Master's thesis

NTNU
Norwegian University of Science and Technology
Faculty of Architecture and Design
Department of Design

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Creating a sense of togetherness in remote Virtual Reality workshops

A collaborative study of applied design and entrepreneurship

Master's thesis in Industrial Design and NTNU School of Entrepreneurship
Supervisor: Nielsen, Brita Fladvad
Co-supervisor: Aaboen, Lise
June 2021

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Cohere

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PREFACE AND ACKNOWLEDGEMENTS

This thesis constitutes the master's thesis as defined by the subjects TIØ4945 and TPD4900. The thesis was written during the spring semester of 2021 by MSc student Andreas Ore Larssen (Faculty of Economics and Management), and MS students Sondre Kvam and Tobias Wulvik (Faculty of Architecture and Design).

Note to the reader

The authors conducted the study as a part of establishing their startup, Cohere, which aims to make remote workshops more engaging and inclusive through Virtual Reality (VR) technology.

Our process has evolved as we have gained new insights about users and VR. In addition the thesis is a collaboration between the fields of entrepreneurship and design, intended to contribute to both fields of study. Therefore, the study does not strictly follow a traditional structure. As the development of our understanding itself is relevant to the research, we have opted to present our results chronologically, and to include indirect results from our business development process to the same effect. The following quote on product development for VR seems fitting:

"Best practices are not the 'truth' but have been found to be useful in the way we think about design and interaction. Studying theory can be useful, but VR development should always follow pragmatism over theory." - (Jerald, 2015)

Acknowledgements

A special thanks to our thesis advisors Brita Fladvad Nielsen and Lise Aaboen for providing feedback, guidance and motivation throughout this extraordinary semester, facing the challenges of the ongoing pandemic. In addition, we are grateful to Karoline Kaspersen for advice on our new venture, and our co-workers Magnus Lie Fridheim and Bao Nguyen at Umble, for their patience and support. It is entertaining that the idea of "being able to walk among thoughts in VR" led us to discover problems in remote work that would result in a business venture and master thesis.

ABSTRACT

This thesis explores how VR software can be designed to make it desirable for remote workshops, by comparing findings from a four-month Lead User Innovation program with relevant literature. Studying the process as a whole, we also investigate how design practice differs from entrepreneurial literature on customer-oriented business development.

We found that when designing for human collaboration and motivation, the fidelity of the VR software seems to influence the expressed user needs and observed motivation and engagement. Also, VR technology creates opportunities for new revenue models by changing the customers' perception from "paying for a subscription per user" to "renting virtual spaces". Lastly, we find that designers' tacit knowledge of when to treat users as "experts" or "subjects" might be missing from entrepreneurial literature. We conclude that in practice, a collaboration between the fields of study is necessary to successfully create VR ventures for productivity and/or creative fields.

Further research within entrepreneurship on how to better represent the complexity of user involvement and empowerment might be needed. Additional research on the effect of VR software fidelity on expressed and observed user motivation is necessary to fully understand design and venture creation for VR.

SAMMENDRAG

Denne oppgaven utforsker hvordan VR-programvare kan utformes for å gjøre det appellerende å holde “remote” workshops, ved å sammenligne funn fra et fire måneders Lead User innovasjonsprogram med relevant litteratur. Når vi studerer prosessen i sin helhet, undersøker vi også hvordan designpraksis skiller seg fra entreprenørskapslitteratur om kundeorientert forretningsutvikling.

Når vi designer for menneskelig samarbeid, så vi at både uttrykte behov og observert engasjement hos brukere påvirkes av hvor virkelighetsnær VR-programvaren er. VR-teknologi skaper også muligheter for nye inntektsmodeller ved å endre kundenes oppfatning fra å "betale for et abonnement per bruker" til å "leie virtuelle rom". Til slutt avdekkes det at designernes underbevisste kunnskap om når de skal behandle brukere som "eksperter" eller “forskningsobjekter” mangler i entreprenørskapslitteraturen. Vi konkluderer med at samarbeid mellom fagfeltene er nødvendig for å lykkes i praksis med oppstartsbedrifter sentrert rundt VR-teknologi for produktivitet og/eller kreativt arbeid.

Ytterligere forskning innen entreprenørskap om hvordan en bedre kan representere kompleksiteten i brukerinvolvering kan være nødvendig. Videre kan forskning på effekten av virkelighetsnær VR-programvare på motivasjon og engasjement være nødvendig for å forstå design og entreprenørskap for VR.

NTNU
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Masteroppgave for student Tobias Wulvik (ID), Sondre Kvam (ID) og Andreas Ore Larssen (IØT)

Hvordan kan VR-teknologi forbedre workshops for å skape verdi i den nye arbeidshverdagen?

How can VR technology improve workshops to create value in the new worklife?

Den nåværende pandemien har bidratt til å akselerere en tydelig eksisterende trend mot "remote work". Samtidig som mange har opplevd høyere aksept for hjemmekontor, har vi har lært at det kan være utfordrende å gjennomføre visuelle diskusjoner (workshops) med den samme kvaliteten vi får av å være fysisk samlet. Blant utfordringene er redusert energi og aktivitet blant deltakere, mindre kontroll for fasilitatorer og tap av kroppsspråk som kommunikasjonsmiddel. Derfor ønsker vi å utvikle en software-løsning til eksisterende VR produkter som løser disse utfordringene.

Oppgavens gjøremål:

- [Design] Beskrive forskjellene, utfordringene og fordelene knyttet til å gjennomføre workshops remote og i VR.
- [Design] Utforske hvordan vi kan anvende VR for å gi deltakere og fasilitatorer muligheter utover hva som er mulig i analoge workshops.
- [Design] Utforske hvordan vi kan skape naturlig interaksjon i VR, spisset mot kreative workshops.
- [Forretningsutvikling] Utforske hvilken rolle interaksjonsdesign spiller i forretningsutvikling for VR-startups.
- [Forretningsutvikling] Utforske hvordan entreprenører kan skape verdi gjennom bruken av VR teknologi.

Oppgaven utføres etter "Retningslinjer for masteroppgaver i Industriell design".

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Trondheim, NTNU, 08.01.21

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Ansvarlig faglærer

Ole Andreas Alsos
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TABLE OF CONTENTS

FIGURES

TABLES

Chapter 1

INTRODUCTION

CHAPTER 1.1

IMPORTANCE OF TOPIC

The work patterns of collaborative teams have changed as a result of the COVID-19 pandemic. Senior Researcher Nils Brede Moe has researched this in his paper "Work Patterns of Software Engineers in the Forced Working-From-Home Mode". Moe discovered that team members found video conferencing more exhausting than regular meetings (Smite, Moe, Klotins, & Gonzalez-Huerta, 2021). While this did not necessarily mean that the output of their work changed, the social aspect was suddenly different. This social and emotional isolation can cause loneliness, especially among people living alone and expats who live abroad from their families (Smite et al., 2021). Still, many people enjoy working from home (Smite et al., 2021), and the trend towards remote work is likely to continue, as 22.9% of teams and departments expect to be fully remote within 2025 (Statista, 2020). Therefore, creating ways of working from home that fit the social and emotional needs of employees is important.

As the adoption of immersive technologies accelerate, they are being applied in ways that affect human health and safety, such as treating phobias and critical safety drills for off-shore work (GlobalData, 2020). Contribution to design or entrepreneurship for immersive technologies, could help improve people's lives or reduce the chance of accidentally causing harm to people or the environment.

Usability issues(17%) and failing to listen to customers (14%) rank 6th and 9th respectively among the top 20 reasons startups fail (CB Insights, 2019). In addition, Jason Gerald states that "VR is a relatively new medium and is not yet well understood." and that "subtle design choices can influence user behavior" in his book on Human-Centered Design for Virtual Reality (VR) (Jerald, 2015). Therefore it is reasonable to assume that successful application of design is necessary for these innovations to find their way to society, and that exploring how entrepreneurial praxis could make use of design for VR ventures is important.

CHAPTER 1.2

THE PURPOSE AND RESEARCH QUESTIONS

The purpose of the thesis is to add to the body of knowledge on practical implementation of design in entrepreneurship, and further develop know-how on user involvement in design and business development for VR. We focus on VR specifically because of the existing evidence that its immersive qualities can induce psychological effects. In the case of this thesis; creating a sense of togetherness and presence in remote workshops.

First, we investigate how VR software can be designed in a way that makes it desirable as an alternative to regular video conferencing tools. Through a co-creation process with five industry partners, we research how to approach the design of the software and design and the use of VR influenced the strategy for realisation. This formed the basis of our first research question (RQ1):

RQ1: ***How can VR software be designed in a way that makes it desirable for employees to use for remote workshops on a regular basis?***

Second, we investigate how different design mindsets, processes and methods can be applied in the context of entrepreneurship, to develop sustainable business models for VR. Business development requires knowledge of user needs to create the "right" product. But how should entrepreneurs work to gain this knowledge? Does working with VR-ventures specifically have an effect on this process? Choosing a fitting design framework for a startup-venture affects the business-, product- and customer development. Therefore, the second research question (RQ2) is:

RQ2: ***How can entrepreneurs utilise design knowledge to better understand customer needs, in order to influence their business and customer development for VR ventures?***

CHAPTER 1.3

CONTRIBUTION

Our research indicates that there are aspects of the design mindset that may be underreported in entrepreneurial literature. More specifically, how designers can alternate between looking at users as "solution creators" and "subjects of study", or the degrees of user involvement at different stages in the product development.

We have used a combination of both entrepreneurial- and design-methods to contribute to the research of both fields of study, as well as researching what knowledge is needed for conducting a similar customer-driven development process.

While answering the research questions, we will explore and contribute to the literature written on customer-oriented startup processes and how entrepreneurs can utilise design knowledge to better understand the different aspects of product development. Our findings on RQ1 will contribute to the research by our own findings during the pilot project, and answering RQ2 contributes to research through what might be new findings, by looking at the process as a whole in retrospect.

Chapter 2

LITERATURE

This chapter presents the theoretical foundation used to shape and influence our process and thinking during the master thesis.

CHAPTER 2.1

DEFINITION OF USERS AND CUSTOMERS

The definition of users vary (Keitsch, 2014), and there are multiple words with nuanced differences such as "participant", "customer", "person" or "consumer" (Sanders, 2012). In the context of this thesis, "users" are considered people who either use a product or service directly or are using the service through a mediator. These are also known as primary and secondary users (Eason, 1989).

While a customer is often defined as "an individual or business that purchases another company's goods or services" (Kenton, 2021), we use the term "customers" and "users" to differentiate between addressing people from an entrepreneurial or design standpoint respectively. This is because the general user experience influences the likelihood of a continued customer relationship (Cagan, 2017).

CHAPTER 2.2

WORKING WITH UNCERTAINTY

The field of design is often used to tackle highly complex or vague problems (Buchanan, 1992). An important part of the design practice therefore, is to come to terms with the resulting uncertainty, and use design knowledge and methods to discover the path as we move forward (Stickdorn, Hormess, Lawrence, & Schneider, 2018). These methods include gathering and analysing qualitative and quantitative data, and designers often plan their research to encompass different types of data gathering (interviews, observations, statistics) in order to create a wholesome picture of a situation. This process is called data triangulation (Stickdorn et al., 2018).

During these processes the decision to gather more or different data for analysis, is often based on the designer's gut feeling that something "isn't quite right", "missing" or "unclear" (Mascitelli, 2000). This feeling of unease is a result of the designer's experience, and an example of tacit knowledge, defined as "things we know but are unable to verbally communicate to others" (Sanders, 2012). A consequence is that valuable contributions from tacit knowledge are often underappreciated and go unrecognised (Rust, 2004).

This is not unlike aspects of entrepreneurship. Saras D. Sarasvathy advocates "effectual reasoning as the defining factor of entrepreneurship, a way of thinking that "begins with a given set of means and allows goals to emerge contingently over time from the varied imagination and diverse aspirations of the founders and the people they interact with [...] like explorers setting out on voyages into uncharted waters" (Sarasvathy, 2001).

Furthermore Carolyn Woo (1994) agrees with Block and Mac Millan (1985) saying that "a new venture is an experiment with implicit hypotheses which can only be tested through experience". They then go on to state that this experimentation fosters learning (Block & MacMillan, 1985; Woo, Daellenbach, & Nicholls-Nixon, 1994).

This literature indicates that design, entrepreneurship and new ventures themselves are exploratory endeavours reliant on experience and experimentation.

CHAPTER 2.3

THE USE AND CHARACTERISTICS OF A WORKSHOP

There are multiple definitions of workshops such as "a meeting at which a group of people engage in intensive discussion and activity on a particular subject or project" (The Oxford English Dictionary) and "a usually brief intensive educational program for a relatively small group of people that focuses especially on techniques and skills in a particular field" (Merriam-Webster). Workshops have multiple uses including: "[...] problem solving, skill-building, increasing knowledge, systemic change, personal awareness and self-improvement" (Brooks-Harris & Stock-Ward, 1999). In a workshop, many consider facilitation as a key ingredient. The act of facilitation can be defined as "[...] providing unobtrusive, objective guidance to a group in order to collaboratively progress towards a goal." (Gibbons, 2020).

Common for most definitions is that they help people from multiple disciplines collaborate through creative exercises (Hanington & Martin, 2019). Teams with different skills meet to discuss and share perspectives on a given problem, idea, or concept. In workshops, we use both speech and non-verbal cues to communicate. We illustrate, point our fingers, and show understanding by nodding our heads and moving our arms. Physical activity promotes engagement and creative energy around potential solutions (Stickdorn et al., 2018).

GENERALISING THE BUILDING BLOCKS OF WORKSHOPS

As mentioned, a workshop can consist of a wide range of different methods (Stickdorn et al., 2018), but Jonathan Courtney has attempted to generalise the process by describing workshops as a construction of four phases: *Collect*, gathering data about the problem; *Choose*, the participants should decide which problem is the most important to solve now; *Create*, people generate ideas on how to solve the problem; And lastly, *Commit*, choose which problem to continue developing after the workshop (Courtney, 2020).

IMPORTANCE OF PSYCHOLOGICAL SAFETY

People not used to the creative process can feel uncomfortable in a workshop situation. The methods used often delve in the area of uncertainty and require people to continuously fail in order to create a working solution (Stickdorn et al., 2018). Therefore, it is important to create a psychological safe space to encourage participants to take part and share their knowledge and creativity freely. Creating a safe space is a combination of the social dynamic between the participants, the competence of the workshop facilitator and the physical (or remote) space (Stickdorn et al., 2018).

CHAPTER 2.4

FUNDAMENTAL KNOWLEDGE FOR WORKING WITH VR

"VR – An artificial environment which is experienced through sensory stimuli (such as sights and sounds) provided by a computer and in which one's actions partially determine what happens in the environment." (Merriam-Webster)

The main opportunities from VR stem from constructing brand new virtual environments or copies of the real world, the possibilities of lifelike interactions, and the "immersiveness" of the technology (Jerald, 2015). Some studies also indicate that the immersion of VR increases understanding and retention of knowledge (Coulter, Saland, Caudell, Goldsmith, & Alverson, 2007).

Stepping into a virtual world can cause a mismatch between multiple sensory inputs. A classical example is being on a virtual roller coaster, while physically still in the real world. This can cause simulation sickness, causing people to progress through symptoms of postural instability, cold sweating, disorientation, vertigo, nausea and finally vomiting (Lewis-Evans, 2015). Therefore, mitigating risks for simulation sickness is an important baseline requirement for designing VR software. Most modern head-mounted displays comply with the hardware requirements to reduce the risk of simulation sickness, related to latency, tracking accuracy, and refresh rate (Lewis-Evans, 2015).

CHAPTER 2.5

FRAMEWORKS FOR USER INVOLVEMENT IN DESIGN

Multiple sources argue that design can be viewed as a set of methods, a process or a mindset (Brenner, Uebernickel, & Abrell, 2016a; Sanders, 2012; Stickdorn et al., 2018). Therefore an individual's view of design will determine the influence design will have on their project or organisation.

In their book Convivial Toolbox (2012), Elizabeth Sanders and Pieter Stappers state that there is also a difference between design frameworks, such as Human Centered Design, and design disciplines, such as Service Design or User Experience Design. Frameworks shape our mindset and processes, while a discipline often refers to the type of problems or products that are being designed for. Some frameworks are more fitting than others to solve certain problems, and as more complex design disciplines emerge, designers must learn to navigate between frameworks to create wholesome solutions (Sanders, 2012). Despite this, most practitioners tend to identify with and favorise a specific framework for all purposes, and lack an explicit knowledge of which frameworks are best fit for specific problems or situations (Sanders, 2012). On the other hand experienced designers often navigate between levels of user empowerment naturally on the basis of their tacit knowledge (Sanders, 2012).

One of the key differences between frameworks is how they involve users. **Figure 2.1** highlights how frameworks view users as "subjects to be studied" or "experts to be listened to" through their position on the x-axis (Sanders, 2012). A selection of popular

design frameworks relevant to this thesis are outlined below.

HUMAN-CENTRED DESIGN

Human-Centred Design (HCD) is an iterative design approach for developing products targeted towards user needs. The process is divided into four phases: "understand and specify the context of use", "specify the user requirements", "produce design solutions to meet user needs" and "Evaluate the design against requirements" (ISO). After evaluating the results, the designer will move back and repeat one or more of the steps until the "designed solution meets user requirements" (ISO). The data feeding this loop is gathered through methods such as interviews, observations or usability tests.

Human-Centered Design is representative of the view of users as subjects to be studied. The designer is the expert using this data to create some designed solution. The design is then presented to the user and tested, and the designer brings back observations from these tests in order to iterate on the solution until it is satisfactory (Sanders, 2012). A typical example of this is the use of "personas" (Usability.gov, 2021), which are constructed representations of the people you are designing for, that are created by looking for trends in data from interviews and observations. Rather than involving the customers themselves, Human-Centered design practitioners combine data from multiple sources to create an abstraction to be referenced during the design process.

LEAD USER INNOVATION

Innovation studies regularly show that some users adopt innovations before others (Rogers & Ellis, 1994). "Lead users" are defined as a user population who expect to gain a lot of value from obtaining a solution to a specific need. Therefore, they may create ad-hoc solutions themselves (Osterwalder, Pigneur, Bernarda, & Smith, 2014), and are often at the leading edge of important trends in the market (Franke, Von Hippel, & Schreier, 2006). They are experiencing needs that will later be experienced by many users in that market (Von Hippel, 1986), different from the end user, who represent the people that will eventually use the product (Von Hippel, 2006).

The foundational principle of Lead User Innovation is that "among the multitude of end-users, there are some who are more capable than others of using their first hand knowledge for creations solutions." (Sanders, 2012). Our job as designers and innovators is to channel that knowledge into our products and services. Lead User Innovation depends on establishing relationships with such individuals or organisations and inviting them to participate in the design process. Lead Users can be found by searching forums for people in need of a solution to a specific problem (Osterwalder et al., 2014), or by approaching a hypothesised target group with a specific proposal, as was our case when approaching our customers.

Users are considered vital in defining a product and involving them in ideating solutions and prioritising features is a necessity. Yet, it is still the responsibility of the designer to realise solutions to the problem. This differs from the most extreme level of user

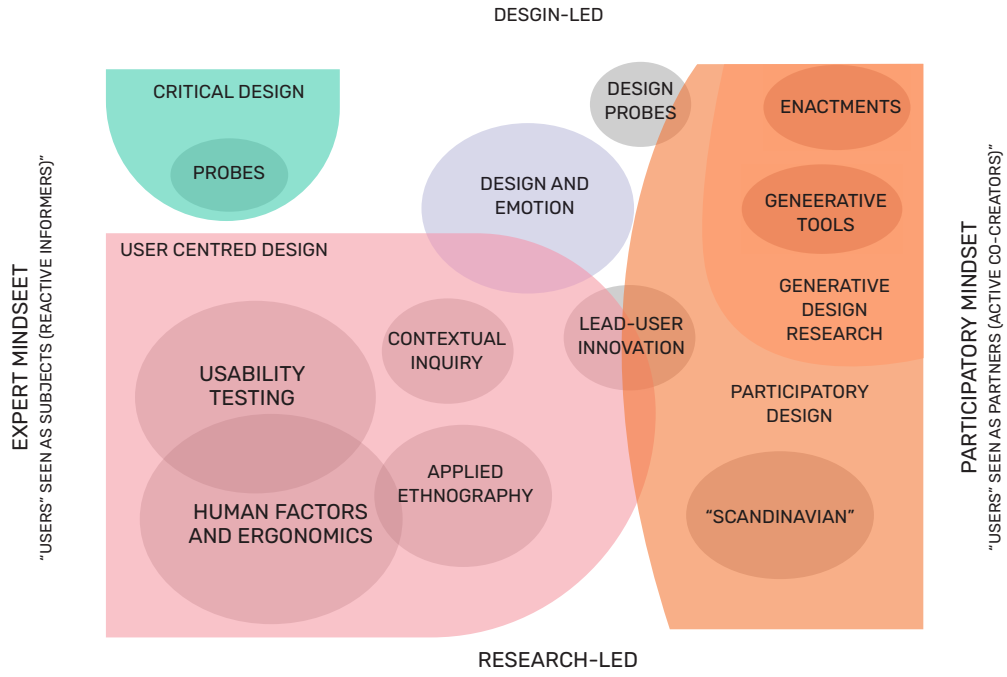


Figure 2.1: *Frameworks for user involvment in design (Sanders, 2012)*

involvement processes, such as "generative design research", where the user is made responsible for designing the final solution, and the designer is tasked in creating the circumstances to make that possible (Sanders, 2012).

DESIGN THINKING

"Design thinking is a human-centered approach to innovation that draws from the designer's toolkit to integrate the needs of people, the possibilities of technology, and the requirements for business success." - Tim Brown, Executive Chair of IDEO (slett i affinity: (Brown))

Design Thinking stipulates that for any innovation to work in the real world it has to fulfill three criteria. First, the innovation must be desirable, meaning it is something people either want or need. Second, we need the capability and technology to realise the idea. Lastly, the innovation must be economically viable, so that it may be sustainable in the market (Neck, Neck, & Murray, 2019).

Design Thinking has been defined as a mindset, process and set of methods like other frameworks (Brenner, Uebernickel, & Abrell, 2016b), but is most often referred to as a process. This might explain its absence from the design framework overview (**Figure 2.1**). The process entails researching people to be able to empathise with their needs and define a problem worth solving. Next there are phases for ideating and selecting a solution, as well as prototyping and testing. The process is meant to capture the iterative user-centric mentality (Razzouk & Shute, 2012), as well as the back

and forth between exploring possibilities and narrowing down and selecting solutions, known respectively as diverging and converging activities (Thoring & Müller, 2011). Design Thinking also advocates the needs of people to be the starting point of innovation (Neck et al., 2019). This "need finding" might be a reason why the process has gained increasing popularity in entrepreneurial education. Alternatively its popularity might arise from the explicit recognition of economic concerns and emphasis on resource allocation.

Literature on Design Thinking advocates the importance of user involvement (Razzouk & Shute, 2012), especially in the empathy and testing phases. On the other hand, it does not specifically address whether or not – and in which way – users need to be involved in the problem definition, ideation and prototyping phases. Sprint, a book famous for popularising a compressed Design Thinking process of the same name, skips the empathy step and relies on participants having sufficient knowledge of their users, or experts available to provide input (Knapp, Zeratsky, & Kowitz, 2016). Conversely IDEO, a company famous for their expertise on Design Thinking, states that "if you stay focused on the people you're designing for—and listen to them directly—you can arrive at optimal solutions that meet their needs." (IDEO, 2021)

CHAPTER 2.6

LEAN DESIGN THINKING AS A BRIDGE BETWEEN DESIGN AND ENTREPRENEURSHIP

The term "Lean startup" evolved from the "customer development" method (Blank, 2020) and was later popularised by Eric Ries. In addition to a process for "product development", a startup also needs a process for "customer development". This leads to developing solutions that are based on adapting to customer needs. The process aims to build a continuous feedback loop with customers, during the product development cycles (Müller & Thoring, 2012). The process tests core business assumptions early, sometimes even before any product is built at all (Müller & Thoring, 2012).

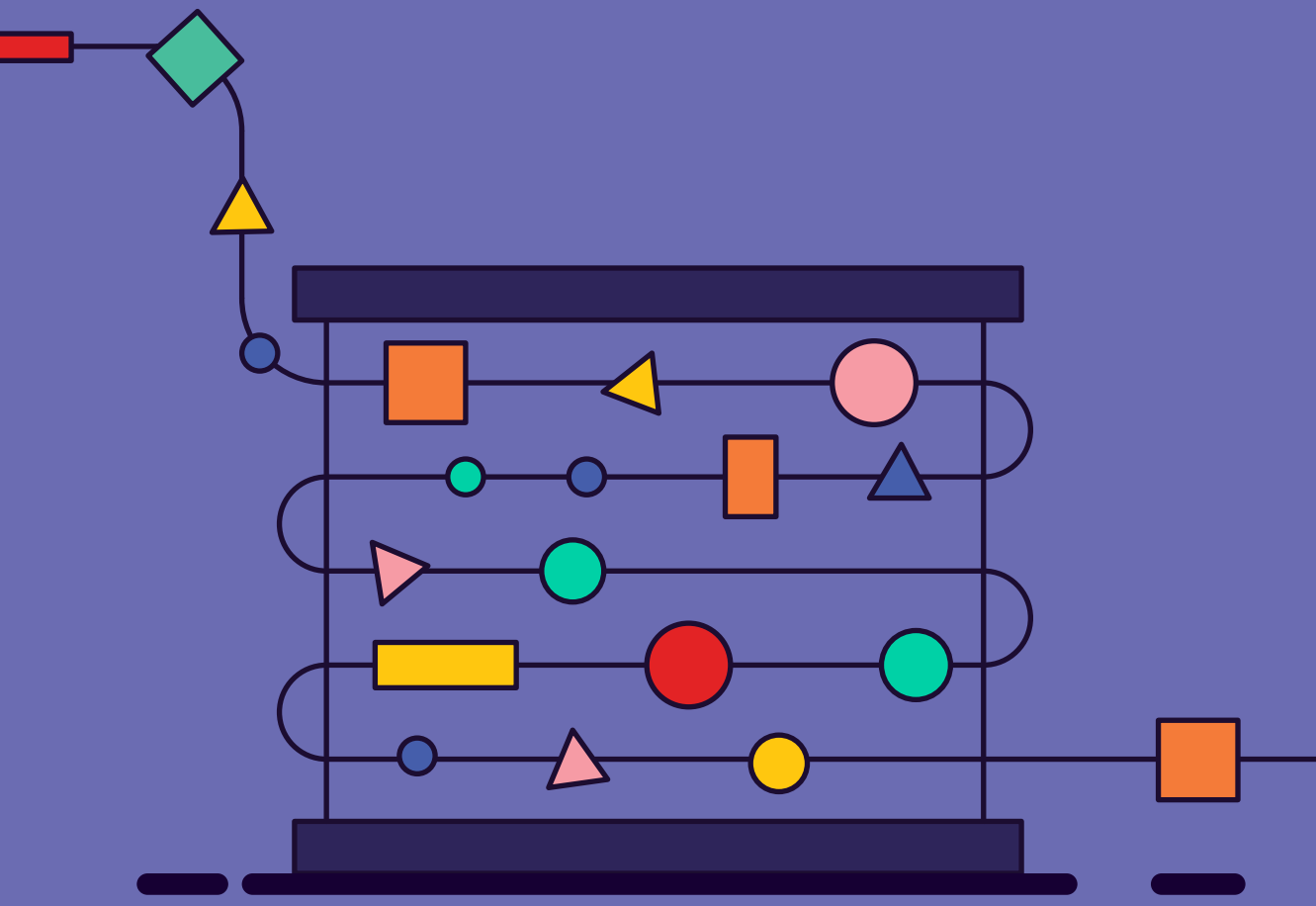
Similar to lean startup, design thinking is also focused on users (Müller & Thoring, 2012). In both methods, the goal is to discover a problem and to test if the problem is worth solving (Blank, 2020). Lean Startup advocates the use of a Minimum Viable Product (MVP) to find and validate a solution to such problems (Reis, 2011). An MVP is the simplest possible version of your product that still solves the core problem. The next key feature of Lean Startup is to release the product to customers and to use quantitative data to measure its performance. This data is used to create an hypothesis of how the product could be improved. The product is then updated, and the quantitative metrics are observed in order to determine if the change had a positive effect. This loop is named "build, measure, learn" (Reis, 2011). The aim is to find "product-market-fit", at which point the business will experience accelerated growth.

Whereas Design Thinking starts with identifying a problem, Lean Startup starts with an idea and the concept is then tested for its validity (Müller & Thoring, 2012). What separates the two processes further is that Design Thinking is focused on using qualitative data to understand and empathise with users, while Lean Startup is focused on the progression of quantitative metrics. Note that this does not exclude either process from gathering and analysing qualitative or quantitative data, but rather that they are primarily driven by one or the other.

Müller (2012) proposes an interlaced process model that combines the main aspects of both innovation strategies, called "Lean Design Thinking". This combines what Mülller considers the most promising aspects of both strategies and addresses the identified gaps. The first steps of a Design Thinking Process are maintained, and prototyping is merged with quantitative customer development from Lean Startup. Here, the business model generation is added, and the customer validation from Lean Startup is added to the end of the process.

Chapter 3

RESEARCH METHODOLOGY



This chapter gives a detailed description of the research methodology used to explore the different aspects of the research questions. Some methods are used prior to the development of the VR workshop software in order to create system requirements. The others are qualitative data gathering methods used to learn and iterate on the value proposition throughout the project period.

CHAPTER 3.1

RESEARCH DESIGN

The goal of the research was to explore how VR workshop software can be designed to be desirable to employees and to explore how entrepreneurs can utilise design in VR ventures.

In the first phase of the process (**Figure 3.1**), we validated the market to ensure that we were able to build a viable business in the team collaboration software industry. We moved on to validating the solution by using a one-pager to sign customers. Then, we conducted focus groups on workshops and researched literature that contributed to answer the research questions. Lastly, we recruited Lead Users among potential customers, and collaborated with them to further define the value proposition, ideate and prioritise features. These activities created deeper bonds with our customers helping us gather feedback of increasing sincerity. We observed, interviewed and performed usability tests on users in order to iterate and further develop the solution. The collective data gathered was used to reflect on the process, and compared to relevant literature in order to explore our research questions.

The process was centered around the Lead User Innovation framework, but influenced by Lean Design Thinking, and Human-Centered Design. Users were invited to influence the ideation and feature prioritisation, and we channeled their input into the software. On the other hand, the complexity of designing for emotions and novelty of VR made us opt to draw from Human-Centered Design, where observing workshops helped us understand how new features affected the dynamic of people. Furthermore usability testing gave insights of how the individual features performed. Our attempts to quantify qualitative data to measure the performance of the software is done in accordance with Lean Design Thinking.

CHAPTER 3.2

METHODS OF DATA COLLECTION

Our main goal was to create software that enables people to conduct workshops in VR that they perceive as fruitful and preferable to other remote workshops. In order to fulfil this purpose we facilitated and observed workshops held in VR using prototypes of our software. Between March and June, we facilitated and observed a total of 21 workshops with our 5 pilot customers. Each workshop lasted for approximately one hour, with the number of participants varying between 3 and 13.

We have used a wide variety of methods for data collection. In this section we will briefly describe each of them and discuss why we chose these methods. Examples are usability testing, high fidelity prototypes, interviews and focus groups.

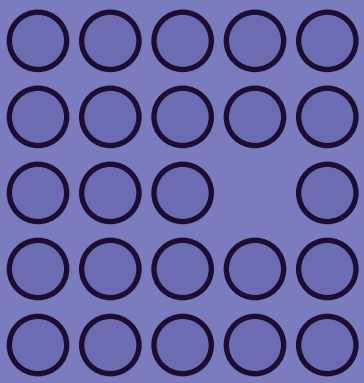
Figure 4.2

PROCESS ILLUSTRATION

During our project, we reached phase 3

Problem validation

"I've found a real, poorly met need a reachable market faces."



Expert interview

Market analysis

Focus group

Solution validation

"I've figured out how to solve the problem in a way they will accept and pay for."

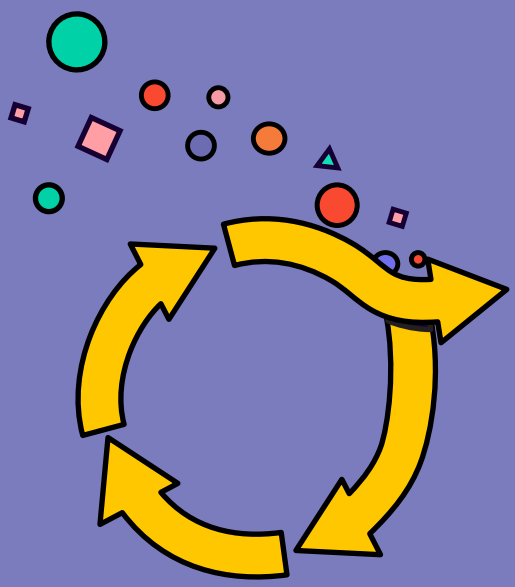
Competitor analysis

Lead user reqruiting

Heuristics analysis

Product iterations

"I've built the right product/ features/functionality that keeps users around"



Facilitating workshops

Customer conversations

Boundary objects

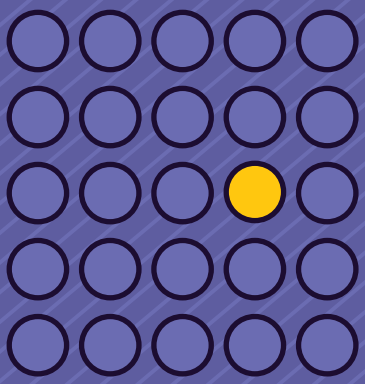
Usability testing

High-fidelity prototype

Observation

Implement

"The users and features fuel growth orgincally and artificially"



LEARNING FROM FACILITATING AND OBSERVING WORKSHOPS

By working with our customers and participating as facilitators we were able to experience how the platform helped and halted our attempts at leading a group towards a common goal. This autoethnographic approach helped us understand the needs of a facilitator, and we could use our own experiences to engage in deeper discussions about issues and opportunities.

Later, users were tasked to plan and facilitate their own workshops. One group opted for planning a new onboarding process for employees, while others fleshed out product ideas or worked on a marketing campaign. One group of executives used the software to map out risks for their conglomerate. Some were working with their existing team, some were collaborating across divisions and some introduced external consultants. By taking a step back we could observe the interaction and social dynamics between people.

BOUNDARY OBJECTS

Boundary objects are "things" used to discuss something else, and their value lies in the fact that all parties involved understand them *(Cooper-Wright, 2012)*. To most people, VR is unfamiliar, as only 19% of those asked report having tried it once or more (Gilbert, 2021). Therefore, we used boundary objects such as "post-it notes" and "staged workshops" to help participants draw from their experience with traditional workshops when discussing the possibilities of VR.

The post-it notes allowed users to express how they wanted to manipulate data. While VR technology does not limit us to gather and portray information in a specific way, the yellow post-it note is recogniseable for most knowledge workers. With a post-it note in place, users were able to discuss their needs more clearly such as the ability to organise and differentiate information, exemplified by clustering and colouring post-it notes.

The second notable boundary object was "the staged workshop". With us as facilitators, users were asked to solve problems constructed by us to mimic traditional workshop patterns, such as a lightning decision jam. By putting a group of users through the "experience of a workshop", we were able to discuss the dynamic between the participants, and how they felt the software had influenced them. These experiences also helped users ideate and discuss the future potential of the software.

USABILITY TESTING

One of the main obstacles to successful remote workshops is issues related to software usability. Users unable to interact with the medium through which the workshop is facilitated are unable to focus and participate effectively. As a result, frustration rises, schedules are delayed and valuable insights lost (Workshopper, 2021).

"The point is to [...] identify the friction points in the prototype so you can fix them. Today we do usability testing in discovery—using prototypes before we build the product—and not at the end, where it's really too late to correct the issues without significant waste or worse." – (Cagan, 2017)

Usability tests are intended to mitigate this

problem and ensure we create products that people intuitively understand. What is considered intuitive varies between user groups, so testing on people representative for the target audience is important. During the pilot period, we have been performing usability tests on our customers with each new feature and iteration. The users are aged from 22 to 57, generally have higher education and, like the population in general, most have not used VR before. On the other hand, as our users become more familiar with VR, they tend to master new concepts more quickly, creating a need for fresh users to test on. Therefore, new pilot customers were introduced to the platform over time, allowing observation of first-time users at different stages of development.

INTERVIEWS

"Interviewing means conducting contextual research and analysing it to reveal a deep understanding of people that informs design and business problems." – (Portigal, 2013)

Interviews are a method of information gathering used to gain a deeper knowledge of a subject or insights into people's lives and thinking (Goodwin, 2011). By asking open-ended questions, interviewees are encouraged to elaborate on their thoughts. Their answers often open new avenues for exploration through further questioning (Portigal, 2013). This format, referred to as a semi-structured interview, has the potential to uncover deeper personal truths, including personality traits, fears, and ambitions. On the other hand, such interviews are prone to bias on the part of the interviewer. Follow-up questions set the direction of the interview, and the way they are shaped and conveyed will influence the answers.

Interviews are also unsuited for predicting future behaviour (Portigal, 2013), as people often envision their future based on their intentions and aspirations rather than their empirical evidence from their past (Poon, Koehler, & Buehler, 2014). For instance, the answer to "will you buy this product once it is released?" does not predict whether or not an individual actually will. Therefore, we could not use interviews alone to confirm purchase interest for our product.

Interacting with the customer

We applied the mentality and method of asking questions weekly in our interactions with users and customers. Many users opted to stay and talk after workshops, creating opportunities for informal interviews. These were often the most valuable, as they allowed participants time to reflect on a deeper level than the facilitated feedback exercises. The conversations would vary from product feedback to daily routines and wellbeing. In turn, this allowed us to gain a deeper understanding of our role in their lives, while at the same time building trust. This would be necessary moving forward to gain candid feedback.

FOCUS GROUP

"A focus group is a facilitated, usually 60- to 90-minute meeting with anywhere from five to a dozen members of a target market. [...] A group can help you learn more about the various roles and processes in an industry or the different usage characteristics in a consumer domain." – (Goodwin, 2011)

A focus group could help us highlight how physical and remote workshops are perceived in the workplace. We hypothesise that the participants' perspectives would better represent the views of regular people in the workplace than academic literature. Because of the SARS-CoV-19 pandemic, we required a new way to conduct our focus group. At the same time Clubhouse, an audio-only group conferencing platform, had risen sharply in popularity (Tankovska, 2021). We discovered that Clubhouse also allowed us to make the discussion available to the public while providing tools to facilitate the discussion.

The group dynamic is what makes the focus group unique. If the group dynamic works, people will comment on previous statements and the discussion can help surface multiple perspectives (Preece, Sharp, & Rogers, 2015). Conversely, if the group dynamic is poor, it may hinder some participants from sharing what they think and feel, or lead to "groupthink" a situation where people conform to a set of ideas to create a pleasant atmosphere (Janis, 2008).

Using Clubhouse raised concerns about whether the platform added pressure on participants that could alter their responses or suppress introverted voices. This is an inherent problem of any focus group, and as our goal was to gain as many new perspectives as possible, we decided the potential benefit of additional people contributing outweighed the drawbacks.

BUILDING HIGH-FIDELITY PROTOTYPES

"The primary purpose of a prototype is to tackle one or more product risks (user value, usability, feasibility, or viability) in discovery" – (Cagan, 2017)

High fidelity prototypes tend to generate detail-oriented feedback (Stickdorn et al., 2018). Instead of high fidelity prototypes, we could have used low-fidelity prototyping methods such as roleplaying or Wizard of Oz tests, which tend to provide more high-level feedback. But, being immersed in a virtual environment changes depth perception, as the world is more abstract and the spatial sound is estimated. Observing people in physical prototypes of virtual environments would be too far from the real experience for the data to be conclusive. The implications are that the immersion of VR experiences can not be prototypes through real-life reenactments.

To study if the value proposition resonated with the target customer, we had to use a high-fidelity prototype. As most people have little experience with VR, it is easy to present a glorified vision for how VR can be used as a collaborative productivity tool. To gather reliable data on the desirability to adopt VR workshops in their day-to-day remote work, we had to give users the possibility to test real VR workshops themselves.

Furthermore, the high-fidelity prototype helped us observe usability issues during real workshops. As mentioned in the usability testing chapter, usability issues are considered a hindering factor in remote workshops, and learning about these issues meant we could fix them. Not only is a prototype in VR the best choice to test desirability and usability issues, but also allows for testing the technical feasibility, as we had to program each working prototype during the project.

To prototype the software we used Unity and Photon to allow users to see, navigate and interact with the virtual environment as well as communicate with other workshop participants. Limits of our technical capabilities shaped the prototypes and initial direction, limiting the possibilities, but validating the technical feasibility. As a result, all successful features in the prototype would be possible to implement in a later more robust development and commercialisation phase.

CHAPTER 3.3
METHODS OF DATA ANALYSIS

MEASURING QUALITATIVE DATA

During workshops, we would continuously get different kinds of feedback on different parts of the system. Some would be feature requests, others would be suggestions to make changes, and some were general usability problems, bugs and as well as our observations. These were logged and linked to specific user intents that we could in turn analyse and figure out how to prioritise to add or change features. In addition, every entry was tagged with how the data was collected.

For instance, our software allows users to add text to post-its with speech-to-text. **Figure 3.1** shows how insights gathered with these methods impact the decision-making process of the speech-to-text-functionality. As data was gathered, it was eventually grouped and sorted into user intents called jobs-to-be-done (JTBD) and new problems for us to solve known as "how-might-we's" (HMW). Each insight was connected to an HMW or JTBD with an importance score from +0 (not important), +1 (Nice to have), +2 (Important) to +3 (Critical). The importance scores for each item was summed together to create a "user impact score". This score was used as a basis for the prioritisation process and planning of further work, but not solely deterministic.

LEARNING FROM QUALITATIVE DATA

In the last step of the iterations, the results from the previous iteration were analysed in order to learn what changes were necessary, both in terms of the user experience and our relationship with the customer. We analysed the data and in turn updated our "belief system". Using the Lean Design Thinking approach, this is similar to the learning-step of a build-measure-learn process.

CHAPTER 3.4
REFLECTIONS ON METHOD AND PROCESS

TESTING BUSINESS IDEAS

The results from both the problem- and solution validation phases presented a go/kill-decision. If the data from the validation phase did not reinforce that there was a problem people needed solved, then the process should stop. Similarly, during the solution validation phase, if the specific solution is not economically viable, technically feasible, or desirable it should not be built. In the results chapter, our findings from these validating steps are presented.

In the context of a master thesis however, killing the venture after these initial phases

would leave us unable to answer our research question. Thus, we have a bias to look for encouraging data in order to prevent a feeling of wasting time. The sunk cost fallacy is a phenomenon where people continue a project as a result of having put a lot of work into it (Arkes & Blumer, 1985). Being aware of this, we need to take a step back after the thesis and reevaluate if there is a poorly met need in a reachable market, and if VR is an acceptable solution people are willing to pay for. Signing our existing customers for a new and extended period of time after the master thesis period would be a sign of such validation.

FEATURE PRIORITISATION

From all the 21 workshops hosted, more than 133 individual notes, containing one or more insight, were documented and tagged as observations, results from usability tests, feature requests or customer feedback (**See Appendix 1**). Because of the large quantities of data and the fact that the insights were collected over a time span of four months, we needed an overview and the possibility to compare feedback across iterations. The process of connecting insights to problems and features, as well as being able to calculate a score was preferred over traditional Affinity Diagramming, a method used to categorise insights into meaningful clusters (Hanington & Martin, 2019). Doing so revealed areas that were frequently commented by users or observations, and narrowed the scope of our discussions in order to increase efficiency.

Even though we had a list of features, bugs and abstract problems sorted by their user impact score, other factors were taken into account when deciding what to prioritise. We could not simply pick the top item from the list. Firstly, the process of deciding the validity of the user impact score requires balancing concrete concerns such as the bugs preventing certain actions, with perceived importance of new features or changes based on observations and feedback from users. Second, an overarching constraint was the complexity of designing a new feature and how time consuming it would be to implement. Lastly, in order to exploit the novelty of VR, we had to alternate between diverging phases used to ideate and test concepts that helped explore the possibilities of virtual workshops, and converging activities such as reiterating on existing features in order to fix usability issues. This process is known as ambidextrous innovation (Tushman, 2004).

MAKING MULTIPLE CHANGES PER ITERATION

Ideally, we would have tested one feature update at a time in order to isolate changing variables. Constraints on time, the number of workshops, and the number of pilot customers forced us to make multiple changes simultaneously. This increased our speed but added uncertainty as to the impact of individual features.

USABILITY TESTING

"The ultimate user experience is improved much more by 3 studies with 5 users each than by a single monster study with 15 users." — (Nielsen, 2000)

Each new or updated feature was tested during 3-6 workshops on 3-10 participants. According to the Nielsen Norman group this is

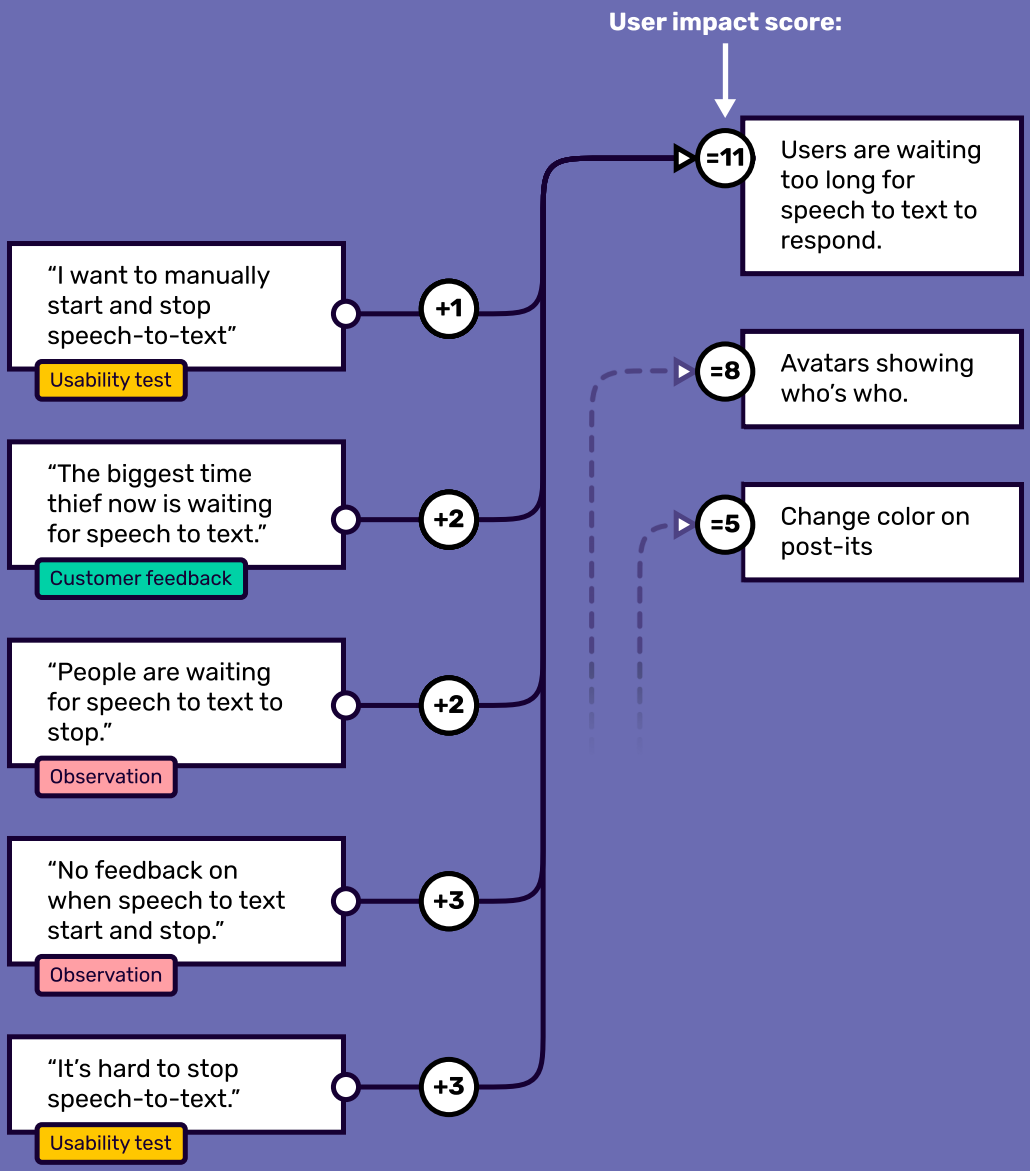


Figure 3.1: *Using user impact score to sort and analyze user insights*

sufficient to ensure validity of the results (Nielsen, 2000).

On the other hand, a source of error in the gathered data is the increasing experience users gain throughout the pilot project. Data showing that experienced users find a feature intuitive, is not representative for inexperienced users. New users were therefore introduced throughout the project in order to mitigate some of this risk.

Another hindering factor in our usability tests was the fact that we could only see the user's avatar inside VR. Their facial expressions and what buttons they pressed on their controllers were hidden from view. To compensate for this, the "think-aloud"-method was used to gain insight into the user's thought process. While this added clarity, it also stopped users from fully focusing on the task at hand, adding a source of error in our data.

HOSTING FOCUS GROUPS ON CLUBHOUSE

The open platform approach itself also created an interesting dynamic, with opinions and questions posed by outsiders adding additional perspectives and depth. For instance, multiple participants agreed that domain knowledge was unnecessary to facilitate a successful workshop. A hospital administrator then joined the conversation to oppose this view. In his experience facilitators were often unable to recognise unproductive behaviour without the knowledge of medical jargon or the specific topic.

In general we perceived the open approach as useful, but the professional facilitators had monetary incentives in promoting remote workshops as valuable and successful. While we perceived the feedback as truthful, this poses a potential issue for the validity of the data.

ADOPTING BOUNDARIES AND CONSTRAINTS FROM USER BEHAVIOUR

In the process of designing features, we designed features with as few constraints as possible. For example, allowing people to scale a post-it does not automatically set a maximum size. We have consciously avoided adding restrictions before allowing users to test, and the results have been interesting. It allows us to observe people playing with the features, testing their boundaries and using them in ways we did not predict. For instance, people have been building castles, tables and other things using post-its. We also get a view of how large most people scale post-its, and can observe at what scale it becomes a nuisance. This helped us set boundaries based on contextual observations, rather than guesswork.

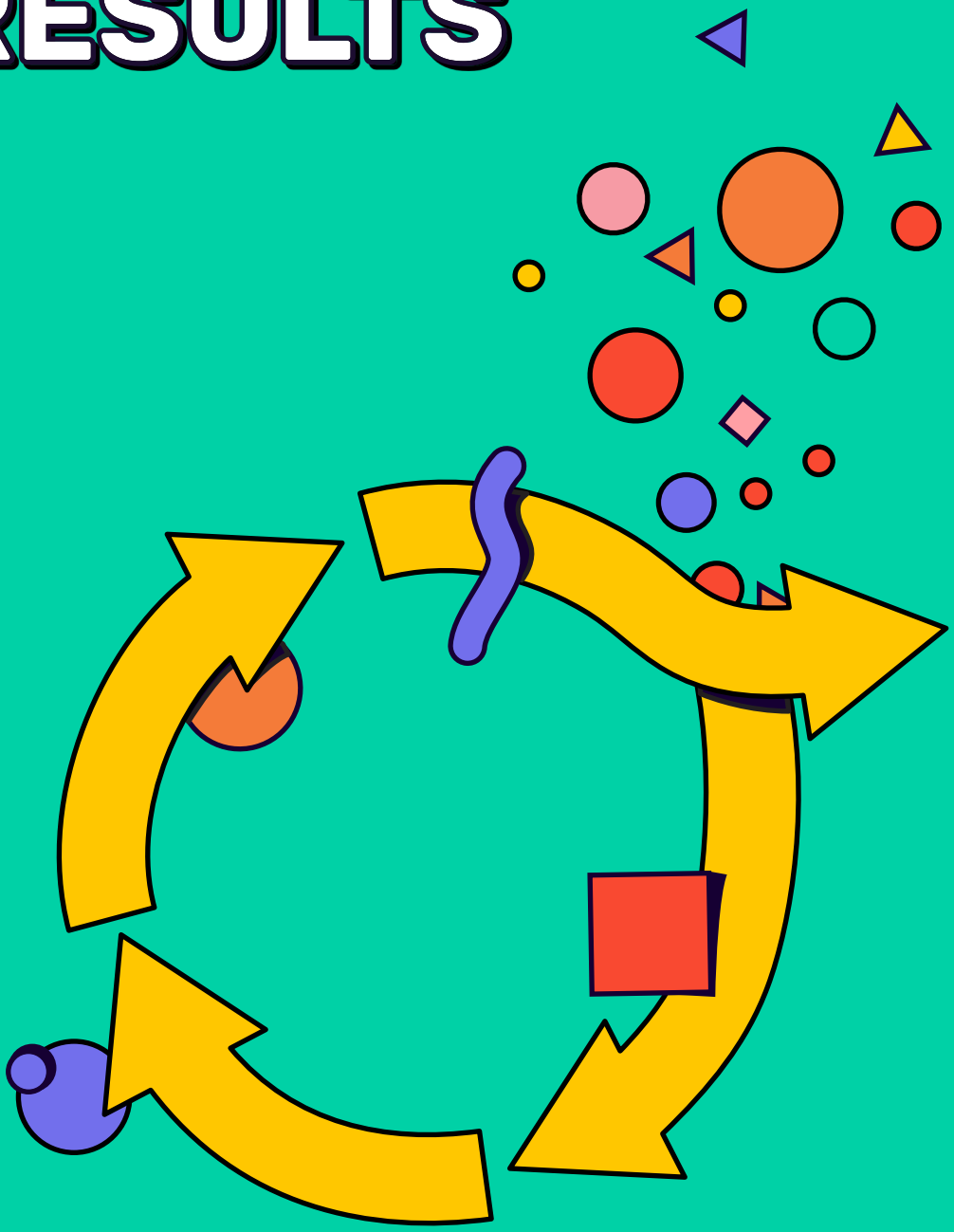
A SIDE NOTE ON KEY FEATURES STILL MISSING

Timers and the ability to draw are used frequently in workshops. Neither have been implemented, despite being suggested by multiple users during ideation phases. Timers were postponed due to time constraints and the fact that there are physical substitutes available. We were willing to sacrifice some immersion, by having people lift their headset to check the time, in order to explore the implications of implementing other features. Our technical capabilities left us unable to provide users with the capability to draw in a

user-friendly way within the timeframe of the project, while also updating other aspects of the application. This is unfortunate as illustrations are an important part of workshops and communication in general.

Chapter 4

RESULTS



While the process chapter serves as a guideline for how and why we went through different phases, the results chapter is intended to provide information necessary to discuss our research questions thoroughly.

The first part presents relevant results from our validation phase, where we researched the commercialisation potential of our solution. The second part, presents how the process and value proposition were shaped as we have gained new insights about users and VR.

CHAPTER 4.1

FINDINGS FROM THE MARKET VALIDATION PROCESS

This section highlights how a combination of qualitative and quantitative data gathering and analysis shaped our concept to the point of garnering interest from potential customers and users. In order to answer RQ1, that has to do with the desirability of the product, we needed to get an overview of the current situation and market.

MARKET SIZE AND THE USE OF SUBSTITUTES

The objectives of performing a market analysis are to show that we understand the characteristics of the market and that the market is large enough to build a sustainable business. The analysis is a combination of gathering both quantitative- and qualitative data, to better understand who our potential customers are and how we should target customers within the market. To make sure that we are entering an economically feasible market, we need to find what value can be captured (Neck et al., 2019). The process for obtaining market insight was to; Use data from leading research institutes on the size of the productivity management tools market; Addressing which portion accounted for team collaboration software; And using the adoption rate of extended reality (XR) technology in enterprises to obtain the total available market.

"The user adoption of collaborative technologies accelerated by almost five years in early 2020. We are not going back to the old way of working," - Wayne Kurtzman, IDC research director for Social, Communities, and Collaboration (Kurtzman, 2021).

Productivity management tools are estimated to have a market size of $45.8Bn, where team collaboration software accounts for 20% of this (Grand view research, 2020). Furthermore, the adoption rate of XR technology amongst global business executives, 35% had already adopted XR technology into at least one business unit. While it was somewhat complicated to find the exact overlap between the XR adoption rate and the productivity software market, we estimated that up to 35% of $9.5Bn ($3.3Bn) can be captured globally (total available market). The estimation was supported by experts from the Research Council of Norway in their feedback on our recent application sent in regards to a grant they announced this spring.

"Attempts to address the global market have been estimated in a credible way. The market is precisely defined." - Expert opinion from the Research Council of Norway.

Today organisations use tools such as Teams, Zoom and Slack in combination with creative tools such as Miro, Mural or FigJam. Team

collaboration software using a personal computer or a 2D visual plane is to be considered a substitute, as the technology can be used to perform similar tasks, but is not considered a direct competitor.

Collectively, this information showed there was a sizable market available, and that users were already solving the problems of being remote through substitutes. Moving forward it would be necessary to understand whether people were satisfied with the existing substitutes used to collaborate online, and how their creative problem-solving process worked when not physically together.

FOCUS GROUP ON PERCEPTION OF REMOTE WORKSHOPS

As mentioned previously, we hosted a focus group on Clubhouse with four predetermined participants, in order to gain insight of how workshops are perceived outside academic literature. The facilitated discussions lasted for approximately two hours, with an additional 80 people listening and 7 outsider participants joining the conversation. Our focus group was centred around a few key themes: Defining a workshop, the role of and need for facilitators, and remote workshops and technology.

There were multiple definitions of a workshop proposed during the focus group. Some believed that a workshop could be as simple as "putting smart people in a room, and waiting for great things to happen", while others stated that a workshop is a "structured and facilitated process to solve a problem". While, the general consensus on the intent of workshops was "problem solving", one person also stated that he had "conducted workshops solely to help people feel more connected". Another interesting agreement was that no one believed facilitation could be fully automated. There would always be a need for a human facilitator that could "sense" the participants mood, and maintain forward momentum.

Another notable result was the different perceptions on remote workshops. On one hand, there was consensus that remote workshops had made new opportunities available. "Meeting" and working with new people had become easier during the pandemic. On the other hand there was a disparity in the perceived quality of these workshops. Professional facilitators reported the quality of remote workshops to be on par with that of physical workshops, while many others reported to struggle. Issues ranged from human factors such as focus, engagement and energy to usability issues and technical issues such as network connectivity. An interesting benefit posed by one participant was the ease of scaling workshops.

AN EXPERT INTERVIEW ON WORKSHOP FACILITATION

The differences in opinion on the quality of remote workshops posed in the focus group, led us to conduct an in-depth interview with Viljar Rystad, the founder of a company specialised on facilitating workshops. The aim was to better understand how professional facilitators adapt to remote work in order to maintain the quality of workshops. Insights from this interview could then be used to influence our product development process. During the interview, Viljar presented what he considered key elements of successful workshops, and the typical pitfalls that ruin them.

As preparations for remote workshops, he would require users to complete steps provided in an instruction manual that would onboard them to the software ahead of time. He also required every participant to use two screens, silence their phones and close all other tabs in their web browser. Additionally the problem statement had to be defined before the workshop in order to create a common goal for the team. Vague problem statements were among the most common pitfalls, and he would make sure the problem was well defined in advance.

During the workshop, the facilitators role is to keep participants informed about the process, focused and engaged in their work. Generally the facilitator is "herding the group towards the goal". This last part requires the facilitator to break up circular- or irrelevant discussions, as well as forcing the group to make decisions. During the decision making process, it is very important to notice the body language of people, to further understand if they feel a decision is being made without merit or too fast. This can be especially difficult in remote workshops, as body language is missing.

These insights were used in ideation and development of features for the VR workshop software, as well as in our own facilitation of workshops in VR.

CONCEPT DEVELOPMENT

After we had estimated the market opportunities and gathered user insights from the focus group and expert interview, we needed to validate the market for our specific proposed solution: Using VR to create a sense of being together, while physically apart. The concept at this stage was "some way to do workshops in VR", which was vague, yet sufficiently understandable to discuss the premise with external stakeholders.

Signing our first customers

Before reaching out to customers, we created a one-page (**Appendix 2**) description of our definition of the problem, what the possibilities with VR were, our proposed solution (Cohere), and a summary of the pilot project. The latter was formulated so that the customers knew that the solution was not yet firmly set, and the product was not yet created, and therefore lowering the customer's technical expectations of the solution. It also included the fact that we only were looking for five customers to take part in the pilot project, creating a "first-come-first-served"-mentality when reading the description.

The one-pager was intended to trigger the customer's interest and want to learn more about the project. It was important to charge money for the pilot project to validate the revenue model. They would be participating in a learning-based project and given the power to influence the product through a co-creation process. That way, the customer would feel empowered and help us create something that could be incorporated into their workflow more easily.

When reaching out to customers, we primarily contacted people who worked with creative problem solving as part of their work. This included tech experiments teams, innovation labs, competence development teams, and marketing departments. Using the one-pager we asked the companies if they were interested. They stated that indeed they were looking for better workplace productivity tools,

and were looking to increase employee engagement. Within two weeks of contacting our first 10 companies, we had filled up the five available seats with paying customers from five different industries. This would ensure that we gathered different perspectives so that the software would be useful for a wide range of professionals and workshop use cases. We also received two rejections. One from a company stating that they "didn't have the time to participate in a pilot project" and another stating "they just wanted to get back to the office, and did not need any remote work software".

Focusing our concept (usability and competitor analysis)

Marty Cagan (2017) states that usability is one of the necessary prerequisites of any successful venture (Cagan, 2017). This holds true for workshops, as a hindering factors for successful remote workshops is usability issues in the used digital software (Workshopper, 2021). Therefore, a deciding factor of whether or not to pursue a VR workshops venture was evaluating the usability of competing solutions.

"Heuristic evaluation is a […] method for evaluating user interfaces to find their usability problems. Basically, a set of evaluators inspects the interface with respect to a small set of fairly broad usability principles, which are referred to as the 'heuristics'." – (Nielsen, 1994)

The usability (heuristic) analysis formed the basis for a set of project-specific guidelines used to design interactions for our prototype. The main goal however, was the systematic exploration of competitors, VR usability, and what workshop features existed in the market. "Usability" and "Design Thinking features" became two of six components included in our competitor analysis.

Figure 4.1 indicates our subjective ranking of competitors on different competing factors. This ranking was used to outline a product vision and strategy to differentiate our solution from competitors. This is known as creating a blue ocean strategy in order to create a competitive advantage (Kim, 2021).

The competitor analysis (**Table 4.1**) explains how we perceived competitors, and the strategy developed to differentiate our product from others.

Choosing technologies

The decision of which headset to use in this project depended on price, the ability to distribute software prototypes remotely, and ease of setup. The Oculus Quest 2 headset was the best fit. The head and hand tracking do not require any external tracking units, there is no cable, it is relatively cheap to buy, and distributing the prototypes can easily be done by registering users as beta testers in the Oculus App Lab. Also, working with this platform did not prevent us from making the software compatible with other hardware in the future.

Using the literature as a basis (Jerald, 2015), we opted for user input through controllers rather than hand tracking because hand tracking lacks tactile feedback. For instance, when picking up a cube in VR with hand tracking, users will receive visual and auditory feedback only. On the other hand, controllers allow for haptic vibrations to provide timely feedback, increasing the sense of touch. Also, hand tracking uses deep neural networks to analyse

camera data. Small errors in tracking and the additional latency from processing tracking data, can result in frustration and lower immersion, as people expect their hands to be accurate and responsive (Lewis-Evans, 2015).

Figure 4.1: *Competitor analysis*

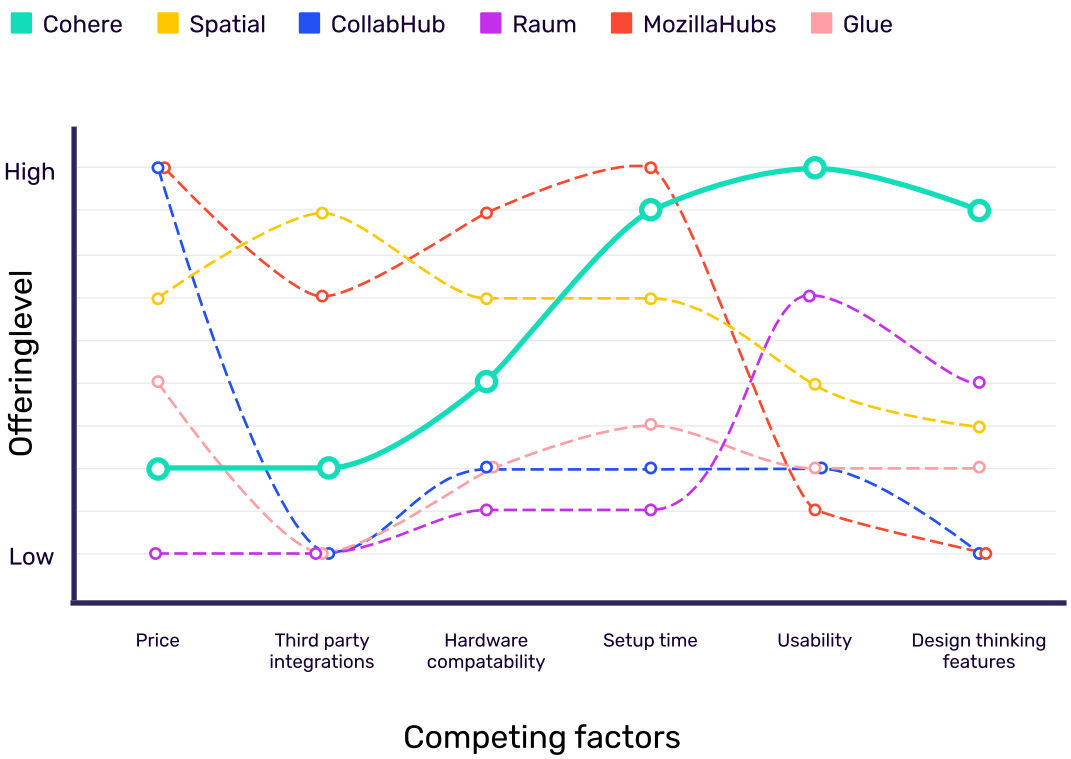


Table 4.1:

COMPETITOR ANALYSIS

Competitors

Cohere

Price	Spatial: 20 EUR/User
	Cohere: 5000 NOK/room. Our strategy is to focus on the enterprise market, and our licences are based on pay-per-room subscription. This pricing model reflects the
Third party integrations	Our competitors have a different range of supported third party integrations. Some of our competitors have a large variety of integrations, and some have none. Spatial, Mozilla Hubs, and Glue has support for file-import, Google Drive, Figma, Slack and more. But the way these are integrated inhibit the user from actually interacting with the content.
	Cohere is built to foster creativity, collaboration and focus. Our strategy for third party integrations reflects this by prioritising integrations that ease the flow of information and ideas into and out of Cohere, while inhibiting distractions and elements that pull the focus away from the matter at hand.
Hardware compatibility	Our competitors have support for different VR headsets from Oculus, HTC, Microsoft and others. We see this as a strength for our competitors.
	Initially, we focus on support for Oculus Quest 2. The headset is one of the most affordable VR headsets currently on the market, and thus lowers the entry cost for our customers to get started with Cohere. However, the visual fidelity of the application will be somewhat limited due to the headset's processing unit. To tackle this, we are developing Cohere to use low polygon 3D models when developing the virtual creative area, for increased efficiency. Coincidentally, this also makes for a visually playful and creative space, and has received positive feedback from our pilot participants.

Setup time / onboarding	One of our competitors, MozillaHubs has a well developed onboarding routine where the users don't have to install an application, just go to a specific website and start the web-application. However, this negatively affects the scalability of the application when multiple users join the same room. Spatial on the other hand has a standalone application, but has achieved a relatively easy setup process. The other competitors have a somewhat complicated and time consuming setup process.
	Our experiences from the last year, facilitating remote workshops using digital collaboration software has shown how long setup times and inadequate onboarding will ruin the user experience and negatively affect the outcome of the workshop. Feeling like others are waiting for you increases stress during onboarding, and removes focus from understanding the application. Therefore, we will help initiate the onboarding process ahead of time using reminders, include instructions in the hardware package, and create an interactive onboarding inside our application tailored to the users' technical abilities.
Usability	Most of our competitors have more features available than Cohere is planning to ever implement, making software feel bloated and hard to use. While many of the features are good, they are hidden and not intuitively available. Lastly, most of our competitors are failing to keep their interaction design consistent, meaning the same action causes different responses from the software, thereby confusing and frustrating users.
	The potential of a natural interface are among the greatest benefits of building for VR, and we will focus heavily on making our software accessible for technologically inept users. Establishing a safe atmosphere and a sense of equality and trust between participants is considered vital for a successful workshop. Therefore, making sure Cohere enables users to feel confident in their actions is our highest priority in product development.
Design thinking features	As most of our competitors are trying to replace the entire office, most also include Post-it-notes and whiteboards, often considered the pillars of design thinking workshops. Only Raum expands the toolbox to also include design templates such as a Business Model Canvas, yet they still lack rudimentary workshop tools such as dot voting and timers.
	Cohere will include all the necessary tools for conducting a successful workshop. In contrast to the competitors who design features to compete with the physical office, Cohere creates specific tools to complement the physical workspace through remote workshops. These tools include a timer, post-it notes, whiteboard and drawing, "dot voting", communication, purpose built spaces, workshop guides, and facilitation features such as grouping and moving participants, and monitoring activity levels and engagement.

CHAPTER 4.2

FINDINGS FROM PRODUCT ITERATIONS

This section describes the results of the iterative development process undertaken from February through May. While the software was updated weekly, our findings are presented in month-by-month cycles in order to clarify how the product developed over time.

FEBRUARY - THE VOID

In the first prototype (**Figure 4.2**), we implemented post-it notes, voice chat for communication and the ability to move. The environment was a 20x20m white floor with a blank grey void for a sky. Workshop participants had blank black cubes as heads and hands. Use of the software at this stage was intended to help us come to terms with the standards of VR, how to apply guidelines to prevent simulation sickness, and learning a new framework for Human-Machine Interaction. Because of our inexperience with the field of VR and the state of the prototype, we wanted a soft start for the pilot customers. Thus, their first encounter with the software was a guided technical setup of their headsets, greetings in VR and completing usability test tasks. As February progressed, we were able to host 2 ideation sessions in VR with a total of 9 participants, in order to generate ideas that would shape the future of the product. The initial onboarding process and ideation sessions also allowed us to observe and gather feedback from users.

The impact of users with experience from gaming

Most of our pilot customers were first-time VR users. Some had previous experience with game consoles and had an easier time adapting navigation and interactions, as VR controllers and interaction borrow multiple concepts from game design, such as the trigger design and joystick movement. Interestingly, people with some limited experience with game consoles struggled more than those totally inexperienced. They seemed to rely heavily on their past experience, without the confidence to explore

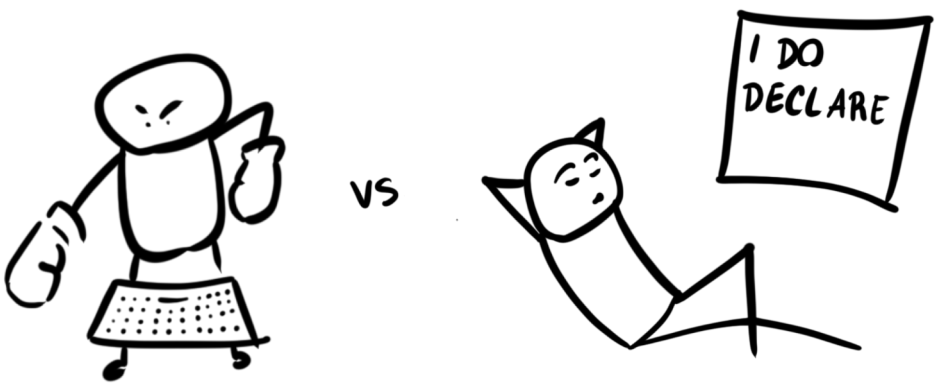


Figure 4.3: *Speech to text as input method*

Figure 4.2: *Screenshot from Cohere captured in February 2021*

alternatives. People older than about 40 also seemed scared of trying buttons without prior knowledge of the consequences.

Initial feedback on the audio system

Even though voice chat was a very intuitive feature to use, it had several issues in practice. First, it was difficult to understand who was talking. Due to the symmetric head and hands of the avatars, it was almost impossible to determine which way people looked. Furthermore, everyone using speech to text at the same time created sensory overload. People had trouble filling their post-it notes with text because their train of thought got interrupted by others also speaking to their post-its. Another issue with "speech to text" was a prolonged delay waiting for the system to detect silence and end dictation. This interrupted flow and caused some frustration.

Debating the need for virtual keyboards

We had previously conducted a heuristic analysis on competitors in the VR workshop software domain. The results showed that most keyboard input systems were a pain to use. Using controllers on keyboards gave the feeling of trying to type while wearing gloves. Furthermore, hand tracking had left us feeling like our hands did not listen and incapable of executing our intentions.

Our best experience so far had been using speech-to-text as the input method. It was precise enough for rapid idea generation, thus allowing the users to think about their ideas, rather than how to use the technology (**Figure 4.3**). For our prototype, we used a machine-learning model that worked well with Norwegian, including dialects. Speech to text worked similarly to typical voice assistants, pressing a button to start recording, and wait for the software to respond to silence.

Excitement and VR hype

Lacking many of the basic functions necessary to conduct successful workshops, it was hard to pinpoint if we were on the right track to creating a desirable solution. So far the only indications from the customers were excitement, despite the uninspiring environment. On the other hand, their excitement could just as likely be related to the use of VR in general. Considering multiple customers had mentioned the learning opportunities when signing up for our pilot, a growing concern for "VR hype" stayed with us throughout the project.

MARCH – WELCOME TO THE MOUNTAINS

During march (**Figure 4.4**), we aimed to solve some basic usability issues like the chaotic audio experience, and to create a more engaging environment. We also made our first attempt at helping users get started with our software on their own, known as onboarding. To help users communicate better, we implemented a new avatar with more human-like features. A round head with a smile and hands with thumbs, made it possible to make out the direction people were facing and the rotation of the arms. Additionally, the grey sky was replaced with a 2D mountain scape wrapped around the world like a panorama and a warmer light source imitating the sun.

Two more companies received their VR headsets and started participating during this month. The state of the software had limited us to usability testing in February. By the end of March, we could facilitate simple staged

Figure 4.4: *Screenshot from Cohere captured in March 2021*

workshops. As a result, our customers started to get more familiar with using VR technology and our application. These workshops and frequent contact left our participants more comfortable with us. We were still getting to know our customers, yet we perceived increased honesty in the feedback gathered, as feedback got more direct and simply felt more sincere.

The rise and fall of the onboarding wall

As a solution to the low discoverability of functions and to make onboarding new users more efficient, we added a user manual wall, describing what each button on the controller did (**Figure 4.5**).

Figure 4.5: *The user manual wall*

Among other instructions, the user manual had instructions for how to teleport. The only problem was that users could not read the text unless they teleported closer to the wall. Designing the user manual in a 2D prototyping software with the appropriate text sizes for WCAG 3 AAA legibility did not transfer to 3D space. Fortunately, Google's VR team had devised a system for sizing text in VR. It is a standard text size guideline that scales with viewing distance. An example of this is the text guidelines we know from 2D interfaces are the text size guidelines at mobile viewing distance. This system was used frequently in all designs concerning text going forward (**Figure 4.6**).

After fixing the text sizing issues, the user manual still did not perform. People could not see their controllers at this point, so the instructions did not relate to anything in their (VR) world. They kept looking down at their controllers, but they only saw the abstract avatar hands. It was not possible to compare what they saw on the wall and what they were holding. Possibly because of the immersiveness of VR, few thought to remove their head-mounted display to look at their real world controllers.

Aiding concentration with silence

To relieve the overwhelming noise during ideation, using speech to text on a post-it would mute yourself and muffle conversations between others. These changes removed the overload of sound when concentrating on what to say to your post-it note. The constant noise was replaced with silence, just as one would hope from individual brainstorming (**Figure 4.7**).

Lack of audio directionality caused awkward social mishaps

Despite these changes, audio directionality was still lacking. All participant voices originated from the same source in the virtual room. This was confusing. As participants were spread out in the room, everyone would turn towards the centre of the room expecting to face whoever was talking. Instead no one was

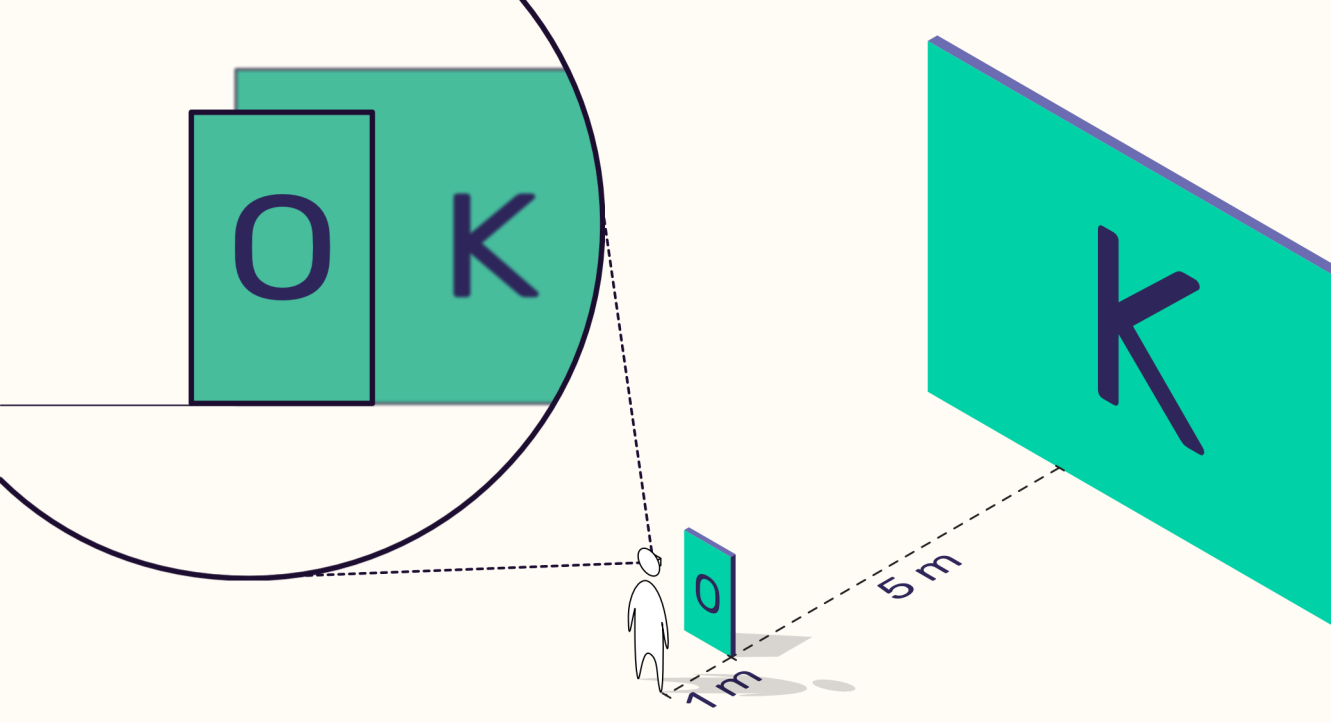


Figure 4.6: *Distance independent millimeter used to create UI in VR (Keen, 2019)*

Figure 4.7: *The new muting system*

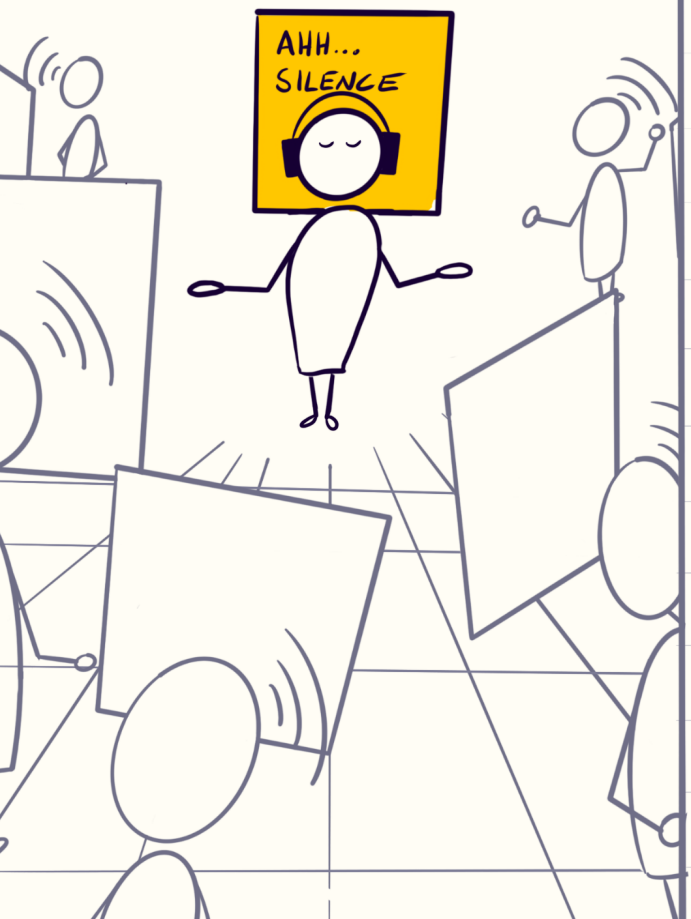
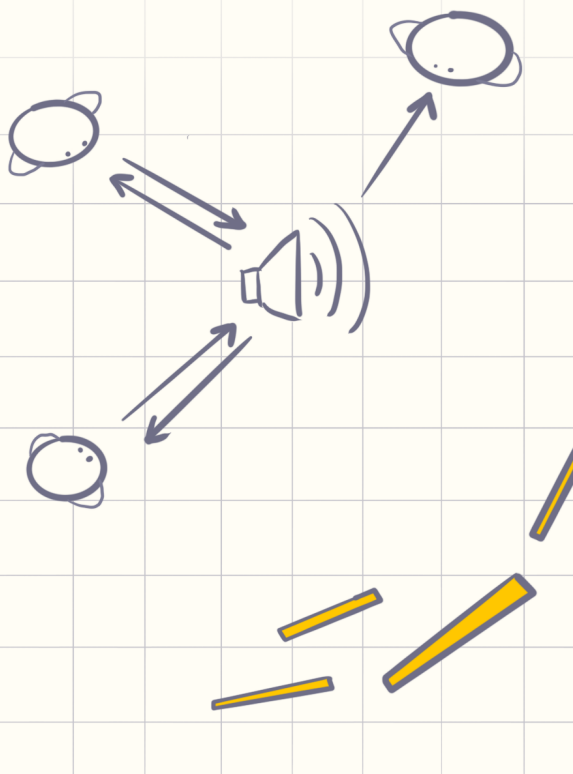


Figure 4.8: *Single speaker for voice chat*



there and participants struggled to be supportive and good listeners, as they did not know whom to look at or nod towards when having discussions (**Figure 4.8**).

Three mental models for using speech-to-text

During the usability tests, we asked users what they were doing when attempting to use speech to text. There were three mental models, meaning ways users had interpreted the functionality should work (Norman, 2013): The walkie-talkie, pushing and holding a button while talking and releasing to stop. The telephone, press once to start and press again to stop. Lastly, the voice assistant, press once to start and wait for the software to stop automatically when it detects silence. The walkie-talkie model was the mental model most users had. Choosing this, we acknowledge that the two (or more) other groups with different mental models will not learn to use the feature intuitively, and require instruction in onboarding. This frames the question if we should design for redundancy and implement multiple ways for users to fulfil the same intent?

The 30-minute mark

Even though audio and usability still needed further work, the excitement level was higher than in the first versions from February. We realised there could be multiple factors causing this, and we did not know if this was due to the new environment, the usability improvements or the new smile on the avatars. Simultaneously, participants seemed to lose their energy faster than what we were used to from physical workshops. In workshops lasting for about an hour, the average time until people started sitting down was approximately 30 minutes. We had noticed this during our first iterations, but believed it was due to the dull environment. There seemed to be a conflict between the increasing excitement and accelerated weariness of using the application.

This seeming paradox made us realise that placing workshops in VR, providing workshop features and focusing on usability was not enough on its own to make the software desirable. The updated avatars had had a greater effect on the dynamic of the group than adding practical features such as scaling post-its. On the other hand, scaling post-its were among the features considered necessary to carry out a workshop. From this point, we started balancing the need for what was considered practical necessities of a workshop with ways to better the communication between people.

Psychological safety in VR

Changes made to the avatars and environment also highlighted the importance of psychological safety for participants to be creative and speak freely. After introducing avatars that were friendly looking, slightly silly, yet not similar to humans, seemed to have relieved some tension between participants. By also making the environment playful and unrealistic users seemed to relax as nothing was perceived as “too serious”.

Developing a revenue model from our value proposition

Feedback from our customers and initial grant applications also revealed issues with our initial revenue model. At the time, we had planned a per-user subscription fee, as we

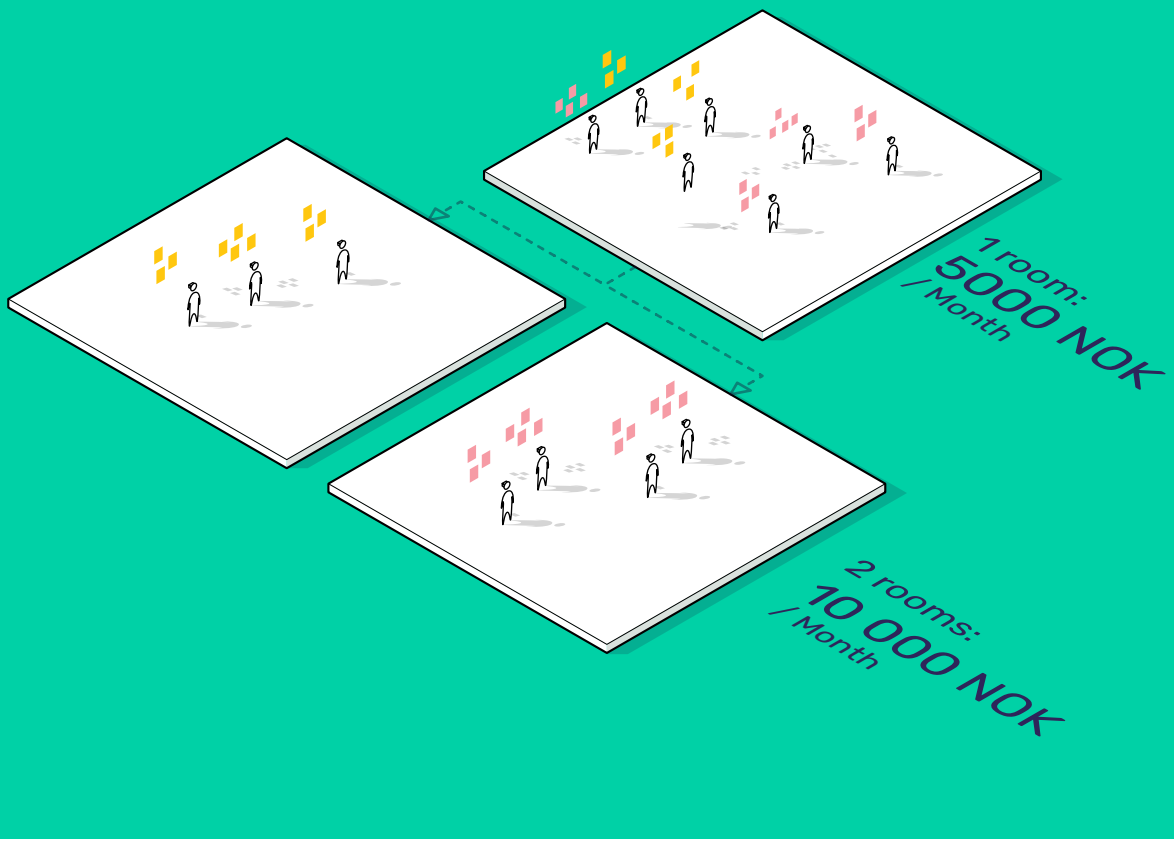


Figure 4.9: *Illustration of how the revenue model works.*

believed "personal avatars and name tags" would be sufficient to prevent sharing of accounts. Looking at other applications showed that this was not the case. Users needed some personal content that they did not want others interfering with, in order to prevent them from sharing. Furthermore, customers reported that it would be "a pain to justify another subscription".

This led us to think about what scarce resources people were getting from our product, and we realised we were selling virtual spaces for collaboration. Therefore we developed a per-room-subscription model. This model is meant to leverage room ownership to avoid shared accounts within organisations, as sharing a room would also mean sharing its content (**Figure 4.9**). Opportunities related to room-size-pricing also arose, as users could experience a need for a larger space as the team size grows or for special events. The revenue model got positive feedback from our customers stating that "We get a lot more value for our money when renting a virtual room, rather than having to pay for each user entering the room."

APRIL – BACK TO THE VOID

During April (**Figure 4.10**) our focus was to lower the weariness of our participants, and improve the usability and onboarding so participants could focus on the workshop, and not how to use the software.

Attempting to reduce weariness

Our hypothesis was that the combined strain of three issues were forcing users to constantly concentrate, leaving them unable to relax. The first issue was having no name tags, which meant users would have to keep track of everyone's whereabouts in their mind. Second was the lack of sound directionality that amplified the first issue as people had to wave and explain where they were and who-was-who. Lastly, users felt like they had to stop and wait to check if the speech-to-text had interpreted them correctly each time they made a post-it. As a result they were constantly interrupted from any natural flow of thoughts "from pen to paper".

By having each participant emit sound from their position and adding a name tag floating over their heads, users could now understand who was talking (**Figure 4.10**). People suddenly started addressing each other more naturally. This allowed users to focus on how it made them feel to conduct workshops and meetings in VR.

We updated speech-to-text to match the most common mental model of holding a button for the duration of speech like a walkie talkie. At the same time we improved the feedback system. Instead of only outputting text on completion, text was now continuously transcribed as you were speaking. Users reported this to increase focus and help them "stay in the flow".

Improving onboarding

The user manual wall failed due to bad mapping. We had observed users looking down at their hands trying to compare the wall with their controllers. This would confuse them, as the controllers were not visible to them in VR. Therefore, we made it so that users could see a virtual copy of their controllers. We also moved the instructions directly onto these controllers (**Figure 4.11**). Many VR controllers know not only when people press buttons, but also when they rest their fingers on them. We used this functionality to display a little "note" about what pressing the button they were resting on would do. That way people would get an indication of what their actions would result in before actually testing them.

Figure 4.11: *Tooltips on controller*

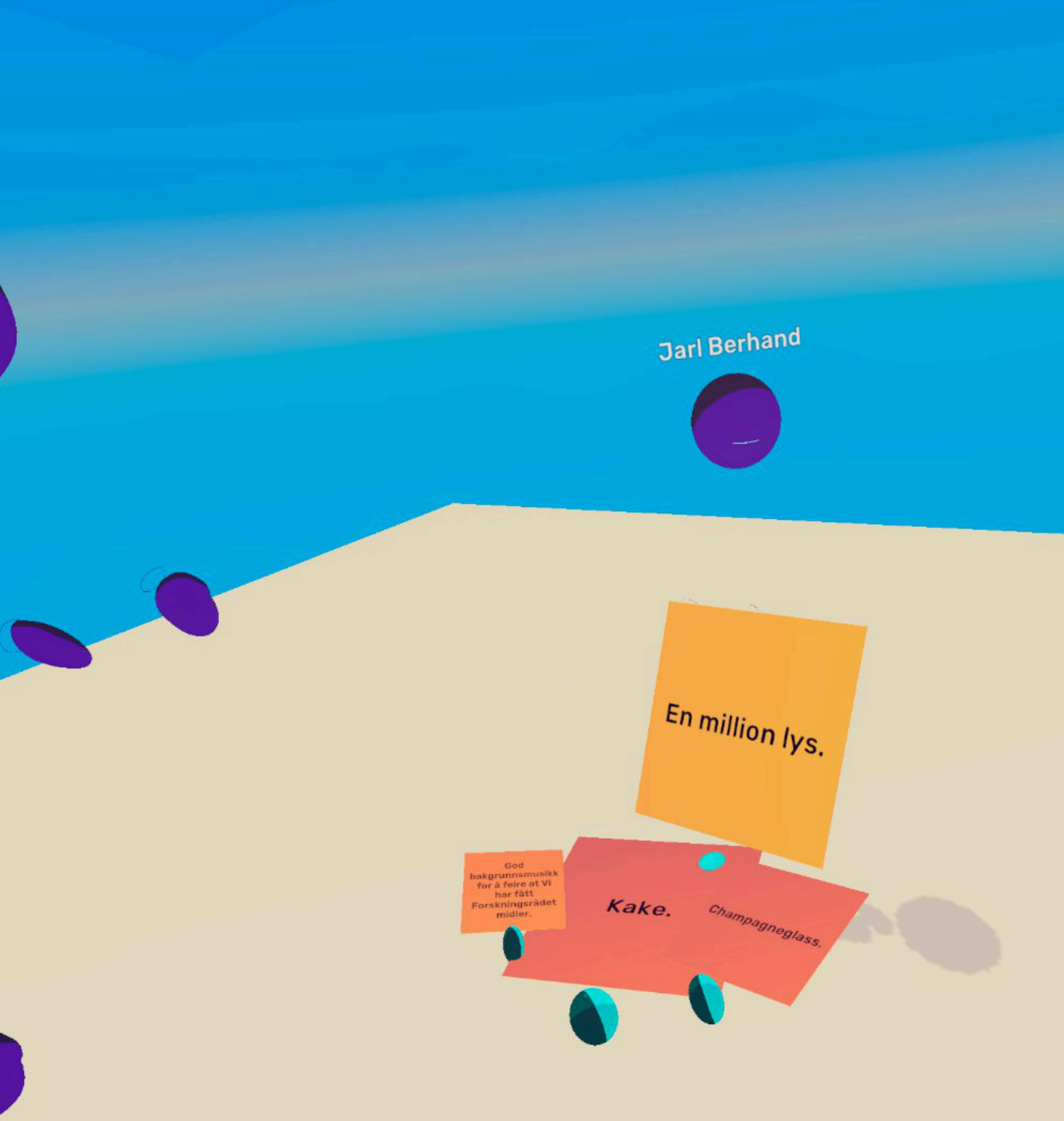


Figure 4.10: *Users creating their own world by using post-its as representations of other things, such as a cake and candles in celebration of Cohere receiving 1 MNOK from the Research Council of Norway.*

Screenshot from the April version of Cohere showing nametags among other things.

Engagement drops with dull environments

During a general overhaul of the technical implementation of the software, the 2D mountain environment had been removed and not re-implemented. We were left with another gradient sky that was more colourful than the original grey void. This was a time saving initiative, but would lead to new insights about designing the virtual world.

The new environment was perceived equally uninspiring as the "void". We had not realised the importance of texture in the background. Going from "the void"-environment to the 2D mountain scape was a clear improvement, but we assumed it was because of the lighter and more vibrant colours. Though the mountainscape performed better, it was in reality a repeating 2D pattern that did not provide much for the sense of direction. For the next iteration, a background with more distinct points of reference could give users better opportunities to orient themselves in the room.

The 30-minute mark persists

By working on onboarding, system feedback and audio issues, we had aimed to reduce the weariness workshop participants experienced after the 30 min mark. Yet during our workshops this month, people still seem to get tired at about the same time. Either the reversal to a boring environment had cancelled out the benefits from all our usability improvements, or the weariness was caused by something else.

People build castles

It was first noticed in the previous versions, every new group of people started building structures with post-it notes, varying from cabins to basketball hoops (**Figure 4.10**). It was now becoming a pattern. As users get more and more familiar with the software, they constantly challenge what is possible with the few tools they have available. This may be the basis for envisioning a future where people gain more ownership of their rooms by building them themselves. It may also broaden the use-case of the software, for example by prototyping retail store spaces or facilitating role-playing in custom spaces (**Figure 4.12**).

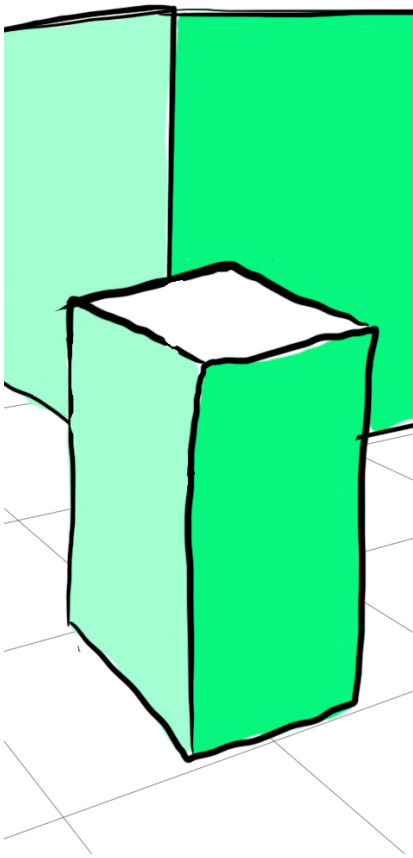
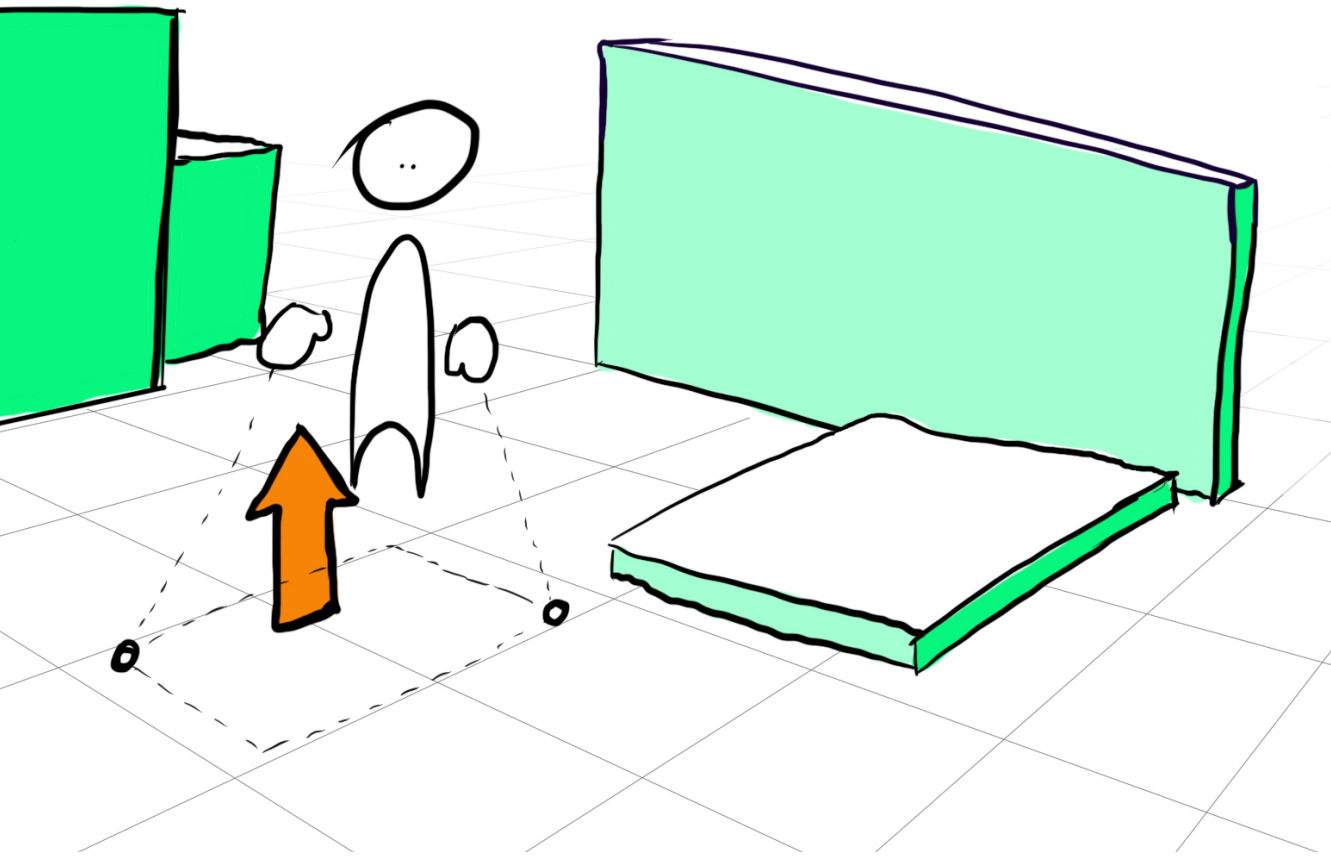


Figure 4.12: *Idea sketch of how users can create their own environments.*



MAY - A SPLASH OF COLOUR

At the end of April, we reached a new level of fidelity, and while there were still some usability issues, people were no longer feeling like they were "constantly tolerating" the software, but rather "interacting within it". In May, we released a major update with a more advanced audio processor, a total redesign of the environment, and new workshop features (**Figure 4.13**). It was time for users to facilitate their own workshops and work on real problems.

While directional audio had helped people locate each other, the volume had been constant, making it difficult to have multiple conversations in the same room or judge distance. The updated audio processor decreased the volume based on the distance between the users. With this update, workshop participants could move to different parts of the environment to create separate meeting rooms or break-out rooms in a workshop context.

Updating the environment

The environment has gone through three iterations from "the void" to the 2D mountains to the purple gradient. To summarise the findings from testing these environments: a lighter and more vibrant world increased energy and more details in the background helped users orient themselves in the world. Thus, the new environment was a non-uniform 3D terrain with vibrant green mountains and plateaus, and a blue sky with white clouds. Additionally, our workshop space was only 20x20m. This was doubled in size to take advantage of the new spatial audio. Furthermore, there are numerous workshop space functions we have not yet explored: presentation space or auditorium, break-out rooms, individual boxes for solo thinking and possibly social areas. In the timespan of our thesis, we added more abstract structures to the environment that users could interact with, this way, we could observe if some of these room functions appeared naturally without spending a lot of time designing the specific areas.

The negative effects from the dull environments were no longer reported, and combined with the new abstract structures in the room, it was easier to orient yourself after turning or teleporting. The open area with the cubes was the starting point for all workshops, the pilot customers had become accustomed to using these as a warm-up. When the workshop started, the large flat wall was the go-to for presenting the workshop subject as well as gathering and presenting post-it notes after silent brainstorming sessions. The open cylinders were not used unprovoked, but when we invited participants into them, the mood of the conversation seemed to become deeper and more reflective.

Discoveries from post-it colour changes

A feature on our roadmap with a high user impact score was the ability to change colours on post-its. This feature had multiple use cases such as dot voting, categorising post-its or distinguishing contributors of content. Adding this feature would delay the need for adding specific features for these use cases. Equally, the ability to delete post-its was a feature everyone had expected to exist from day one. Interestingly, we had successfully postponed implementing deletion for four months without many complaints. Users had

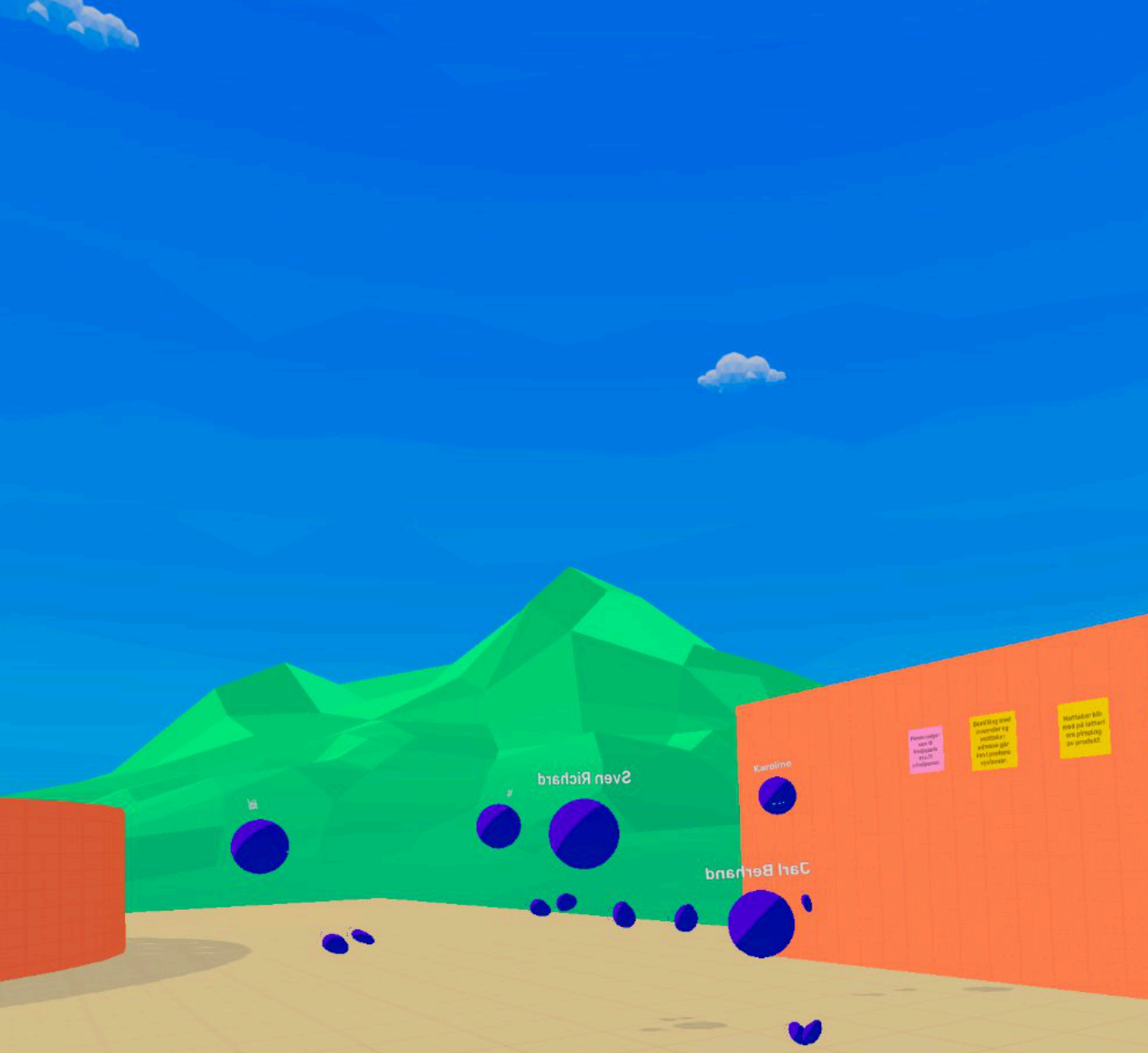


Figure 4.13: *Screenshot from Cohere captured in May 2021*

gotten by with scaling or hiding unwanted notes. Both of these features exemplify how the process has prioritised urgent additions that lacked substitutions or workarounds first.

Changing colours of notes was done by pointing at a colour with a laser pointer emanating from your hand, and using your trigger finger to click, changing the colour. While this seemed intuitive for most users without any instructions, about a third struggled. Further inquiry revealed that the ones who succeeded had recognised the interaction from the Oculus menu system. The ones who struggled had tried to manipulate it physically by grabbing or slapping the colours like they had learned when moving post-it notes.

These tests highlighted how we had been mixing multiple different mental models for interacting with our software. How people interact with computers when using a mouse and keyboard, differs from interacting with game console controllers, which in turn differs from natural interaction with physical objects, like doors, levers and switches.

VR technologies allow designers the freedom to draw from all these interaction models. We can make flat designs of pointers and virtual computer screens, or recreate physical objects with their real world interactivity. The Oculus controllers are also inspired by regular game consoles with buttons and joysticks. As a result, interactions from the world of gaming are also available. When users were faced with the software, they seemed to flip through their mental models to see what fit best. Users would adopt a certain model early on, and expect other features to follow the same pattern. This caused a cluster of usability issues that seemed unrelated, but actually were.

Feedback on the sense togetherness

Customers said they felt closer using VR than using video conferencing software, and they wondered how they could maximise that feeling of togetherness. This caused us to reframe our product a bit: While usability for this type of software is absolutely key, the relationship between people is just as important. We started contemplating ways of implementing more expressive avatars and finding ways to add even more depth to the body language, as they are now just heads and hands floating in the air. We start realising that strengthening people's ability to communicate is what is missing. People are connecting, but not fully. In which ways, taking the limitations of the current technology into account, can we help people communicate better? This also reflects the changes that have been most successful in previous versions, like directional and spatial audio, upgraded avatars, nametags and the playful little cube.

Developing this further, it is clear that we have to base our designs on more than just user feedback. Exactly what is preventing customers from full emotional immersion is difficult for them or us to know. This realisation calls for further exploration, and testing. We started contemplating metrics able to validate if the social aspects of the software improve, for instance using physical activity as a metric of engagement.

Reestablishing personal spaces and the sensation of being together

Among the most interesting findings during may was the reestablishment of personal

space. Users would feel comfortable standing close to some people and not others, and we even observed blatant flirting, all in VR. Physical activity such as throwing a ball to your colleagues in VR had a positive impact on the rest of the workshop. In real-world workshops "energisers" like these are common to "loosen up" the participants and get them ready to be creative and open towards each other.

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PILOT-PROJECT RETROSPECTIVES

Our retrospective sessions were intended to evaluate how their experience of the development process and perception of the software had developed over time. The sessions varied in length and number of participants, and consisted of informal group interviews.

In the beginning, our customers felt that VR gave them a sense of presence they had not yet experienced when using digital desktop collaboration tools. Also, the low fidelity of the application, lack of basic features, and primitive environment made it easy for the customers to understand that this was not a finished product. This lowered the bar for constructive criticism.

In later iterations, the customers saw real progress in both the feature set, the usability of the different functions, and the environment. On the other hand, as their initial excitement of VR technology subsided, they realised that they were not fully immersed when using the software. Lack of facial tracking and some "unknown factor that just didn't feel right" was preventing them from "tricking their brain into thinking they are actually in the same place as their colleagues". Still the feedback was that this was promising and that the warm-up sessions using boxes made them feel more present and together than they had during the entire pandemic so far. As the product got better, the customer relationships also developed, and they reported that the increasing trust opened for candid feedback, even as the fidelity was getting higher.

They also reported that the continuous updates of the application, as well as testing and learning from them together was exciting. It made them see the progress clearly, and start to believe in the concept and grasp the product vision, which increased the quality of their feedback. Giving customers the ability to affect the design and development process also gave them a sense of ownership, which in turn made them more interested in knowing "what's next".

Chapter 5

DISCUSSION

In this chapter we will discuss the results presented above, in order to answer our two research questions. First, how VR workshop software can be designed to be desirable for daily use in remote work, and second how entrepreneurs can utilise design knowledge in VR ventures.

CHAPTER 5.1

DESIGNING DESIRABLE VR WORKSHOP SOFTWARE

RQ1: "How can VR software be designed in a way that makes it desirable for employees to use it for remote workshops on a regular basis?"

CHOOSING AN INTERACTION MODEL WHEN DESIGNING FOR VR

Even though users may be familiar with many or all of the three interaction models presented in our findings, they quickly adopt one model as their primary framework of understanding and expecting the system to work. Our findings show that users get confused when multiple mental models of interaction are applied to the same context, in accordance with Norman (Norman, 2013). Further, unlike our hypothesis, we were unable to create "local contexts" within the software to mitigate this problem. As a result, we argue that designers must choose one model of interaction for their entire system. While there might not be a general answer to which is the better interaction framework, natural physical interactions create opportunities for systems that do not rely on cultural signifiers (Norman, 2013) such as their prior experience with technology. On the opposite side of the spectrum, leaning into the game console model excludes the largest part of the population. Yet, the physical buttons known from game consoles make for highly efficient ways to trigger key actions in the software, and some way of moving only in the virtual space is often needed. Subsequently, combining some elements of game consoles with *either* the physical or computer-like interaction frameworks may be necessary. As VR technology improves so does the natural interaction frameworks, such as hand tracking. Therefore, speaking or snapping one's fingers may be just as intuitive and efficient as pressing buttons in the future.

Issues surfacing from peoples initial mental models are highlighted in **Figure 5.1.** Further **Figure 5.2** accentuates how these issues are made worse when we use different interaction frameworks during design of new features.

A side note on simulation sickness

The causes of simulation sickness are already thoroughly researched and understood (Jerald, 2015). While simulation sickness still poses an issue for games, where continuous movement is highly important for immersion, we were able to design a world that worked around the issue without, by using teleportation for movement and avoiding flashing lights and blurred motions. As many of our users had relatively physical confined spaces in the first place, this mode of navigation was seen as a benefit rather than a problem breaking immersion. This indicates that simulation sickness might be a solved problem for certain use cases of VR.

ENABLING HUMAN MOTIVATION AND ENGAGEMENT IN VR

Analysing how the dynamic between people, and engagement with the software developed over time lead to an interesting observation. Early versions of the software with limited possibilities of interactions brought users attention to the incapabilities of their virtual self. Once this was fixed and people moved more freely, they felt like it was necessary to exclaim their fear of bumping into objects, as well as pointing out that "it was all sort of silly". As they got used to VR and its perceived "dorkiness", users felt safe and were able to fully focus on the workshops. At the same time, they started noticing that the experience was not fully immersive, and that their need of feeling "like they were together" was not yet met.

This progression through user motivations from physiological needs (being able to move), through psychological safety (fear of bumping into things and feeling silly) to expressing a need of belonging (being together) reminded us of Maslow's hierarchy of Needs (McLeod, 2020) (**Figure 5.3**). Hence, our results indicate that there could be some correlation between the fidelity of the virtual world and the perceived needs of people. This would correlate to common knowledge on prototypes from design in general. For instance, paper prototypes are often used to gain conceptual feedback, while higher fidelity mockups of user interfaces could be used to gather feedback on the visuals and aesthetics of a solution.

This observation begs an important question. If we assume the relationship between our observations and Maslow's hierarchy of needs is not random, does that imply that VR software intended to create value on a specific level, such as self realization, must first fulfill the lower level goals? Alternatively, are there other unknown levels of motivations above "belongingness and love" that are specific to immersion of virtual reality? Asked in a different way, do the aims and motivations of people change when transitioning from physical to virtual presence? For the purpose of this thesis, these questions will stand unanswered, yet we do believe that future inquiry on the subject is important to the general understanding of design for VR.

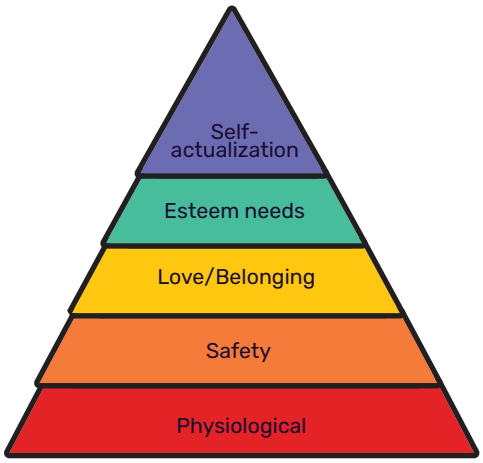


Figure 5.3: *Maslow's hierarchy of needs*

Even though these observations are highly qualitative, research on quantitative metrics able to measure social aspects of virtual reality could help future endeavours achieve psychological goals in VR. As an example, it might be possible to measure certain types of physical activity as a metric of engagement.

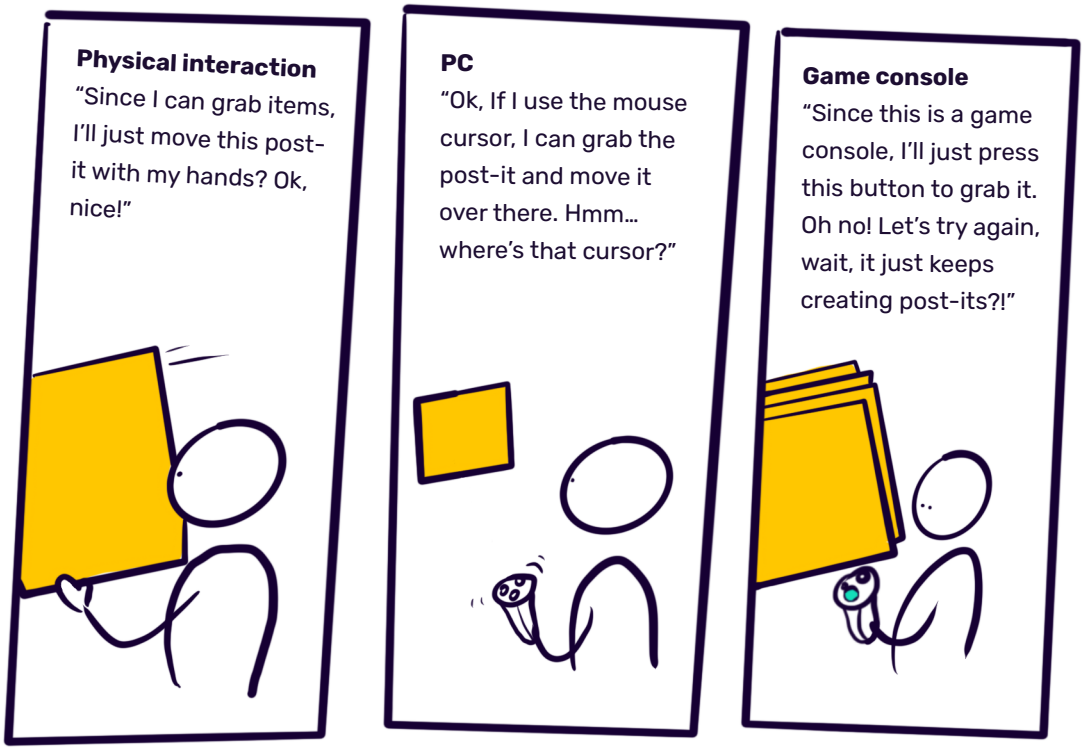


Figure 5.1: *Moving post-its*

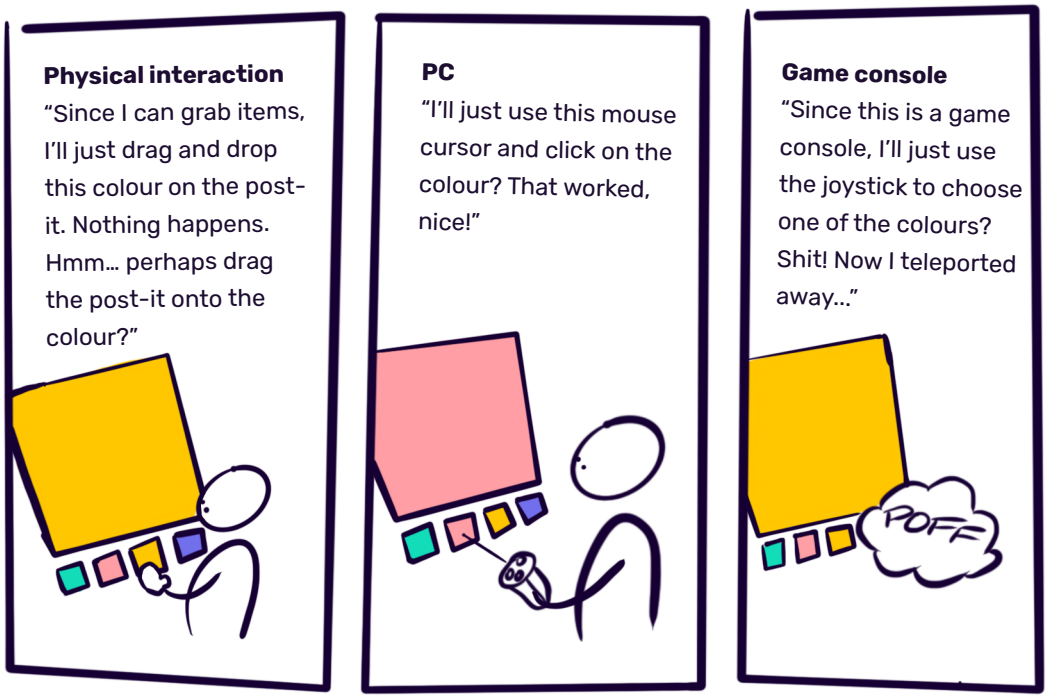


Figure 5.2: *Changing colour on post-its*

The 30-minute mark discussed

After iterating on the software for four months the time until people start getting tired and sit down has been constant at about 30 minutes. Our hypothesis is that this is a result of the current hardware, as many users report blurred vision, tired necks and other symptoms that could relate to the hardware, after sitting down. Another explanation is that there are no chairs in our software, and lacking any visual cue to sit down, might cause users to forget until the need reaches a certain level. If our hypothesis is correct, then workshop facilitators will have to rethink when and how they apply pauses to their workshop agenda.

OPPORTUNITIES OF REVENUE MODELS FOR VR

Our results showed that VR technology opens for new and revenue models based on the digital artifacts sold or rented. By changing from a pay-per-user to a pay-per-room model, we had consequently altered the customers' perception from "paying for a subscription" to "renting space". While it may be possible to change the perception of what is being sold for any digital product, we argue that the immersion of VR makes these changes more convincing to the customer, circumventing the crowded space of "subscriptions" in our customers minds, while still creating sustainable recurring revenue.

AVOIDING THE DRAWBACKS OF PHYSICAL WORKSHOPS

Expert facilitators and our users agreed that some actions, such as organising data using affinity diagramming, manipulating data after the workshop and using storyboards is easier when remote. Without the ability to export data, we reestablish drawbacks from physical workshops. As for the time being, VR workshops are not as immersive as meeting in the real world. Therefore it is important to leverage the benefits of the digital medium, for instance by helping the flow of data in-and-out of our software, in order to add convenience.

THE PARADOX OF FRUSTRATION AMONG INEXPERIENCED TEAMS

Our findings from observing users during independent workshops concur with results from our focus group and expert interview. Teams without a clear problem statement, decision maker and facilitator struggle to conduct fruitful workshops. When experiencing a lack of purpose or direction, users started looking for plausible explanations. For example, one technically adept team had previously been successful with an experienced facilitator present. When getting stuck on a problem during an independent session, multiple participants stated that the software was inefficient. While this may indeed be the case, their previous success could indicate that users were channeling frustrations with the process out of the group. Criticising an inanimate third party software is a psychologically safe option that unites the group against a common "enemy" rather than creating potential conflicts within. Therefore, prioritizing not only practical tools, but also theoretical tools for users to succeed may be necessary for VR workshops to succeed.

CHAPTER 5.2

UTILISING DESIGN KNOWLEDGE IN ENTREPRENEURSHIP FOR VR VENTURES

RQ2: "How can entrepreneurs utilise design knowledge to better understand customer needs, in order to influence their business and customer development for VR ventures?"

USING DESIGN FRAMEWORKS IN ENTREPRENEURSHIP

During the course of this thesis, it was debated how and to what degree we should involve the users of the application. Should the users be given the opportunity to participate in establishing requirements for different features, or should we only define them ourselves from interviews and observations? Further, should we get them into the drawing room to shape the features, or present them with solutions? When testing features, how should we interpret and incorporate direct feedback? Should we attempt to rely on their experience and implement proposed changes directly, or interpret their intent and ideate solutions ourselves?

We chose a Lead User approach, where our role was to facilitate user needs and ideas for the product. This approach left us somewhere in the middle on the axis of user agency on product development. It allowed us to rely on users previous experience with workshops, while making use of our increasing knowledge of VR design and development. Maintaining close contact with customers, and observing workshops weekly, was especially important because the value proposition is related to the perceived perception of togetherness, which we are not able to quantitatively measure.

As we had spent more time with VR and had a deeper understanding of its possibilities, we switched from having users make decisions (lead user approach) to Human-Centered-Design framework when testing and validating how functions should work. During testing designers seemed to have some tacit knowledge of how much time they should give participants to figure things out on their own, and when to provide guidance during testing. On a higher level, designers seem to have an intuitive grasp of how much influence users should have over various aspects of product development, and tailor this to specific problems or use cases.

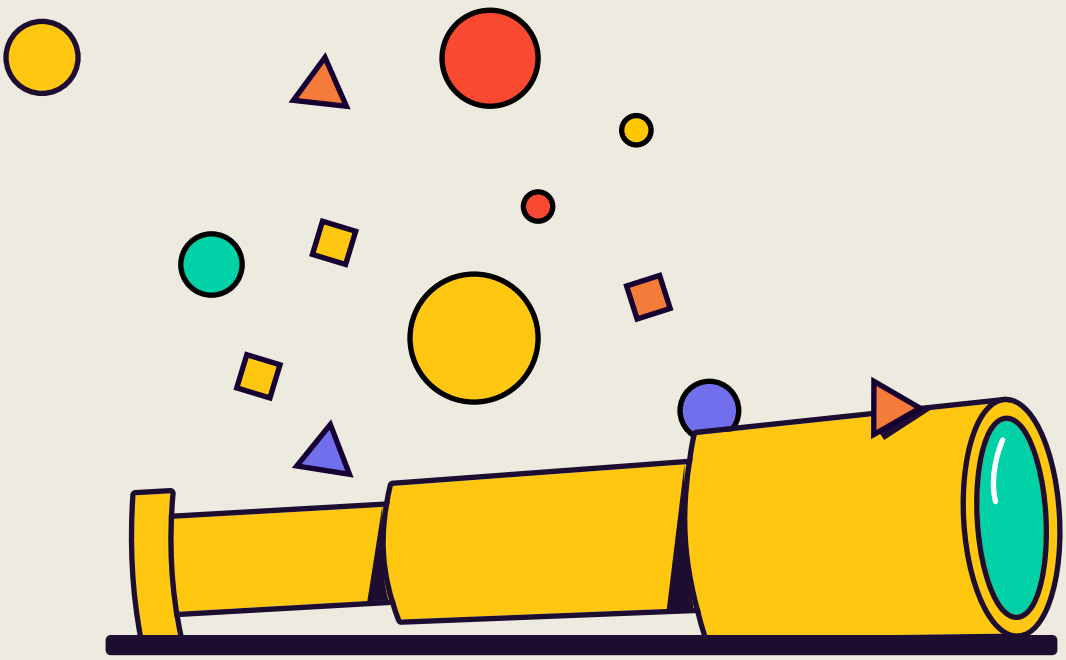
By comparing literature on design frameworks with popular educational books on entrepreneurship like Neck, Blank, and Reise (Blank, 2020; Neck et al., 2019; Reis, 2011) , there seems to be a gap in entrepreneurial literature tied to this specific thought process. This might be because this kind of knowledge often lies subconsciously in the minds of the designers. A book explaining the need to involve users to collect different kinds of data is "Testing Business Ideas", written by Osterwalder (Bland & Osterwalder, 2019). However, the focus of the book revolves around what tools to use in order to understand and validate the needs of users, rather than explaining how much "power" the entrepreneur should give to the users in the different steps of the product development.

THE DESIGNERS MINDSET IN CUSTOMER INTERACTIONS

Another important benefit of taking on a designers mindset was the approach to user

inquiry, which turned out to be applicable for customer interactions as well. The designer's way of asking open-ended non-leading questions does not only apply to interviews, but is utilized in almost all contact with users. As a result, they are constantly mindful of how to minimize bias during data gathering. While this is valuable for the product development process, it also requires some patience on behalf of the customer. As a result, the designer's fundamental goal of understanding users could come into conflict with business needs in certain situations, such as product demos for prospective customers. As a result we adopted a habit of clarifying the intent of user and customer interactions beforehand.

CONCLUSION & FUTURE WORK



CONCLUDING WORDS

Designing for Virtual Reality requires adopting a mental model of either "interacting with a computer" or "interacting with a physical world". Further, when designing for human collaboration and motivation, the fidelity of VR software seems to influence the expressed needs of users. Similar to Maslow's Hierarchy of Needs, users progress from expressing physical needs (the ability to move), to safety (feeling like they will not hurt- or make a fool of themselves) and then love/belonging (friendship and a sense of connection). This effect creates a lower bound for the software fidelity when designing for human connection. The reinforcement of body language in VR collaboration also reinstate some social dynamics only known when physically together, such as personal space boundaries.

Virtual Reality technologies also create opportunities for reshaping revenue models around digital artifacts. For instance, providing digital spaces for remote collaboration allows a pay-per-room model. These models seem to change the customers' conception from paying for "a software subscription" to "renting a workspace".

Lastly, our thesis has highlighted how there might be a gap in the literature of user involvement and empowerment in entrepreneurship. Knowledge of when to treat users as "experts" or "subjects" may be missing from entrepreneurial literature, because it is often tacit or latent within the designer and displayed only through action.

FUTURE WORK

The similarities between Maslow's theory of psychological motivation, and our observations of the expressed needs of users in VR, could be an interesting point of explicit research. Establishing a similar model for immersion, collaboration and creativity in VR could be useful.

While this thesis provides answers to the research questions posed, it also raises opportunities for future research within remote collaboration technologies. This thesis mainly observed VR workshops and collaboration within teams, but does not explicitly explore how such a tool can be used to connect different businesses together. This could aid cross-organisational collaboration, limiting time consuming and environmentally damaging business travel. Furthermore, the focus of this thesis has been on participants rather than facilitators. How VR workshop software could be designed to specifically empower both experienced and novice facilitators could enable people everywhere to enjoy better and more productive workshops.

Lastly, our observations imply that entrepreneurial literature might fail to capture the complexity of user involvement in design. As this particular observation was a result of retroactively analysing our process, the set of literature examined to validate this hypothesis is not exhaustive. Therefore, a thorough literature review aimed to explore this potential issue is encouraged.

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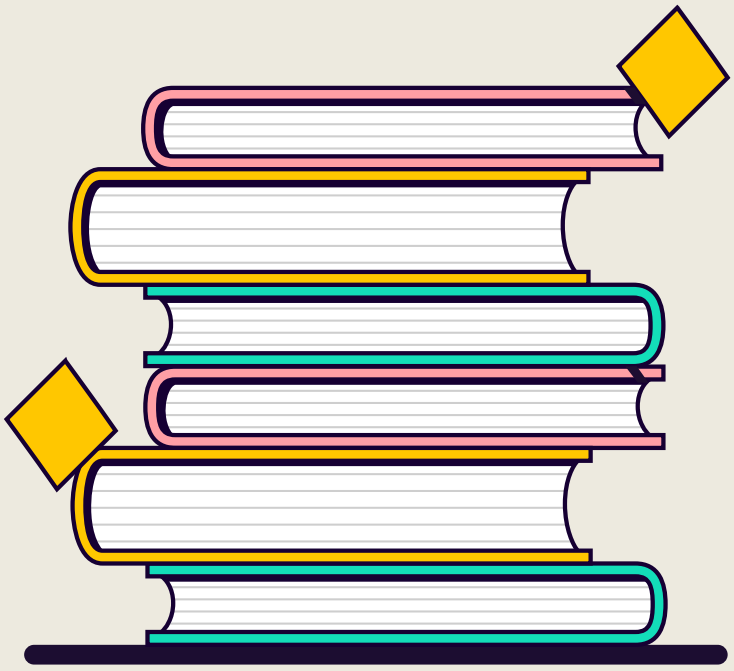
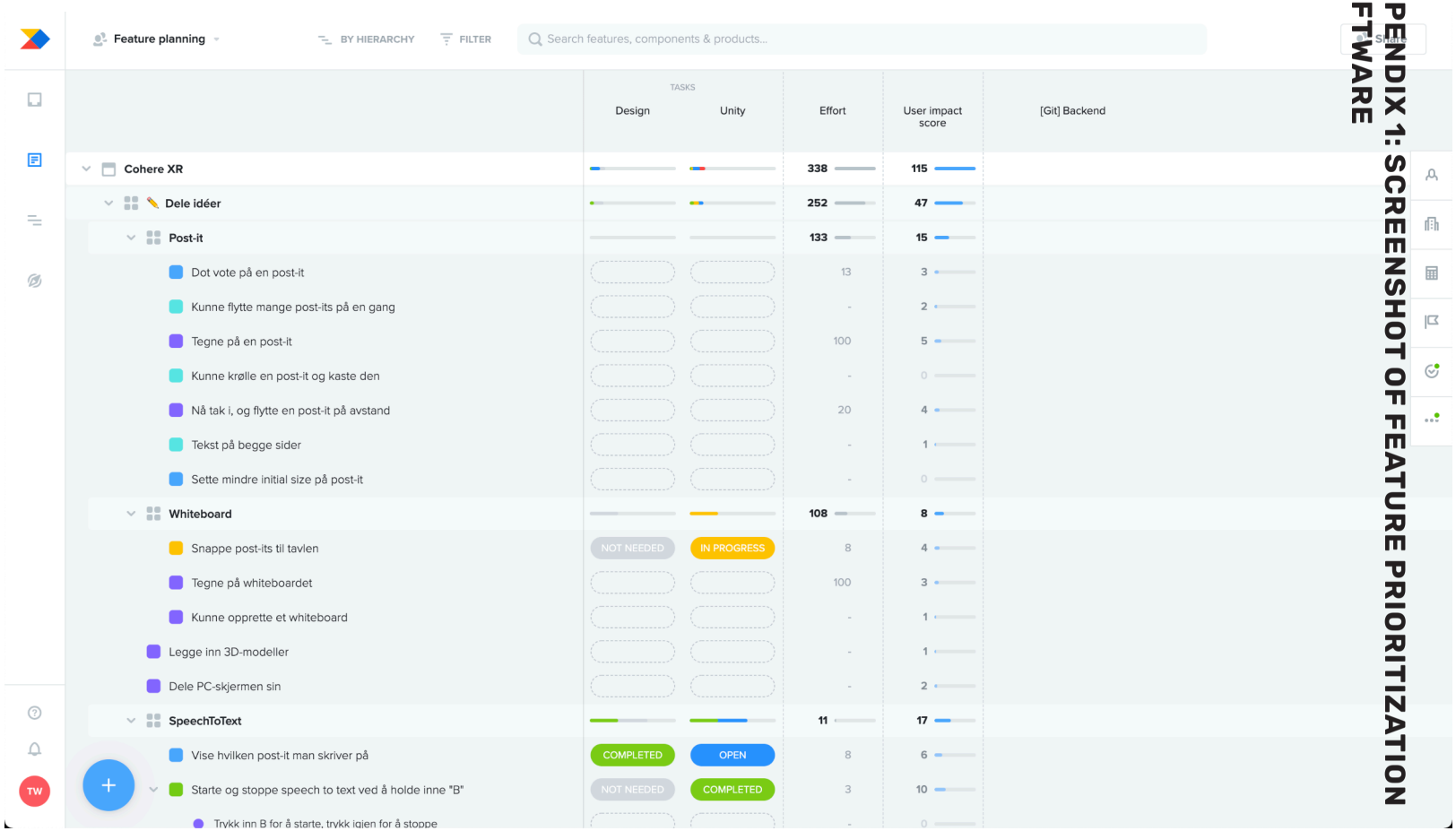
APPENDIX



APPENDIX 1: SCREENSHOT OF FEATURE PRIORITIZATION SOFTWARE



APPENDIX 2: ONE PAGER FOR LEAD USER RECRUITMENT

Cohere oppsummert

I en hverdag der folk sitter hver for seg, opplever mange at det kreative samarbeidet svekkes. Cohere bruker Virtual Reality (VR) for å samle folk til workshops - hvor som helst, når som helst.

Bakgrunn

Workshops er et verktøy for tverrfaglig problemløsing gjennom kreative øvelser. Folk med forskjellig bakgrunn møtes for å forstå hverandre og belyse problemer fra forskjellige perspektiv. Underveis bruker vi blant annet kroppsspråk til å formidle konsepter, følelser og meninger. Vi peker og illustrerer med hendene og viser forståelse ved å nikke på hodet. Den fysiske aktiviteten skaper energi og engasjement rundt arbeidet.

Problem

Hjemmekontoret har satt lys på en utfordring ved remote arbeid i distribuerte team. Mangel på ikke-verbal kommunikasjon svekket samarbeidet. Det er vanskeligere å forstå hverandre og det oppstår mer friksjon i arbeidshverdagen. Workshops blir mindre kreative, det blir flere misforståelser og vi går fortere lei. Spørsmålet er hvordan vi kan ta vare på kreativiteten når vi sitter på hjemmekontor?

Mulighet

VR (Virtual Reality) kan være løsningen, og fremtiden, for workshops og kreativt samarbeid. Teknologien introduserer kroppsspråk og fysisk aktivitet på hjemmekontoret. I tillegg kan VR gå forbi begrensningene av den fysiske verden, og skape nye måter å gjennomføre workshops. Vi ønsker å ha med oss dere i ***** som en av fem pilotkunder, som vil påvirke hvordan workshops gjennomføres i fremtiden. Så, la oss fortelle om Cohere.

Løsning

Cohere er en VR-applikasjon der teamet kan samles, uansett hvor hver og én befinner seg. I Cohere er det workshopen som er i fokus. Teamet kan bruke post-its, tegne, dra inn bilder og kommunisere med både kropp og stemme. Smart romlyd lar flere grupper ha samtaler samtidig uten å overdøve hverandre. De som styrer workshopen får verktøy som hjelper dem lede og inspirere deltakerne. Vi kan gi fasilitatorene oversikt med sjekklister og stoppeklokker, eller bidra til å engasjere teamet med digitale aktiviteter og oppgaver. Vi håper våre pilotkunder kan hjelpe oss å sette retningen for utviklingsløpet, gjennom en brukersentrert designprosess de neste fire månedene.

Pilotprosjektet

I løpet prosjektet vil vi definere hvordan produktet bør fungere gjennom co-creation workshops. Vi vil gi dere hyppig tilgang til oppdaterte prototyper som vi tester sammen. Vårt mål er å utvikle en førsteversjon av Cohere i løpet av pilotprosjektet, og dere vil være de første som får tilgang til det endelige produktet. Prosjektet er også knyttet til en masteroppgave på NTNU, og deres engasjement vil gi et verdifullt bidrag til oppgaven.

Pilotprosjektet vil foregå mellom 10. Februar og 10. juni 2021, og de fem plassene tildeles fortløpende. Deltakere forventes å stille med en kontaktperson og 1-3 personer som vil være med å teste løsningen, etterhvert som den utvikles. Deltakeravgift 20.000kr, som vil gå til utvikling av løsning, innkjøp av hardware og driftskostnader av tjenesten under pilotfasen. Andre tilpasninger avtales skriftlig.

Appendix 2: One-pager sent to customers

Cohere

+47 902 38 900

andreasol@me.com

Andreas Larssen
Entreprenørskolen

Utviklet et verktøy for kvantitativ finansanalyse som i dag brukes på BI. Lanserte Smøretips, den mest populære appen i Norge hver vinter siden 2013, profilert i VG, E24, DN og Dine Penger.

in **andreasol**

Tobias Wulvik
Industriell Design

Designer og utvikler i Umble. Utviklet merkevarer og nettsider for Oslobukta, DNB Samsolgt, Progit, Kronprinsparets fond, og TRY Pearl i 2020.

in **tobias-wulvik**

Sondre Kvam
Industriell Design

Daglig leder i Umble. Vant beste narrativ og nominert til Game of Year for spillet Albert. Utviklet Able, et verktøy som hjelper mer enn 40.000 designere med universell utforming.

in **kvam**

Lars-Kristian Dahl
Datateknologi

CTO i Hoopit, en plattform for administrasjon av idrettslag og frivillige organisasjoner. Utviklet mest populære Stripe SDK for Flutter.

in **larskdahl**

Brukertesting

💡 **Ting å huske på:**
1. Begynn å fortelle om "tenke høyt"-metoden. Vis et eksempel med ett eller annet du har rundt deg.
2. Om de står fast, ikke si hvordan de skal komme seg videre umiddelbart. Godta den kleine stillheten. Om de absolutt ikke kommer seg videre, begynn å hinte litt.
3. Hvis de jobber mye i stillhet, minn dem på "tenk høyt" ved å si "hva tenker du nå?", "hva tenkte du når du gjorde det?". Og still oppfølgingsspørsmål som "hvorfor tenkte du det?".

Spørsmål i forkant

Presentere samtykkeskjema og gi dem tid til å lese gjennom

1. Hva heter du, hvor gammel er du og hva jobber du med?
2. Hvilket forhold har du til VR?
3. Enn produktivitetsapplikasjoner? (eks. Miro, Figma, Notion)

Oppgaver

Starter Oculus Quest 2-headsetet og passer på at det er på hjemskjermen.

1. Du skal nå ha en workshop sammen med teamet ditt i appen Cohere? Teamet heter CollabSolutions. Nå kan du bare gjøre det du vil inne i VR-headsetet, og gjerne tenk høyt.

   De er nå inne i rommet CollabSolutions. Og en annen person i student-teamet er der inne sammen med dem for å gi en mer realistisk opplevelse. Noter deg hvordan brukeren bruker stemmen for å kommunisere med den andre.

1. Gjennomfør tutorialen som vises.
2. Du får nå i oppgave å komme opp med idéer om hvordan folk kan tilfredsstille sine sosiale behov nå under Korona-pandemien.

Enten har brukeren begynt å opprette post-it-lapper, eller de begynner å tegne på whiteboardet.

3. *Om brukeren har brukt post-its.* Nå som alle idéene er satt opp, kan du begynne å sortere dem i kategorier?
4. Nå er det dot-voting-tid. Du får nå et antall prikker som du kan legge på de post-it-lappene du mener løser problemet best.

Spørsmål i etterkant

Hvis det har blitt observert situasjoner hvor brukeren opplevde problemer, kan man grave litt mer i hva de tenkte der og da. Om de har noen tanker om hva de heller ville at skulle skje.

1. Hvordan opplevde du denne korte workshoppen?
2. Kan du tenke tilbake til en situasjon hvor Cohere kunne vært et godt alternativ til det dere brukte da?

APPENDIX 4: CONSENT FORM

Vil du delta i forskningsprosjektet **Cohere – Workshops i VR?**

Dette er et spørsmål til deg om å delta i et forskningsprosjekt hvor formålet er å undersøke hvordan VR-teknologi kan brukes til digital workshops. I dette skrivet gir vi deg informasjon om målene for prosjektet og hva deltakelse vil innebære for deg.

Formål

Den nåværende pandemien har bidratt til å akselerere en tydelig eksisterende trend mot "remote work". Samtidig som mange har opplevd høyere aksept for hjemmekontor, har vi har lært at det kan være utfordrende å gjennomføre visuelle diskusjoner (workshops) med den samme kvaliteten vi får av å være fysisk samlet. Blant utfordringene er redusert energi og aktivitet blant deltakere, mindre kontroll for fasilitatorer og tap av kroppsspråk som kommunikasjonsmiddel. Derfor ønsker vi å utvikle en VR software-løsning ved navn Cohere som løser disse utfordringene.

Hvem er ansvarlig for forskningsprosjektet?
Andreas Ore Larssen, Sondre Kvam og Tobias Wulvik er studentene som aktivt vil gjennomføre forskningen. Brita Fladvad Nielsen er veileder for designaktivitetene. Alle gjennom NTNU som er ansvarlig for prosjektet.

Hvorfor får du spørsmål om å delta?
Fordi du er en del av et pilotprosjekt eller du er i målgruppen for digitale workshops.

Hva innebærer det for deg å delta?
Jeg er:

- ☐ Pilotprosjekt-deltaker – Utvalg 1
- ☐ Brukertester – Utvalg 2

Pilotprosjekt-deltaker – Utvalg 1
Hvis du velger å delta i prosjektet, innebærer det at du deltar i workshops fasilitert av student-teamet. Denne workshopen vil bli observert for å lære mer om brukbarhetsutfordringer med produktet, og hvilke funksjoner som burde implementeres for å kunne gjennomføre bedre design thinking workshops.

Brukertester – Utvalg 2
Hvis du velger å delta i prosjektet, innebærer det at du deltar i en brukertest av Cohere-produktet. Dette innebærer å bruke produktet Cohere og fortelle hvordan du tenker underveis. Etter brukertesten vil vi stille noen oppfølgingsspørsmål om utfordringer du opplevde under brukertesten og om produktet generelt.

Det er frivillig å delta
Det er frivillig å delta i prosjektet. Hvis du velger å delta, kan du når som helst trekke

samtykket tilbake uten å oppgi noen grunn. Alle dine personopplysninger vil da bli slettet. Det vil ikke ha noen negative konsekvenser for deg hvis du ikke vil delta eller senere velger å trekke deg.

Ditt personvern – hvordan vi oppbevarer og bruker dine opplysninger
Vi vil bare bruke opplysningene om deg til formålene vi har fortalt om i dette skrivet. Vi behandler opplysningene konfidensielt og i samsvar med personvernregelverket.

Navnet og kontaktopplysningene dine vil jeg erstatte med en kode som lagres på egen navneliste adskilt fra øvrige data. Det anonymiserte datamaterialet fra observasjonen vil lagres på forskningsserver.

Hva skjer med opplysningene dine når vi avslutter forskningsprosjektet?
Opplysningene anonymiseres når prosjektet avsluttes/oppgaven er godkjent, noe som etter planen er 11. juni 2021. Etter forskningsprosjektet er avsluttet, vil personidentifiserbare opplysninger fjernes, omskrives eller grovkategoriseres.

Dine rettigheter
Så lenge du kan identifiseres i datamaterialet, har du rett til:
- innsyn i hvilke personopplysninger som er registrert om deg, og å få utlevert en kopi av opplysningene,
- å få rettet personopplysninger om deg,
- å få slettet personopplysninger om deg, og
- å sende klage til Datatilsynet om behandlingen av dine personopplysninger.

Hva gir oss rett til å behandle personopplysninger om deg?
Vi behandler opplysninger om deg basert på ditt samtykke.

På oppdrag fra NTNU har NSD – Norsk senter for forskningsdata AS vurdert at behandlingen av personopplysninger i dette prosjektet er i samsvar med personvernregelverket.

Hvor kan jeg finne ut mer?
Hvis du har spørsmål til studien, eller ønsker å benytte deg av dine rettigheter, ta kontakt med:
- NTNU ved Tobias Wulvik, 47244448, tobias.wulvik@gmail.com. Ev. veileder i prosjektet Brita Fladvad Nielsen, 73590121, brita.nielsen@ntnu.no. I studentprosjekt må kontaktopplysninger til veileder/prosjektansvarlig fremgå, ikke kun student.
- Vårt personvernombud: Thomas Helgesen, 93079038, thomas.helgesen@ntnu.no.

Hvis du har spørsmål knyttet til NSD sin vurdering av prosjektet, kan du ta kontakt med:
- NSD – Norsk senter for forskningsdata AS på epost (personverntjenester@nsd.no) eller på telefon: 55 58 21 17.

Med vennlig hilsen

Brita Fladvad Nielsen
(Forsker/veileder)

Andreas Ore Larssen, student

Samtykkeerklæring

Jeg har mottatt og forstått informasjon om prosjektet *Cohere – Workshops i VR,* og har fått anledning til å stille spørsmål. Jeg samtykker til:

- ☐ å delta på brukertest.
- ☐ å delta på workshops som blir observert av student-teamet.

Jeg samtykker til at mine opplysninger behandles frem til prosjektet er avsluttet

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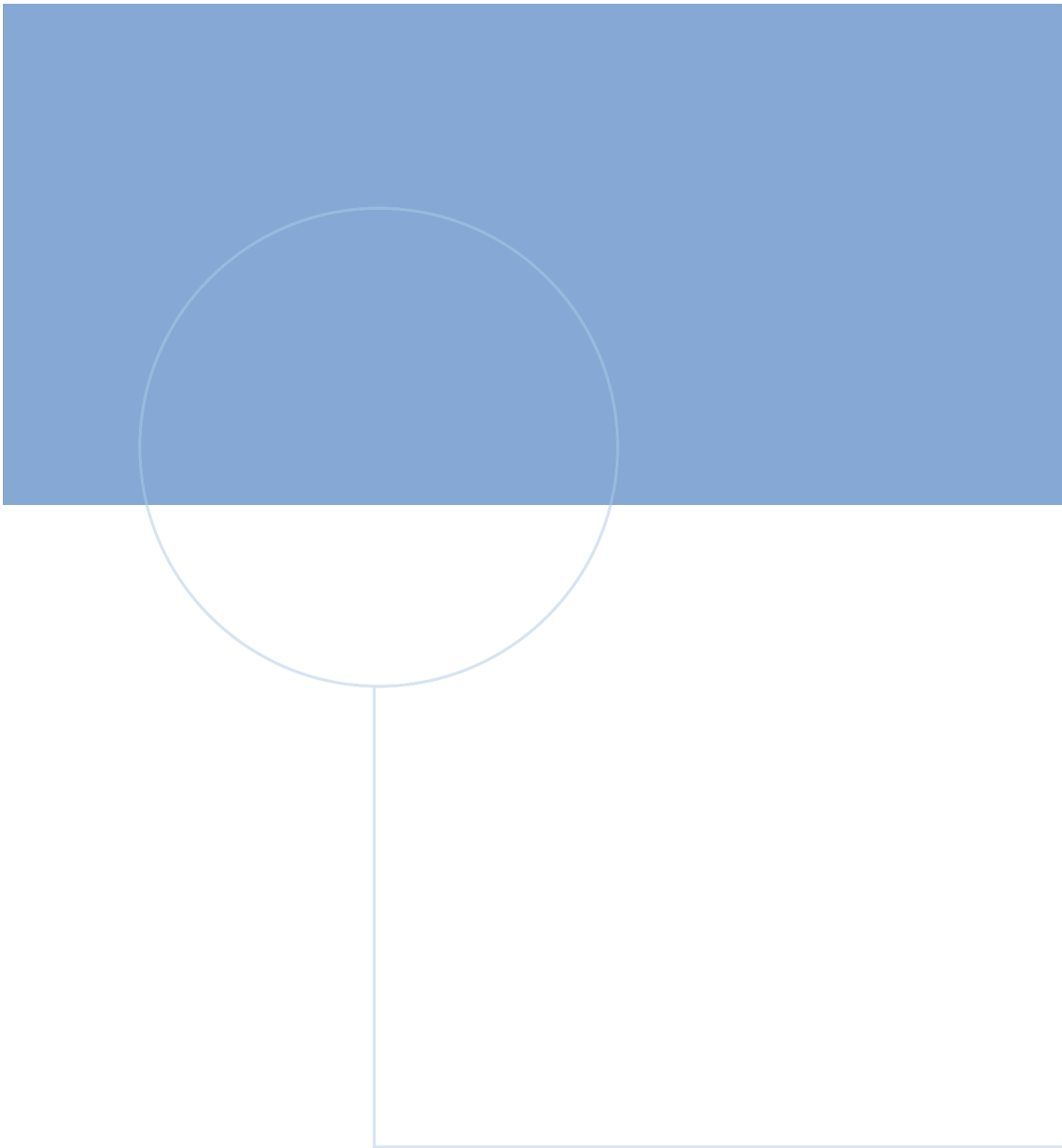
(Signert av prosjektdeltaker, dato)



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