).
Due to the wide range of possibilities, the designer can select a suitable activity based on the purpose and intended audience (Blomkvist & Holmlid, 2011). Also based on available resources, in-house skills and experience (in 't Veld & Stoimenova, 2020; Passera, 2012).

It should be noted specific activities could influence the validity of the generated outcomes. Factors such as the context should be close to reality to generate reliable feedback (Convertine et al., 2004) and the authenticity of the user's behavior (Blomkvist & Holmlid, 2010)

Prototype

As prototypes are often regarded as representations of a possible future (Blomkvist & Holmlid, 2011) and present a 'filtered' idea (Lim et al., 2008) the prototypes are often described at their fidelity level, which refers to the refinement of a prototype on certain aspects. The level is often described as either low-fidelity or high-fidelity (Houde and Hill 1997; Yang 2005; Blomkvist and Holmlind 2011). Low-fidelity refers to prototypes with low refinement such as sketches, paper prototypes or cardboards (Deininger et al., 2019) . Low-fidelity prototype could be more inviting for participants to contribute to the design (Viswanathan and Linsey's, 2011). While high refinement prototypes, such as 3D printed models or a wizard of oz prototype (Buchenau & Suri, 2000) could lead to more reliable and desirable results (Holmquist ,2005; Deininger et al., 2019).

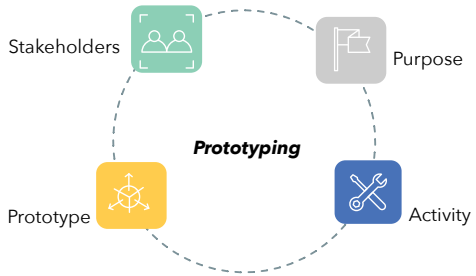


Figure 2.9 prototyping dimensions as discussed in this paragraph. Based on the work from Blomkvist & Holmlid (2011),

2.5
Understand:
Prototyping as a way to address uncertainty

So far this chapter established an overall view how organizations could go about prototyping. The processes are explained and further elaborated upon with the use of dimensions as described in literature. As this project aims to make use of prototyping to address uncertainty, it is important to further explore this construct. As already stated in chapter 1, Business Models Inc. aims to address uncertainty on different levels, but always takes the business model as a center point for the innovation efforts. Together with their clients (organizations) they make use of a search process to discover 'on what might be'. Based on the vision ideas are generated and shaped in the form of a business model idea. The initial created ideas, however, can be viewed as 'guesses'. It is not certain yet if this idea would work in 'practice', as such it is unknown and uncertain. Uncertainty in this context could be therefore defined as the lack of adequate knowledge that might appear in the future, or has yet to be revealed to the subject (designer) (Tracey and Hutchinson, 2016). These knowledge gaps could refer to different 'categories' as mentioned in design literature such as, 'epistemic uncertainty' (Ball et al., 2010) or 'ontological uncertainty' (Sutcliffe & Sawyer, 2013), or as mentioned in the field of innovation, 'truth uncertainty' and 'semantic uncertainty' (Lane & Maxfield, 2005).

Uncertainty: knowledge perspective

As uncertainty implies adequate knowledge is missing, designers could be either aware and make the missing knowledge explicit, or they might be unaware of the missing knowledge. Figure 2.10 illustrates this through the image of a radar, the explicit 'unknowns' (e.g. Sutcliffe & Sawyer, 2013) imply designers could act upon these gaps (e.g. is this claim true, will things go as expected). Yet, when missing knowledge that is not explicit and when 'off' the radar, these types seems harder to pursue. However, these could emerge during projects and can be described as a surprise or unexpected discovery (e.g. Suwa et al, 2000). These unexpected discoveries are recognized as important 'stimuli' for the design process (Suwa et al, 2000).

Dimensions of uncertainty

As stated, uncertainty could refer to different categories such as epistemic, ontological and truth uncertainty. To bring clarity to uncertainty in this thesis, based on these categories I defined two axes. Since uncertainty is mostly framed in the thesis as 'assumption' driven, and as such initial ideas are considered to be 'guesses', based on truth uncertainty (Lane & Maxfield, 2005) one could either view the assumption as true or untrue. As prototypes enable to generate learnings, the learnings could either confirm or disconfirm the initial idea or direction. Disconfirming information could in theory be seen as driver of iteration to adjust the idea accordingly based on the generated information.

Inspired by the work of Sutcliffe & Sawyer (2013) & Suwa and colleagues (2000) when engaging in design activities, designers are able to test upfront formulated assumptions. These could be framed as expected findings, since designers deliberately generate data to learn something. The expected findings therefore create anticipated knowledge. As Suwa and colleagues (2000) described during prototyping, unexpected discoveries could emerge. So called unanticipated knowledge is created during the process. In the axes these are defined as unexpected findings.

During prototyping activities knowledge could be created and thus enable to address uncertainty. An activity could lead to output as categorized in the quadrants (see figure 2.11). These entitle:

- *Expected confirming :*
  Anticipated outcome that confirms the direction (hunch)
- *Expected disconfirming:*
  Anticipated outcome that challenges the direction (hunch)
- *Unexpected confirming:*
  Unanticipated outcome that confirms the direction (hunch)
- *Unexpected disconfirming:*
  Unanticipated outcome that challenges the direction (hunch)

In theory one could pursue expected results through evaluative prototypes (testing a hypothesis). The output could either confirm of disconfirm the initial hypothesis. When prototypes allow for exploration (generative) unexpected findings could be generated. The next paragraph further elaborates on addressing uncertainty in the context of business model innovation.

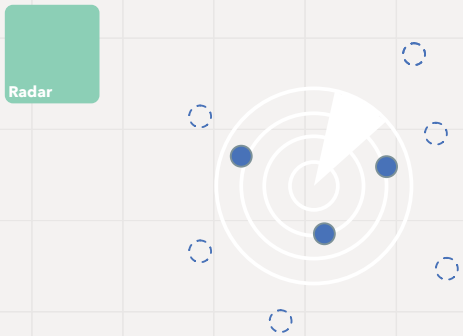


Figure 2.10 the illustration of a radar, where explicit unknowns are captured and displayed while not explicit unknowns fall of the display

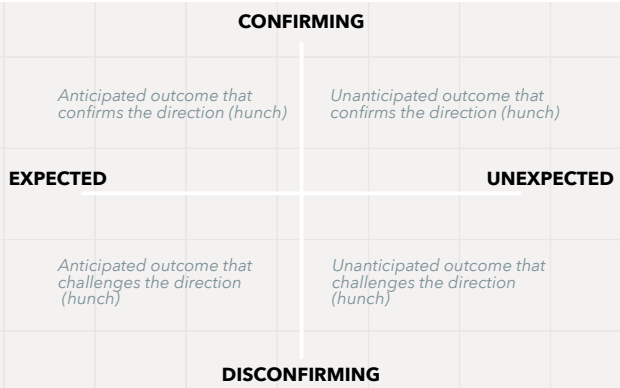


Figure 2.11 uncertainty defined through the dimensions of confirming and disconfirming, expected and unexpected

Prototyping to address uncertainty

When engaging in innovation efforts to achieve business model innovation, the business models canvas is most often used as boundary object to generate business model ideas (Athanasopoulou & De Reuver, 2020). It is still uncertain if these ideas actual 'hold up' in the real world. The assumptions need to be tested, while to some extent along the journey unexpected discoveries could help to develop the concept further. Figure 2.12 shows a simplified journey, the initial assumptions needs to be tested and based on the result the idea could be iterated upon. A way to do so, is by making use of a prototyping process. Based on the created prototypes, the uncertainty 'could' be reduced step-by-step. A sequence of experiments that build up slowly from low fidelity to high fidelity, eventually enables to reduce the uncertainty to a minimum (figure 2.13)

The developed theoretical framework suggest, different types of uncertainty could be addressed (see figure 2.14.). Through evaluative prototyping current assumptions could be tested which could be either be true or false. If the assumptions turn out to be false, it 'disconfirms' the initial idea and therefore need to be iterated upon. While generative prototypes could help to tap in the realm of unexpected findings as they reveal assumptions that were not explicit at first. These newly revealed assumptions could further steer the idea to a different direction.

The overall process could give guidance to address uncertainty step by step. Various dimensions are of relevance and should be considered during the process to fulfill the purpose and thus address uncertainty. For example, to explore customer needs designers should use the right activity to generate valid learnings, but moreover, create an artifact that is suitable for the specific stakeholders. In a way, on could state that these dimensions are interconnected. As such, as organizations go through a prototyping process to deal with uncertainty, during the process relevant dimensions should be considered.

In short, the prototyping process could enable teams to address different types of uncertainty. Carefully considering the dimensions should give the teams the tools to do so. However, to what extend the teams are able to actual make it work is still unclear. The next chapter will further explore the current practice within the context.

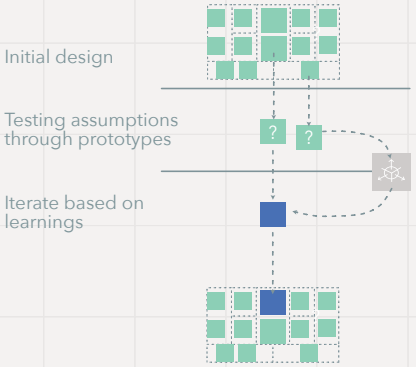


Figure 2.12 Prototyping approaches validation teams could utilize to address certain types of uncertainty

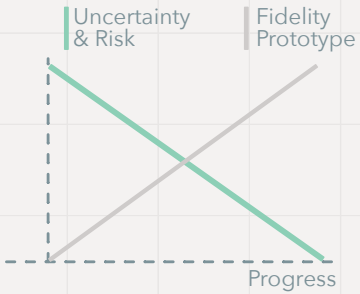


Figure 2.13 Illustrative graphs that shows uncertainty around newly designed business models could be reduced through (higher fidelity) prototypes. Adopted from Bland & Osterwalder (2019)

2.6 Understand: Conclusion

This chapter aimed to answer the question: in what ways can prototypes enable to address uncertainty? First, the chapter introduced approaches to deal enable learning. The view is established and views the Lean Startup and Design thinking methods as ways to enable learning through prototyping. The remainder of the chapter elaborated upon the prototyping process and explains the various dimensions. Eventually this chapter theorizes and views the prototyping process as way to generate and test your assumption (the expected) through evaluative prototyping approaches. While underlying assumption could be revealed by 'unexpected discoveries', which could be addressed by making use of generative prototyping. Moreover, I established the view the purpose is connected with various other dimensions such as stakeholders, activity and prototype. All dimensions should therefore be considered at some point during the process to generate knowledge to deal with uncertainty with uncertainty.

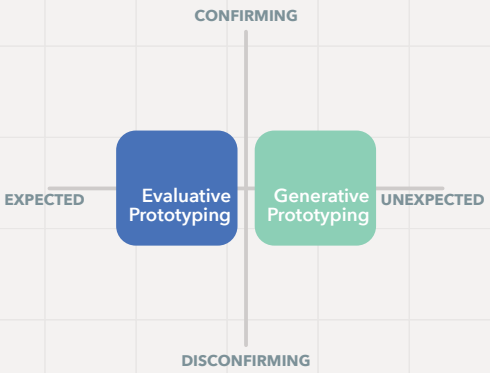


Figure 2.14 Prototyping approaches validation teams could utilize to address certain types of uncertainty

3 Define

3.1 Introduction

To develop an initial understanding of the context, this chapter describes the context the thesis is executed in, by describing the current prototyping process and the various relevant stakeholders. In order to gain an initial insight and answer the sub research question:

What are the current practices of prototyping within BMI?

The chapter presents an overview of the current materials . Based on this overview opportunities are identified to further enhance the prototyping practice within Business Models Inc. .

3.2
Define:
Stakeholders

Method

To define and develop understandings of the stakeholders within the context, 5 generative interviews of 30-45 minutes were carried out with business designers, since they are considered to be "knowledgeable agents" (Gioia et al., 2012).

As part of the interviews, paper profiles were created that served as objects the interviewee could adjust. These profiles were based on the work from Kelley (2005), and personal observation during meetings.

Additionally, to dig a bit deeper in current expertise, the frame of the prototyping mountain was created with upfront formulated levels of expertise. These levels were defined by using the work from Diefenbach and colleagues (2019).

The complete set up and results are presented in Appendix 1. Based on these findings the paragraph introduces the stakeholders and defines the scope for the project.

Stakeholders

During the prototyping process, and thus this thesis, multiple stakeholders are involved in one way or another. This paragraph aims to clarify what the roles of these stakeholders are within the scope of the project.

Graduate Student - Me

As a graduate student from the master program Strategic Product Design at the TU Delft, I aim to help BMI to better facilitate their validation teams. To do so, I constantly aim to translate my ideas into prototypes, to explore how to enhance the process. These prototypes are 'co-created' with the Business Designer so they can be directly utilized and implemented during their workshops. I participate during those workshops, in observing what the influence is of those prototypes, which helps to gain understanding if such an idea is successful.

Business designers -
Business Models Inc.

Business designers describe themselves as rebels and aim to help organizations search for new opportunities, and provide assistance to realize their vision. By using a 'design doing approach' these business minded designers take employees from the organization along by providing training, a clear process and supporting materials. Their ambition could be described as willing to drive changes in a creative yet practical way. This means the business designers try to keep things simple and visual to enable their clients to 'get started'.

Within the scope of this project, the main role of business designers is to guide the validation teams by what they call the validation process, and help teams to create the appropriate prototypes. As stated by an interviewee: " I am the bus driver who shows the way, eventually they should be able to drive the route themselves, from bus driver I become the co-driver, to passenger and eventual I leave the bus". (see Appendix 1) This quote illustrates the role changes during project. Initially the business designer takes the lead to show the route, eventually this grows into a role where they are just part of the 'team'.

As validation teams are most often new to the prototyping process, the designers more or less co-create the prototypes, and design the activities (referred to as the experiments).

Client
Client organization

The client of BMI often initiates and funds the project to fulfill a specific goal like business growth. While this is considered to be an important stakeholder, the client is not included in the scope of this project, since they often do not participate during the prototyping process.

Validation team
Client organization

These multidisciplinary teams are employees from the client organization. The teams are temporary formed for the project. Team members come from different departments, such as marketing, sales and product (engineering). It should be noted most teams consist of novice designers, especially when it comes to prototyping (Appendix 1). Therefore, clear guidance is needed in terms of process, however, it should be noted the team members all have their own expertise such as , technology knowledge or extensive knowledge about the industry and current customer segments. While the teams could vary a lot based on the type of organizations. To illustrate this, people who are often part of such a validation team are described more in-depth on page 42.

Customers

Each business idea tries to create value for specific people. Those people are here described as the customers. To make sure the team designs the right product or service, customers are often involved during prototyping activities such as testing. The aim is to gather insights in order to further iterate upon the idea, or target different customers

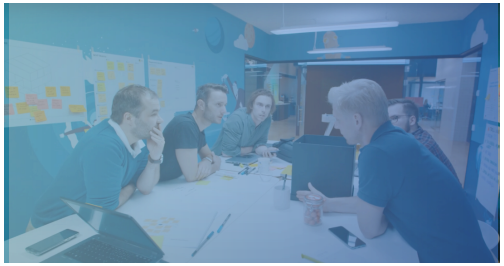


Figure 3.1, an illustrative example of a team at work in a warroom (Business Models Inc., 2019)

Validation Teams

To illustrate, the people who are often part of such a validation team, those could be described as following: (these profiles are based on the generative interviews see, Appendix 1)

Marketing communicator

The marketing communicator is part of the team to bring a 'customer experience' perspective on board. People in these kind of roles make use of customer journey tools, as a result, they are often quite knowledgable when it comes to customers and their desires. Their strength also lies in storytelling and explaining what the product could mean for the customer, rather than why certain features are 'cool'.

Account manager

The account manager often maintains relations with current customers, and therefore, knows them quite well. As a sales person they are target-driven and as a result under constant pressure to meet those (often short term targets). As a result, innovation projects are not always as rewarding for them. They usually try to serve the current customer segment and use anecdotical evidence to support their claims. The account manager is often solution focused.

Product Engineer

A Product Engineer (/designer) could be described as a 'maker or do'er', who wants to get things done. They are quite capable when it comes to creating prototypes when clear design criteria emerged. They are quite practical and can be described as feature focused. The engineer is quite good in translating criteria into features, but sometimes builds to many features already in an early stage. Their frame is often to create a prototype that represent the end product.

Business developer

The business developer could also be described as a corporate entrepreneur, a real 'change agent' who understands the corporate life. He/she looks at the bigger picture at a strategic level, however it could be quite hard for them to make their ideas tangible and testable. Their aim is often to create new value for their current customers, or in some way find new customer segments for existing value propositions.

Product Manager

The product manager is often 'owner' of a specific product within an organization, but also engages in activities such as new product development. They believe the 'customer is king' and therefore often takes a customer centered approach when (further) developing products. In innovation projects, the product manager is often a lead to help the (validation) team keep moving forward.

Stakeholders scope

This project aims to help validation teams address uncertainty. This uncertainty can be reduced in this context through two activities: 1) the prototyping workshops and 2) by engaging with customers and other stakeholders. Thus, the validation teams are the 'user', and the help that could be offered is through workshops where prototypes are designed and findings are discussed. These workshops eventually should enable the to teams generate the necessary learnings to address uncertainty. The role of the business designer is to facilitate and co-create with the team. Within this project, for clarity, the business designer is viewed as an 'expert' who is part of the validation team. As such, the business designer is also regarded as user, since they actively create and participant during the sessions (figure 3.2).

During this project my role could be described as developing 'supporting' materials that are tested and implemented during the workshops. The developed materials (called prototypes) will be used during the meetings/workshops by the validation team(s).

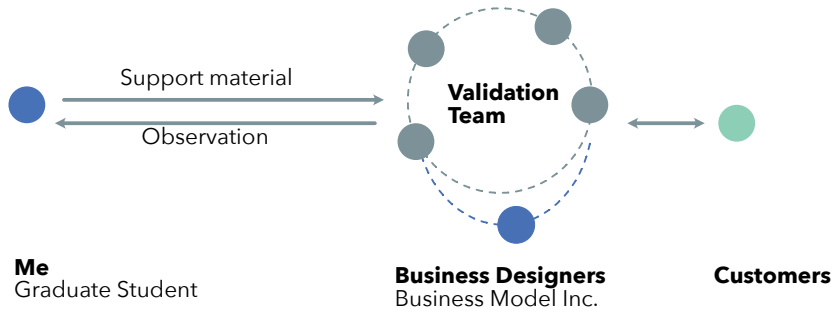


Figure 3.2 Stakeholder map that present the included stakeholders within the scope. The business designers is considered to be a temporary team member.

3.3
Define:
Prototyping in practice

Method

As theoretical processes might work differently in reality, the current way of working regarding prototyping within Business Models Inc. might be different. The current approach was analyzed by observing the sessions and the used materials and created designs. Since processes within organizational contexts are complex, it is rather difficult to analyze these processes (Langley, 1999). To tackle this issue a wide range of data sources are used, to make sense of the current process and activities. Data were collected and generated in a time period of 4 weeks. Table 3.1 shows the used data sources and activities (elaborated upon in paragraph 3.2.2) to generate data.

Activities

To gain an understanding of the context and the prototyping practice within Business Models Inc. (BMI), multiple activities were carried out. As BMI published their methodology and approach in a book (Van der Pijl et al., 2016) as well as an online course (Design Doing Academy, n.d.). In the first week I used this content to get an initial understanding.
Moreover, I reviewed documents and slide decks used during sessions with the validation teams. I observed 5 meetings/ workshops to understand how this process 'unfolds' in the given context. A selection of materials used/discussed during these session are analyzed in the upcoming paragraph (3.4.4). This paragraph also discusses multiple activities ('experiments') which were carried out and made use of prototypes. I observed two of those activities (the mockup interviews & life sized prototype) and took notes.

Category	Type	Amount	Description
Organization	Book written by BMI	1	The Book [x] describes the design doing methodology used by BMI Inc. in their daily practice
	Design Academy	1	This online course developed by BMI teaches the design doing approaches through text, videos and questions
	On boarding guide	1	Guide for 'employees' to onboard the agency
	Interview sessions	5	Five generative interviews sessions with BMI facilitators
	(online) Tool library	>20	All the tools BMI uses to guide their clients during the process
Project	Workshop Slidedecks	10	To facilitate workshop session and guide teams slides decks are used. Utilized
	Prototypes	15	Digital and physical artifacts that were build and used during the projects
	Workbooks	3	Workbook consisting of canvases for team to set up an experiment
	Sessions	5	Participated in 5 sessions in different project, note taking of the observations
	Experiment (activity)	2	Participated/ observed two experiment that were executed by the validation teams

Table 3.1 this table outlines the used data sources to define current challenges

Prototyping process in practice

Based on the observed sessions and materials the overall prototyping process can be framed as following (see figure 3.3): at first an initial 'experiment' is designed by defining a scope and a set up. During the setup initial low fidelity design could be made in the form of paper prototypes, to quickly go over what the prototype could look like. In the next phase the prototype is build and tested with the defined audience by the validation teams. Eventually, the gathered data will be discussed together with the team, derived from this data it is concluded if the hypothesis is true or false. This process could be framed as a blend of the lean startup, the build-measure-learn process, and a design thinking cycles as previous described in paragraph 2.2. As observed, the outlined process in the book is mostly similar as it is observed during the sessions. There are, however, small nuances, for example in practice 'low fidelity' prototypes are mostly used during specific step to create an initial outline. For instance when the team wanted to create a landing page, at first an initial 'paper' low fidelity version was designed that was used to make an actual functioning (high fidelity) landing page. The next paragraph further explores these steps by analyzing the materials and taking an uncertainty perspective.

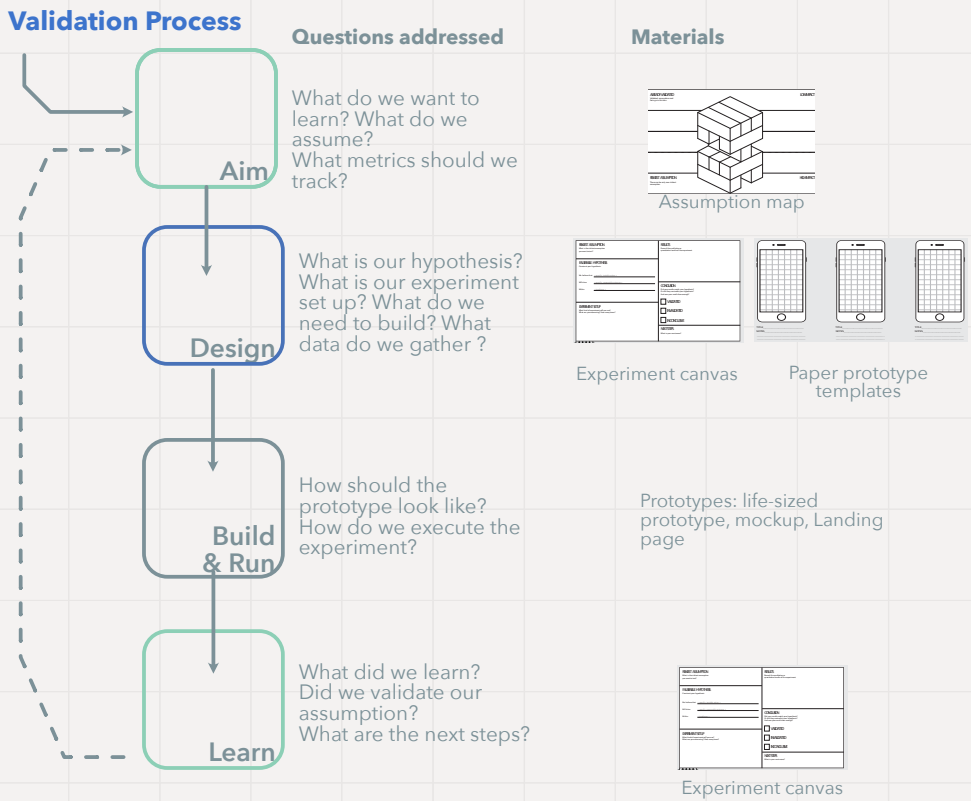


Figure 3.3 based on the data sources from table 3.1 an overview of the current validation process and materials utilized (see Appendix 2)

Analysis

To gain a deeper understanding of the overall process within BMI, the activities during the described steps were analyzed. To structure the activities during the described steps, layers within the process could be defined. These layers are 'touched upon' during specific steps (see figure 3.4). Based on these dimensions within the process specific materials could be used. Inspired by Lim and colleagues (2008), the defined dimensions are process, activities and prototypes. These dimensions are already discussed in chapter 2.

In short, the prototyping process refers to the overall process as defined by the steps. These steps are facilitated through workshops where the canvases and slide decks are used as mostly boundary objects. The activity dimension refers to a determined set up to generate learnings. To do so, materials such as canvases are used. Finally, the dimension prototypes refers to the actual design of the artifact. Supporting materials are templates often in paper form, where teams for example can draw initial wireframes or scenarios.
Table 3.2 shows different materials that are used by BMI to guide the teams through the process and eventually help them to create the right set up and design suitable prototypes. This table present artifacts where the use was clearly documented and the meetings were observed by myself to ensure validity. The next paragraph analyzes these materials as presented in table 3.2. Besides the dimensions the table also describes the purpose of the artifact, the observed 'type of uncertainty' teams were able to address, the stakeholders, the materials that were used and the relevant observations.

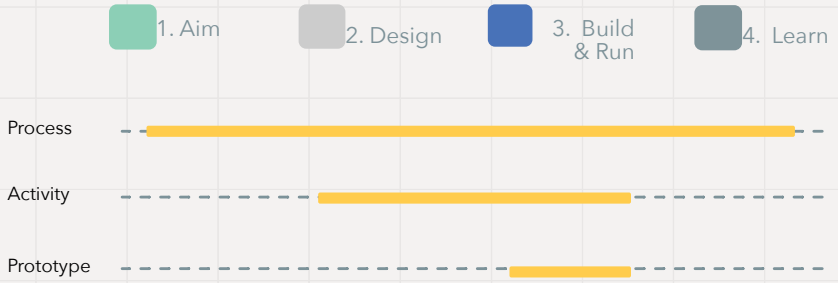


Figure 3.4 Figure that shows which 'dimensions' are relevant during specific steps of the prototyping process.

3.4
Define:
Ability to address uncertainty

Analysis - Results

Figure 3.3 shows 'materials' that were used during multiple sessions. Derived from the analysis of the presented data (table 3.2), two themes emerged, addressing uncertainty and creating suitable prototypes.

Addressing uncertainty
A pattern that emerges from the table is that the current prototyping practice mostly aims to address uncertainty through evaluative approaches. As example 4 and 5 clearly show the purpose of these prototypes are described as evaluative. While the tools used during the process such as the experiment canvas (see Appendix 2) clearly show the aim is to frame expected outcomes. Thus, the prototypes that are used by the teams mainly aim to help create the expected results. Example 2 illustrates 'experiments' that are designed to test specific hypothesis and as such an outcome is framed upfront. It should be noted, the efforts of the validation teams to (at first) formulate a hypothesis resulted in untestable hypothesis. To illustrate this, teams frame the hypothesis with vague terms such as 'some customers' and 'are willing to pay'. Testing such a hypothesis can be quite difficult, one could therefore question if these evaluative practices can actual address uncertainty.

Beside example 2 , example 3 also clearly shows the aim is to either verify or falsify the hypothesis. This approach helps to test a certain aspect of the idea with a clear 'yes or no', while it should be noted teams sometimes find it difficult to come to such a conclusion based on the data. Due to the focus on the evaluative practice, unexpected findings are seldom revealed. With the exception of example 5 where semi-structured interviews allowed to gather unexpected findings to some extent. As such, the overall pattern that emerges is the focus on generating expected results. Different types of uncertainty are thus neglected.

Creating suitable prototypes
Derived from the table, creating suitable prototypes seems to be difficult as well within this context. As example 4 shows, the created landing page was considered to be too vague, as such, they prototype could be regarded as 'unsuitable'. As a result, the generated data could be considered as unreliable. Drawing a conclusion on this basis is not preferable, this prototype therefore didn't enable the team to address uncertainty. This example highlights the importance of creating suitable prototypes to address uncertainty. Based on example 2, it seems the current process fails to give (enough) guidance to the teams to make a suitable prototype. The observation in table 3.2 shows most often important dimensions such as the stakeholders (audience) and prototype (fidelity) are rarely considered when a prototype and experiment is designed.

	Scope	Dimension	Purpose	Stakeholders	Materials	Uncertainty	Observation
1	Aim	Process	Make assumptions explicit and map those to make a selection what should be addressed	Validation teams	assumption canvas	Expected, confirming	- teams seem to be able to make many assumptions explicit
2	Design	Process	Set up an experiment to test a specific hypothesis	Validation teams	Experiment canvas / paper prototype canvas	Expected, confirming	- important dimensions are rarely explicitly considered (such as audience, fidelity) - untestable vague hypothesis - enabled to make explicit what is still uncertain
3	Learn	Process	Validate or invalidate your hypothesis based on the generated data	Validation teams	Experiment canvas	Expected, confirming/ disconfirming	- learnings based on generated data can be difficult - helps to pick and formulate a clear 'signal' if teams are on the right track or need to adjust
4	Build & Run	Prototype	Evaluating what specific use case is most interesting	Validation teams, Consumers	Landing page	None	- prototype was considered to be too vague and thus not appropriate for the audience (consumers) - quantitative data forced the team to reflect on the data
5	Build & Run	Prototype	Evaluate the appeal and willingness to pay	Validation teams, Consumers	Brochure mockup	Expected, confirming, Unexpected confirming,	- the mockup presented a lot features that are difficult to respond to. - mockup enabled to elicit expected and unexpected user feedback
6	Build & Run	Activity	Test real life behavior of users	Validation teams, Users	Life-sized prototype	Expected disconfirming	- not a single user used the actual prototype in their context - through questions the test made issues explicit

Table 3.2 table showing the analyzed materials including the observations

3.5
Define:

Opportunities to enhance the prototyping process

So far this chapter described the context, the stakeholders and current prototyping practice. Based on the analysis section, two opportunities could be defined to help validation teams better deal with uncertainty through prototyping.

Addressing uncertainty
As stated in the analysis section, the current practice neglects certain 'types of uncertainty'. Especially unexpected findings seldom emerge through the current prototyping process. The prototypes are rarely utilized to generated unexpected outcomes in a purposeful way. More precisely, the current practice leans towards an evaluative prototyping approach and neglects generative approaches. As such, to help teams deal with uncertainty in a more extensive way , the opportunity could be defined as enabling the validation teams to target unexpected learnings. This could be achieved by for example generative practices. In short, the practice could be extended by enabling teams throughout the process to generate unexpected outcomes.

Creating suitable prototypes
As derived from the data, prototypes are not always created in a thoughtful manner. While current literature already clearly emphasizes the consideration of certain constructs, such practices are not embedded in the current process. Since the implications of neglecting such dimensions could lead to a situation where the data is unreliable, and teams are therefore unable to address uncertainty. This situation is not desirable. This issue was also recognized during the generative interviews (Appendix 1):

"I didn't know enough; how can you formulate the right hypothesis and create the right prototype? [..] it is quite hard"

"Teams find it difficult to keep it small, [..] They are solution minded and want to make things complex and make things to big, rather than think which assumptions we want to test, ..[talking about their purpose] keeping it too vague"

Both quotes and analysis from paragraph (3.4.5) suggest creating the right prototype can be considered to be difficult for the validation teams. Therefore, the opportunity could be framed to enable teams to think more purposeful about the way they design and use prototypes to generate (valid) data.

COVID-19
As this project was carried out during the COVID-19 pandemic, additional challenges needed to be overcome. All activities changed to online 'version', and all created prototypes had a digital twist. The pandemic made the current challenges, framed as opportunities for improvement, even more important. The virus brought new levels of uncertainty to the ongoing business model innovation projects, questions like; 'would this still have a priority for our customer?' became common. While prototypes and activities all needed to shift new digital ways. New ways to collaborate as team and new ways to reach and interact with customer to gather feedback needed to be explored.

3.6
Define:

Limitations

This chapter aimed to get a better understanding how the prototyping process can help validation teams within the context to address uncertainty. Earlier I outlined the process as described in theory (e.g. Van der Pijl et al., 2016) and observed what 'happened' in practice. Due to the complexity of processes, some nuances are difficult to capture through observation in order to develop a deeper understanding of the process. However, many factors could influence the approach, which makes it hard the pin point certain issues. For instance, the observed sessions took place at different stages of the overall projects. It is difficult to observe and state in what ways the process could be evolved 'along the way'. Moreover, it is a challenge to capture why certain events happen. For example, is an 'insufficient' generated output the result of a flawed process or is training to improve the skills needed to follow such a process?

This chapter also aimed to describe the stakeholders involved and illustrate how these multidisciplinary teams look like. Business Models Inc. serves many different organizations, such as large multinationals, non profit organizations and governmental institutions such as schools. These organizations mostly diverge and the actual 'teams' could therefore consist of different people. The stakeholders thus represent only a selection of the possible involved people.

3.7
Define:

Conclusion

To understand the current practices of prototyping with BMI, various activities were carried out in the course of four weeks. An understanding of the current practice was established by analyzing current materials, observations at sessions and generative interviews. Based on these activities the process was framed and explained, while the current materials (prototypes) were analyzed to gain a deeper understanding whether the process has the ability to address different types of uncertainty. The current approach only enables to generate unexpected findings to some extend. The analysis in combination with the interviews helped frame opportunities to further improve the process to help the validation teams deal with uncertainty.

4
Explore

4.1
Introduction

As the previous chapter showed the current prototyping practice within Business Models Inc, this chapter aims to explore through prototypes how the current approach could be enhanced, with a focus on addressing uncertainty and creating suitable prototypes. By actively embedding the prototypes in the process, this approach helps to set foot in the direction to gain a deeper understanding how to utilize prototyping to address uncertainty. This chapter therefore aims to answer the following subquestion:

How can the current prototyping process be improved in order to enable teams to address uncertainty?

4.2
Explore

Enhancing the prototyping process

Method

To explore how the prototyping process could be enhanced, this chapter aims to answer the following research question: *How can the current prototyping process be improved to enable teams in order to address uncertainty?* Within the course of 4 months prototypes were continuously created and implemented within the context of the three case studies that aim to address uncertainty around their newly designed (business model) ideas (see next paragraph). These three case studies are used as a 'playground' to explore how the current process could be enhanced.

As for complex systems, implementing designs to learn about the context is of importance (Norman & Stappers, 2015). Therefore, the created prototypes are directly embedded in the current process (as described in paragraph 3.4.3), and can be regarded as interventions to develop a better understanding of the context. The method is displayed in figure 4.1. This figure shows that validation teams start with an initial business model and value proposition design and go through the prototyping process as earlier defined. Prototypes are created to generate insights which can be used to further improve their ideas. To enhance this process (way or working) activities during this process are influenced by 'artifacts' that can be considered as 'generative prototypes' (see figure 1). Since the artifacts aim to develop understanding and explore how the process could be enhanced. Figure 4.1 also shows the generative prototypes are used to explore specific step and level of the process (process, activity, prototype). These generative prototypes allow to generate learnings through observations. Based on the observation new prototypes could be developed to further explore how the process could be improved and so on. This approach was inspired by the work of Stoimenova and colleagues (2019) who show that using prototypes can help to explore and enhance the way of working of and enable infra-structuring (providing resources) for the teams within the organizations.

The data was collected by participating in sessions to observe and take notes. The prototypes were used by multiple 'validation teams' from three organizations (5 teams in total). Two organizations are active in the telecom industry and one in the media industry.

Derived from created 'pretotypes' , which refers to the initial rough idea such as sketches, the eventual implemented prototypes, the observation notes and reflective conversations with the company mentor, an overview is created in the form of a timeline and various tables. These are analyzed and discussed.

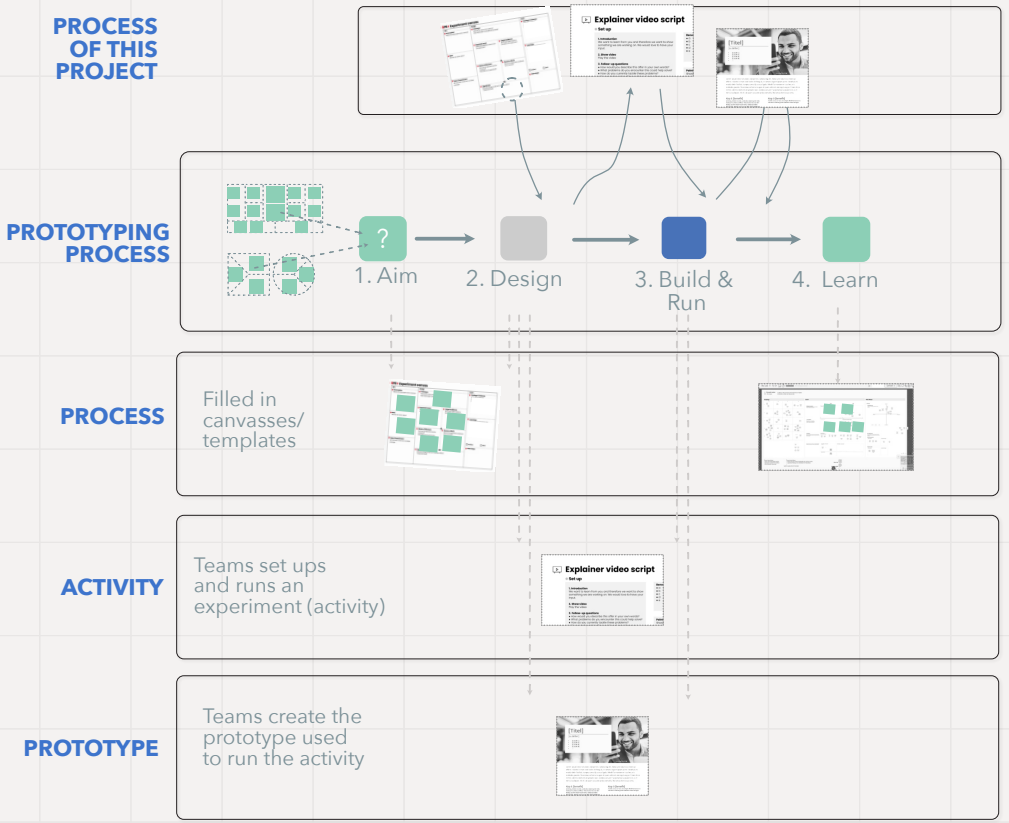


Figure 4.1 illustrated approach of implementing prototypes within the process to generate learnings which fuel the creation of new prototypes and so on.

Case studies

The created prototypes were implemented in a real life context with real validation team from three different organizations. This paragraph explains the context of the case studies to illustrate the efforts of the teams.

The first case study refers to an organization that is active in the telecom industry. With a total of three teams three different business models and value propositions were designed to create value for (future) customers. The newly designed business models fall in the category of B2B in the service realm. Unique of this case study is the lack of Design Thinking experience within the organization and business model perspective. While new product development projects are carried out, these projects often do not involve customers and focus mainly on features.
From a business model , value proposition and product and services perspective the scope of the first case study mostly aims to find a 'problem-solution fit'. The initial problem to tackle is to find out the 'desirable' side of the business model, while considering whether customers consider the eventual offering as valuable and thus are willing to pay (revenue streams).

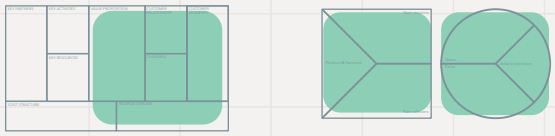
The second case study refers to an organization that is active in the media industry. As part of their new corporate startup the project aims to search what value could be delivered for the customer. Based on the business model design and value proposition design the project also aims to search and validate what is valuable for customers. An extra dimensions to this project is that the designed value proposition will be delivered through a partnership with a consultancy, as such part of the scope is to fill in how these two forces can bring value together (1+1=3).
From a business model, value proposition and product & services perspective, the search mostly tries to explore both desirability and feasible questions (partnership).

In the end, the third case study is carried out in the context of an organizations in the telecom industry (different one). As the product is already defined, the aim is to explore how to find a 'solution-market' fit. Meaning explore how value could be captured within the market through the business model.

CASE STUDY 1

Corporate active in the telecom industry
3 teams

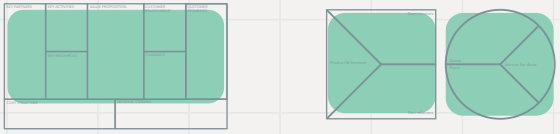
SCOPE : Problem-Solution fit, strong focus on desirability



CASE STUDY 2

Corporate active in the media industry
1 team

SCOPE : Problem-Solution fit focus on desirability and to some extent feasibility



CASE STUDY 3

Corporate active in the telecom industry
1 team

SCOPE : Solution-market fit, product is fixed, focus on viability

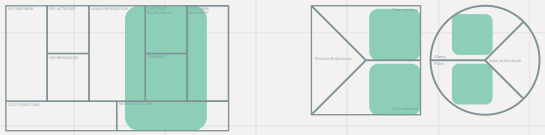


Figure 4.2 Case studies described that served as context to implement various prototypes.

Exploring new ways

As figure 4.3 shows, a wide range of prototypes are created and implemented within the context, in order to explore what new ways could help to improve the practice. This paragraph will describe the journey.

Initially several cards were developed, inspired by the work of Passera and colleagues (2012); Prepare, Set up, Prototype and Learn. Since it was already established, (chapter 3) relevant dimensions are seldom considered. Based on feedback from a business designer: (translated) "people need to have an overview, it should be one canvas", the cards were adjusted to a canvas. This adjusted version was implemented in digital warroom setup. The experiment canvas helped to sharpen the general set up, and steer the discussion during session towards specific questions. For example, a big question mark was placed in the warroom as a starting point for discussion. It should be noted, however, these canvasses mostly grant a high overview. The prototype and way to capture data is reduced to just a post it. The need emerged to provide a way to make the conversations about prototypes tangible, and provide help to create the 'right' prototypes.

In the context of the explainer video an initial outline was created in the form of a setup to use the video as a 'conversation' tool during a semi-structured interview with potential customers or experts. The practice of a 'smoke signal test' was introduced as well, to let validation teams check if the prototypes is considered to be understandable for the audience. The need for such an approach was fueled by the other track, within a team an initial mockup was created. This mockup however, was not considered to be really understandable as it consisted of many technical specifications. To guide these teams toward the direction of 'looking through the eyes of the customer', a template was created. Rather than features, the headers explicit asked to fill in benefits (see figure 4.3 or Appendix 3). Based on these learnings, the mockup template was included as part of the digital warroom of another team (casestudy 1, team 3). With the use of post-its a quick outline could be created. The team ,however, hesitated to make this brochure, as they viewed key information was missing. Anyway, the team gave it a try and viewed such an approach at first helps to narrow down and further scope their idea.

As the warroom was already utilized during multiple sessions, the way 'learnings' are captured wasn't ideal yet. All findings were simply plotted on the digital wall, or only a selection of the gathered findings. It is quite hard when you are in search mode, to decide what is important and not. In order to structure this wall of insights an extensive digital result template was created, to plot these findings on. The goal was to go beyond 'validating' the initial assumptions but also further elaborating on other things the team learned, and what should be done with it. This helped to explicitly state assumptions that could be addressed during future experiments. When faced with assumptions it is still rather difficult to decide what kind of activity would be best during the circumstances, especially in the light of Corona were all activities needed to be shifted to digital alternatives. The wide range of possibilities and limited experience in such a specific context can make this difficult. As the journey showed, previous experiment and 'additional gathered information' could help to decide the next step. For example, based on the explainer video activity, besides the feedback from the customer, the customers (in a b2b context) also shared many ideas. Based on this small insight, it was decided co-creation session would be an interesting approach to enable the customers to share their ideas.

As co-creation is a broad term an initial digital 'paper prototype' was created to discuss with the validation team. The designed activity could best be described as "digital journey mapping", the aim of this paper prototype at first was to trigger the team (member) to generate options for this ideal journey, here described as ingredients. Besides generated options, the questions was also raised "what would be the benefit if these ingredients would be combined?". This questions was

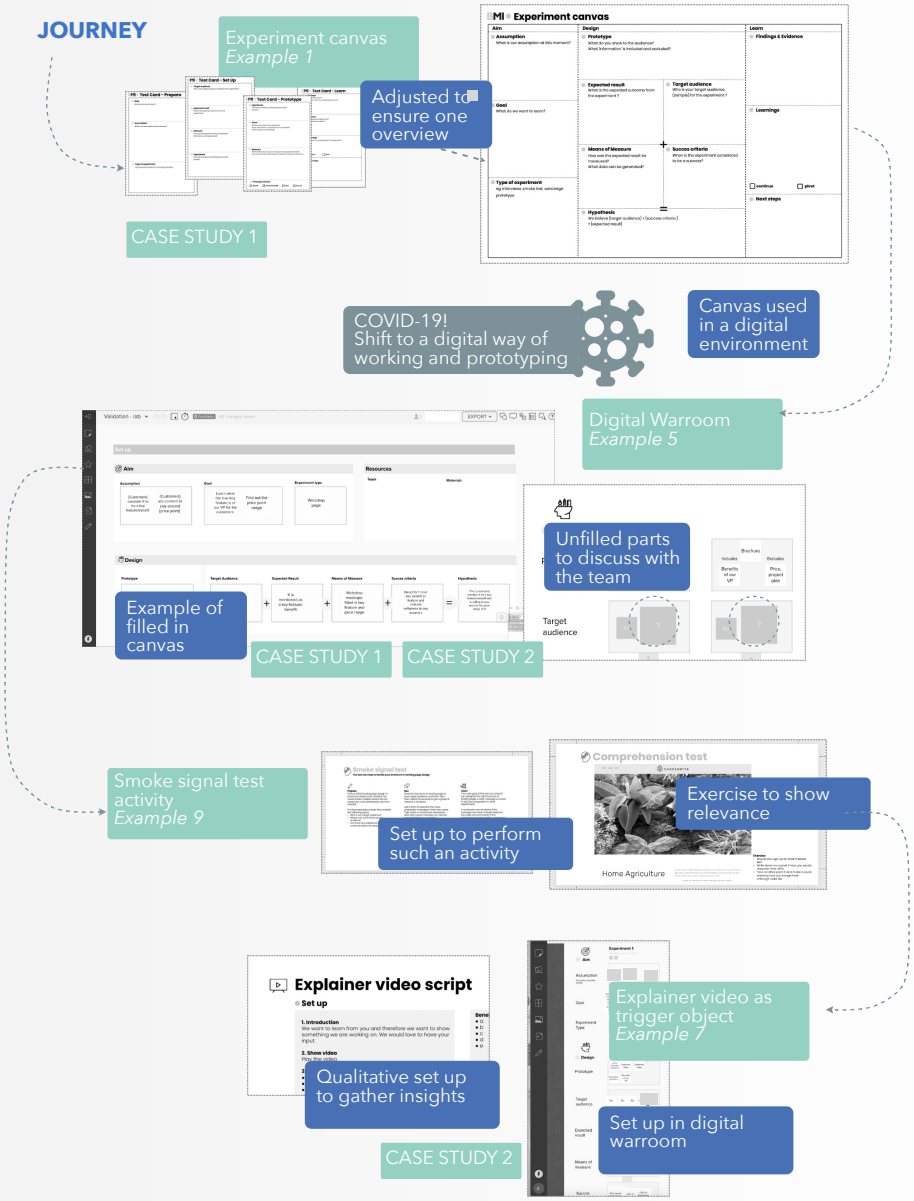


Figure 4.3 Snapshots of the implemented prototypes. (See Appendix 3 for larger images)

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considered to be important and as such if was decided to adjust the co-creation session. The eventual design resulted in timeline builder, team builder and a template to elicit the perceived benefits. This design was meant to be an open ended, however, eventually the co-creation was already mostly filled in leading to using it only adjust is together with the participant. Finding the right balance of leaving things open but do not let customers be clueless is difficult, while filling it in might lead to missed opportunities.

As the team within the case study aimed to make a landing page mockup, the earlier implemented smoke signal test was used within this context as well. In order to two compare alternatives, as this resulted in an answer the difficult question here was more or less: what's next? Not all experiments lead to clear clues what's still 'unknown', deciding upon the next steps can be therefore hard. To explore which activities could be of use within the context, a sequence design session was organized. During this session the consideration 'what is the team willing and able to do' was of great importance to keep things realistic and achievable. This was possible since the project was already running some weeks. Based on defining an end goal various activities were considered and eventually decided upon. The aim of each activity is a building block for the next activity, for example if the team wants to build a minimal viable product the team should first find out what benefits are the bare minimum. Based on the sequence design, a card sorting activity was set out. Again the challenge here was to create a prototype that enables to discuss the cards with customers, but also take a critical look at the initial Value Proposition/Business model design. The cards also enabled to state the 'dislikes'. This approach helped to identify 'what is considered to be great and nonessential.

The explained journey as above is further elaborated upon through the lens of the impact of such activities, while the boundaries are also discussed. These boundaries are used as input to take the prototyping process to the next level in the next chapter

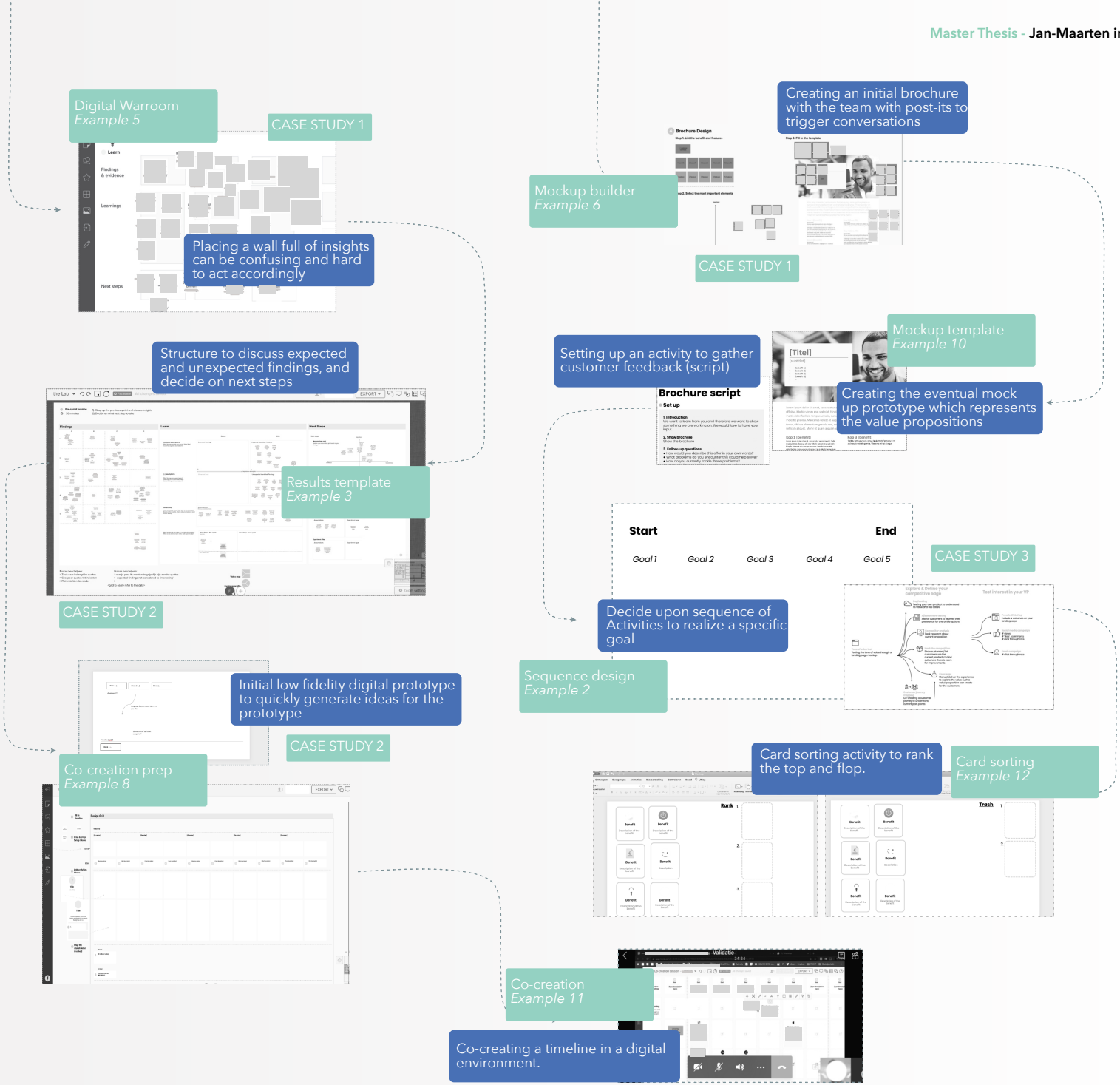

Figure 4.3 *Snapshots of the implemented prototypes. (See Appendix 3 for larger images)*

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4.3
Explore:

Impact of the prototypes

The previous chapter concluded by defining two opportunities to enhance the current process. To explore how to seize these opportunities multiple prototypes were created. Through a wide range of activities this chapter aimed to enhance the practice. This paragraph elaborates upon the 'impact', how the generative prototypes (see tables 4.1 - 4.12 at page 66-69 & Appendix 3) enabled to enhance the process.

Addressing uncertainty:
As previously stated, dealing with uncertainty not only entitles to test current assumptions, but also includes revealing underlying assumptions that are not explicit at first. To move towards this practice, multiple prototypes and approaches (see figure 4.5 and tables 4.1-4.12) were taken to explore how to enable validation teams to uncover this potential of prototyping.

Revealing Assumptions
Through multiple activities such as the co-creation session, card sorting and the explainer video (#6,#10,#7,#8,#11) the teams were able to reveal 'assumptions' by gathering unexpected insights. With the use of the results template (#3) teams were able to act upon these new assumptions by setting up new activities.

Prototypes as a straw man.
During the Build & Run step, example 6 shows the creation of an artifact (mockup) to use a straw man to evoke discussion, enables critical thinking and team members to challenge each other in a concrete way. Such an activity therefore helped to identify issues, for instance at on point the team realized the important question 'why' this is of any value. Eventually, the team was able to connect the promise with a clear 'why'.

Prototyping to trigger
Initially it could be stated the activity of the prototyping process entitles the 1) consideration of what assumptions needs to be tested, 2) how they can test this assumption and 3) what the prototype should look like to do so.
However, as example 1 and 8 shows the act of designing to activity and prototype actual results more or less as a 'by product', teams 'run into walls' and realize certain assumptions are not made explicit yet. As such, the process itself triggers the team in certain ways. For example when a setup was created (example 8) the question was raised "what is the role of stakeholder (x)? [in our solution] as these questions pop up, assumptions can be revealed.

Additionally, when prototypes are used to engage with customers the prototypes enabled to trigger the stakeholders. As example 7 and 9 show prototypes could be effective to trigger customers to reveal information that is new to the team. The prototypes triggered certain thoughts.

Prototyping to drive continuous learning
As the prototypes enabled the teams to reveal assumptions in all sorts of way and therefore, helped to address different types of uncertainty. It was found additionally, as the overview (figure 4.2) shows at case study 3, example 3, when made explicit the newly revealed assumptions actually influence the next step(s). These insights were used as input to formulate assumptions to test these in future experiments. In a way, the output of an activity is not necessarily that teams 'addressed uncertainty' but rather reveal uncertainty to act upon in a later stage. When considering the framework from paragraph [2.2], a two step by step approach helped to firstly reveal assumptions and secondly test this assumption (see figure 4.1). The process can be regarded as driver for continuous learning as new 'assumptions' could emerge that needs to be addressed during a later stage (next steps).

Creating suitable prototypes
To make the prototyping process of use, the bare minimum is a to create a suitable prototype. Within this context of novice designers this could be challenge. To tackle this issue a range of generative prototypes were developed to explore how I could help validation teams to set foot in the direction of creating the right prototype.

Evolving prototypes
As a numerous of examples still show (example 9,10) it is difficult to make the right prototype due to the fact knowledge is missing within the teams. As example 7 illustrates, testing your prototype to further improve upon the artifact can help to let the prototype evolve to a 'suitable' one. This 'learn by doing approach' is made possible if the prototype is explicitly reflected upon based on the generated data. While the co-creation set up was made in such a way, flexibility to improve the prototype was taken into account. Since digital environment allow to rapidly change the prototype accordingly.

Understandable prototypes
As early stated, prototypes should be at least understandable for the audience. By a rather simple activity (smoke signal test) teams used this activity to generate insights how the prototype is actual perceived. This way the team not only is able to develop understanding of the mental models of their customers/stakeholders, but it also enables them to iterate upon the current prototype.

COVID-19
Quite early on the COVID-19 influenced the implemented prototypes. As the way of working needed to adapt to digital ways, the prototypes were also used to try out new digital ways and learn while doing. This approach helped at first to adapt the way of working to a digital way (e.g. Through the digital warroom, digital prototyping building) and help to continue the efforts of continuous learning.

Apart from the process, the designed activities and prototypes of the teams shifted to a digital approach. These efforts might need constant adjustments since it could be difficult to determine how these things work. For example, as it turned out, gathering feedback by sending a video, might result in that people do not bother to watch the video and if they do it is hard to determine if they looked at the whole video. One could therefore question the validity of the gathered feedback, adjusting the setup might be a wise thing to do.

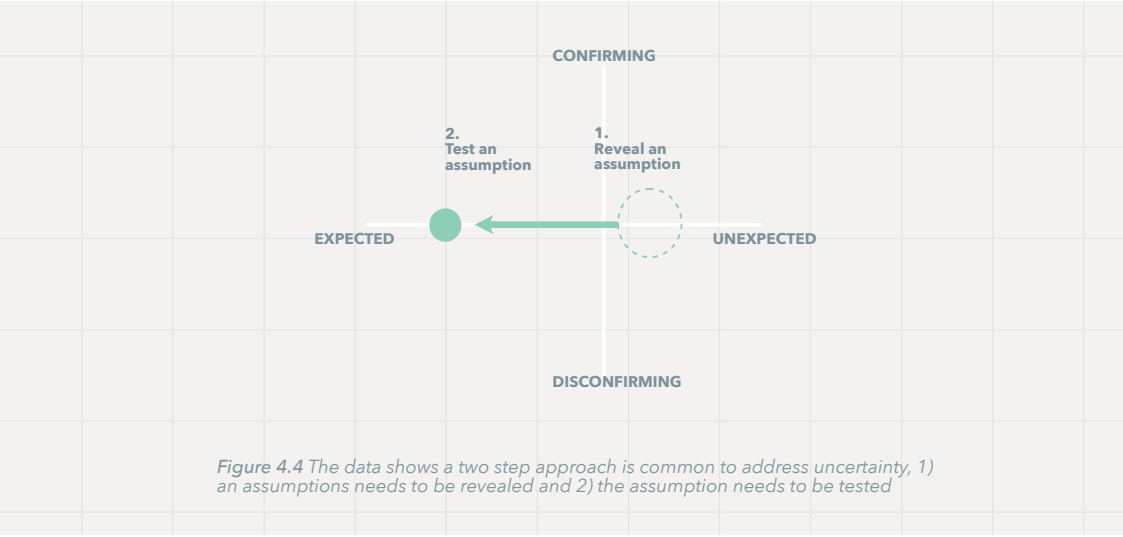


Figure 4.4 The data shows a two step approach is common to address uncertainty, 1) an assumptions needs to be revealed and 2) the assumption needs to be tested

CASE STUDY 1

SCOPE : Problem-Solution fit, strong focus on desirability

Implemented prototypes:

1. Aim
2. Design
3. Build & Run
4. Learn

	#1 Experiment Canvas		
#5 Digital Warrroom	#5 Digital Warrroom	#5 Digital Warrroom	#5 Digital Warrroom
	#6 Mockup Conversation	#10 Mockup Design	
#5 Digital Warrroom	#5 Digital Warrroom	#5 Digital Warrroom	#5 Digital Warrroom

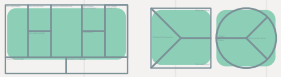
GENERAL

#4 Chatbot	#4 Chatbot	#4 Chatbot	#4 Chatbot

Figure 4.5 An overview of the implemented prototypes categorized by case study and position in the process (step)

CASE STUDY 2

SCOPE : Problem-Solution fit focus on desirability and to some extent feasibility



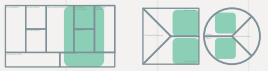
Implemented prototypes:

1. Aim
2. Design
3. Build & Run
4. Learn

#5 Digital Warrroom	#1 Experiment Canvas #5 Digital Warrroom	#7 Explainer video #9 Understandable prototypes	#3 Digital Results template
#3 Digital Results template	#8 Set up co-creation session	#11 Co-create a timeline	

CASE STUDY 3

SCOPE : Solution-market fit, product is fixed, focus on viability



Implemented prototypes:

1. Aim
2. Design
3. Build & Run
4. Learn

	#9 Understandable prototypes		
#2 Co-creating a sequence design	#1 Experiment canvas	#12 Mockup design	

Table 4.1 - Table 4.3, overview of the implemented prototypes presented in multiple tables

1

Scope	Purpose	Uncertainty	Observation
Design	Co-creating a clear experiment set up by considering multiple important construct such as stakeholders (audience), purpose, expected result, prototype and ways to capture data.	Expected confirming	- helped to state assumptions such as "We expect X views [such] an integrated approach as beneficial " - setup enables to only co-created on very specific elements such as audience - Considering all elements is experienced as difficult and complex - stating what the prototype include and shouldn't works as stimuli to identify 'uncertainty' to some extent
Dimension			
Process			
Prototype			
Digital experiment canvas			
Stakeholders			
Validation teams,			

2

Scope	Purpose	Uncertainty	Observation
Aim	Create a sequence of activities (experiments) to iterate upon the initial idea (Value Proposition)	Unexpected disconfirming	- questioning a current Value Proposition as stimuli. "Is our Value Proposition unique?" - sequence created to work towards a specific goal (output) - 'Activities' (experiments) selected on the basis what the team could do and are willing to do
Dimension			
Process			
Prototype			
Visuals			
Stakeholders			
Validation teams			

3

Scope	Purpose	Uncertainty	Observation
Aim, Learn	Reflecting on the gathered data by plotting the information in a structure and deciding on next steps	Expected confirming, Unexpected confirming	- unexpected learnings are viewed as most valuable -clustering the findings helped to make unexpected learnings explicit. - Unexpected findings lead to increase awareness of current knowledge gaps; "how would this look like" - When the output of an activity resulted in only a few unexpected findings the team questioned why this happened: "Did we fail to explore due to our setup?"
Dimension			
Process			
Prototype			
Digital template with dimensions of: expected and unexpected results			
Stakeholders			
Validation teams			

Table 4.4 - Table 4.6 , overview of the implemented prototypes presented in multiple tables

4

Scope	Purpose	Uncertainty	Observation
All	Explore what content is needed to enable business designers to improve their sessions, and find out if existing content is relevant to do so.	None [prototype didn't influence the process of the validation teams]	- chatbot mostly used to browse for inspirational purposes - not explicit ask for content by business designers
Dimension			
Process			
Prototype			
Chatbot prototypes			
Stakeholders			
Validation teams			

5

Scope	Purpose	Uncertainty	Observation
All	Align team members continuously in the process to work towards a clear goal in a digital way by providing	Expected confirming	- shared digital warroom grants overview - author (who is responsible) of the content is unclear which makes it still rather static, unexpected hiccups are thus seldom addressed - Issues only addressed during team meetings
Dimension			
Process			
Prototype			
Digital warroom			
Stakeholders			
Validation teams			

6

Scope	Purpose	Uncertainty	Observation
Design	Enable teams to create a mockup to evoke team discussion	Expected confirming, Unexpected confirming	- mockup served as a straw man to enable teammates to challenge each other; *"Customer do not know what x and y means",* this helped the team to further detail the idea - [1/2]teams rather avoid making a mockup with 'insufficient' information, "It would be useless because we don't know what would be in this [mockup]" - [2/2]After creating the mockup the team viewed this approach helped them to make the idea more concrete and thus streamline their thoughts
Dimension			
Activity			
Prototype			
Mockup setup, explanation cards			
Stakeholders			
Validation teams			

Table 4.7 - Table 4.9 , overview of the implemented prototypes presented in multiple tables

7

Scope	Purpose	Uncertainty	Observation
Build & Run **Dimension** Activity **Prototype** Script, explainer video, visuals, experiment set up **Stakeholders** Validation teams,(customers)	Creating an experiment outline to trigger customers through artifacts to gather user needs	Expected confirming, Unexpected confirming	- evoking through artifacts helped the team to gather unexpected input and identify key issues and elicit concrete customer needs; (total of 10 expected findings and 15 unexpected findings) - By engaging with customers team realized their artifact (explainer video) was unclear on many parts, therefore the video was iterated upon.

8

Scope	Purpose	Uncertainty	Observation
Design **Dimension** Activity **Prototype** Facilitation script, digital timeline builder **Stakeholders** Validation teams	Design a co-creation session to create an ideal timeline together with customers	Unexpected confirming	- creating the 'ingredients' helped to further shape the idea in unexpected ways since it enabled to identify new (design) questions such as: "what is the role of [stakeholder] ?"

9

Scope	Purpose	Uncertainty	Observation
Design & Build & Run **Dimension** Prototype **Prototype** simulation exercise, explanation cards **Stakeholders** Validation teams, customers	Help teams create understanding how people perceive their prototype	Unexpected disconfirming	- utilized to test alternative 'mockups' - lacking knowledge of audience mental models makes it hard to upfront create the right prototyping, e.g. do people understand these technical details. - Teams were able to gather data by asking the participants to describe the artifact in their own words through this approach they realized that the artifact was inappropriate

Table 4.10 - Table 4.12 , overview of the implemented prototypes presented in multiple tables

10

Scope	Purpose	Uncertainty	Observation
Build & Run **Dimension** Prototype **Prototype** Brochure template **Stakeholders** Validation teams	Enable teams to present their idea through a mockup to gather customer feedback	Unexpected disconfirming	- prototypes often created from authors own 'thought world' and as such not through the lens of customers, e.g. listing the features instead of explaining what these features mean for the customers - Lack of customer knowledge makes it hard to imagine why this could be useful for the customers - Eventual lack of 'interest' let the team question if they targeted the right customer/audience. This was adjusted

11

Scope	Purpose	Uncertainty	Observation
Build & Run **Dimension** Prototype **Prototype** digital timeline builder **Stakeholders** Validation teams, customers	Co-create an ideal situation/ timeline together with customers or experts	Expected confirming, Unexpected confirming	- Pilot session helped to identify issues with prototype, for example starting without inspirational content starting from blank is hard, the customers should be inspired - Prototype could trigger in unexpected ways, using this prototype eventual resulted in the question "what are you not able to do" popped up. - Upfront defined ingredients could be reframed in such a context; e.g. "This is really old school, I would prefer x"

12

Scope	Purpose	Uncertainty	Observation
Build & Run **Dimension** Prototype **Prototype** Digital card template **Stakeholders** Validation teams, customers	Let teams create 'cards' to gather feedback on the importance of specific features and intended benefit	Expected confirming, Unexpected disconfirming	- Initially the benefits were defined in quite abstract terms such as "great customer service", "security", these were adjusted to fit the audience (eg. "We answer all your questions") - The cards helped to trigger the customers to talk about their preferences which let to a wall of expected insights (e.g. We want someone to answer our questions) ... .. and unexpected insights for the team (e.g. some of their defined customers turned out to be only users, the product is 'bought' by another party)

4.4
Explore:
Faced boundaries

As described in the impact paragraph 4.3, the current practice was extended in a positive way. Engaging in this context also resulted in many learnings (figure 4.6) that could fuel an iteration on the current practice. (Prototypes; see tables 4.1 - 4.12 at page 66-69 & Appendix 3)

Risk avoidance
One boundary that emerged is the risk avoidance within the teams. As example 6 shows 2 teams rather avoided to make a mockup when there is according to them there is insufficient information. As a result, they viewed prototypes should represent findings rather than as a way to explore through the creation of an artifact, and trigger customers with the use the mockup. However, after creating this mockup they realized such an approach could be a helpful tool to make your own thoughts concrete. It seems the team hesitated due the fact they were not sure whether they could make a sufficient mockup at this stage due to the lack of information. At first, the tendency was whether they were not able to make the thing 'right' is would better not to do it. They were not comfortable to take 'this risk'. Their mindset can be therefore viewed as 'risk avoidance'.

Lack of disconfirming information
Overall pattern could be noticed disconfirming information was not often revealed, it seems this dimension is seldom pursuit. Meaning the revealed information seldom challenged the idea in such a way the concept was iterated upon. A few exceptions that enabled to generate such information is for example 2, however, due to position in the process this prototype only enabled to generate critical questions to pursue. Example 9 was also able to reveal disconfirming information but this was mostly situated around the prototype, the idea itself was not iterated upon. Finally, example 12 revealed new information about the 'potential' customers and revealed underlying assumptions, however, it seems even though revealed, the information was barely used to iterate upon the idea itself. As such, it seems for teams challenging to actively pursue disconfirming information and if revealed act upon accordingly.

Lacking Skills
A common boundary to the use of prototyping within teams was the lack of 'skills' or experience to create suitable prototypes. As the observation in example 9 shows within the context there is a lack of knowledge to make a suitable prototype, for instance missing knowledge about the customer (audience) can make it difficult to create a mockup that is understandable for the audience. Moreover, example 10 shows this lack of understanding actual manifested in a mockup that is created without considering the audience. As the observation section shows, these prototypes are actual most of the time created based on the 'thought world' of the author instead of the customer, meaning the author includes what would be important based on his/her perspective. In short, it is quite common certain 'important' dimensions such as considering the stakeholders are ignored during the act of making prototypes. This problem is framed as lack of 'prototyping skills' or experience which result in prototypes that are unsuitable.

Continuously adjusting
As especially during the Covid-19 the teams face a rapidly changing context, processes needed to adapt, and simple necessary tasks such as connecting with customers was sometimes difficult. If activities are suddenly changed to digital ones, one could question what would be the best approach. In practice the teams should adjust their activities accordingly. However, to date, working in a digital environment did not lead to such practices. The observations at example 5 show, co-creating the activities and artifacts doesn't lead to clear 'authorship', as such during the run phase things are seldom adjusted, even if necessary. These issues are eventually mostly addressed if made explicit during team meetings.

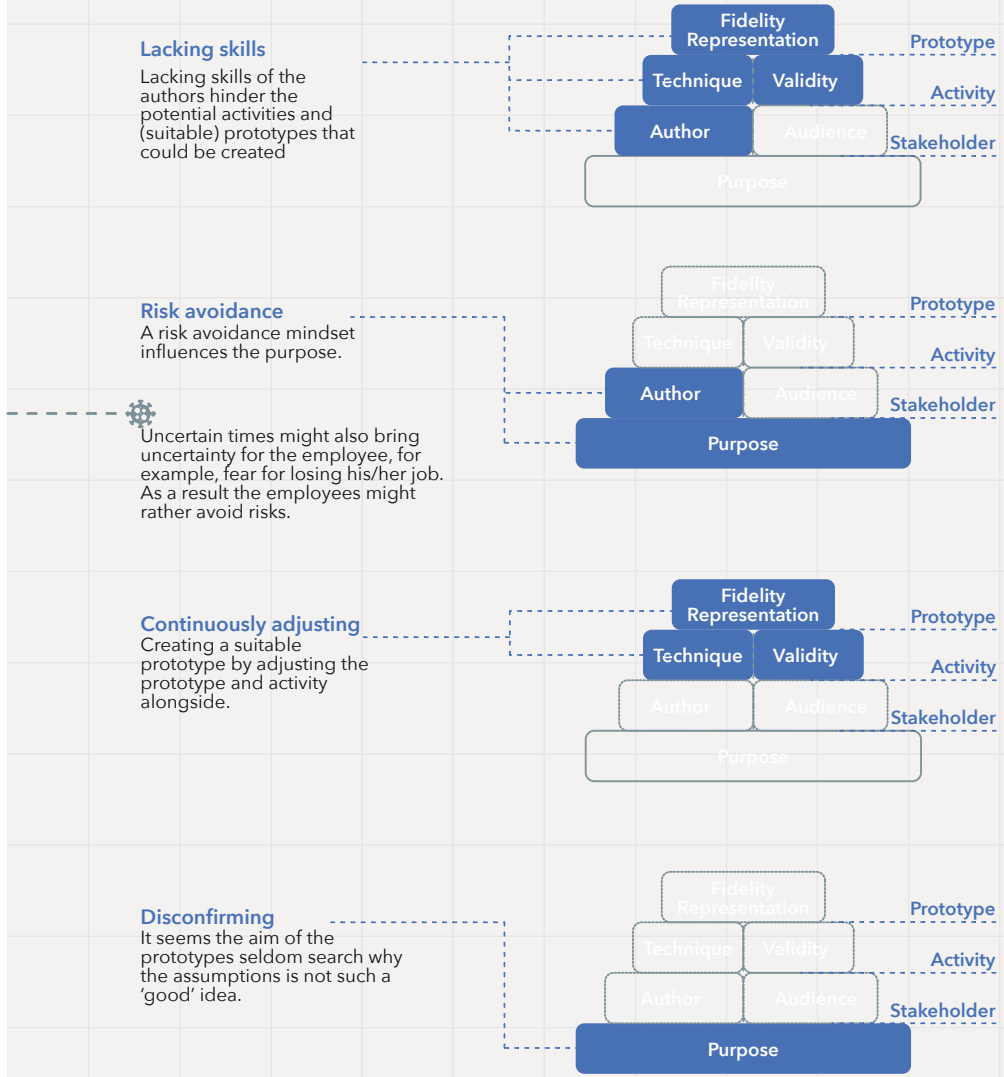


Figure 4.6 Emerged boundaries presented with the relevant the relevant prototyping dimensions. Model adapted from Blomkvist & Holmlid (2011)

4.5
Explore:

Implications when dealing with uncertainty

As this thesis aimed to develop understanding how uncertainty could be addressed, the following map, figure 4.7, illustrates to what extend the implemented efforts could help to realize this. The figure shows the current practice was somewhat extended.

While at the same time it should be acknowledged, the current boundaries could hinder to what extend the uncertainty could be addressed. As figure 4.8 shows it could be theorized, lacking skills could only address the uncertainty to a limited extend. Since only limited 'options' are available and it is questionable if these could be executed in the right way, meaning adjust to the circumstances and create suitable prototypes.

Finally, as observed in the context, a risk avoided mindset and avoidance for disconfirming information could in theory impact the addressed uncertainty. As figure 4.7 the implication is this limits the addressed types, since disconfirming information is more or less avoided, ignorance or pursued.

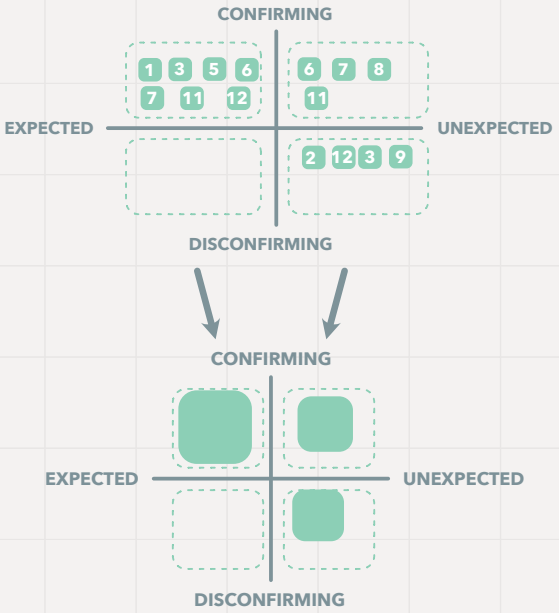


Figure 4.7 The prototypes examples plotted in the uncertainty quatrants to illustrated disconfirming information is not often revealed compared to confirming information

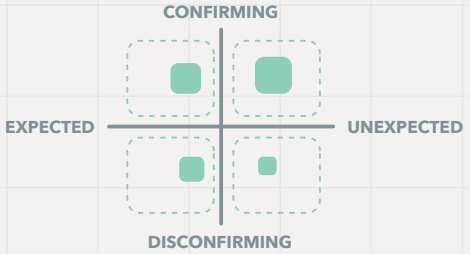


Figure 4.8 Theoretical implications of the lacking prototyping skills schematically plotted in the quarters to illustrate this could lead to the practice teams are only able to address uncertainty to a limited extent

4.6
Explore:
Reflection & Learnings

This chapter showed the current process was enhanced through a wide range of activities, implemented one by one over the course of 4 months. For instance the project aimed to extend the practice to reveal new assumptions by using prototypes for instance as straw man or as trigger objects. The unexpected discoveries were viewed as 'valuable' and as such directly influenced future activities. It should however be stated, these findings are still unexpected, and as such could be considered one could only design for such findings to some extent. Enabling certain activities might lead to those moments but not per se. As reflected upon during a team meeting, when "less unexpected findings are revealed does that mean the setup of the activity did not allow to do so"? This question illustrates how difficult it is to deal with uncertainty, it is hard to tell if all the knowledge gaps are identified.

As current literature already states, risk avoidance within corporates might hinder a successful adoption of Design Thinking (Carlgren, 2016). It seems more a less the same is happening within the prototyping process. Teams are hesitant to design when there is incomplete information and to some extend do not actively look for 'disconfirming' information. When disconfirming information is revealed, the concept idea is rarely iterated upon. The cause of this can be complex, disconfirming information could be ignored and not thus not be shared, the so called 'cherry picking' of information. For expected results it is quite easy to asses if the information confirms or disconfirms the assumptions, it is a different case when it comes to unexpected information. Since these assumptions are seldom explicit, one could either present these new assumption as 'confirming' and therefore, do not challenge the current idea. This highlights the fuzziness of the unexpected, it's not easy to asses whether such information is confirming or disconfirming and when iteration is needed.

Additionally, in this context creating a suitable prototype could be hard, since teams are often not aware what would be relevant for their audience in the first place. While audiences are often framed as an important dimension in literature (see paragraph 2.6) it seems quit difficult to design a suitable prototype for the audience. Learning by doing could be seen as a way to solve such problems, teams could constantly adjust their 'experiment design' if necessary. However, the current (lineair) process does not always give room to do so (run is run), while another problem is that the co-creation approach to prototyping does not lead to clear authorship and therefore a lack of a person who takes responsibility to adjust the set up constantly.

4.7
Explore:
Limitations to current approach

While the activities enabled to explore how the current approach could be improved, the approach did have its limitations. As this project defined different types of uncertainty to explore and analysis the efforts, the initial view point has it limits. As already shortly mentioned in the learning & reflection paragraph, it remains difficult to state when information is confirming or disconfirming especially if new information is revealed and assumptions are suddenly explicit. If a team is confronted with new information the 'meaning' is not often explicit initially. The current research approach neglects the manner of how such information is treated. Rather than following the prototyping process, the overall project process could make these iteration over time possibly more explicit.

The current approach helped to observe real life behavior. The used approach however, only enabled to produce insights why this occurs to a limited extent. For instance, team members from the validation teams also have to fulfill different roles in their organizations. As already suggested by Blomkvist & Holmlid (2011) underlying relationships might be a barrier during prototyping. For example a team member might want to avoid 'learn through failure' since this role is opposing to their current role. It is hard to isolate the reason for this, but as example, an account manager might be hesitant to 'learn through failure' in front of his /her relations (e.g. customers).

4.8
Explore:
Conclusion

This chapter aimed to explore how the current prototyping practice could be enhanced by taking the opportunities defined in chapter 3 as starting point.

By creating prototypes that were tested in a real life context, the prototyping process was enhanced in several ways. First this allowed the teams to reveal underlying assumptions by using prototypes as trigger object or straw mans for internal use. Moreover, it was found revealing new assumptions can drive teams to continue their efforts and further test the newly revealed assumptions. As creating suitable prototypes is considered to be a challenge, iterating upon the prototype itself is found to be an useful practice. The prototypes also enabled to reveal clear boundaries, such as risk avoidance and lacking skills. These boundaries are likely to have an impact to what extend uncertainty could be addressed.

The generated learnings and created prototypes serve to develop an eventual boundary object.

5.1

Introduction

Chapter 4 explored through the use prototypes how the prototyping process could be improved. Using insights from the previous chapter, this chapter presents a redesign of the prototyping process through the design of a boundary object, a 'digital warroom' , as well as an answer to the research question:

How can we help validation teams in order to address uncertainty by making use of prototyping?

This chapter presents a redesign of this process through a design of a digital warroom, and aims to show in a concrete way how validation could go about addressing uncertainty.

5.2
Develop:
Improving the current approach

Chapter 3 already described the current process within Business Models Inc., to explore how this process could be improved, prototypes were created. Generated findings consisted of:

- Making underlying assumptions through prototypes
- Evolve prototypes to make them suitable

The implemented prototypes helped to influence the process as executed. Initially the process was framed as 1) *identify uncertainty* 2) *design a set up to address the uncertainty* 3) *build the prototype* 4) *learn by analyzing the results*. In reality the 'uncertainty' is defined along the process. Through the creation of an initial prototype the team is ,for example, able to develop understandings and make uncertainty explicit. In a way these activities work as a stimuli. Moreover, as the team consisted of novice designers the team also faced a level of 'uncertainty' when it comes to prototyping itself. It is not obvious for novice designing how to design the right 'experiment' and prototype. Questions such as : *Is this the right prototype for the audience?* cannot be answered upfront, the knowledge or experience is lacking. An iterative approach when it comes to designing those is needed within this context.

In contrast with the current prototyping process as used by BMI, this process is build around the idea that teams are aware which knowledge is missing, and the only challenge remaining is finding a way to 'access' the knowledge. This simplification is troublesome, as teams seem to be unaware which knowledge is missing Moreover, the teams face uncertainty whether these prototypes can actually 'deliver' and reveal valid information.

Therefore, this paragraph introduces an iteration on the current approach (figure 5.1 & 5.3). This adjusted approach should enable iterating along the way and while introduces uncertainty should be viewed as an underlying force. For instance, as the preparation of the co-creation showed by creating the setup and the prototype itself, not upfront assumptions are considered and integrated in the approach. 'Muddling' can help to uncover the uncertainty step-by-step. The aim of the prototypes can be regarded as dynamic in this context. This in line with the common view on early design activities where it is more about muddling through instead of following a clear line (figure 5.2). The overall process could be viewed as a step-by-step approach that aims to reveal assumptions and test these accordingly.

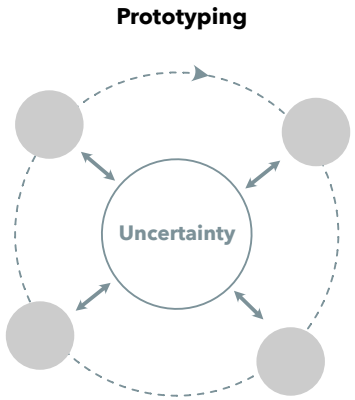


Figure 5.1 Uncertainty can be viewed as a underlying force that influences all steps of the process

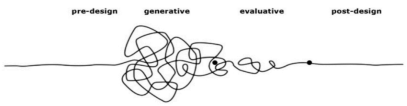


Figure 5.2 Design is partly about muddling through, adopted from Sanders & Stappers (2014)

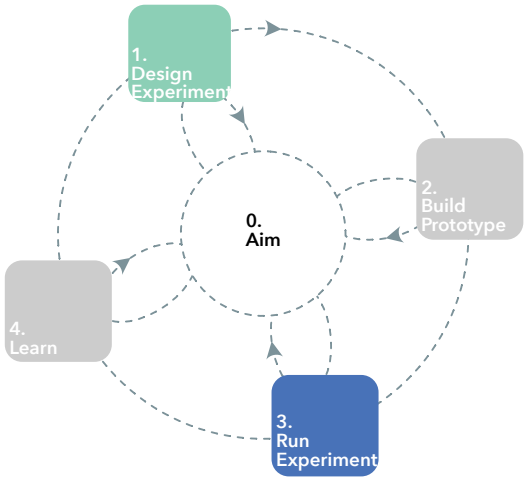


Figure 5.3 The proposed redesign of the prototyping process, where the step aim (0) is viewed as an ongoing step.

5.3
Develop:
Tackling current obstacles

Through the exploration phase, several obstacles were identified that can be considered as a challenge to enable teams to address uncertainty. In short, it was determined that validation teams tend to avoid risk and only too a limited extend pursue/communicate disconfirming information. Moreover, the lack of skills in the prototypes realm limits possible use, and needs teams to continuously consider to adjust their prototypes to make them suitable. Learning by doing can help to develop these skills step-by-step. To tackle these issues a digital warroom was developed based on earlier efforts.

Due to the COVID-19 the practices needed to shift to a digital way of working. A collaborative tool called 'Mural' was used. This tool 'digital wall' enables different team members to place post-its in the environment. It is mainly used during meeting and workshops but also beyond. Several prototypes were created to experiment with the use of such a tool, example 1,3,5,6 mainly made use of this tool, while the co-creation prototype was also created in a collaborative way with the use of this tool (example 8) . As figure 5.7 shows within the warroom, the rough setup of an experiment could be plotted. Learnings could be analyzed but also prototypes of a mockup quickly build. This live building enables to make iterations and idea what to prototype immediately concrete.

Integrating the learnings

Based on a numerous of prototypes (see figure 5.4) a range of learnings emerged that served as input to design this digital warroom in the digital collaborative environment Miro. The developed warroom can be regarded as an iteration on earlier prototypes. Issues in earlier versions (see example 5 page 67) resulted in unclear authorship. The designed digital warroom aims to tackle this issue by stating 'clear' authors per section (figure 5.5). Additional elements were added to enable the teams to address the obstacles. The following chapter further explains the design.

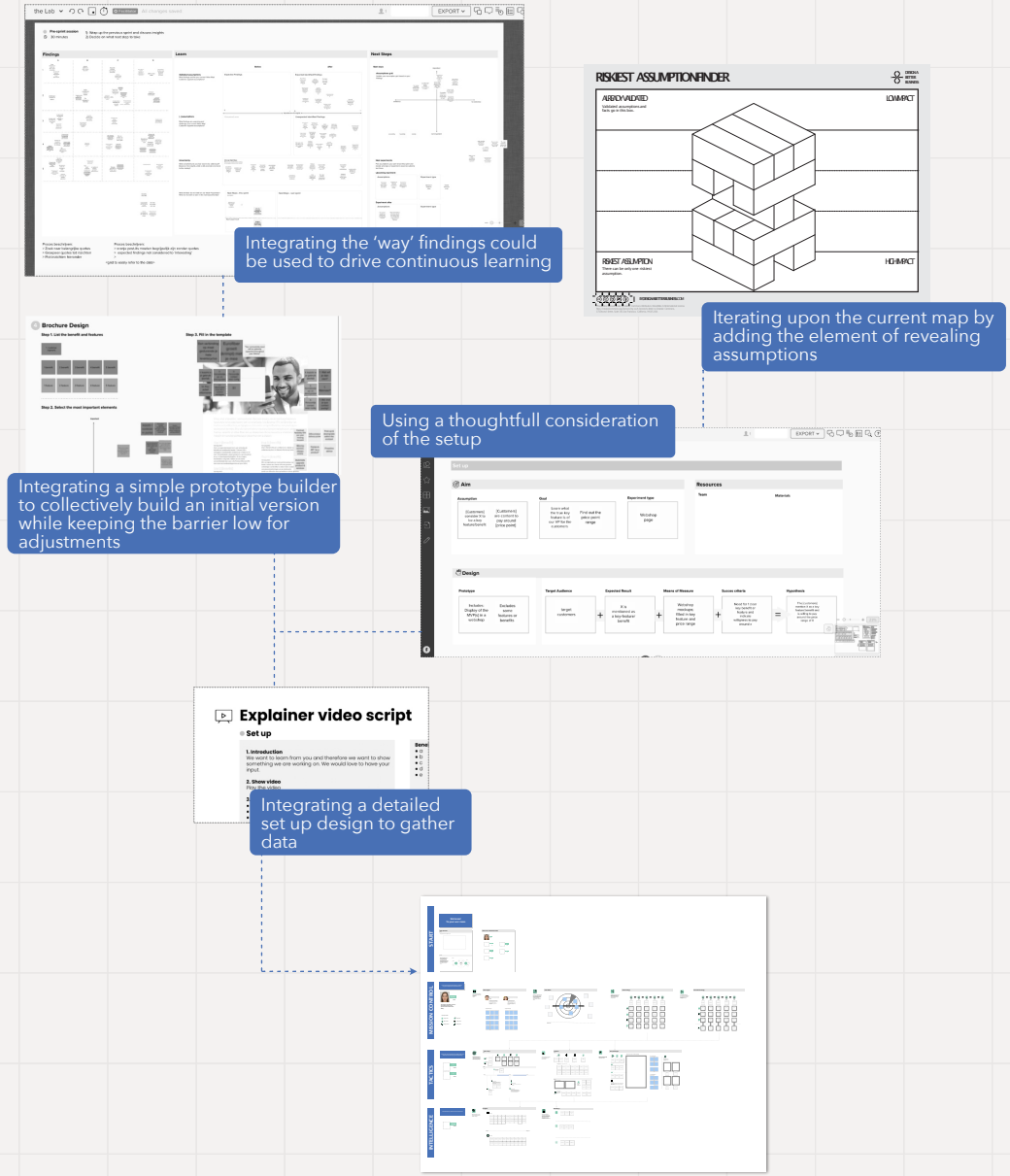


Figure 5.4 An snapshot of the various prototypes that could be considered as the basis to design the eventual design of the digital warroom

0. Aim | 1. Design | 2. Build | 3. Run | 4. Learn

5.4
Develop:
Enabling teams to deal with uncertainty

To enable the the validation teams to go (successfully) through the prototyping, a Warroom was created. This Warroom should guide them through the process, and enable the teams to collaborate in a digital manner. For that reason, the Warroom could be viewed as a boundary object.

The Warroom consist of multiple sections: titled Mission control, Tactics and Intelligence. These all represent certain phase of the process (see figure 5.5). The remainder of this chapter will further elaborate on these steps and explain iterations based on earlier prototypes.

Access the digital warroom through this link or Appendix 4

https://miro.com/app/board/o9J_kp2gfwo=/

Mission control
5.3.2

0. Aim

Tactics
5.3.3

1. 2. 3. Run

Intelligence
5.3.4

4. Learn

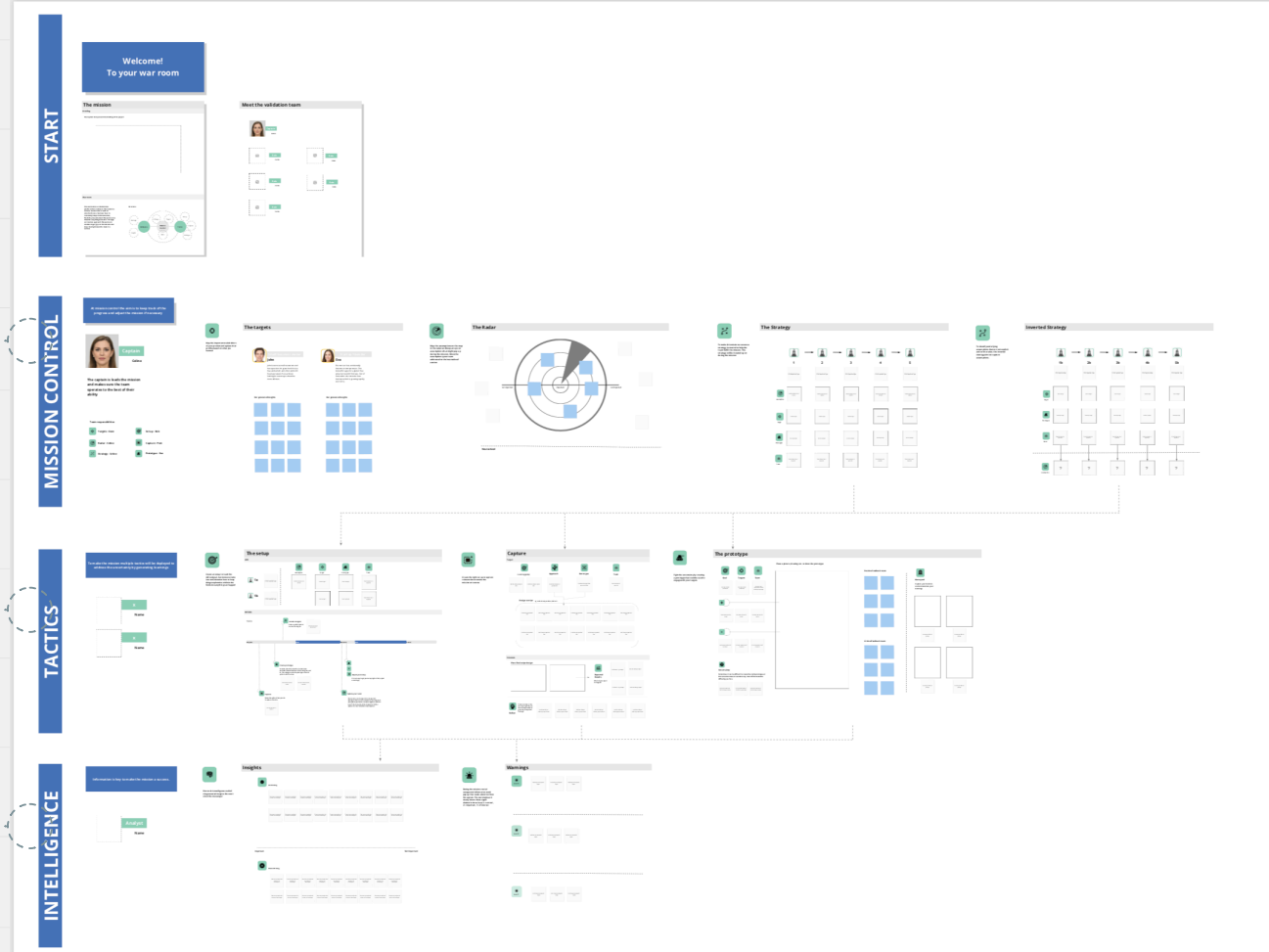


Figure 5.5, A screenshot of the interactive digital warroom.

Aim - Mission Control
- *Deal with uncertainty by testing and revealing assumptions*

As displayed in figure 5.6, Mission Control could be considered as the embodiment of a core element of the redesigned prototyping process: dealing with uncertainty. The mission control follows a similar approach as the current process, where first assumptions are mapped to select an assumption to test. The warroom is designed in a way to make this mapping a continuous process, as new assumptions could emerge. The mapping of assumptions should be viewed as an ongoing process rather than 'one time activity'. This approach is needed since, as previously showed in chapter 4, uncertainties could emerge at different steps of the process (e.g. when building a prototype). Eventually, based on the selected assumption a 'strategy' is defined to test these assumptions.

Mission control aims to enable the testing and revealing of assumptions, multiple sections were designed, including a 'target' section, radar and a(n) (inverted) strategy map:

1. The targets (customers) communicates a customer profile which, is so the say, 'never finished'. The teams can continuously build and further detail these profiles. To date these were captured on the learning section but never included in the customer profile/persona.

2. The radar element was created to map and make assumptions explicit, while suggesting to keep an eye on underlying assumptions that are not explicit yet. Especially revealed 'assumptions' were not formally captured.

3. Also a 'strategy' map was created to let teams design an 'approach' to address test assumptions. In contrast with the 'strategy', the inverted strategy map aims to provide an approach to make underlying assumptions explicit. This approach focusses more on deciding on an 'activity' that could lead to learnings, rather than achieving your learning goal through an activity.

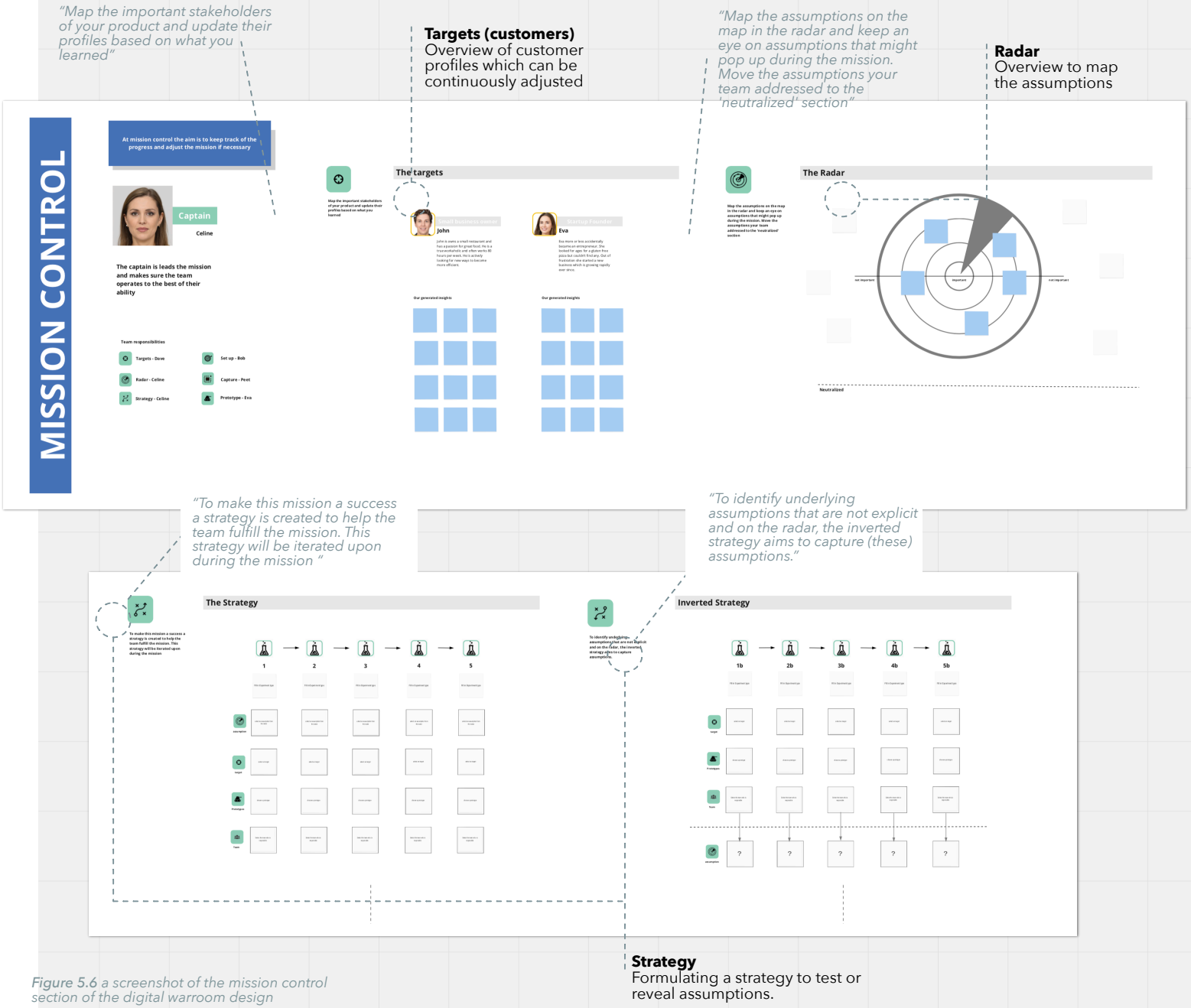


Figure 5.6 a screenshot of the mission control section of the digital warroom design

1. Design | 2. Build | 3. Run

Design, Build& Run - Tactics
- create suitable prototype
- continuously adjust the prototype
- build skills by learning by doing

Dealing with uncertainty takes a real effort. To help teams set up the right activities (set up, capture) and prototypes, the tactics section was designed. This design was based on prototype examples 1, 6 and 7.

The initial set-up finds its origin as defined in mission control. The set-up and the capture section should enable the teams to further detail the activities. Moreover, as the timeline shows (figure), it could be the case that design teams iterate upon this initial setup halfway through. Since, it could be difficult for validation teams to design a suitable setup. At first, testing the setup can help to make issues explicit. Based on these learnings the team could make changes. The previous chapter shows; building the right prototype is considered to be difficult. Little experience with a specific audience could make it hard to create an appropriate prototype. As the setup outline shows, the aim is to tackle this issue by iterating upon the prototype throughout the run phase based on the new insights. Thus the central idea is, the prototypes are flawed. These flaws need to be addressed during the process. A learning by doing approach helps to develop the (lacking) skills of the team.

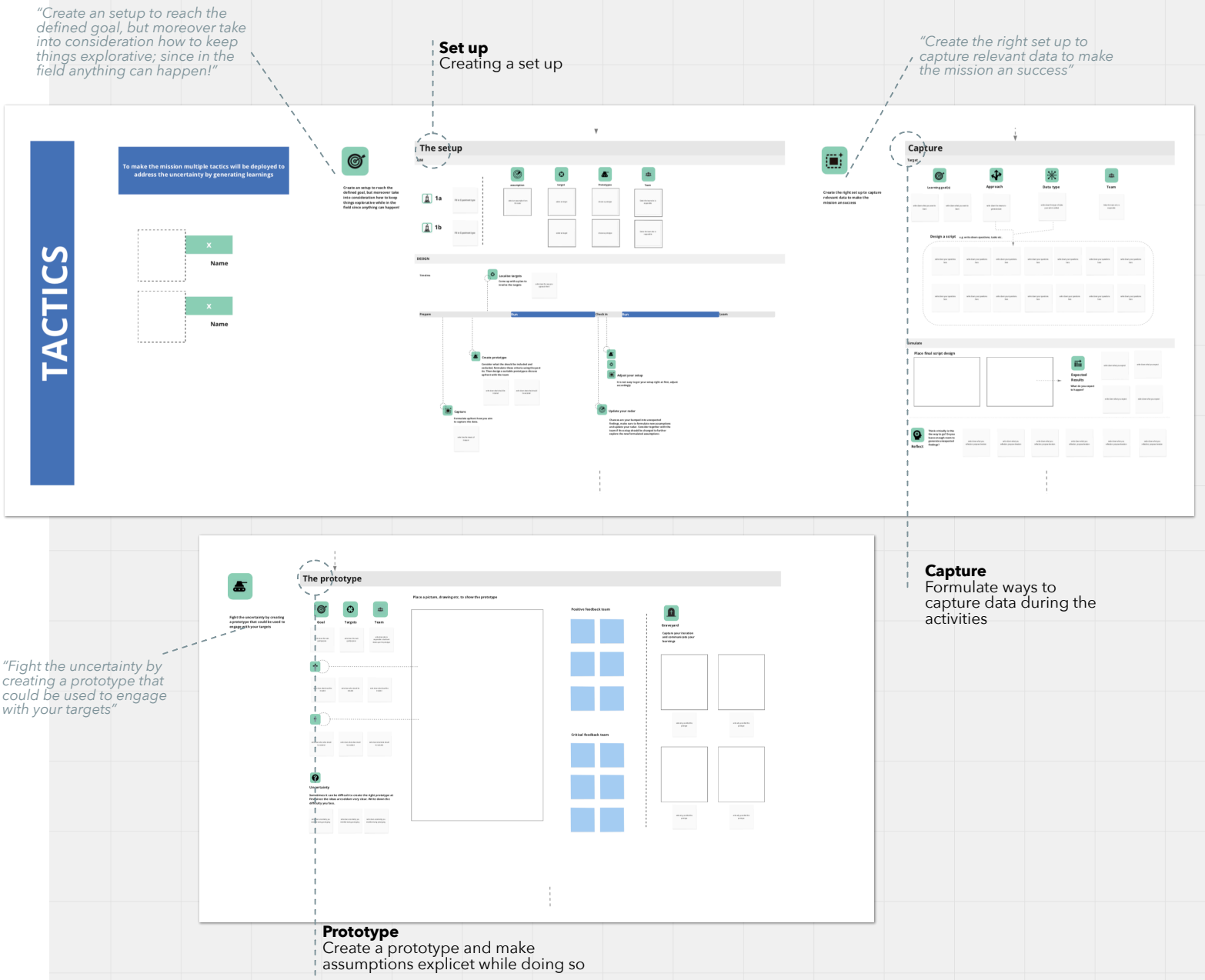


Figure 5.7 a screenshot of the tactics section of the digital warroom design

4. Learn

Learn - Intelligence
- *Test and reveal assumptions*
- *Drive discussion about disconfirming information*
- *Drive the failure mentality*

Eventually, uncertainty could be addressed by deriving knowledge from the gathered data. Data could help to test could provide evidence whether certain assumptions are true, or untrue (disconfirming information) , as well as indicate issues not under consideration. Therefore, the data can reveal underlying assumptions.

This template was deliberately created categories to place gathered data on in the confirming or disconfirming category, without filtering the relevance at first. This can help to discuss these insights in an appropriate way, for example, confirming insights are less likely to stimulate the team to iterate the idea, while disconfirming insights give a clear signal. The discussion should then be pointed towards what this means for the initial business model and value proposition design. This clear distinction should stimulate teams to create prototypes that can help to gather such information. More precisely, teams should design experiments that allow to generate disconfirming and embrace the sense of 'failure to learn'. As example 12 already showed, incorporating this can indeed help to reveal such information. As such, clearly working towards such information should help to set foot in the direction of the failure mentality.

Moreover, based on example 3, unexpected findings could help to formulate assumptions. The danger of creating new assumptions of based on data is the overwhelming amount of assumptions it could help to make explicit. As during prototyping, the problem of information overload is just around the corner especially in qualitative context. By plotting the new assumptions on the scale of importance. A special warning section is created to divide these insights, which can serve as input for future experiments. the teams can bring it down to further test specific assumptions.

Insights
Map the gather insights based

"Plot on this intelligence wall all the generated insights. We won't shoot the messenger"

"During the mission crucial unexpected information could pop up that needs attention from the captain. The warning board clearly shows these signal divided in three level, 3 = critical , 2 = important, 1= of interest"

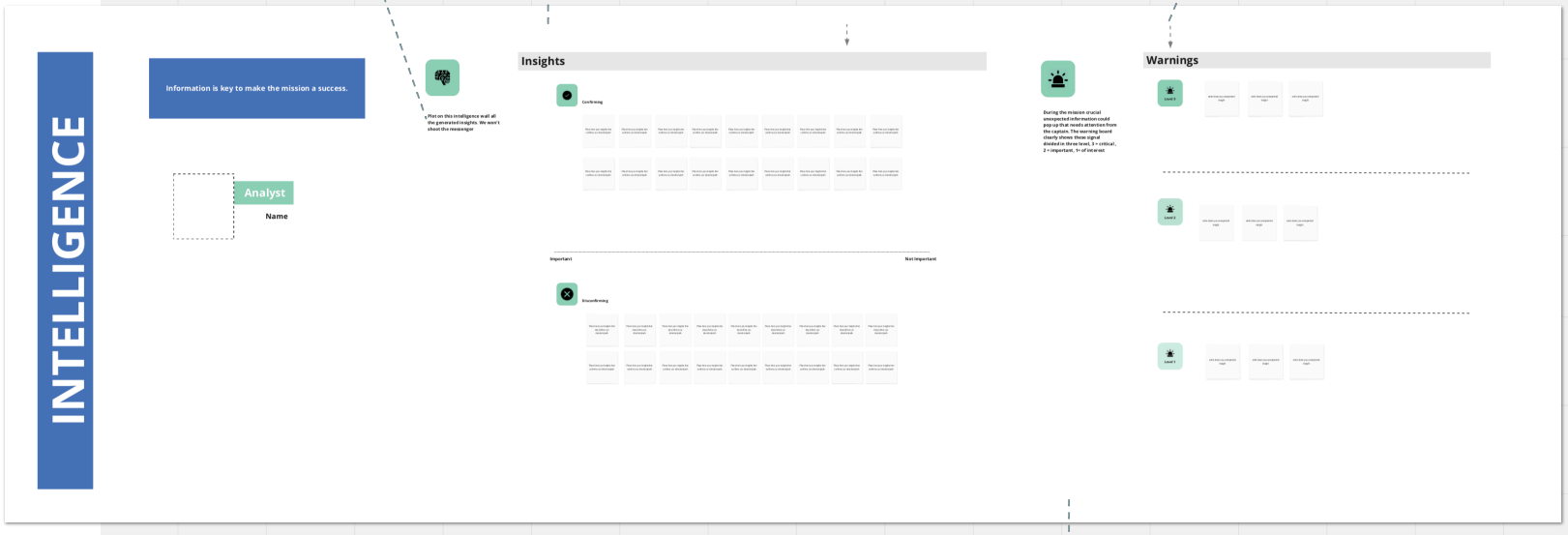


Figure 5.8 a screenshot of the intelligence section of the digital warroom design

Warnings
Gather the newly revealed assumptions and map them accordingly

5.5
Develop:

Warroom as driver for adaptability

Turbulent environments force organizations to search for new business models to stay relevant and adapt. To drive this adaptability, processes are needed within an organizations that can specifically help to deal with uncertainty. This project explored the use of prototyping within the context of different organizations, who aim to create value for customers to stay relevant. To successfully utilize the prototyping process, 'just start prototyping' is not likely to be enough. The prototyping process is complex and especially within the context of organizations who lack design and prototyping skills. The warroom is especially designed for those organizations who aim to search for new business models but still need guidance to go through such a process (figure 5.9). Therefore, the warroom helps team within organizations to organize and adopt prototyping practices within their context. While going through this process, which in a way a learning by doing approach. The warroom can be viewed as a boundary object, that enables organizations to deal with uncertainty and learn in what ways adaption is needed to remain relevant as an organization. Thus, the warroom enables teams to:

- Drive a continuous path of prototyping activities to test and reveal assumptions
- Drive to the generation of knowledge by enabling to design suitable activities an prototypes
- Drive failure mentality
- Drive discussion about findings

These drivers should help the teams to move towards the practice of utilizing prototyping to deal with uncertainty. The discussion paragraph further discusses these drivers.

5.6
Develop:

Uniqueness of approach

Prototyping is not a revolutionary novel mechanism to learn. As early discussed, both the Lean Startup & Design and both embedded this practice in their 'method'. However, it seems prototyping is mostly utilized and embedded in the projects to around the principle that teams are aware what they need to test, and only have to figure out how they could learn this. Building on this principle, the common view is that uncertainty could be reduced step-by-step (figure 5.10).

As clearly stated previously, the opposite is true. Teams are simply not aware at first what knowledge is missing and learn along the way. Meaning, many assumptions still need to be revealed. In a way, the perspective taken should be framed as perceived uncertainty (see figure 5.10). The warroom was designed around this understanding of prototyping and as such aimed to facilitate this dynamic nature of the process.

Current approaches also neglect the learning element, teams are pushed to a process quickly and expected this will result in the outcomes as anticipated. Using these processes are also a matter of learning by doing. One cannot really expect a novice designer can follow the process and 'really' test the assumption. The process should give room to iterate while doing.

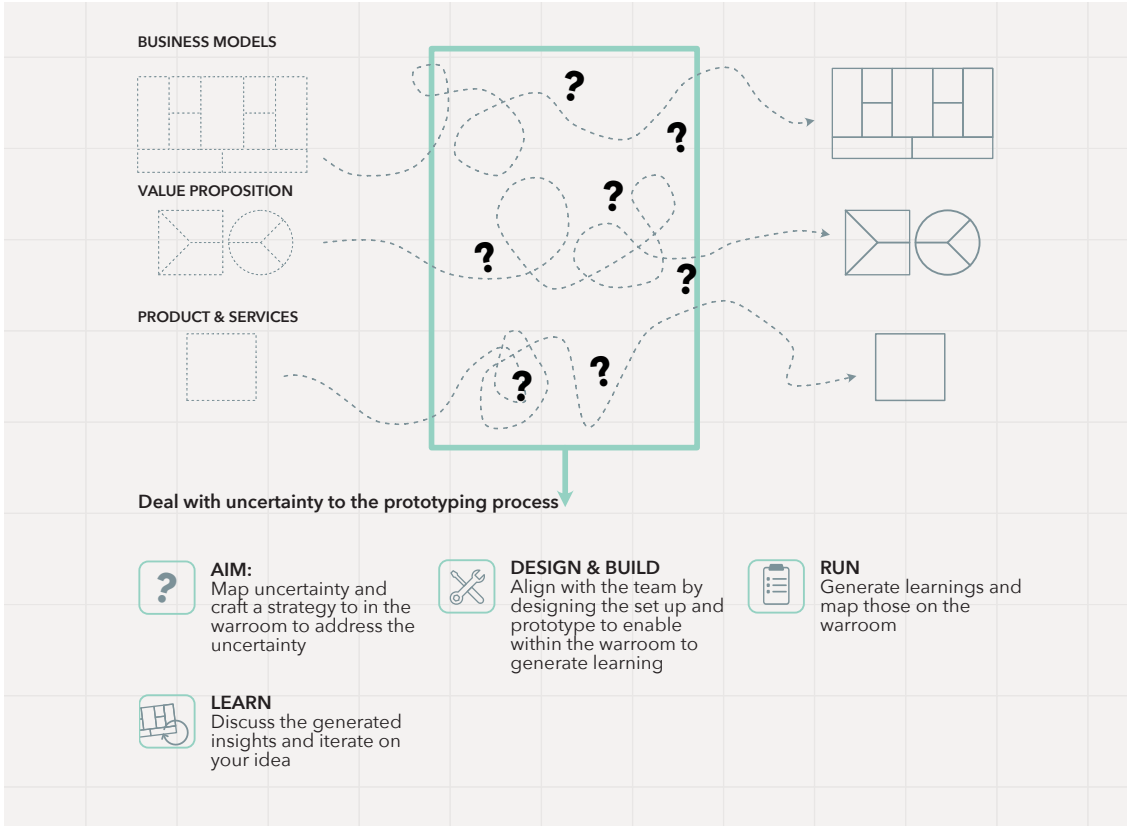


Figure 5.9 image that shows the warroom could help to deal with uncertainty to drive change on business model, value proposition and product & services level

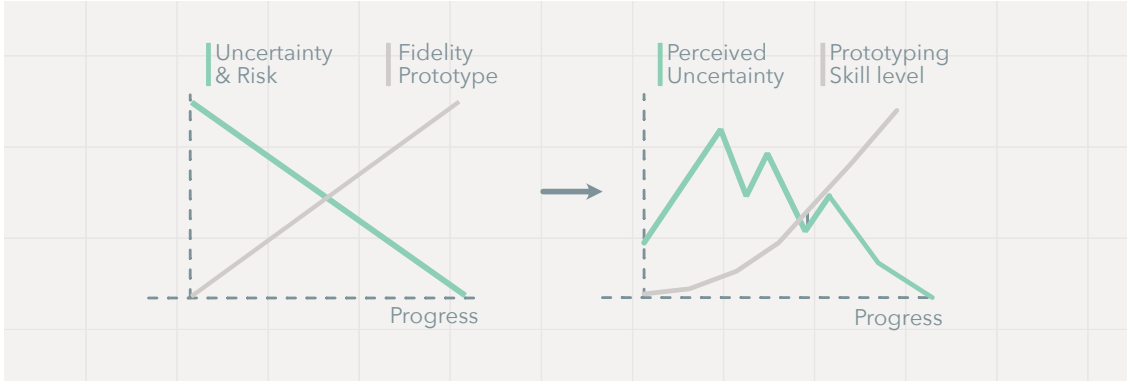


Figure 5.10 common believe is uncertainty could be reduced step-by-step. In the context it was found the uncertainty could be addressed and emerge, leading to fluctuating graph. Additionally, teams still needs to build the prototyping capability skills to adress uncerintay in the first place

5.7
Develop:

Discussion warroom design

As the warroom design aims to drive adaptability, multiple drivers were identified. These drivers were based on the generated learnings and created prototypes. This paragraph further discusses and elaborates upon the design and these drivers.

Drive the search for knowledge through prototyping continuously

Based on my experience as a design student, designers often view the prototyping as 'phase' in the design process and often make use of this prototypes only once . The warroom should prevent these practices, and make teams aware they still need to learn a lot before moving forward. It is the aim to enable an iterative loop, that drives continuously learning through prototyping to a certain extent. In this chapter, the redesigned process proposes a new way to ensure teams adopt a 'search' mindset. The strong focus is to embed a constant form of searching and monitoring during the process, rather than framing a specific assumption to 'derisk'.

Merely adopting search processes might not be enough, as already stated in the understand chapter (2). Lean startup approaches only help to reveal certain information. As a result, validation processes might hinder revealing new (crucial) information, as unexpected findings are simply rarely targeted. Rather than constantly validating your assumptions, teams should design their experiments (activities) in such a way that unexpected findings could be generated during early stages. The warroom tries to evoke teams to do so through the inverted strategies but also ask them to actively reflect on their designed setup and prototypes.

The 'inverted strategy' should help team to target underlying assumptions that have yet to be made explicit. This practice should enable to gather learnings in pursuance of identifying knowledge gaps (underlying assumptions), which triggers the team to continue prototyping in order to 'close these gaps'.

It should be acknowledged, such a complex approach might be unmanageable for novice designers. As chapter 4 shows, it remains difficult for teams to purposefully consider various dimensions to create a suitable prototypes. Adopting discovery driven prototyping practices (e.g. Odom et al, 2016), where prototypes are left ambiguous in a purposeful way might be challenging. I view an 'expert' is needed to translate this process in manageable activities for the team. More specifically, the role of the designer might need to evolve from 'Product Designers, 'Service Designers' to a more specialist role such as 'Prototype Designers'.

Drive failure mentality

Current literature already describes adoption of designerly processes might be hindered due to the risk avoidance mindset within organizations (Carlgren , 2016). The explorative prototypes showed that this problem also arises during prototyping. It remains unclear how these processes could be enhanced to prevent these issues. While Gibson (1977) argued the use of language such as, 'experiment' allows for imperfection and affordances, however, this is not likely to be enough. The warroom intends to embed the willingness to fail mentality by deliberately adding a section to capture disconfirming information. As the explore chapter showed, if targeted the data will at least be captured (e.g. the prototype example 12 were cards could be selected for 'the trash' can). This could be seen as a first step to move towards such practices.

Drive discussion about findings

Prototypes can help to generate data. Teams still should put the gathered information to use. Numerous biases might hinder to do so such as hypothesis confirmation bias (Liedtka, 2015), which results in neglecting to (discuss) disconfirming data (called cherry picking in this thesis). The planning fallacy, described as overoptimism and thus, results in overcommitment to inferior ideas (Liedtka, 2015). To prevent such practices, the learnings section aim to enable discussions in a thoughtful manner. For example, both confirming and disconfirming information is plotted leading to discussions to see two 'sides' of the stories.
While unexpected findings that can be formulated as assumptions, need a different type of discussion. These emerged assumptions *what do they mean for our idea?, should they be tested ?*

5.8
Develop:

Conclusion

This chapter aimed to answer the research question how validation team could address uncertainty. Based on the learnings from chapter 4, a redesign of the current validation process was proposed. and further detailed and communicated through the design of a digital 'warroom'. The warroom should guide teams through the prototyping process to address uncertainty. The warroom enables such as practice, as it consists of multiple 'tools' that should enable the validation teams to develop deal with uncertainty.

6 Discussion & Reflection

6.1 Discussion & Reflection
Introduction

This chapter discusses the overall process of the project and its outcomes. Both the contribution to the context and design discipline are elaborated upon. Additionally, the implications and limitations of the project are discussed. Lastly, I reflect upon the carried out project.

6.2
Discussion & Reflection

Discussion

Project Approach

To answer the main research question the double diamond approach was defined as: understand, define, explore and develop. These steps helped to propose a redesign of the prototyping process. In a way, this project aimed to improve what could be considered a complex system. To understand the prototyping process, this project 'prototyped prototyping'. In order to get a grasp of how the process could be improved upon, I actively explored through the use of prototypes. However, It should be noted, as this thesis was performed during the Covid-19 pandemic, the processes and problems with it changed over time since the context changed (e.g. shift to digital sessions). This illustrates the difficulty when designing for complex systems. When systems (processes) are dynamic and an ever changing, it could be challenging for designers to cope with. One should keep an 'eye on the ball' and keep developing understanding of the process since it evolves constantly. Therefore I view, when designers enter such terrains a constant state of designing and redesigning is needed since the system is simply not fixed (i.e. Norman & Stappers, 2015) .

Contribution to the context

Within the context an approach to 'validate' assumptions was already well established. This thesis showed these approaches only help to eventually address uncertainty to a limited amount. By introducing certain prototyping methods such as, co-creation and a stronger focus on making use of prototypes as trigger objects. This project enabled the validation teams to generate unexpected findings and thus, 'revealing assumptions'.
Moreover, as this project was carried out during the Covid-19 pandemic, many organizations faced a rapid changing environment which brings uncertainty. This resulted that the current prototyping process should be adjusted to a digital environments. Numerous prototypes helped to shift to this new context. In contrast with the reaction of many organization and governments, instead of creating a fixed policy, a prototyping approach and mindset of seeing it as a playground allows to search and adopt to a more optimal way of working within the new context. The prototyping mindset helped to try out new initiative and iterate while doing. Resulting in an adapted (digital) process which enabled these organizations to continue learning.

This project enabled to set foot in the direction to create suitable prototypes despite changing situations (e.g. Digital shift). Through implementation of various prototypes validation teams started considering dimensions such as stakeholders, and fidelity in order to decide what would be an appropriate artifact. More importantly, the appropriateness of the prototype was also considered during activities and as such iterated upon if necessary.
Moreover, the redesign of the process including the warroom could help the validation teams even more in the future to embrace uncertainty to a larger extent. Additionally, let them adopt a 'search mindset' that aims to explore and reveal new information.

Contribution to design discipline

Whereas prototyping can be considered a core competence and activity of design (Coughlan, et al., 2007; Benson & Dresdow, 2013 ; Carlgren et al, 2016;), design as a discipline tends to keep 'expanding the house'. Therefore, further development of the core competences is necessary to live up to the new promises and claims we make. Advancing the understanding of using prototypes in a real-life context is needed if designers wish to be successful beyond product development. The scope of this project explored the use of prototyping in the emerging field of business model innovation (Simonse, 2014). A broader prototyping perspective is needed as designers are also increasingly active in the fields of brand innovation (Beverland et al, 2014), social innovation (Yee & White, 2015) and or as corporate entrepreneur/ intrapreneur (eg. Abrell & Uebernickel, 2014). Entering these fields, designers also have to deal with uncertainty in domains they are not trained. It is likely they developed little knowledge about these specific fields, as such they need to address these knowledge gaps. As Norman (2010) highlighted in his essay, designers often have too little understanding of a problem and are not able to deal with complex issues. Lack of knowledge about the problem might hinder to create a solution. This thesis established the view, that prototyping is especially useful to deal with missing knowledge by testing and revealing assumptions. As such, this approach helps to develop understanding is new fields. The outlined process in the warroom could be used to create an initial understanding of the uncertainty one faces in that domain and besides help to address these uncertainties.

This project also builds further on the notion that prototyping can be used to address uncertainty (Jensen et al., 2017). This project contributes to this work through the design of boundary object to enable teams to engage in the prototyping process. The project therefore sets foot to enable adaption of explorative approaches, or what Jensen and colleague (2017) call prototrial driven approach where organizations continuously target unknown unknowns.

6.3
Discussion & Reflection

Implications

For organizations who aim to innovate in order to adapt to changing environments, the prototyping process could be viewed as a mechanism to do so. Since it facilitates to learn, prototypes can in potential help to deal with different types of uncertainty. This project indeed showed this is the case.

This project also showed adopting these practices is not particularly easy. Creating suitable prototypes to learn brings a certain degree of uncertainty. The carried out project hints this is a major barrier to successfully adopt such approaches. Providing the necessary tools could help to some extent. It is my view that is essential that organizations develop the prototyping capability to fulfill its full capacity.
Since, there are different levels of uncertainty, this project showed generating 'unexpected findings' is considered to be a 'good strategy' to get an initial understanding of the context. Through this approach underlying assumptions become more explicit. Which can serve as the basis to iterate further on ones idea. It seems this is not the common approach for most organizations, as such they need to make a shift.

6.4
Discussion & Reflection

Limitations

As this carried out project aimed to answer the main research context the project still faced limitations to the current approach. This paragraph further elaborates on these four limitations.

Firstly, while literature describes especially in prototyping failure can help to learn quickly, the project itself mostly did not observed 'disconfirming' was often revealed. As possible explanation could be experienced as a step back rather than forward. As prototyping is linked with giving teams a sense to move progress (Gerber & Carroll 2012), truly pursuing disconfirming information might challenge this notion. Teams could be guided through questions such as "why is this a bad idea". These type of interventions were not included in this project since these approaches could be considered to be quite the opposite of the current practice within the context. Future projects could further explore such practices to develop a deeper understanding how 'disconfirming results' could help teams deal with uncertainty.

Secondly, a common view is that prototyping can help to reduce uncertainty step-by-step. This thesis suggest this is not necessarily the case since, teams could identify new assumptions explicit and therefore the 'perceived uncertainty' is greater. Which means the team is more aware of the all the assumptions that needs to be addressed and as such the perceived uncertainty is greater (larger amount of assumptions). Future research with a more quantitative approach could get a better view how these graphs develop in practice.

Thirdly, some literature already suggested prototypes could have negative consequences. Schneider (1996) warns prototype should not become "developers toys", meaning the aim to learn slips away (Passera et al, 2012). Passera and colleagues (2012) highlight evaluating the validity should be part of the process. Still, a research gap remains if teams could have an honest view and can so the say 'resist' certain information. I view this question as fundamental as especially during early phase innovation decisions are mainly based on information gathered during prototyping activities. Moreover, prototypes sometimes tend to oversell (e.g. boundary objects that are considered to be even better than the real thing as for example concept cars (Stomphff & Smulders, 2015)) the eventual offering might generate 'false information' and therefore give the illusion uncertainty is addressed. One could question if important decisions such as deciding upon the customer segments, should be guided through prototyping. Further research could focus on exploring if teams are able to filter information out even though these potentially could confirm their idea.

Lastly, as this project described the process as a complex systems, the redesign is established to further improve the current approach. Designing for complex systems can be viewed as a muddling through process, as systems are ever changing (Norman & Stappers, 2015). To some extent, the developed process needs to be constantly adjusted. A remaining question is however, if teams are able to reshape their own process while doing. Digital environments give you the ability to constantly adjust since things are not per se fixed. The digital warroom serves as boundary object of the process. If teams adjust the boundary object itself, in theory they would have to ability and opportunity to adjust the process continuously if necessary. To my knowledge such an approach is novel and needs to be further explored if processes could be continuously improved and adjusted.

6.5
Discussion & Reflection

Conclusion

Turbulent environments bring uncertainty and force organizations to adapt. During the COVID-19 pandemic a wide range or organizations faced this difficulty. To tackle and deal with uncertainty, processes such as prototyping can help. Within a real life context of a design agency, Business Models Inc., this thesis explored how organizations can deal with uncertainty and answer the research question: *How can validation teams make use of prototyping in order to address uncertainty?*

The created prototypes allowed the exploration of how the prototyping practice could be enhanced within the context. This resulted in an enhanced approach to enable novice designers to create suitable prototypes and address uncertainty beyond testing assumption but revealing assumption as well. The prototypes also enable to identify clear obstacles to such approaches such as risk avoidance, the seldom pursuit of disconfirming information and lacking skills to create prototypes. Based on learnings, a redesign of the process is proposed which is embodied in the design of a boundary object. By using this object (warroom) teams are able to shape their prototyping efforts in order to either test or reveal assumptions. This approach should help the teams design and build new business model and as such drive change and enable organizations to adapt. Since, "There is nothing more certain and unchanging than uncertainty and change."
- John F. Kennedy

6.6
Discussion & Reflection

Reflection

Project in general
I personally believe prototyping is an under valued secret weapon of design. Prototyping allows to muddle through to make something great. My personal learning goal of this project was to develop a deeper understandings about prototyping and especially its application in 'the real world'. At the start it looked all simple and straightforward, but the more I worked on the project, the more I realized the process is quite complex. Especially enhancing this process is no easy task. At first, it was hard to determine what would be a 'preferred process', muddling through was the way to go. As a result, it was hard to asses if this was 'any good'. This meant I tried to pay attention to all things that happened. However, the large amount of data can make it rather difficult. In the end, it is the job of the designer to not oversimplify things, try to understand the complexity and then make it simple enough in order to make in understandable.

During the project I also aimed to include a thorough literature review. I viewed this unique opportunity as a way to better understand these theories by 'playing around' in the real life context. The danger of this approach is this could lead to a reinvention of the wheel. I view this a necessary step for designers, since (new) when entering domains we often lack crucial information that is unknown for us but known for experts. To evolve to the expert realm and contribute it is at least needed to understand the current theories. Reflecting back on this approach, 100 days for a project is probably too short for such an approach. Scoping the prototyping practice to for example 'picking the right audience for your prototype' would make such an approach more doable, but a the same time less exciting.

The COVID-19 pandemic, framed often as a motivational killer was for me a personal driver to try out new things. The sudden digital shift resulted in an interesting new dimensions to the project. The old ways did not work anymore, resulting in an acceleration of adopting new approaches.

Approach
The moment I started the project, I did not have any experience with projects that aimed to enhance a practice and process with a context. At the very start, I was more familiar and comfortable with developing new product and services. This project opened a whole new world for me in that sense. As a result, finding the right approach was in some extent difficult. In the end the approach was something like a blended research and design project. Mostly since I still had to figure out and understand what I am doing. I learned theories from literature can help as a 'framework' to think about your efforts, by creating and implementing prototypes these theories could be linked with experiences. Especially these experiences can be considered to be stimuli, as they enable to understand 'abstract' terms while interesting insights can help to further develop new ways of working. I realized it was a matter of trying out theories within a context and based on this adjust of create new theories. During such projects continuously going 'down and up' again is difficult. Before you know you are actual muddling at only one level and lose sight of the bigger picture.

7

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