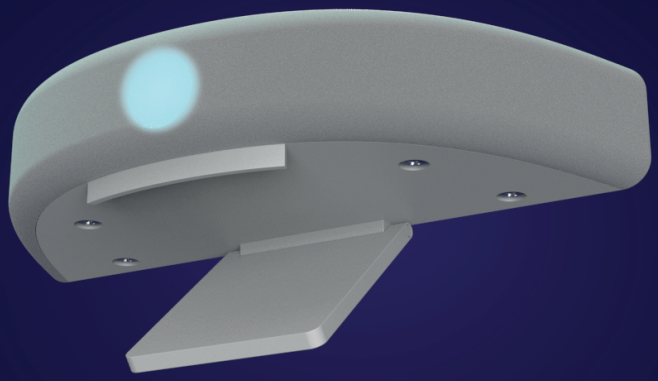
Graduation Report | IPD

Improving group dynamics and involvement in hybrid meetings



Kasper de Haas | 4443454

<3 Thank you

A special thanks to everyone who supported me during the project.

My family, Nanneke Koopman, Peter de Haas, Mara de Haas and Mats de Haas.

My supervisors Ruud van Heur and Gert Hans Berghuis.

All subscribers to my Remote Working Newsletter who were kind enough to let me interview them.

Also a special thanks to Julia Verhaegh.

To everyone who's name I did not mention but contributed to the project in any form, I did not forget about you.
A sincere thank you.

Executive Summary

In 2020 our lives have been turned upside down by the outbreak of COVID-19. Working from home became the new standard, forcing the whole world into the biggest remote working experiment ever. The already existing remote working trend caught wind and changed the future of work to hybrid working in an office ecosystem.

With a large number of companies and employees being inexperienced with hybrid working, new challenges and unfulfilled needs came to light. Literature research and more than 50 interviews with people from 31 companies were done to identify these challenges and develop a deep understanding of them. The three problem categories are asymmetrical communication, disconnected office ecosystem and unprepared companies. The decision was made to focus on asymmetrical communication in hybrid meetings.

Hybrid meetings are meetings with both online and in-office participants. These types of meetings make the online participants feel invaluable. This is caused by them not feeling involved and struggling to give input. In the long term this can lead to a decrease in employee satisfaction.

Communication science helps explain why hybrid communication is hard, especially for the remote attendees. We humans collect countless information points from each other, which we unconsciously process and use for smooth and natural conversation. With video communication crucial information is filtered out, with eye contact and (selective) gaze, body language and life-sized scale being the most impactful ones. The goal of the project is to develop a product that enriches hybrid communication by supporting previously lost information.

The technology developed in the design phase is coined artificial eye contact, which is based on the science of eye contact and selective gaze. Through validation experiments artificial eye contact was found to be successful in establishing similar effects. These effects are involvement, group dynamics, trust and convincement for eye contact, and more attention towards online participants, better group dynamics and a higher turn taking frequency for selective gaze.

The product, called Be There One, is a device that is placed on top of the screen in the conference room. It visualizes the gaze direction of the online user, adding a 3-Dimensional property to video conferencing. The retail price is 300 euros, but an additional data driven dashboard with a subscription model will still be validated.

The product will form the foundation for a Startup, called Be There, with the mission of enabling natural and equal communication between meeting participants from different locations in the office ecosystem. Raising capital and patenting the technology are the next steps in the company planning.

To conclude the project, validate the problem solution fit and partially validate the product market fit a pilot was done with Delta Capita, a technology consultancy from Amsterdam. The Be There One proved its value and collected the first Letter of Intent.

To be continued.

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Introduction

1.1 Since the beginning of 2020 our lives have been turned upside down by the outbreak of COVID-19. Our current new lifestyles will open our eyes to new possibilities and opportunities we previously ignored or neglected. One of these new opportunities is remote working.

1.1 The big experiment

Although remote working is not at all a new phenomenon, the amount of companies allowing their employees to work remotely permanently is expected to increase because of the recent events (see figure 1). A large driver in this change is the employee demand. Remote work, which means working from outside the office, results in higher employee satisfaction caused by higher autonomy and lower work life conflict (Cushman & Wakefield & CREUA, 2020a).

1.2 Hybrid future

My vision on the future of work is based around the concept of hybrid working. Since remote working comes with both pros and cons, hybrid working is expected to increase in popularity. This future of work requires an office ecosystem; no longer will the office be the sole location for a company's operations. Companies will create a network of different locations and experiences, supporting convenience, functionality and wellbeing, while optimizing connection, innovation, collaboration and learning (Cushman & Wakefield & CREUA, 2020b).

1.3 Problem statement

Current research shows the biggest problems experienced with remote work are: 1) losing out on personal connections, 2) mental disadvantages, 3) no clear distinction between work & private life and 4) less innovation & creativity (Buffer & AngelList, 2020; Cushman & Wakefield, 2020; Cushman & Wakefield & CREUA, 2020a; Hodder, 2020).
This information serves as input for the, mainly, future scenario: hybrid working. More research has to be done to test problem **hypothesis 1** (Research Question: What problem is caused by hybrid working?): Hybrid working reduces the quality of hybrid communication* between coworkers in the office ecosystem.

**Hybrid communication happens when part of the participants are remote and part in the office.*

Figure 1: Companies adopting remote work permanently

This will reduce employee satisfaction, retention and engagement (Cushman & Wakefield & CREUA, 2020b) and negatively impact creativity and innovation, and learning and development (Cushman & Wakefield & CREUA, 2020a). These effects concern not only the employee, who is the end user of the product, but also the management, who is the paying customer.

If problem hypothesis 1 is true, problem **hypothesis 2** will be tested:
Bad quality in hybrid communication is caused by a low social presence of remote participants.

If problem hypothesis 2 is true, the solution hypothesis will be tested (see Assignment). If a hypothesis turns out false, the research results will be used to define a different answer to the research question.

1.4 Assignment

Solution hypothesis: A higher social presence* for remote participants in hybrid communication will increase the quality of communication.

**Social presence is "the degree to which a person is perceived as 'real' in mediated communication" (Cobb, 2009).*

If the solution hypothesis is untrue, other solutions will be explored through ideation and testing.

The research will be focussed on the future of work, hybrid working and communication.

The solution
- has to improve the quality of hybrid communication;
- can be a product or service;
- has to suit the future of work;
- will be focussed on in-office work;
- has to be functional in different company sizes;

The goal is to end the project with a problem solution fit and MVP.

See Appendix 16.28 for the official project brief.

1.5 Approach

Qualitative research will be frequently done because there is little information available about remote working. Also literature research is useful for gathering knowledge, but not for exploring the deeper layer of information. These deeper layers will develop an understanding of the behaviour of the target group, find the core of the problems and hopefully reveal unique insights. These unique insights are what gives a company advantage over its competitors.

In this project the Lean Startup will be used as the main methodology. This means all unvalidated knowledge is defined as a hypothesis, and is not perceived as true until experimentation proves it is.

The solution has to suit the future of work. In order to achieve this a future vision has to be defined, supported by results of the research phase. The type of work that will be focussed on is in-office work.

Next to this social connection and genuine interaction have to be researched in order to get an understanding of what is needed to tackle the problem.

1.6 Research questions

- What problem is caused by hybrid working?
- What will the future of work look like?
- How can we solve this problem with a product or service?
- How can this product be made?
- How can this product be profitable in a business context?

Figure 2: Work from home situation

02

Remote work

2.1 Remote work is part of hybrid working, it can be used as a powerful tool. Understanding the advantages and disadvantages of remote working reveals more about what the future of hybrid work might look like.

2.2 Method

Research questions

1. What are the advantages of remote working?
   a. What is the biggest advantage? **(Main RQ)**
2. What are the disadvantages of remote working?
   a. What is the biggest disadvantage? **(Main RQ)**
3. What work is easy to do remotely?
4. What work is hard to do remotely?

Hypothesis

2 a. The biggest problems in remote work are 1) losing out on personal connections, 2) mental disadvantages, 3) no clear distinction between work & private life and 4) less innovation & creativity. (Information from preliminary research) (Buffer & AngelList, 2020; Cushman & Wakefield, 2020; Cushman & Wakefield & CREUA, 2020a; Hodder, 2020).

This hypothesis is turned into an experiment card, which can be found in paragraph 2.5.

Approach

First literature research will be done to get familiar with the pros and cons of remote working. Secondly interviews will be done with people from various companies, aiming for a wide range of roles, company types, sizes and industries. Information from the interviews can be used to verify literature information, create a hierarchy in the pros and cons, and develop a deeper understanding of how and why certain things happen. In total 21 people were interviewed.

Remote work can be done in many places, but since the Corona virus causes everyone to work from home, this will be the main driver behind the answers given in the interviews.

Methods

The Mom Test
The method used for the interviews is The Mom Test (Fitzpatrick, 2013). This method focuses on talking about someone's past instead of the future, resulting in the most reliable information. The principles of the Mom Test are:

- Don't talk about your idea.
- Don't ask questions about the future.
- Do talk about the person's life.
- Do talk about the past.

One question about the future of work was used, but the unreliability of the answers were taken into account. The questions used in the conversations can be seen in Appendix 16.1.
The first group of participants will be referred to as Participant group 1.

Zoom interviews
The interviews are done through Zoom and take around 30-50 minutes. This media was chosen because face-to-face conversations were not possible due to Corona regulations, and it makes it possible to reach a large number of people spread across the country without having to commute.

Remote Working Newsletter
In order to reach a high amount of participants from various companies a landing page (see figure 3) and newsletter were set up. The newsletter is sent out every two weeks, filled with new insights, tips & tricks and best in class examples about remote work collected during the project.

Because remote working is a hot topic and every company and individual is still learning how to get good at it there is a demand for this type of information. In exchange for the information I ask new subscribers to have a chat with me through Zoom, automatically collecting interview participants during the project. With the information and contact information from all subscribers an audience of potential customers for the final product was also built. Subscribers (42 in total) were mainly collected through LinkedIn posts and word-of-mouth. An example of a newsletter can be seen in Appendix 16.2.

2.3 Remote working

What is remote working?

Before diving into the subject, what is remote working exactly? The Cambridge Dictionary (2021) defines remote working as: "*the practice of an employee working at their home, or in some other place that is not an organization's usual place of business*". Since this project is focussed on office work, we can call these unusual places 'out-of-office' locations.

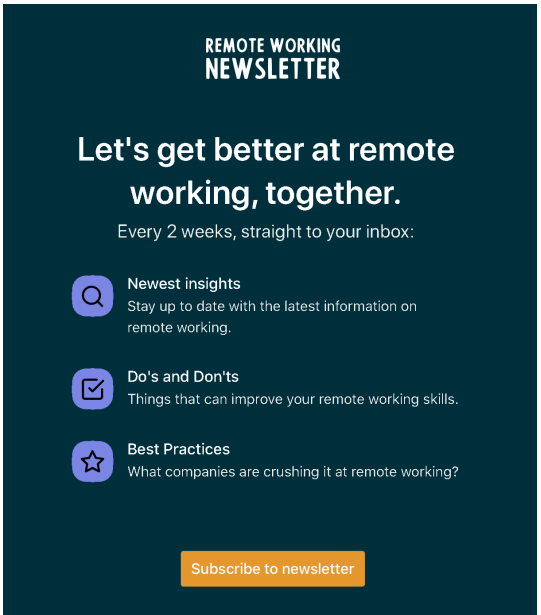


Figure 3: Remote working newsletter page

Figure 4: All interviewed companies

Notice that, according to this definition, the place where remote work is done is not the usual place of business. It will be interesting to see whether these remote locations will end up becoming a usual place too because of the new office ecosystem. Nevertheless, this definition gives an accurate description of what remote working actually is.

Pros & cons data

The pros and cons of remote working identified through literature research and interviews are combined to either strengthen an existing finding or add a new one.

In order to process the interview data all answers were labelled and processed in a DIKW scheme (Data, Knowledge, Information, Wisdom) (Sanders & Stappers, 2013). This method enables a researcher to find patterns and theories in different levels of data processing.

All the pros and cons are grouped into 6 categories: productivity, collaboration, connection, innovation, learning and wellbeing. The description of each pro and con can be found in Appendix 16.3. Every interviewee was asked which of their mentioned (dis)advantages was their ultimate (dis)advantage of remote working. This data differentiates frequent but small (dis)advantages from the more significant ones. The 3 most important pros and cons are discussed.

Biggest advantages

No commute
Not having to travel to work in the morning and back in the evening is perceived as a real advantage of remote working. Where it might seem like a slight convenience at first, it was seen as one of the biggest advantages of remote working by many interviewees. The type of remote working this applies to is obviously working from home, but a workplace that is closer to home than the office will also reduce travel time.

The BCO found that almost half of UK office workers complain that they endure an unpleasant and stressful trip to work. (Harris, 2015)

80% of participants talked about this.

Autonomy
Being able to decide when and where you work turns out to be satisfactory to employees. It gives a feeling of greater trust and autonomy, which in turn can lead to higher employee satisfaction and productivity.

40% of participants talked about this.

Lower work-life conflict
Working remotely enables people to feel free to go for a walk, do some chores between work tasks or start working earlier so they can spend more time with the kids in the evening. Working remotely up to 2.5 days per week results in higher autonomy and lower work-life conflict (Cushman & Wakefield & CREUA, 2020a)

30% of participants talked about this.

Biggest disadvantages

Building and maintaining relations with coworkers
Good relations between co workers positively impact employee satisfaction, personal and professional development (Cushman & Wakefield, 2020). Strong connections are created on the workfloor and often stem from moments of informal communication. Working from home causes colleagues to not meet face-to-face, and planning meetings to catching up is often skipped because of the already full agenda. This makes it hard to maintain relations, but especially hard for new colleagues to build them up (Interviews, 2020).

80% Of participants talked about this.

Less creativity and innovation
Remote working can decrease communication between colleagues, which "ultimately can lead to employees missing out on all sorts of important information and sources of inspiration." (Cushman & Wakefield & CREUA, 2020a). New ideas and solutions often come from informal communication and spontaneous conversations. These moments occur when bumping into colleagues at the coffee machine or in the hallway, but can also be planned as brainstorm sessions. Because of the informal nature of this communication it is hard to replicate it online (Interviews, 2020).

50% of participants talked about this.

Incomplete communication
Communication exists of 7% verbal communication, 38% tone of voice and 55% body language, the last two are greatly oppressed by video conferencing software and hardware. (Lee, 2020)

30% of participants talked about this.

Analysis

In order to develop a deeper understanding of the collected data patterns and groups of labels were identified. The amount of participants that talked about each topic combined with the ones labeled by interviewees as most important revealed the impact of each group. These patterns also revealed more about the underlying causes of pros and cons in remote work. The 4 biggest groups are discussed below.

1. Emotional and practical advantages
Interesting is that most of the biggest advantages for people are related to emotions or practical things. It gives freedom, less stress or convenience. Apparently remote working is mainly a tool for employee satisfaction. There are obviously work related factors, but not ones that appear to weigh heavily to employees.

2. No informal communication
In the conversations about remote working one theme kept coming back: informal communication. Video calls make communication mostly formal, leaving the need for informal communication unfulfilled. Because so many of the disadvantages seem to be caused by the lack of informal communication two different types are used: functional informal communication and emotional informal communication.

- **Functional informal communication**

The functional type covers all the communication that gives work-related output. Examples are a quick ideation about your project, or a question about how to create a new folder in the server.

- **Emotional informal communication**

Interactions that fulfill your social and emotional needs belong to the emotional informal communications. Examples are talking about what you did last weekend, or playing a game of kicker with your colleagues.

Next breaking informal communication into these two types, there is another level that is interesting to mention. Both types of informal communication can be split into planned and spontaneous interactions. Each of these serve their own purpose.

3. Improper management

If remote work is not properly managed it can cause both mental and physical health problems, but it is proven to be difficult. People tend to work more and find it hard to create a clear beginning and ending of the workday. In the long term this can lead to problems such as a burn-out. Creating a proper home office is also easier said than done. Distractions can cause productivity to go down, and insufficient tools (desk, screen, chair) can result in back and neck pain.

4. Lack of communicative information

Communication exists out of 7% verbal communication, 38% tone of voice and 55% body language, the last two are greatly oppressed by video conferencing software and hardware. (Lee, 2020) Also the flow of the conversation is broken everytime someone wants to join the conversation.

Types of work

Easy to do

People noted that online meetings work well for collaborating on projects and discussing work. Especially when working in small teams a video call is well manageable. Not all types of meetings are easy to perform remotely, this will be discussed further in the next research question.

The most frequent answer to this question was desk work like email, administration, writing and reading. Furthermore individual work and tasks that require good concentration seem to be a good fit for remote working.

Hard to do

Like noted previously, online meetings are a good alternative to physical ones. This is not the case for all types of meetings. Creative sessions and brainstorms prove to be hard when the participants are not in the same room. The results of these sessions are the product of smooth communication, seamless documentation, supporting materials and plenty of enthusiasm. These ingredients are hard to replicate in a video call.
Other than that, meetings where signals like emotion, body language and facial expressions are important, such as supervisory or sales meetings, are experienced as ineffective.

2.4 Conclusion

The main research questions were:

1a. What is the biggest advantage?

No commute
Autonomy
Lower work-life conflict

2a. What is the biggest disadvantage?

Building and maintaining relations with coworkers
Less creativity and innovation
Incomplete communication

Other important findings

- Remote working is not better or worse than office work.
- Remote working is not a replacement, it is a tool.
- Understanding when, where and why remote working will be used in the future of work.
- Perceived pros and cons highly depend on person, role and company.
- The biggest gain in remote work is:
  - Emotional and practical advantages
- The 3 biggest losses in remote work are:
  - No informal communication
    - Functional informal communication
    - Emotional informal communication
  - Improper management
  - Lack of communicative information

The pros of remote working lead to a higher employee satisfaction. This causes a demand for the permanent option of remote work in the future. It will be expected from companies to offer this flexibility. The cons however create the desire to go back to the office and reconnect with colleagues. The informal communication is missed greatly, on both functional and emotional levels. Together the pros and cons of remote work cause employees to want a combination of both remote and office work. This will be further discussed in the next chapter.

02

Remote Work 2.5 Experiment 1

Experiment 1	What is the biggest problem with remote working?
I believe that	Losing out on personal connections is the biggest problem with remote working.
In order to test I will	Do 15 minute Zoom interviews with at least 15 people who currently work remotely more than 50% of the time, and ask what problems they encounter.
And measure	The amount of people who label losing out on personal connections as the biggest problem they experience.
I'm right when	At least 50% of the people label losing out on personal connections as the biggest problem they experience.

Result

Talked to 21 participants.
40% labeled "Losing out on personal connections" as the biggest problem. (76% mentioned it)

The target percentage of the experiment was not achieved, yet this experiment was marked as a success. Firstly because the percentage was relatively close to the target percentage, and secondly because a wider range of problems was identified than expected. The effect of the latter is further explained in the next alinea.

Learning

Without specified target group pros and cons are really diverse.

In the conversations many cons were identified, with the biggest problem experienced by that participant greatly depending on multiple factors. Aspects like personality, role, company type and company size all seemed to influence what was important to them, and thus what problems were more significant.

This learning underlines the importance of deciding on a target group. Defining this group and slowly limiting myself to the people in this group should increase the percentage of participants talking about the focus problem.

The next steps in the project will include deciding on a target group strategy and defining the first high level target group hypothesis. The target group will be specified as the project goes, the final definition is described in chapter 14.

03

The future of work

3.1 The way we work is constantly changing because of new trends, regulations and technology. The recent changes as a result of the pandemic have made some of those trends accelerate. Although the future cannot be predicted, a future vision can be built on research and personal belief. Since this future will be the context of the product to be developed it is crucial to know what it will look like.

3.2 Method

Research questions

1. What will the future of work look like? **(Main RQ)**
   a. To what extent does remote working play a role in the future of work?
   b. What trends will influence the future of work?
   c. What will the office in the future of work look like?

Hypothesis

1a. Remote working will be used in combination with office work, creating a hybrid company.

1c. The office will be replaced by the office ecosystem. (Information from preliminary research) (Cushman & Wakefield & CREUA, 2020b)

Approach

The learnings from the research on remote working will be used as input for shaping a vision on the future of work. In addition to that literature research will be done to collect trends and developments influencing the way we work. Finally interviews with trend and technology expert Danny Mekic and Founder of Mibo Taco Ekkel were done. They were able to confirm trends from the literature research, while also expressing critical concerns and considerations on remote and hybrid working. The timeframe that will be analyzed is 1 to 5 years from now.

Figure 5: Informal VC software Mibo

Methods

Zoom interviews
The interview with Danny Mekić was done through Zoom because of the COVID restrictions and the time efficiency in a busy schedule like his.

Literature research
Research papers, articles, blog posts and books were used to gather data on the future of work. This was done to create a broad collection of facts and opinions, which can then be used to build a vision.

Figure 6: Danny Mekić, a Dutch entrepreneur, technology expert and trend watcher. He has been awarded the title "best young entrepreneur of the year" and has made several appearances on tv where he talked about technology.

3.3 The future of work trends

Remote working

Remote working is a trend that has been around since long before the pandemic. More and more jobs are becoming ICT-enabled, allowing more location flexibility and increasing the amount of telework (Eurofound & the International Labour Office, 2017). There have been events that were expected to rapidly increase the frequency of remote working before.

Examples of this can be seen in America, where the tragedy of 9/11 in 2001 would spike the amount of people wanting to work from home, or where the increased gas prices in 2008 would boost remote working to reduce the need for commutes (Semuels, 2020). This trend has however not had a large impact on the way we work yet. Will the expectations caused by the COVID pandemic not just be the same? I believe it is not, because this time we all have actually experienced working this way. Everyone has had to figure out how to work from home, and companies have had to redesign their organization. When this current event is over almost all companies will have an infrastructure for remote work in place. This is the first time in history this has happened on such a large scale. Employees and companies have experienced the advantages of telework, and now support the systems required for it.

Danny Mekic agrees with this view and noted that even if remote working would not have found its breakthrough as a result of the pandemic it would have found its rising with the upcoming of autonomous cars. This new transportation type allows people to live further away from the office, and start working comfortably as soon as they step into the vehicle.

Autonomy

A sub-trend that influences remote working is increased autonomy for employees. Employees get more trust and responsibility from their employer, resulting in more flexibility and in the end more creativity and motivation (IOE, 2017). This shows employees can start working remotely more often if they want to, and the data shows they do. (See figure 7).

Research shows increased autonomy is especially seen in the knowledge industry, where people work on more individual tasks and are less dependent on location (Harris,2015).

Danny Mekic added to this the awareness for the people who do not wish to have more autonomy and flexibility. There is a tradeoff between flexibility and consistency. For many more flexibility is currently experienced as an upgrade, but for employees that appreciate consistency, for example when you have to take care of your kids on a wednesday, this can turn out to be a downgrade. It will be important for companies to develop and iterate on a new culture that takes into account the experiences of their employees.

Gig economy

Work is expected to become more temporary and flexible, referred to as gigs (Balliester & Elsheikhi, 2018). Companies will outsource work to smaller companies or experts, and focus on their own core activities (Harris, 2015). This way of collaborating with external parties can be supported by the remote working infrastructure. Talent and specialists from the other side of the country, or even the world, can be consulted without them having to be physically present in the office. This trend is most visible in popular platforms like Upwork and TaskRabbit (IOE, 2017), but also happens behind the screens.

"98% of participants would like to work remotely at least some of the time, for the rest of their career."
Buffer.com

"73% of respondents think companies should embrace flexible working policies."
Cushman and Wakefield

"93% of the questioned tech workers does not want to go back to the office every day of the week."
Hired

Figure 7: Quotes on remote working

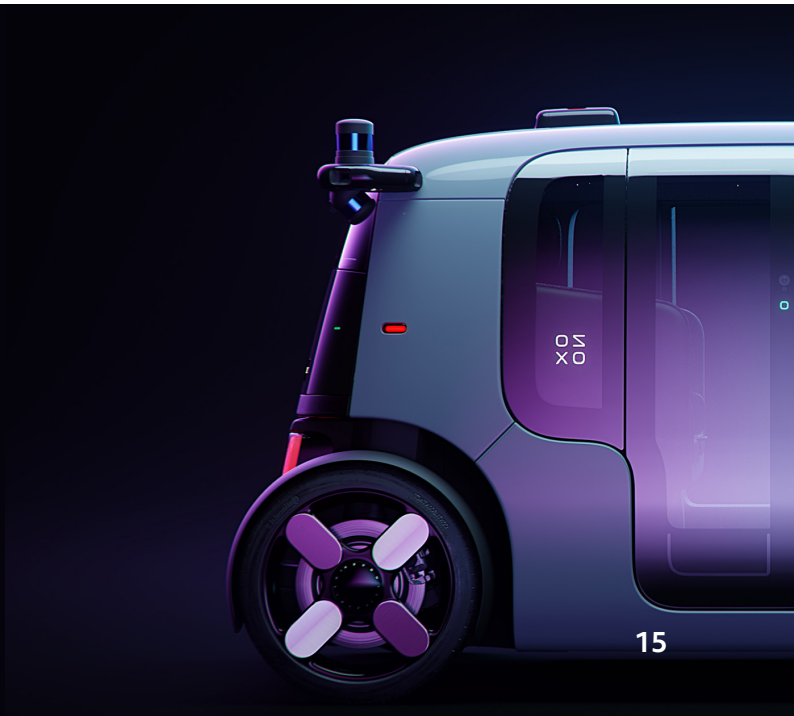


Figure 8: The future of autonomous cars

Hybrid working

When talking to Participant group 1 the question was asked whether they want to keep working remotely in the future. 76% Of the participants answered they plan on working hybrid in the future. Most of them said their wish is to work remotely 1 or 2 days a week. The other 24% wanted to go back to the office full time, and none of the interviewees expressed the need to keep working remotely every day. The theory of the Mom Test states people tend to have utopical thoughts about the future, making answers to future questions less reliable. This is taken into consideration, but these results do give some insight in the view people have on remote working. Also, other research shows similar results. Cushman & Wakefield (2020b) found the amount of companies that plan to work hybrid after the pandemic is 52 percentage points higher than the amount that did before, totalling 81%.

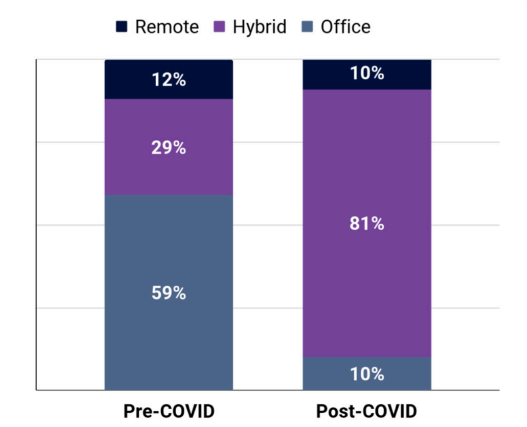


Figure 9: Amount of companies planning on working hybrid (Cushman & Wakefield 2020b)

Demographics

Today the workforce is dominated by millenials, who will make up a total of 40% in 2020-2030. Boomers make up 21% of the workforce, but in 2030 everyone of this generation will be 65 years old and retire. At the end of the current decade the world population will be dominated by a different generation; generation Z. This means the future of work will be experienced by millenials, with a growing number of generation Z. (Cushman & Wakefield, 2020b). Although the focus of this project is on the next 5 years this is an interesting shift to keep in mind for the long term.

The new office

The office will face some changes in the upcoming years. The office will mainly become a place for collaboration, lowering the need for desk spaces while increasing the amount of meeting and social spaces, as seen in figure 10. Also the visitors of the office are turning more into guests, demanding quality experiences. (Harris, 2015).

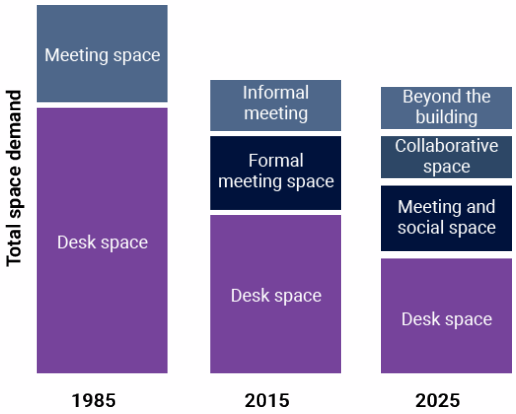


Figure 10: Increase of collaborative and meeting spaces

The total amount of office space is also expected to decrease because of the growing demand for remote work. The total workforce will not be present in the office at the same time, decreasing the required amount of square metres. From 25 of the biggest companies in the Netherlands more than half expects to be needing less office space after the pandemic (NOS, 2021).

The Office Ecosystem

A shift that is expected to take place after the pandemic is that the office will no longer be the sole place for a company's operations. Because of the forced remote working experiment the home office now joined what we call "the office ecosystem", which is the network of locations for employees to work from. Next to the home office, the ecosystem will also be expanded by hotspots (coffee shops, local library, etc.) and office hubs (Cushman & Wakefield & CREUA, 2020b). Each location in this ecosystem, also called a hub & spoke model, has its own advantages and can be used when these can be profited from.

Remember the definition of remote working discussed earlier? It was about all work performed outside of the company's usual workplace. In the future of work the definition of workplace becomes "anywhere an individual performs their duties" (IOE, 2017). Martha Johnson, GSA of America back in 2010, worded this concept perfectly: "Work is what you do, not where you are" (Snibbe, 2010).

Below the different elements of the office ecosystem are described along with a list of its strengths.

Figure 11: Office ecosystem locations

Central office
The central office will remain the company's central place and the ultimate place for collaboration, learning and connecting. Formal meetings can be hosted in the meeting rooms and the presence of a large percentage of the workforce gives the ultimate opportunity for networking and information sharing. This is also the location where a company can express its culture and values.

Strenghts:
- Key meetings
- Collaboration
- Innovation
- Connecting to colleagues
- Connecting to culture
- Networking
- Knowledge sharing
- Mentoring

Home office
When individual and concentration work needs to be done a day in the home office will be the popular choice. In this location emotional and practical benefits like no commute, higher productivity and less work-life conflict can be enjoyed.

Strengths:
- No commute
- Work-life balance
- Productivity

Hotspots
When collaboration and/or creativity are required hotspots can be visited. A nearby coffee bar, library or flex workplace can serve as the perfect environment for these activities.

Strengths:
- Shorter commute
- Collaboration
- Innovation
- Connecting to colleagues

Office hubs
Locations offered by the company itself, like satellite offices or office hubs, where employees can book a space to work or collaborate. This place is similar to the central office but smaller, with less people in it and closer to home.

Strengths:
- Shorter commute
- Collaboration
- Innovation
- Connecting to colleagues
- Connecting to culture

The pros and cons discovered in the previous chapter can be used to get an idea of when remote work will be done. The learning that remote working is not a replacement for office work, but a powerful tool, is most important in this vision on the future of work and the description of the locations in the ecosystem.

3.4 Conclusion

Answering the main research question:

1. What will the future of work look like?

Taking all trends and developments together the future of work will be more flexible and optimized. Employees will be given more choices and more freedom to make them. They can work from different locations, depending on what type of work needs to be done. This way of working can be described as hybrid working, utilizing both remote and office locations. These choices can be made to surround oneself with the most optimal environment. Remote work and the gig economy will also enable companies to further optimize their output, increasing the focus on their core business while outsourcing the rest. All these choices and optimizations are made possible by high quality connectivity, with seamless collaboration and communication.

3.5 Design goals

1. The product has to connect people from different locations in the office ecosystem.
2. The product has to create a quality experience in the office.

04

Hybrid Work

4.1 As concluded from the previous chapters hybrid working will be a large contributor to the future of work. Many companies will be new to hybrid working, or at least to the frequency of it. It is important to understand the unique events resulting from a more geographically distributed workforce. This chapter will be dedicated to identifying these events and challenges.

4.2 Method

Research questions

1. How is hybrid working currently done?
2. What problems are caused by hybrid working?
   c. Which problem in hybrid working will be focussed on? **(Main RQ)**

Hypothesis

2. Bad quality of hybrid communication will be a problem in hybrid working.

This hypothesis is turned into an experiment card, which can be found in paragraph 4.5.

Approach

This research phase will mainly consist of interviews, since there is not much literature available on hybrid organizations. In the interviews people with experience in hybrid working were asked about aspects such as management, meetings and inclusion. Again, the Mom Test methodology was used in the conversations. The questions from the interviews can be seen in Appendix 16.4. This group of participants will be referred to as Participant group 2.

Methods

The Mom Test
Method explained earlier in paragraph 2.2.

4.3 Hybrid work

Cons hybrid work

In order to process the interview data all answers were labelled and processed in a DIKW scheme (Data, Knowledge, Information, Wisdom) (Sanders & Stappers, 2013).

The cons and challenges experienced with hybrid working identified through literature research and interviews are listed below. The interviews were structured into 3 subjects: management, meetings and inclusion. The full description of them can be found in Appendix 16.5. The most frequently mentioned and most interesting problems are listed here.

Work location management
When employees are spread across multiple locations in the office ecosystem good management is essential. This management requires all levels of the organization to communicate clearly and consistently. Everything needs to be managed properly, from work to meetings to availability of workspaces.

The importance of management in hybrid working is illustrated by the fact that two employees, for example a manager and employee, when working remotely 2 days a week, will have a 29% chance of meeting each other in the office (Cushman & Wakefield & CREUA, 2020b). This probability is low and will not be desirable. (See graph). Another problem caused by the lack of management was mentioned in the conversations with employees from two large multinational companies that had already embraced the remote working culture. They said: “When you show up late to the office, you have to fight for a workplace”.

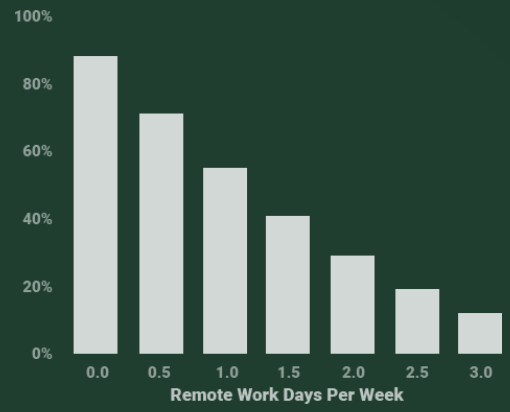


Figure 12: Chance of meeting each other without management

Some companies that participated in the interviews were using a system where you have to reserve a place in the office prior to the day you want to work there. For large companies this system can be a real time consumer if not automated. It also comes with problems like people showing up to the office without a reservation or employees disliking the lack of routine in their workweek. Companies clearly have to find their way in managing the work locations. One participating company in the UK made use of an online automated system that worked satisfactorily.

A frequent worry highlighted in the conversations was figuring out how to optimize the office days. Since office days are reduced to a couple a week, people want to make sure the coworkers they need to talk to or work with are present when they are in the office. It is easy to imagine the upfront alignment required to meet everyone you need to meet at a given day in the office. When you want to meet with 5 people, who each need to meet with 5 others, who then also have to meet with 5 others, it can be a real puzzle to organize optimal meeting schedules in the office.

30% of participants talked about this.

Hybrid meetings
When employees in a company work from different locations during the workweek meetings with attendees from both in- and outside of the office can occur frequently. These meetings are however often experienced as frustrating and inefficient. The difference in communication between the two sides of the group, face-to-face and through video conferencing software, makes for unnatural and unequal contact. The equipment required for such a meeting, like a camera, microphone, speaker and internet does not always function in a satisfactory way, causing even more pain points.

70% of participants talked about this.

Fomo
Earlier results have shown that employees want to work remotely a couple of days a week. Research has however shown the expectation of this wish changing over time. The reason for this: Fomo (Fear Of Missing Out). Remote employees can start worrying about the probability of missing out on important information, opportunities or experiences (Cushman & Wakefield & CREUA, 2020b).

20% of participants talked about this.

Centralized communication
Although communication and collaboration seem to be going well during remote work, hybrid working is a totally different situation. The communication now happens between people in different locations in the office ecosystem. Most online collaboration tools are primarily built for a team in which everyone works remotely. When a team is divided over different locations, and communication starts going through different channels, people are going to miss out on information (Buffer & AngelList, 2020). It will be important to create seamless and centralized communication between employees in different locations in the office ecosystem.

In the office interaction outside of formal meetings can also lead to project advancements or decision making. When a hybrid meeting ends and the online participants have left, the in-office employees often have a conversation about the meeting results or next steps. Since these conversations are not documented it is impossible for remote workers to stay updated on this information. This can create misalignment inside a team, or a feeling of being left out.

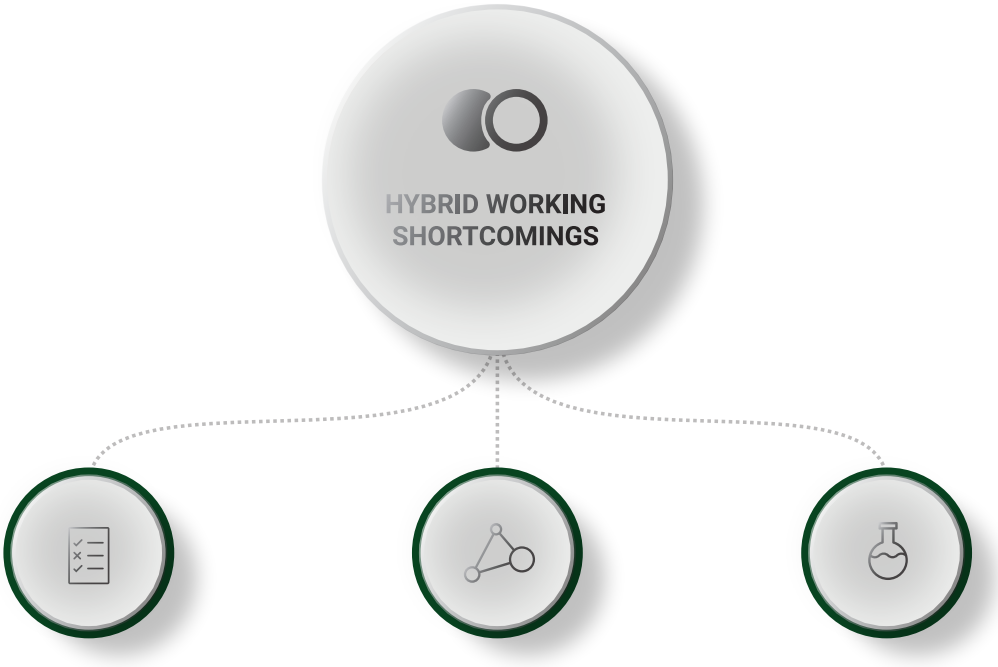
It is a challenge for hybrid companies to make sure the remote workers are not left out of important decisions. When most people are in the office and a key discussion takes place, the remote workers are easily left out, making them feel less important (Gascoigne, 2020).

50% of participants talked about this.

Analysis

The findings were again labelled and grouped in order to identify patterns. This way the three biggest shortcomings that employees experience in hybrid working were identified.

Figure 13: Hybrid working shortcomings



Asymmetrical communication

The way both parties in a hybrid meeting, online and physical, communicate is different. One of the participant explained this through the etiquettes we have gotten used to in online and face-to-face meetings. When both sides of the meeting use different etiquettes this logically leads to friction, with the remote participants suffering. It will be important to develop new hybrid meeting etiquettes that make these meetings go smoothly while allowing all participants to contribute equally.

Disconnected office ecosystem

Where the office ecosystem should be a connected ecosystem, it now often is experienced as a group of separate islands. You do not know what's going on on the other islands, and you have to put effort in to get information. The right management strategies and tools should be used in order to create a seamless experience between these different locations.

Unprepared companies

As concluded from the interviews and literature, the majority of companies are preparing for a hybrid future. Most companies are however not experienced with this new working style, and thus not aware of the challenges. It will be important for companies to use the time left in this forced work-from-home period to get familiar with these challenges and start putting the right solutions in place.

Other findings

Plan meetings in the office
For the hybrid working style it seems to be the goal to have all meetings in the office. As discussed in the Future of Work chapter the office becomes a place for interaction and collaboration. Because meetings seem to be more effective when performed face-to-face, companies want their employees to come to the office for them. The need for this strategy is fuelled by the overdosis of online meetings we had to do during the last year, and the bad experiences with hybrid meetings. It is important to recognize the quality of face-to-face interaction. It should never be fully replaced by online and hybrid meetings, but I am convinced all three meeting types have unique strengths and weaknesses, making them tools that should be utilized at the right moments.

Hybrid meetings are often prevented
Now that the majority of the companies are experienced with online and physical meetings, they know how to execute each well. With hybrid meetings this is often not the case. One participant said they stopped doing them because "it just doesn't work". Because of this some companies choose to prevent hybrid meetings and either go for an online-only or office-only meeting. Sometimes this means the people in the office will scatter around and each join the meeting through their laptop. It is a solution that solves the hybrid meeting problems, but at the same time eliminates the advantages of it. These advantages are discussed in the next chapter.

Problem choice

The problem that will be focussed on for the rest of the project is that of hybrid meetings. This problem is the best fit for a project in the Integrated Product Design master because of its technological roots. The problem is also the one that speaks to me most. There are important and interesting problems identified in the management of a hybrid company and the inclusion of its employees, but these problems mostly require solutions such as cultural changes and tools. Tools are mostly software based, which is not where my strengths and abilities lie. A technological innovation for supporting hybrid meetings will be a good goal for this graduation project.

4.4 Conclusion

The main research question was:

2c. Which problem in hybrid working will be focussed on?

The focus in the rest of the project will be on hybrid meetings. Many participants have talked about the frustrations caused by such meetings, showing the need for improvements. A technological innovation could prove to be valuable in enabling a more natural and successful interaction.

04

Hybrid work 4.5 Experiment 2

Experiment 2	Are hybrid meetings a problem in hybrid organizations?
I believe that	Bad quality of hybrid communication will be a problem for hybrid working.
In order to test I will	Do 15 minute Zoom interviews with people who currently work in a hybrid way, or have worked in a hybrid way in the last 5 months, and talk about how the meetings go. Talk to at least 10 participants.
And measure	The amount of people that talk about the bad quality of hybrid communication.
I'm right when	At least 40% of the people mention the problem of bad quality in hybrid communication.

Result

Talked to 11 participants, of which 7 worked hybrid in the last 5 months.
70% (5/7) of the participants talked about frustrations in hybrid meetings.

While the amount of participants finished 3 people short, the percentage of people mentioning frustrations in hybrid meetings was high enough.

Learning

It is important to note that from the 5 participants that talked about frustrations, 3 named significantly more than the other 2. This shows there are different levels of frustration, and some experiences may lead to a higher demand for a solution than with others. With the gut feeling "I'm on to something" combined with the awareness of the insignificance of the current findings I continue in the direction of hybrid meetings.

Another learning worth noting is that some participants said the hybrid meetings were so inefficient their company decided to prevent them in the future. This raised the question if hybrid meetings will be a frequent event in the future of work or not. I believe hybrid meetings are a promising tool bringing great advantages to the table. If bad execution of the hybrid meetings results in them not taking place anymore it highlights the importance of solving the problems causing this bad execution.

05

Hybrid Meetings

5.1 The topic for the next research phase will be hybrid meetings. This type of meeting is already being performed in companies with remote workers and offices / partners in different countries. With the remote working trend having caught wind the frequency of hybrid meetings is expected to increase. Emotional problems are what make the problem worth solving.

5.2 Method

Research questions

1. What are the practical problems experienced in hybrid meetings?
2. What are the emotional problems experienced in hybrid meetings? **(Main RQ)**

Approach

The practical and emotional problems are identified through interviews. Using the information from the hybrid working interviews with Participant group 2, along with new participants about hybrid meetings, a total of 20 people were spoken with. This total will be referred to as Participant group 3. The questions can be found in Appendix 16.6.

Methods

The Mom Test
Method explained earlier in paragraph 2.2.

Hypothesis

2. Hybrid meetings make the online participants feel unvaluable.

See paragraph 5.8 for the experiment results.

5.3 Different problem levels

The problems identified through interviews can be organized into three levels: practical, behavior and emotional. On the practical level are the problems related to specific tasks or tools. These problems result in specific actions and behaviour, which in turn evoke certain emotions. The emotional problems are the most valuable ones. They are rooted deep into someone's identity, help understand certain choices and can even help predict future events.

Practical

Audio problems
Not having the proper equipment or structured interaction can lead to online participants not hearing what is being said in the office, or the other way around.

Visual problems
When the camera in the conference room is not well positioned not all attendees can be properly seen by the online participants. When the camera is far away it is also hard to read non-verbal cues from people that look like small puppets around a table.

Internet problems
Obviously communication through the internet is hard when the internet connection is not stable. Unfortunately this is still a problem in some meetings nowadays.

Hard to interrupt
Online participants feel like it is hard to interrupt from a distance. This can be caused by the lack of communicative cues, improper audio or other hurdles.

Physical materials
If physical materials like drawings, prototypes or whiteboards are used in the office it is hard for online participants to see what is going on and to participate in creating physical input.

Behavior

In-office dominance
It is easier for in-office participants to communicate with each other, because this feels more natural and direct. This results in more interaction between the in-office part of the meeting compared to the online part. This effect is enhanced when tools like audio or the internet are not working well.

Less input from online participants
When it is hard for online participants to interrupt, they will end up giving less input.

Online participants as spectators
When the in-office group is dominant and it is hard to give input as an online participant, the feeling of being a spectator can be the result. When joining a meeting this is most often not the goal.

Emotional

Not feeling valuable
Not being able to give your input and proof your worth can make you feel less valuable.

No solidarity
Not feeling part of the meeting creates a feeling of separation from the in-office group. This is a problem for a company, where employees have to feel like a team.

5.4 Importance of the problem

The problem of not feeling valuable is an important one to solve because of two reasons, personal and business wise. First of all someone's professional identity is one of the most important aspects of a career, and of someone's identity as a whole. A company is a group of people that work together to achieve a shared goal or vision. You as a professional join a company to add value and help achieve its goals. When hybrid meetings make you feel invaluable this can seriously harm your professional identity in the long term, and decrease your drive and job satisfaction.

One interviewee interestingly noted that he does not see this happening, because people will just start coming to the office more before their professional identity starts taking damage. In this way they can be one of the physical attendees in the upcoming hybrid meetings. This means a couple of unsatisfactory hybrid meetings will lead to employees coming back to the office, bringing us to the business side of the problem. A decline in remote work in a hybrid organization would be a shame taking into consideration all benefits resulting from remote work. These benefits are the reason remote working is here to stay. Not executing hybrid meetings properly can already start taking away remote working advantages, with increased employee satisfaction being one of them. Next to that companies are already preparing for more remote work, by for example reducing the size of their offices. If employees become unsatisfied with remote work after these changes have been made this can turn out to be a big problem.

All together companies are preparing themselves for hybrid working, without knowing what it takes to be a successful hybrid organization. Hybrid companies are more than companies that enable both work from the home- and central office. It comes with unique situations, like hybrid meetings, which have to be tackled well. If not, both the individual employee and the entire organization will suffer from the effects. This sums up the importance of solving the problem of unequal communication in hybrid meetings.

Figure 14: Different problem levels

5.5 Value of hybrid meetings

So if hybrid meetings cause so many problems, why not just prevent them? This may seem like a radical thought, but some interviewees actually said to be using this as a solution. When a meeting has both physical and online attendees, all people in the office will sit spread across the building. This results in an ordinary online meeting, with the pro of having an equal playing field. I am convinced this is a waste. Hybrid meetings have their own unique advantages compared to online and face-to-face meetings. To make the potential benefits of hybrid meetings clear the biggest advantages are listed below.

Dynamics

Hybrid meetings have the dynamics and emotions from a face-to-face meeting, while having the availability and flexibility of video meetings. The existence of a physical space where all communication comes together gives an advantage over remote-only meetings. The physical space gives more possibilities for supporting a specific quality and dynamic.

Natural

Where people use unique online meeting etiquettes to make sure the online-only meeting goes well (like staying muted when listening, or using the 'raise hand' button if you have a question) hybrid meetings enable a natural interaction, similar to that in face-to-face conversation.

Cost and time savings

Cost savings because of reduced travel (and sometimes meals, hotels, etc.), and because of reduced office space and rent. It is no longer necessary to let people drive 2 hours for one meeting, or to fly in business partners from other countries. These savings should not result in reduced performance, or reduced employee satisfaction. So part of the savings should be invested in enabling better hybrid meetings.

Autonomy

As found in the chapter about the future of work autonomy for employees is growing, with a higher employee satisfaction as a result. If an employee is required to come to the office for a meeting while the rest of the activities that day are better executed somewhere else, this would limit his autonomy where it can be worth most. He should have the autonomy to choose where to work and where to join the meeting from.

Availability

The biggest condition for an office-only meeting is that everyone needs to be at a certain place at a certain time. If you have other activities far away from the office that day and cannot be there in time, this means you will miss the meeting. Hybrid meetings enable everyone to participate in the meeting, wherever you are. The conditions for joining become significantly lower. Since a commute is not required anymore it is also easier to find an available time slot in everyone's busy schedule.

Physical space

Hybrid meetings, in contrast with fully online meetings, have a physical space where all communication comes togehter. This opens up more opportunities for (physical) tools that help support the communication from both the online and in-office party.

5.6 Conclusion

The main research question:

2. What are the emotional problems experienced in hybrid meetings?

Hybrid meetings make the online participants feel invaluable, hurting both the individual employee and the company in the long term. It is important to make companies aware of the challenges in events like hybrid meetings, and offer them ways to overcome them. The product has to give the online attendees in a hybrid meeting the feeling of being a valuable participant in the meetings, this is the so called "job to be done".

5.7 Design goals

3. The product has to give the online participants in a hybrid meeting the feeling of being valuable.
4. The product should leverage the availability of the physical space in a hybrid meeting.

05

Hybrid meetings 5.8 Experiment 3

Experiment 3	Why are hybrid meetings a problem?
I believe that	Hybrid meetings are a problem because it makes the online participants feel less valuable.
In order to test I will	Do 15 minute Zoom interviews with 5 people who have experienced a hybrid meeting as an online participant in the last 5 months.
And measure	If they say it makes them feel less valuable (than the in-office participants).
I'm right when	At least 40% of participants say they feel less valuable because of the hybrid meeting.

Result

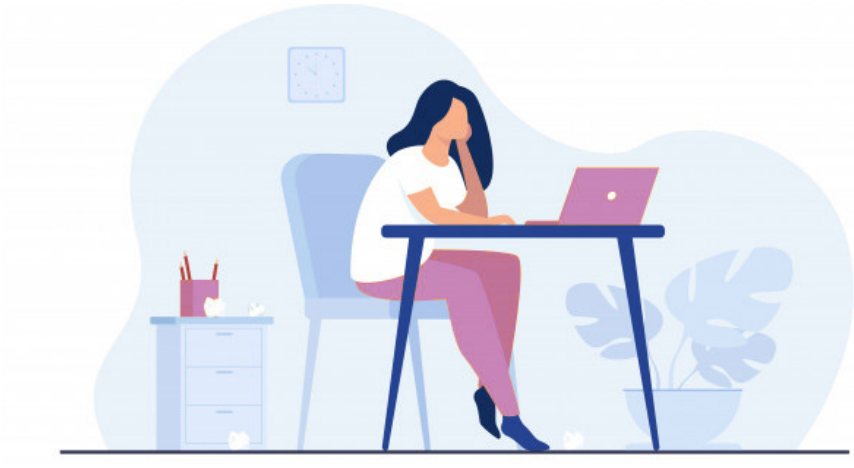
Talked to 5 participants who have recently joined a hybrid meeting as an online participant.

4 Participants mentioned they felt less valuable, or sometimes even useless. All 5 of them admitted to feeling excluded.

Learning

Online participants feel excluded and unvaluable in hybrid meetings. Some even asked themselves why they were even in the meeting. This feeling is an emotional problem, which can have a large negative impact in the long run. No participants could talk about these long term effects, since the hybrid meetings are new to most.

One participant said he expects his employees to come back to the office if they feel unvaluable in hybrid meetings. This is also a problem since remote working is here to stay for a reason, it improves employee satisfaction.



06

Communication Research

6.1 Now that the importance of the problem is clear a better understanding on the reason for this is key. Communication is one of the key aspects of a meeting, and the inequality of it in hybrid meetings can cause frustrations. By researching the way people connect and communicate it can be defined what is missing in communication between in-office and online participants.

6.2 Method

Research questions

1. What aspects play a role in communication?
   b. Which of these are missing in communication with an online participant? **(Main RQ)**
3. What aspect will the product be focussed on? **(Main RQ)**

Approach

Literature research has been done to collect theories about communication and learn about how it is influenced by video conferencing.

Methods

Literature research
Research papers, articles, blog posts and books were used to gather data on the future of work. This was done to create a broad collection of facts and opinions, which can then be used to build a vision.

6.3 Connection

Humans are social creatures who are meant to connect to each other. It is even rooted so deep into our system that neuroscientist Matthew Lieberman argues "the need to connect with other people is so strong that it can top our desire for food and shelter" (Alsever, 2020). Next to the strong desire to connect, feeling rejected can also result in emotions such as anger, anxiety, jealousy and sadness and can even reduce the ability to perform difficult tasks (Manola, 2019).

Besides the need for connection it is also an important tool in business. Face-to-face communication is found to be the most important type of communication in a team (Harris, 2015). The power of face-to-face contact is also illustrated by researchers from Cornell University and Western University; they found that requests are 34 times more successful when face-to-face, compared to email (Bohns, 2018). This shows rich and personal communication is key to successful business.

6.4 Communication aspects

The way humans communicate with others is guided by many unconscious processes and information points. These information points are not new or unexpected to most readers, but their use and effects are something most are unaware of. The most important factors and effects are discussed on the next pages.

6.5 Communication aspects in video conferencing

Communication through video conferencing tools is different from face-to-face. The differences and shortcomings of each factor are discussed on the next pages, in the right column.

Speech

Speech is the most obvious way of communication. We can use different words, create phrases, and vary in speed and tone.

... in videoconferencing

In video conferencing speech is the element that comes across best, given that the proper audio soft- and hardware is in place.

Eye contact and (selective) gaze

Eye contact is a powerful 1-on-1 connection defined as "two brains simultaneously processing one another, each aware of being, at that very instant, the centre of the other's mental world" (Jarrett, 2017). Gaze happens when looking at someone's face and upper body, with selective gaze communicating the direction of it. Eye contact is one of the most important types of non-verbal communication, also in multi person video conferencing (Regenbrecht & Langlotz, 2015). In VC it results in many practical and emotional aspects, but most importantly causes behaviour similar to face-to-face contact (Mukawa et al., 2005). The most important effects from eye contact are:

Attention
Eye contact in conversation gives someone the feeling of being addressed, confirms attention (Holler et al., 2006) and communicates intentions (Fox, 2005).

Trust
Mutual eye contact plays a dominant role in building trust and empathy (Teoh et al., 2010) and the lack of it is found to be the biggest cause in distrust (Bekkering & Shim, 2006). In addition a person with a dilating pupil will be experienced as more trustworthy, and with a constricting pupil as less trustworthy (Jarrett, 2017). This information is unconsciously picked up and helps build the overall impression of an interaction partner.

Emotions
Eyes also communicate our emotions, when someone is excited about something the pupils will dilate, while feeling sad makes them constrict (Alsever, 2020).

Problem solving
Eye contact positively contributes to problem solving and conceptual understanding (Joiner et al., 2002).

Co-presence
In video conferencing gaze has a positive effect on the feeling of being together. Even when simulated with avatars, like Garau et al. (2001) did in their research, gaze creates an improved feeling of co-presence.

Information recall
Gaze in video communication also causes information to better stick with the receiving party. The lack of gaze results in a lower information recall, being important in communication such as teaching, pitching and other forms of important information transfer (Fullwood & Doherty-Sneddon, 2006).

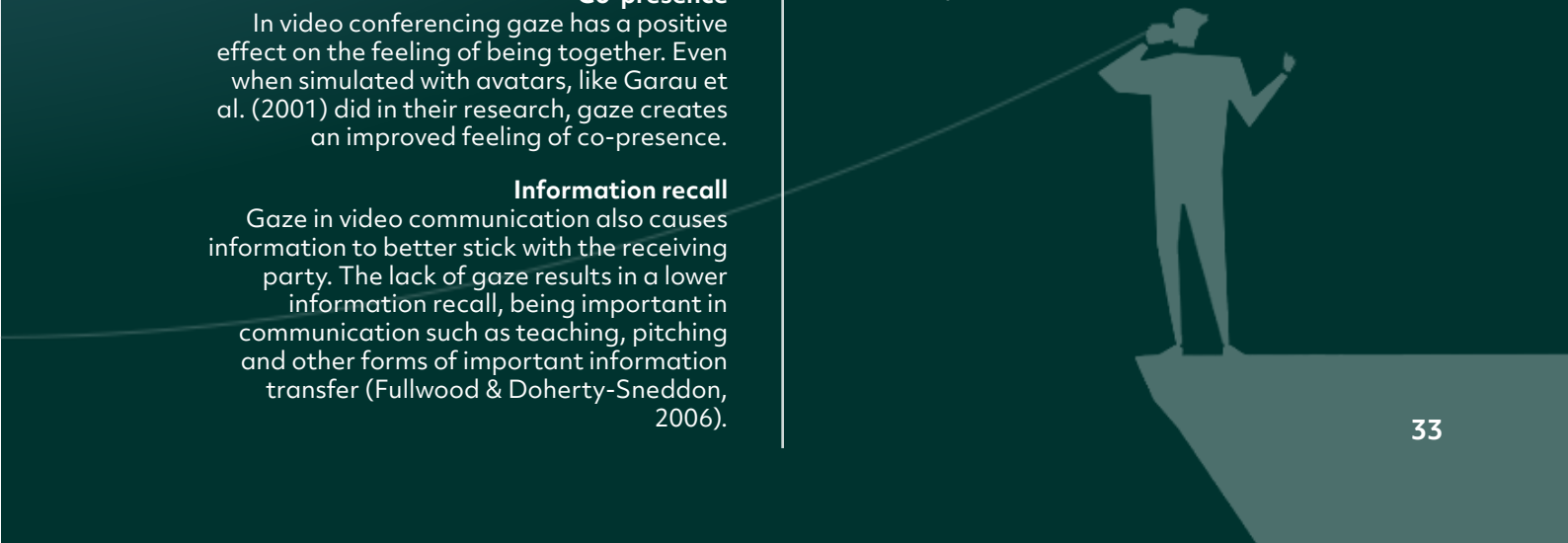
... in videoconferencing

A well known shortcoming in video conferencing is the lack of eye contact. This is caused by the eyes of the person on the screen and the camera being located elsewhere. Also the 2-dimensional property of video conferencing makes it impossible to create that powerful 1-on-1 connection with someone in the room. Benefits such as attention confirmation, trust, a higher feeling of co-presence and better problem solving are lost because of this.

Not receiving direct eye contact makes participants in communication feel excluded, lower self-esteem and a worse relational value (Wirth et al., 2010). Our brains however seem to have an eye contact safety margin pre-installed, which can be helpful in hybrid meetings. It turns out we interpret slight averted eye contact as direct eye contact when we are already feeling excluded (Jarrett, 2017).

Online participants can also not communicate their gaze direction to the in-office group. It is thus unknown who they are adressing when talking, and if they are paying attention to an in-office speaker. The in-office speakers not getting this attention confirmation from the online participants could be an explanation for the latter being forgotten after a while. Adding selective gaze to video conferencing is proven to create:

- More attention towards the remote participant (Colburn et al., 2000)
- Better group interaction (Taylor & Rowe, 2000)
- Higher frequency of turn taking (Vertegaal, 1999)
- Better turn taking behavior (Vertegaal, 1999)
- A better experience for both remote and in-office participants (Vertegaal, 1999).
- Support verbal interaction closer to face-to-face interaction (Vertegaal, 1999)



Facial expressions

In the book Silent Messages the feeling evoked by a message is split into four parts: a general, verbal, vocal and facial feeling. The facial feeling is often the one that dominates the message. Also, when people show emotions others tend to copy these, which is caused by mirror neurons. These neurons in the brain will cause you to smile when the other is smiling, or to frown then the other is frowning (Alsever, 2020). This shows the importance of being visible to the people you are talking to when trying to convince them of an idea or argument.

... in videoconferencing

Facial expressions can still be seen through the head and shoulders view. How well this is visible in the conference room depends on the setup, screen size and amount of other participants on the screen.

Body language

Body language is information we get across with our posture, movements and gestures. Some purposes of body language are supporting or empowering the verbal message (like moving your hands away from each other when talking about something large), replacing verbal messages (pushing away from the desk, telling you are giving up on something) and regulating conversation (by pointing your hand towards a participant to let him know he can speak) (McLean, 2015). Like facial expressions body language triggers the mirror neurons, causing mimicry. If our body shows we are excited, others get excited too (Reeve, 2014).

... in videoconferencing

In video conferencing the view of others is limited to head and shoulders. Creating a wider view, enabling body language to become visible, gives people more communication tools, more control over their appearance and creates a higher feeling of being together. (Teoh et al., 2012). Controlling the way you appear to others is especially important in business, where people tend to care more about this because how they are perceived can have a great impact on their work.

Visual scale

In video communication the size of the displayed online participants also affects the way they are perceived by the viewing party. With a scale smaller than life-size someone is experienced as far away, while a larger scale is perceived as dominant (Okada et al., 1994). Life-sized online participants are experienced more positively (Detenber & Reeves, 1996) and as more realistic (Okada et al., 1994). This is desirable in a meeting, since dominance from one party can lead to incomplete considerations in decision making.

... in videoconferencing

In the standard conference room the online participants are displayed in small squared frames on the screen. This creates a feeling of distance between the people in the office and the people at home and could explain the in-office dominance. In most VC software the person speaking will get a temporary full screen display, this can result in a size close to real-size.

Configuration

The way people are arranged around the table in a meeting is sometimes related to roles and importance of an individual. The configuration influences the amount of transmitted and received non-verbal communication, partner awareness and perceived dominance (Regenbrecht & Langlotz, 2015).

... in videoconferencing

In hybrid meetings all online participants are located on the screen at the head of the table (normally a dominant position) which might have a negative effect on their dominance. They are out of the field of view of the people at the table, who are sitting face-to-face. Maybe different configurations can influence this.

Space

The amount of space a person takes or gets is often in line with the importance or power of that person. Often the more powerful person will demand more space (McLean, 2015).

... in videoconferencing

Currently all online participants share one screen. When they are all displayed on the screen their territory is very small. This might spread the feeling of them not being important. When only the speaker is visible on the screen this removes the territory of the other online participants, resulting in an even weaker perception.

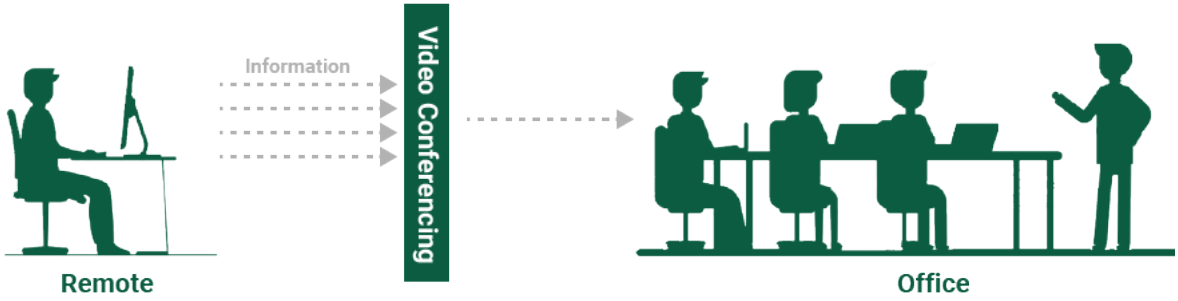


Figure 15: VC as filter in communication

Video conferencing filter

In conclusion a large amount of information points are what make face-to-face interaction smooth and natural. We collect and process all this necessary information unconsciously, the whole interaction system is programmed in our brain. When communicating through video conferencing software and tools most of these information points get lost. As Regenbrecht & Langlotz (2015) state in their literature research on video conferencing, one of the biggest shortcomings in VC is "the lack of support for communication aspects beyond simple head-and-shoulder views. This information is sent by one person, but filtered out by video conferencing, and thus not received by the other. (See figure 15). In a hybrid meeting this creates a stiff and unfair interaction. The in-office participants make use of their complete communication toolbox, where the online participants are limited.

Bringing back the previously lost, fundamental, communication information in video conferencing allows us to make hybrid interaction dynamic, natural and equal.

6.6 Turn taking

Turn taking is the term describing the process of passing on the role as speaker in a conversation. Turn taking can be done by handing the floor to a co-participant or by a person taking the turn himself. Both consciously and unconsciously people are able to pick up and transmit signals used for smooth turn taking, like syntax (structure of words and phrases), semantics (meaning), paralinguistic cues (tone and pitch), eye contact, gaze and body language (Chao & Thomaz, 2010).

Since the audio related cues are already supported in video conferencing we focus on two unsupported factors: timing and gaze. These are described on the next page.

6.7 Turn taking in video conferencing

Turn taking proves to be a mechanism fuelled by subtle cues and perfect timing. How well can this be done through video conferencing? This is discussed on the next page, in the right column.

6.8 Social presence

A person that participates in a conversation without being physically present is obviously perceived differently from the people in the room. Being physically present should however not be a requirement for valuable participation. When enabling the right information streams and by triggering the right mental processes, hybrid communication can be executed in a smooth manner. The latter can be approached by the social presence framework by Biocca et al. (2003). This framework divides social presence, "the degree to which a person is perceived as 'real' in mediated communication", in three contributors: copresence, psychological involvement and behavioral engagement (Biocca et al., 2003).

Copresence is about being aware of other participants and feeling everyone is present in the same environment.

Psychological involvement is about connecting to co-participants and establishing a shared understanding.

Behavioral engagement is about communication aspects such as eye contact, gaze, body language and turn taking.

The goal will be to increase the social presence of online participants in a hybrid meeting, taking these aspects into account.

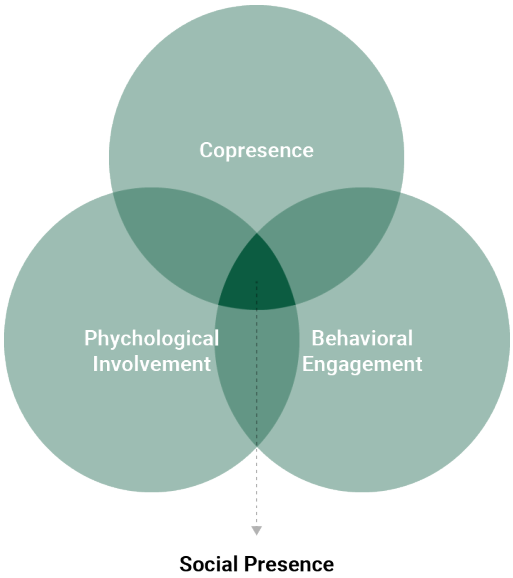


Figure 16: Social presence framework

Timing

The timing of turn taking is influenced by video conferencing tools. In face-to-face conversations the time between two turns is around 100 to 300 milliseconds. This is interesting given the processing of a single word takes 600 ms and for a simple sentence 1500 ms (Holler et al., 2016). This shows turn taking is an activity finding its starting point during the sentence from the current speaker. By analyzing the words, structure of the sentence and tone the next speaker can predict when the sentence will come to an end.

... in videoconferencing

Since turn taking is an event that happens very quickly (100-300 ms) it becomes harder for online participants in a hybrid meeting to compete with other potential turn-takers in the converenceroom. With modern day technology a latency of 150 ms is the recommended norm (Zoom, 2021). This latency gives remote participants a disadvantage in the possibility to take the floor (especially when a quick interruption of 100 ms is being made), but other factors make it even harder.

(Selective) Gaze

Gaze is used to collect information from the current, but also the next speaker. Research has shown participants move their gaze from the current speaker to the addressed speaker just before the current turn is over. This is unconsciously done in order to capture as much information as possible from the current speaker while also seeing the visual response by the addressee (Holler et al., 2016).

In a multi person conversation gaze also plays an important role in making clear who is being spoken to and who can speak next. When the message is aimed at multiple people the speaker will alternate his gaze between every person. The gaze direction at the end of the turn functions as next-speaker selection. Most of the time this selection behavior leads to the gazed-at person taking the next turn. It is also possible the next turn is taken by an un-addressed participant. This is not perceived as rude, underlining the flexibility of the rule. But while the rule is flexible, the power of gaze in next-speaker selection becomes clear when gaze is sustained at a person who withholds a response, often leading to that person taking the next turn after all (Auer, 2018).

Vertegaal & Ding (2002) also found that a gaze amount lower than normal resulted in less turn taking and a lower understanding of who is talking to who. The participants in their earlier research found it hard to take and hand out turns during the conversation with less gaze as a condition (Vertegaal et al., 2001).

... in videoconferencing

As mentioned by multiple interviewees about hybrid meetings the view of the people in the meeting room is often from far away. It might be hard to capture all turn taking cues, including eye contact and gaze, when only having this wide overview of the meeting room. Combining the information about gaze behavior in turn taking with this learning from the interviews I believe remote participants miss a large amount of non-verbal information taking place in the room.

The research discussed before also shows that less gaze results in less turn taking. With a hybrid meeting the people in the room receive the normal amount of gaze, while the online participants do not. This explains gaze and eye contact as a large contributor for the online participants feeling left out and giving less input.

Imagine this; you are having a conversation with 3 friends, and a 4th friend is standing behind you, out of sight. Every time that person says something the flow of the conversation will break. This is because you are not receiving any of his participation cues, you have no idea when he is about to speak. It is even likely you will forget about him after 15 minutes. That 4th person will also start feeling left out since he does not receive any eye contact or gaze from the others. If you succeeded in picturing this situation in your head I am convinced it is quite an awkward event. Sadly this interaction is very similar to a hybrid meeting, with online participants being out of sight, no eye contact being made and every moment of input feeling like an interruption of the conversation.

Lastly the absence of selective gaze plays a role in the limitations of online participants in hybrid meetings. In 1999 Vertegaal stated that "one of the perceived limitations of telephony-based videoconferencing systems is that they do not support selective gaze", with conversation management as the goal in mind.

6.9 Intrinsic factors

Different factors of communication affecting the hybrid meeting have been discussed, but there are many more, especially intrinsic. The role, expertise, motivation and personality of a person can also greatly determine someone's presence in a meeting. Important or extroverted people might experience less problems in participating as an online participant compared to for example a new employee or an introverted person.
I see these two types of persons as the ends of a spectrum. It is hard to use technology to better include someone in a meeting while that person is already experiencing that problem when being physically in the room. Additionally it is unnecessary to help someone be better included if that person is naturally good at obtaining the floor in a conversation. The problem and solution analysis will be focussed on the 20 - 80 range.

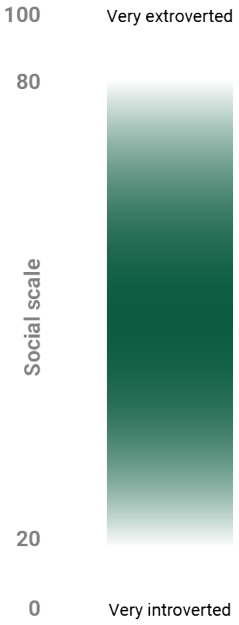


Figure 17: Scale of introvertedness and extrovertedness

6.10 Conclusion

The main research question was:

1a. Which of these [communication aspects] are missing in communication with an online participant?
- Eye contact and (selective) gaze
- Body language
- Life-sized scale

2. What aspect will the product be focussed on?
- Eye contact and (selective) gaze
- Body language

From the missing aspects eye contact and body language seem to have the largest impact on communication and turn taking. Turn taking can be split in two crucial parts: receiving turn taking cues and transmitting them. The online participants do receive some cues but struggle with getting their own across because people in the meeting room are paying little attention to the screen, or simply because their visual representation is so small. Whether adding eye contact and body language makes a hybrid meeting more equal, and if it eventually leads to online participants feeling more valuable should be tested.

6.11 Design goals

5. The product should support the non-verbal communication lost in video conferencing.
   - 5.1 The product should enable in-office and remote participants to make eye contact.
   - 5.2 The product should stimulate more eye contact or gaze towards the remote participants.
   - 5.3 The product should enable selective gaze for the online participants.
   - 5.4 The product should enable remote participants to use body language as a tool during the meeting.
6. The product should give a higher social presence for online participants.

6.12 Design opportunities

- Different configurations of virtual and physical participants might influence the interaction.
- Increasing the scale of virtual participants could positively contribute to equal and natural conversation.

> **"As we begin to head back into the office again, work will increasingly become hybrid. Success will lie in finding ways to create human connection with those working remotely."**
>
> (Alsever, 2020)

07

Context

7.1 The missing communication components in video conferencing identified in the previous chapter can now be used to better understand the problems in hybrid meetings. A session was set up where a hybrid meeting was simulated in a conference room setting, which puts the theory in practice.

7.2 Method

Research questions

1. Why is it hard for online participants to actively take part in the discussion? **(Main RQ)**

Approach

Stimuli
In order to simulate a hybrid meeting as realistically as possible a conference room setting was built. This includes a long table with chairs, a conference speaker and a large screen at the short end of the table (see image below). A laptop with Zoom was connected to the large screen so the online participants could be seen by everyone in the room. A conference speaker from Anker was used to properly record all voices in the room and spread the audio from the online participants.

To create a discussion all participants were given a fictional role in the board of a company. Before the session they were handed out a page with a description of the company, their role, their goal and arguments. These one-pagers can be seen in Appendix 16.7.2.

Measurements
The meeting was recorded through Zoom and via a camera in the room. The videos were used to analyze the behavior and to count the number of turns for each participant to see if certain behavior influences turn taking. The audio recordings were used to process the answers to the questions in the discussion after the simulated meeting.

Methods

Context mapping
Context mapping is a method that puts a user in its context, making it easier for him to explain his experience and enabling the researcher to observe everything that influences it. When only doing interviews you have the risk of missing information that the interviewee forgot about, or what he does unconsciously. It allows for deeper insights to be gained this way. Also seeing the interaction in a hybrid meeting for the first time gave me the chance to apply all knowledge gained until now in order to understand certain behavior. To make sure the context mapping session was well prepared an interview with Pieter Jan Stappers, context mapping expert, was done beforehand.

Figure 18: the conference room setup

7.3 Results

The full list of findings from the observations, interview and turn count can be found in the full research paper in Appendix 16.7.1. The most valuable findings can be found below.

Eye contact dominant in turn taking

This was already learned from the communication research, and could now be seen in action. Eye contact was indeed one of the main drivers behind turn taking.

Body language as powerful discussion tool

As with eye contact it was observed that this communication tool contains lots of information about someone's emotion and upcoming actions.

All online participants are one

Because all online participants join through Zoom, being visible on the same screen, using the same camera in the office, they feel less like an individual. This feeling was later underlined in the discussion when one of the online participants said he was constantly aware him not being the only person on the screen. This lack of individuality could possibly influence the experience and interaction.

Online participants as backup participants

An in-office participant realized he was constantly trying to convince the people in the room of his arguments, but not the remote participants. He explained this with the feeling that the people on the screen are "a backup". This feeling was shared by the people joining the meeting through Zoom. One of them said he felt like a helpline, sometimes providing input that is then used to fuel the discussion between the in-office people. This shows that the online participants are not experienced as active members in the discussion, by both parties.

Interrupting instead of contributing

Adding to the previous point, the online participants felt like they were spectating a discussion between 4 people. Adding to this feeling was their experience when giving input, which felt like interrupting their discussion.

Lack of knowing where someone is at

Someone's posture can tell a lot about where he is at in the discussion. Is he excited or unhappy? Is he still with us or losing his interest? This information from the online participants is not available to the in-office people. The participant explaining this said he had no idea where the online people were at on the discussion topic.

Less convincing input through Zoom

Through the division of the roles it was planned that a new idea would be brought to the table from both a Zoom and office participant. Both ideas were considered and elaborated on, but when asked afterwards about the participation type, physical or remote, it was noted that ideas from a remote participant are less convincing than from someone in the room, not taking the quality of the idea into account. Eye contact, body language and other communicative tools make a difference in delivery.

Also, when reflecting on the meeting, an online participant said he felt like he was not taken seriously. An in-office participant admitted this was actually the case. He said sometimes after the online participant had given an argument he would think to himself "whatever". This is not inappropriate behavior from this specific participant, it underlines the way remote participants are experienced and valued.

7.4 Conclusion

The main research question was:

1. Why is it hard for online participants to actively take part in the discussion?

The lack of involvement of online participants can be explained by two main factors: not feeling like an equal participant and not being able to act like an equal participant.
To solve the first one the remote participants should be given the feeling of being involved and valued. This could be achieved by changing the way they are perceived by the in-office participants and how their input is interpreted (output), or by changing the way the in-office discussion is experienced from an online perspective (input).

For the second factor it will be important to increase the amount of input and non-verbal communication tools for online participants. This way they should be able to express their opinions and insights, take part in the turn taking process without disturbing the conversational flow, and support their input with non verbal aspects such as body language.

The results of the research in this chapter show the problem of feeling like an equal participant is the bigger problem in this context. The online participants had enough moments to give their input, but it turned out they did not feel included and valued. This would mean the problem is not so much in interrupting and turn taking, but in the perception of their input and them as a person. The in-office participants explained the people on the screen felt less important and more like a helpline. Although the batch size of this research is small it should bring up the question if the problem is not so much related to the actual output, but more to the perception of an attendee.

7.5 Design goals

7. **The product should make online participants in a hybrid meeting feel involved / included.**
8. **The product should make online participants in a hybrid meeting feel like an equally valuable participant.**

9. The product should let online participants take turns in the meeting without interrupting the conversational flow.
10. The product should cause the in-office perception of online participants to be equally important to physical participants.

7.6 Design opportunities

- Giving every virtual participant his own individual presence in the room, instead of altogether on the same screen, could improve the feeling of being valuable.
- Showing the entire upper body of remote participants enables them to use body language.
- The audio volume of online participants in the conference room should automatically level to the sound produced by in-office participants, so everyone speaks with the same impact.
- A clear signal should be given to in-office participants that an online participant is about to say something. This way abrupt interruptions are prevented.

08

Design brief

8.1 Throughout the research phases design goals have been formulated. These design goals should all contribute to an effective solution. The key design goals are goal 5, 7 and 8. These are combined into a design vision.

8.2 All design goals

1. The product has to connect people from different locations in the office ecosystem.
2. The product has to create a quality experience in the office.
3. The product has to give the online participants in a hybrid meeting the feeling of being valuable.
4. The product should leverage the availability of the physical space in a hybrid meeting.
5. **The product should support the non-verbal communication lost in video conferencing.**
   - 5.1 The product should enable in-office and remote participants to make eye contact.
   - 5.2 The product should stimulate more eye contact or gaze towards the remote participants.
   - 5.3 The product should enable selective gaze for the online participants.
   - 5.4 The product should enable remote participants to use body language as a tool during the meeting.
6. The product should give a higher social presence for online participants.
7. **The product should make online participants in a hybrid meeting feel involved / included.**
8. **The product should make online participants in a hybrid meeting feel like an equally valuable participant.**
9. The product should let online participants take turns in the meeting without interrupting the conversational flow.
10. The product should cause the in-office perception of online participants to be equally important to physical participants.
11. The product has to offer an immersive experience through a USB product.
12. The product has to meet as many of the five characteristics of innovations as possible (Rogers & Marshall, 2003).
13. The product needs to be aimed at medium and large hybrid companies with high employee autonomy who frequently have interactive meetings with mid sized teams (4-10 people).
14. The product has to be introduced at medium sized Dutch companies in the target group that are inexperienced with hybrid working.

8.3 All design opportunities

- Different configurations of virtual and physical participants might influence the interaction.
- Increasing the scale of virtual participants could positively contribute to equal and natural conversation.
- Giving every virtual participant his own individual presence in the room, instead of altogether on the same screen, could improve the feeling of being valuable.
- Showing the entire upper body of remote participants enables them to use body language.
- The audio volume of online participants in the conference room should automatically level to the sound produced by in-office participants, so everyone speaks with the same impact.
- A clear signal should be given to in-office participants that an online participant is about to say something. This way abrupt interruptions are prevented.

8.4 Problem statement

The majority of companies will soon adopt the hybrid model, with employees working from different locations in the office ecosystem. With hybrid working come frequent hybrid meetings, which turn out to be a real struggle. Online participants are limited in their communication toolbox, creating a disadvantage in the meeting. They cannot make eye contact, use selective gaze or take advantage of body language. In addition they are experienced as distant or less powerful by in-office employees. As a result of the unequal participation in the meeting the online attendees feel excluded and unvaluable, resulting in a lower employee satisfaction or less remote working in the long term.

8.5 Vision

I want to develop a product **to be used in the conference room** that gives online participants in a hybrid meeting the **feeling of being involved** in the conversation and **being equally valuable** to the in-office participants. This will be done by **enabling and stimulating eye contact or gaze.**

The product should also create natural interaction between in-office and remote participants by enabling non-verbal conversational tools such as eye contact and body language.

Figure 19: Early adopter definition

09

Creating Solutions

9.1 With the design vision set in the previous chapter ideation, prototyping and experimenting will support the necessary steps towards a successful solution.

9.2 Method

Research questions

1. How can we realize the design vision (as set in chapter 8)? **(Main RQ)**

Approach

First all possible solution directions are discovered by doing brainstorming sessions. The ideas from the context mapping session from chapter 7 came to good use here. From all ideas the most promising ones were elaborated on or combined to create concepts. The effectiveness and feasibility of the core principle of each concept was validated through experimentation. Finally the concepts were rated with weighted criteria.

Figure 20: Telepresence in movies and series (Community, Modern Family, Kingsman)

Methods

HKJ's, Box Think, SCAMPER
Some of the tools used in the ideation sessions are HKJ's (How Can We's), Box Think and SCAMPER. These methods help explore new fields and ideas.

Weighted criteria
The concept that is best suited for the project goals can be found by using weighted criteria. The most important criteria are each given a weightfactor, and each concept is scored based on them. This numerical method can be used in combination with a more emotional gut feeling level.

Build Measure Learn
The Build Measure Learn cycle from the Lean Startup enables the best ideas from the ideation sessions to be tested and validated quickly. This causes ineffective ideas to be dropped, and effective ones to be recognized early on.

9.3 Solution areas

Different solution areas have been explored and solutions have been tested. The different solution areas are discussed here.

Frequency and quality of eye contact

In order to create a feeling of involvement by changing the context of the interaction we can use the findings from the hybrid meeting session in chapter 7. Here the assumption that the amount and quality of eye contact greatly influence the feeling of involvement will be used. First we need to validate this assumption, then we can start looking for ways to realize this in the meeting.

Eye contact in video conferencing
In order to test the effect of the frequency and quality of eye contact a quick experiment was set up (See Appendix 16.8 for full description). The participants were presented with 4 different videos; each showing 2 people sitting at a table. One of them is giving a pitch about a specific idea. The 4 videos each have a different amount of eye contact towards the camera (thus the online participant). One of the videos shows indirect eye contact, meaning the speaker looks above the camera, simulating the behavior seen in conference rooms where the camera is located below the screen. (See figure 21). At the end of each video the participants are asked to score their feeling of involvement in the meeting on a scale of 1 to 6.

Figure 21: camera location in conference rooms

The results of the experiment show that the video with the most eye contact got the highest score for feeling of involvement. What is also interesting is that the video with sporadic direct eye contact got a higher score than the one with frequent indirect eye contact. This reveals the power of quality eye contact.

Video number	1	2	3	4
Total eye contact duration	0	5	15	15
Type of eye contact	None	Direct	Indirect	Direct
Average score	**2.6**	**4.1**	**3.5**	**4.8**

Figure 22: Scores for all four videos

Now that we know more and better eye contact improves the feeling of involvement we can start ideating and testing ways to do this. Because the goal is to increase the feeling of involvement for online participants the focus will be on the establishment of eye contact between physical and virtual participants in the conference room.

Camera location and quality of eye contact
Conference cameras are used to show the people in the conference room to the people in remote locations. These cameras are continuously improved with higher quality footage and new features, such as auto-framing and -zooming. The placement of the camera in the room and the effect this has on the experience for the remote participants has however not been improved on. Does the location of the camera have an influence on the quality of eye contact? This was tested in a quick experiment. The full description of the experiment can be found in Appendix 16.9.

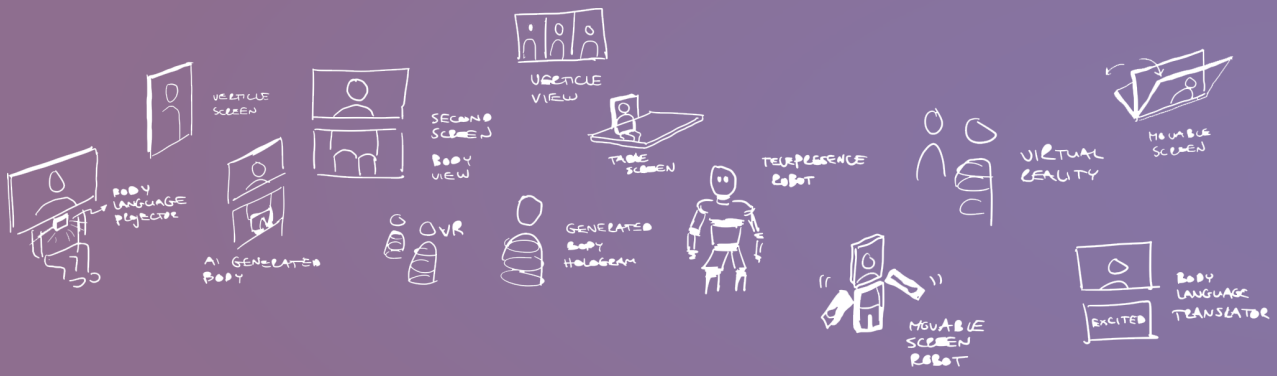
From the experiment we can conclude that the different placements of the camera do not have a significant effect on the involvement of the online participants. Positive impact can only be made with accurate eye contact, without any deviation. Achieving this requires either an under-display camera (which is complex, expensive and patented) or software (which is not my expertise, and already done by Apple) (See figure 23). Because of this, realizing accurate eye contact will be left out of the solution focus for now. Maybe more impact can be made with increasing the frequency of eye contact.

Figure 23: Facetime's attention correction (left: turned off, right: turned on)

Visual presence and body language

The way online participants are perceived in the office greatly influences the remote experience. Whether people frequently look at you or not, and how people respond to your input gives you a feeling of being valuable or not. Solutions that focus on improving the visual presence of online participants and the addition of body language have been explored and tested.

How Can We: improve the visual presence of online participants while adding body language?



The best ideas from the brainstorm are collected. The core principle of these ideas has been tested in two quick experiments.

Experiment 1: Body language in hybrid interaction
The goal of the first experiment was to experience hybrid interaction through the vertical telepresence screen and test the in-office experience. In the experiment a tv screen was placed vertically on a chair. A phone on a flexible mount on top of the screen gave the online person a first-person-view at the table. The experiment had one participant using the screen from a different room, and three participants sitting at the table. The full description of the experiment can be found in Appendix 16.10.

From the experiment it could be concluded that the in-office group enjoyed the product. They noted it felt like the remote participant was sitting at the table with them. The remote experience did however not see significant changes. Because the people at the table did not look straight into the camera, eye contact did not feel like a real connection. Another interesting finding was the amount of time and effort required to build this setup. Video conferencing software does not support vertical views, causing this setup to require additional devices to make this possible.

Experiment 2: Telepresence screen and non verbal communication
Another quick experiment was done to test the effectiveness of the non verbal communication transfer. The game "the Mind", which relies completely on non verbal communication, was played twice; once face-to-face and once with the screen. It turned out the screen did communicate non verbal communication well from the remote participant to the office, but not the other way around. The full description of the experiment can be found in Appendix 16.11.

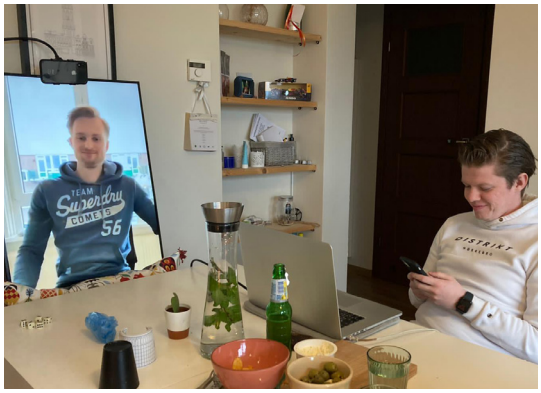


Figure 24: Telepresence screen

Figure 25: Virtual participant in The Mind

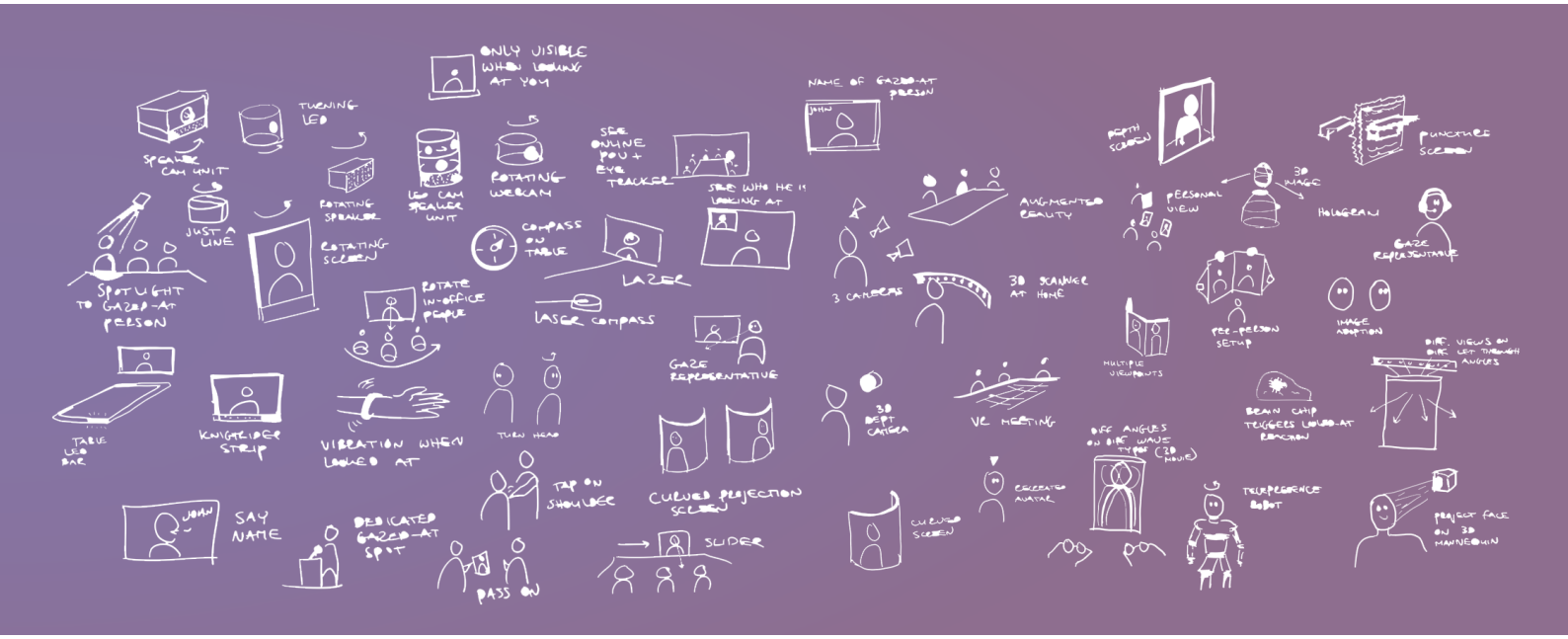
Selective gaze

Earlier in chapter 6 the absence of selective gaze in video conferencing was highlighted. Selective gaze plays a large role in group dynamics, and its directional factor supports the value that eye contact carries with it. Supporting selective gaze from the online participants in the conference room could be a valuable addition to their communication toolbox.

How Can We: communicate the gaze direction of the online participant?

The best ideas from the brainstorm are collected. The core principle of these ideas has been tested in a quick experiment.

Experiment 1: Effect of directional audio and gaze
An experiment was set up to test the effect of directional information, such as audio and gaze. The result was surprisingly positive; if the indicator of the gaze direction was pointing in your way while the person on the screen was speaking this felt like being spoken to.



The directional audio made it sound like the person on the screen is turning his head while speaking, but had less impact when aimed at you. The full experiment is described in Appendix 16.12.

Experiment 2: Projected selective gaze
Another way of communicating the gaze direction of an online participant is by moving the projection. When projecting on a curved surface while rotating the beamer, the impression of that person turning and looking around is created. The effect of this principle was tested in a quick setup. It turned out to be pleasant, because it created a more natural source of information (compared to the previous experiment). Naturalism appeared to be coming with a decrease in impact. The image was less effective in creating that valuable 1-on-1 connection with someone at the table. The full description of the experiment can be found in Appendix 16.13.

Figure 26: Directional gaze tests

Figure 27: Projection on curved surface

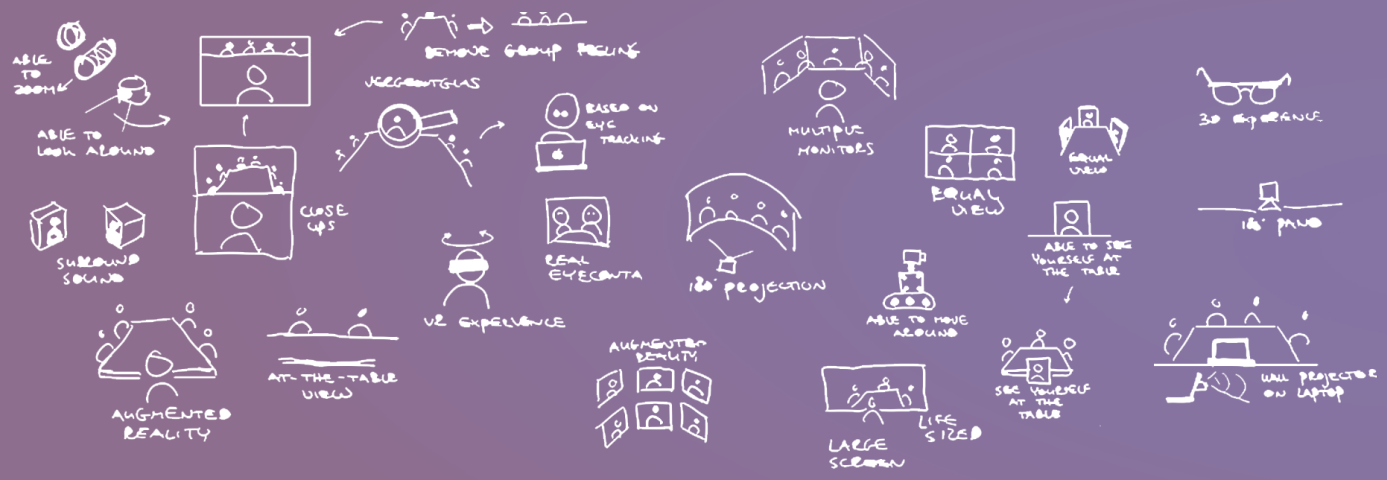
Remote experience

The online participants that feel excluded from the meeting experience this from their home, or other location in the office ecosystem. Maybe this feeling can be improved by focusing on the way the meeting is experienced from a distance.

The solution area of physical products in the home office has been left out of consideration, because this would require a company to buy tens, hundreds, or thousands of products.

view. This makes it easier for the online participants to see everyone at the table, while feeling as if you are sitting next to them. This product was tested in a simulated meeting to evaluate the unique experience.

Joining a meeting through the Panacast was nice and felt natural. The impact is however limited, it is an improvement on one of the sources of information already supported: video and sound. The goal of this project is to bring back lost information, making this solution direction unsuitable.



This makes solving the problem a large investment. Also the interviews earlier in the project revealed that only a small portion of companies offer their employees a monitor and office chair for at home. In addition to that it was noted that additional equipment to this is considered the employee's responsibility.

How Can We: Improve the remote experience in hybrid meetings?

The best ideas from the brainstorm are collected. The core principle of these ideas has been tested in two quick experiments.

Experiment 1: Different video conferencing layouts
Because the remote experience needs to be improved, while using the current home office equipment in place, the layout and view-type of the in-office group is one of the most impactful factors. By editing a conference camera view in Photoshop different configurations were explored. The modifications did not show great potential.

Experiment 2: The panoramic experience
A good example of a product that focuses on improving the remote experience is the Jabra Panacast. This is a webcam equipped with three cameras and a real-time stitching software, creating a 180 degree panoramic

Figure 28: Different video call configurations

Figure 29: Jabra Panacast tested

9.4 Conclusion

The main research question was:

1. How can we realize the design vision (as set in chapter 8)?
The design goal can be realized by communicating the gaze direction of online participants to the conference room.
The second option is by creating a higher visual presence for online attendees, while supporting their body language. How these solutions have been developed into concepts can be seen in the next chapter.

10 Concepts

10.1 From the ideation sessions three concepts were created. Here the concepts are described, and the decision with which one to continue is made.

10.2 Method

Research questions

1. Which of the 3 concepts will be chosen? **(Main RQ)**

Approach

Three different concepts have been created to consider different ways of meeting the design goals. They will be scored using weighted criteria.

Methods

Weighted criteria
Weighted criteria allow for objective consideration of different concepts. It forces you to prioritize what is most important for the solution to be achieved. It gives an overview of the potential of each concept, which can sometimes differ from your initial gut feel.

10.3 Criteria

1. Start-up potential (Weight: 3)
The goal of this project is to finish with a proof of concept that can be used to build a company with. This means the concepts should be scored on startup potential factors, which are:

- Competitive advantage
  - Can this product be patented?
- Resources
  - Can this be made by me and as a startup?
- Competition
  - How competitive is this product category?
- Future plans
  - Can this grow into something big?

2. Scalable (Weight: 3)
Growth is the most important factor in a start-up. If the solution is not easy to scale it does not offer the opportunity to grow and make an impact.

3. Natural (Weight: 2)
The solution should support the way people naturally communicate. It should not force or limit specific behavior. The problem should be solved by improving where the communication comes short, instead of reducing where rich communication creates a large difference between the two categories of participants.

4. Effective (Weight: 1)
The core principle of the concept should create an as big as possible positive impact on the equality and dynamics in a hybrid meeting. The bigger the impact the better.

5. Affordable (Weight: 1)
The goal is to shape the future of work by unlocking the potential of hybrid meetings. This can only be done if the product can be afforded by as many companies as possible.

The concepts are no high level concepts yet, some might even interpret them as ideas, this is done intentionally. Since the goal of this project is to end with a proof of concept, the concept choice needs to be made as early as possible. This means enough information about the project goals and the qualities of the concepts are gathered for a well considered choice. Bringing the concepts to a higher detail level will most likely result in the same concept choice, with valuable time spent on doing so. The chosen concept will be further detailed.

CONCEPT 1

Vertical screens enable body language and give every online participant an individual, lifesized presence at the table.

10.4 Concept 1

In short

Vertical screens enable body language and give every participant an individual life size presence at the table.

Description

Concept 1 aims to create an equal visual participation in the meeting for the online attendees. Instead of being small images on the screen on the wall they **sit at the table**, each on their **individual screen**. Having your own screen allows for natural interaction, because people in the office have to turn their heads to talk to different participants. It also allows for more non verbal communication coming through, because people can see you in their peripheral view even when you are not talking. The screens are positioned vertically to add **body language** to the communication. This gives people in the office more information, and enables the person on the screen to express more emotions and support his arguments better. The vertical screen also allows for **life-sized representation**. This makes it easier for in-office participants to pick up non-verbal information, and creates an equal perception of power. This perception is also achieved by the individual screens each having their own territory at the table, just like the in-office participants.

Because each screen has its own webcam mounted on top of it every online attendee has his/her own point of view. This would be the same if you are joining the meeting in real life, it is not natural to share a point of view with other people. Even if the eye contact is not pure, because of the distance between the eyes on the screen and the webcam above it, you would know someone is making a connection when that person is looking your way.

The placement of the screens around the table is flexible, but the recommended configuration is screens on one side with local employees on the other. This is found to be the best configuration for hybrid communication, resulting in balanced turn taking and the best feeling of unity (Vertegaal & Ding, 2002).

CONCEPT 2

The gaze direction of the online participant is tracked through eye tracking software, and converted to a 3D indicator in the conference room.

10.5 Concept 2

In short

The gaze direction of the online participant is tracked through eye tracking software, and converted to a 3D indicator in the conference room.

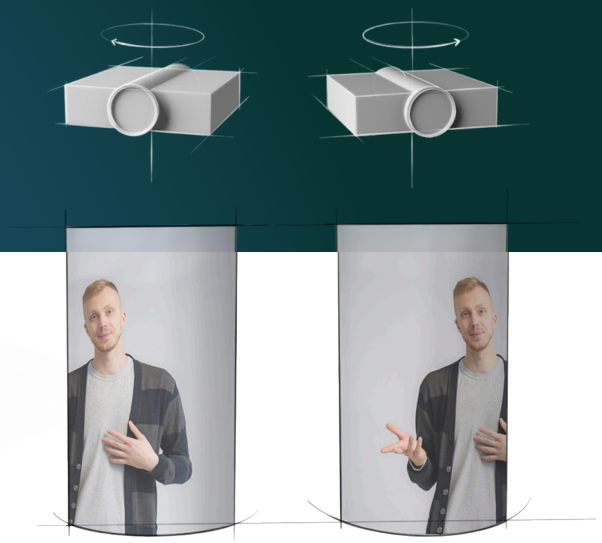
Description

Eye contact and gaze are the most important pieces of information in communication. They are however also still the biggest shortcomings in video conferencing. Concept 2 taps into the advantages of eye contact and gaze by creating artificial eye contact, with the use of a simplified eye representative in the office.

What makes eye contact so powerful is that you can only share it with one person at a time. The **three dimensional product** enables this directional value of gaze to maintain its impact during the information transfer in the video conferencing setup. The artificial eye creates a **unique connection** similar to eye contact: both parties being aware of being the centre of the other's attention. Also, by communicating the gaze direction, known as **selective gaze**, of the online participant to the conference room, group interaction improves (Taylor & Rowe, 2000) and turn taking frequency increases (Vertegaal, 1999). This unlocks the potential of hybrid meeting dynamics. The product also creates more attention towards the remote participants (Colburn et al., 2000) and causes a higher feeling of co-presence (being together) in the office (Garau et al., 2001). Because the in-office group perceive the online participants as being there more, while being able to create that powerful 1-on-1 connection, the attitude towards online attendees will improve.

CONCEPT 3

The online participant is projected on a curved semi transparent surface. By rotating the projection direction the gaze direction changes in a natural way.



10.6 Concept 3

In short

The online participant is projected on a curved semi-transparent surface. By rotating the projection direction the gaze direction changes in a natural way.

Description

Concept 3 makes use of a projector and a curved projection screen to produce **natural selective gaze**. Through eye tracking software it is captured who the remote participant is looking at in the conference room. This information is then translated to the direction of the projector, which can rotate around a vertical axis. The projector screen gives every online participant his/her own **individual screen** in an **at-the-table configuration**, securing an equal space to in-office participants. The height of the screen allows for **body language** to be visual, in combination with a **life sized** representation to improve the information transfer.

The curved screen also makes the placement around the table more flexible. If the screen is sitting in between two in-office participants at the same side of the table they will still be able to see the online participant projected on it.

10.7 Concept choice

When choosing what concept to continue with, weighted criteria were used to score them. The criteria are described at the beginning of this chapter. The scores can be found below, and are explained in Appendix 16.14.

Concept	1	2	3
Startup potential	2	5	5
Scalable	3	5	2
Natural	4	2	5
Effective	4	3	5
Affordable	3	4	2
	30	41	38

Figure 30: Scores for all four videos

10.8 Conclusion

The main research question was:

1. Which of the 3 concepts will be chosen?

Concept 2 has the highest score and proves to be the best fitting solution in the context of this project. The choice also matches my personal beliefs and motivation. Concept 2 will be the concept to further test and develop.

11

Concept detailing

11.1 Now that the concept is chosen further detailing of it can be done. The goal is to create a clear overview of what the product will look like, how it works and how it is used. The product will not be production ready after this, but all use and product aspects should be worked out. First the use of the product is detailed, then the product decisions are explained.

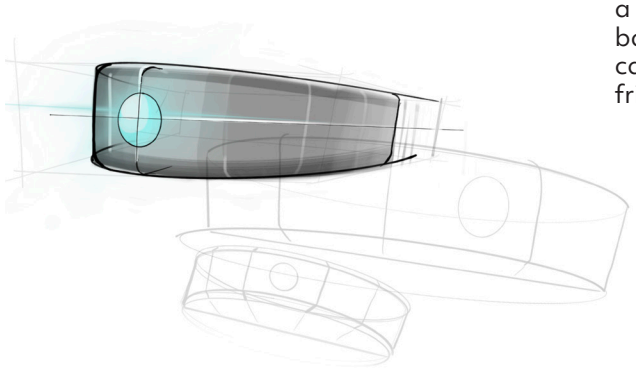
11.2 Method

Research questions

1. What effects from literature are experienced by users? **(Main RQ)**
2. What will the indicator look like? **(Main RQ)**
3. What will the product look like? **(Main RQ)**
4. What will the use of the product in the office be like? **(Main RQ)**
5. What will the use of the product from a remote location be like? **(Main RQ)**
6. What components will the product exist out of?

Approach

Detailing of the concept contains many aspects that need to be considered. Because of the limited timespan of this project it is important to focus on the most important ones. To figure out what aspects are most important the detailing is done through testing and iterating. By testing prototypes with users you find out what they think is important, and what is not. Explaining the concept to others, such as this project's supervisors, also reveals what aspects remain unclear and thus need more explaining.



Hypothesis

1. The effects from literature research mentioned in paragraph 10.5 will be experienced by the users of the product.

See 11.16 for the results of the experiment.

Methods

Build Measure Learn
The Build Measure Learn cycle makes sure the product's use and values are not based personal beliefs or assumptions, but on real life validation.

11.3 Placement mechanism

Location

The product is placed in the center on the top of the screen. This has proven to be the most effective location, since it is inside the field of view of the people looking at the screen. The eyes of the person on the screen are often located in the top half of the screen, and this is where people are looking during interaction with this person.

Mechanism

The clamping mechanism used to secure the product on top of the screen in the conference room is based on the one used in many webcam designs. A leg component can be rotated away from the housing, creating a support that can be placed against the back of the screen. This leg has a rubber top, causing a firm enough placement through friction.

11.4 Indicator system

The indicator is a fundamental component in the product. It represents a part of the online participant and communicates important information to people in the room. Different indicator types and systems have been considered, some of the considerations are discussed here. The choices already made are:

- **The indicator is a visual dot**

This creates an abstract representation of the eye. A realistic representation can be considered as creepy.

- **The main component is a lightsource**

This offers the desired flexibility in adjusting the brightness, color and size.

- **The dot needs to be bright and at least 20 mm in diameter**

If the indicator is too subtle the in-office participants can miss that they are being looked at by the remote participant, as was found in the experiment with the first prototype (Appendix 16.15). Also, the information has to be received without constantly paying attention to the indicator.

System criteria

- The indicator should be able to accurately point to a person in the room.
- The indicator should be an affordable component.
- The indicator should be a robust component that will not easily malfunction.
- The indicator should be adjustable in size, color and brightness.
- The indicator should create a clear visual dot representing the eye.

Components

When creating an indicator that can point to different directions two types of systems can be considered: mechanical and optical. Mechanical systems move one indicator, while an optical system makes one of the indicators visible according to the direction that has to be communicated. The components that can be considered in both systems are researched and listed in Appendix 16.18.

Indicator systems

These components have been used to create different ideas for the indicator. These ideas have been prototyped and evaluated in order to use the best fitting system configuration. The prototypes and tests can be found in Appendix 16.19.

System choice

The decision for the indicator system was made based on the criteria listed earlier in this chapter.

Accuracy
The most accurate systems are system 1 and 3 due to the stepper motor. With the right amount of LEDs system 2 will also provide a satisfactory accuracy.

Affordability
System 2 is the cheapest option, using only LEDs to make the system work. The high amount of LEDs can be slightly more expensive than the stepper motor in the other systems, but the extra (movable) parts that are needed there make the total price higher.

Robustness
System 2 is also the most robust system, not making use of any mechanical components. Mechanical components are more likely to malfunction or depreciate over time. The indicator in system 3 creates a fragile external component.

Adjustability
The systems offering the most flexibility are system 2 and 3. Multiple LEDs create the possibility to variate in indicator size and color.

Clear visibility
System 2 and 3 are able to create a bright and defined dot on the product. System 1 is not able to produce a beam that is narrow enough for this.

When taking all criteria into account system 2 comes out as the best indicator system. Some further decisions that were made in the detailing of this system are discussed next.

System 1: Central spot

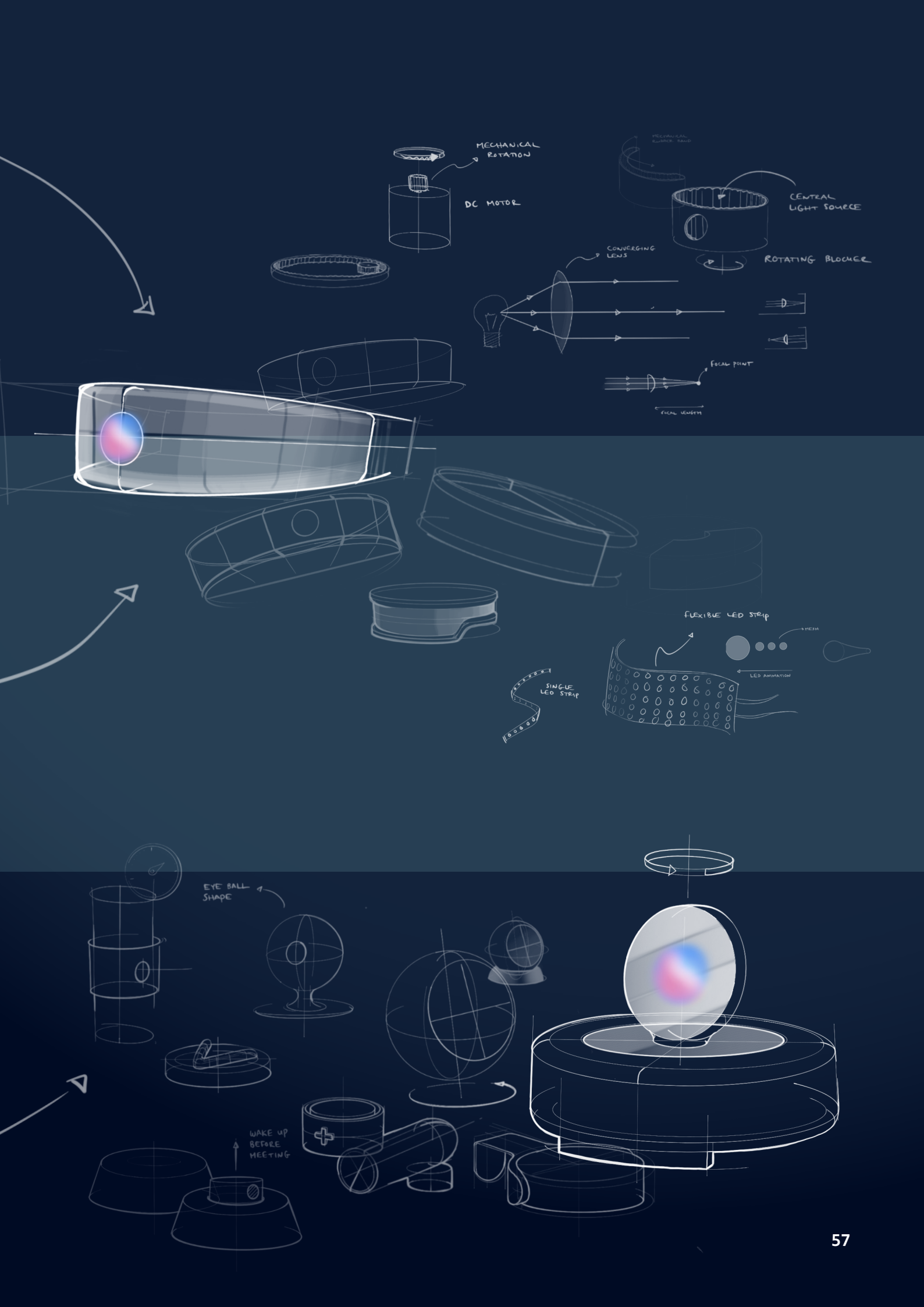
With a centralized LED the indicator can be rotated accurately with a stepper motor, in steps of 1.8 degrees (“Stepper Motor”, 2021). The light beam has to be narrow to create a defined dot on the front of the product. When a LED is placed at a distance from the wall a high brightness is needed. When using a very bright LED a heatsink has to be used to distribute the heat, which increases costs and complexity. Secondly the beam, created with an LED and convex lens, is not narrow enough to create a bright dot on the front of the embodiment.

System 2 LED strip

The LED strip system doesn’t require any moving components, but does need a high amount of LEDs. The higher the amount, the more accurate the indicator becomes. Increasing the radius of the front curve of the product gives more space for more LEDs. This is however limited by the maximum product dimensions and the costs that come with the LEDs. The LEDs need to be individually addressable and need to have an RGB spectrum. WS2812B LEDs do exactly this.

System 3: Rotating jewel

Using a centralized LED jewel (LEDs in circle configuration) outside of the main embodiment eliminates the need for a light source that generates high amounts of heat, and does not require a high amount of LEDs. The main embodiment is used to store the core components, such as the PCB. The indicator has to be connected to the main embodiment while being able to rotate.


MECHANICAL ROTATION
DC MOTOR
CENTRAL LIGHT SOURCE
ROTATING BLOCKER
CONVERGING LENS
FOCAL POINT
FOCAL LENGTH
FLEXIBLE LED STRIP
MESH
LED ANIMATION
SINGLE LED STRIP
EYE BALL SHAPE
WAKE UP BEFORE MEETING

11.5 Indicator detailing

The main topics in detailing the indicator are the LED amount and placement, and the components needed to create a clear and even dot.

LED configuration

The amount of LEDs influences the accuracy of the indicator and the cost price of the product. The ideal amount of LEDs is as low as possible while creating sufficient accuracy. To calculate this amount a drawing of the top view of a use scenario was made (see figure 31). This sketch uses a frequently seen configuration of the conference room together with the expected dimensions. This sketch revealed that the two LEDs that need to be the closest to each other, for an accurate indicator in a meeting with 7 people, is 9 mm (from center point to center point). The LEDs are 5.4 mm each, meaning a space of 3.6 mm is needed in between each LED (Alibaba, z.d.). The front face of the product will need 27 LEDs from side to side.

For larger meetings a bigger version of the product can be made. More people in the room means that the indicator has to become more precise, which can be done by increasing the amount of LEDs. In a larger meeting room the indicator needs to be larger too, so people in the back can see it well too. The same principle can be seen with monitors in conference rooms, which are larger when the room is bigger.

The LEDs will be placed in 3 rows, bringing the total amount to 81 LEDs. One LED costs 5 cents, bringing the total to €4,05. The choice for 3 rows is made because of the required size of the indicator dot. In figure 32 the difference between using 1 row and 3 rows can be seen.

Components

The components needed to create the dot as seen in figure 32 are LEDs, a diffuser and a display material. This combination of components can be found in the Apple Homepod. This and other indicators found in well known products are researched in Appendix 16.17. The diffuser is a translucent plastic that lets through light, while also diffusing it. Because of this the light from multiple LEDs is blended, you won't be able to see the exact location of the hidden LEDs anymore. The display material is a thin plastic that lets through the diffused light and creates the front face of the product.

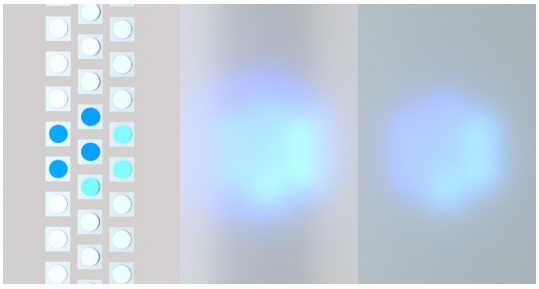


Figure 33: LEDs, diffuser and display material

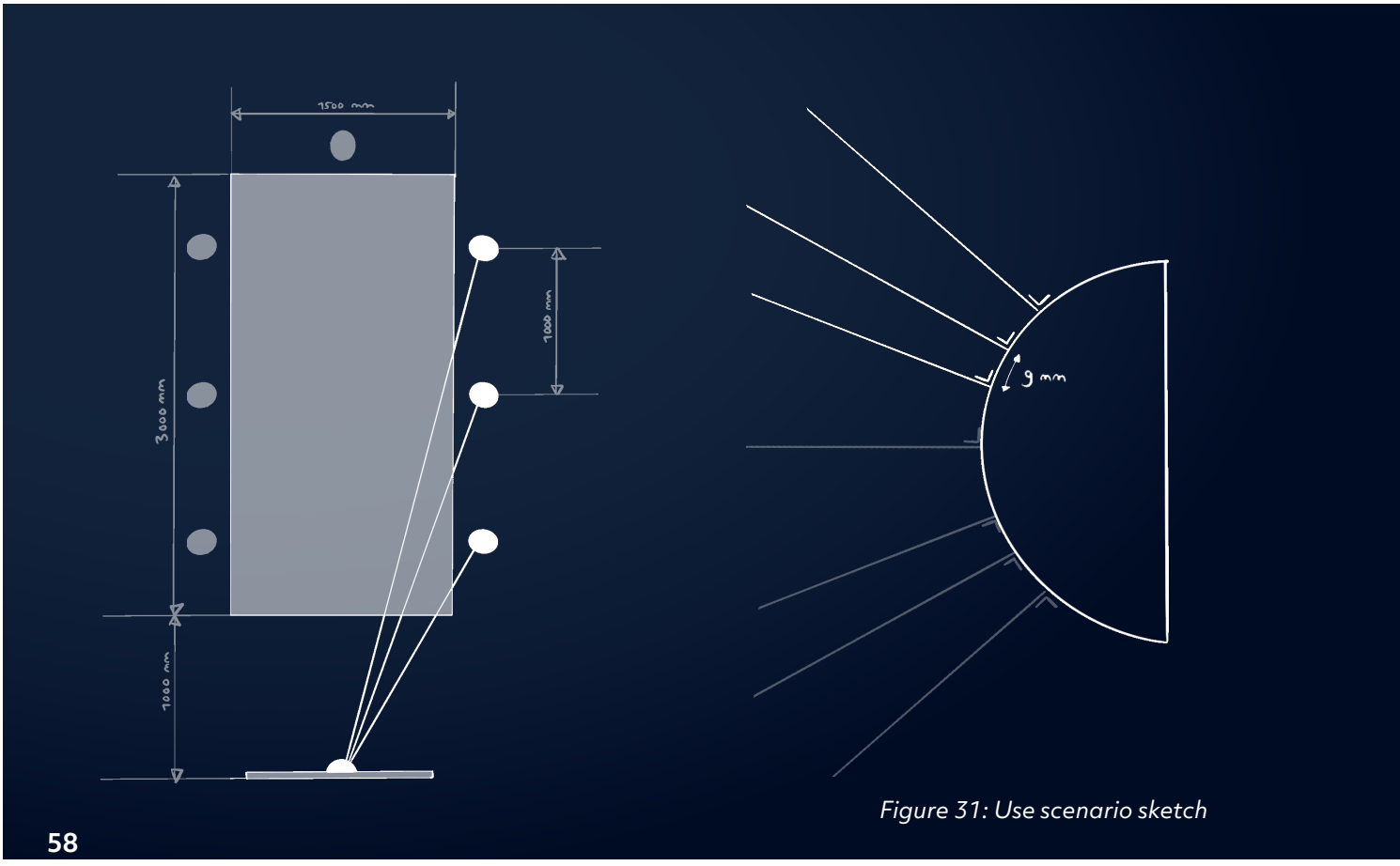


Figure 31: Use scenario sketch

Single feature

The product currently has just this indicator, no additional tools. Interesting additions to the product are directional sound and a camera, but it has been decided to keep these out of the first version. Entering a market as big and competitive as the video conferencing market should be done strategically. Leaving audio and video out of the functionalities for now prevents the product from competing with a camera from Logitech or a speaker from Jabra. It can easily be added to existing conference rooms, without having to replace the current equipment, creating a lower hurdle for new customers.

11.6 Embodiment

The current housing design can be seen in figure 34. This design was chosen because it suits the product's context and functionality best. The product has to be corporate, and should match the other products in the conference room. At the same time this product stands for a new dimension in hybrid meetings, namely the directional factor of communication. This means the product should show it is special and valuable.
The product and the indicator also have to look friendly. Most of the time meetings have a friendly nature, so the product should not interfere with that. The mood board used for the design of the embodiment can be found in Appendix 16.20.

11.7 Components

Software

The software component of the product enables the remote user to communicate his gaze direction through passive control of the physical indicator in the office. The software is active on the remote participant's computer.

Hardware

Microcontroller
The most important hardware component is the microcontroller. This chip receives the instructions which LED should be turned on, and executes it.

WiFi chip
The WiFi chip enables the product to receive the eye tracking data without being physically connected to a computer.

LEDs (81x)
The WS2812B LEDs are the visual expression of the gaze direction. Which LEDs on the strip are turned on communicates which direction the online participant is looking.

Power cable
The AC DC power adapter supplies the hardware components with 5V power through the power cord. It can be plugged in a wall outlet. The length of the cable is 5 meters, making it easy to bridge the distance between the screen and the nearest socket.

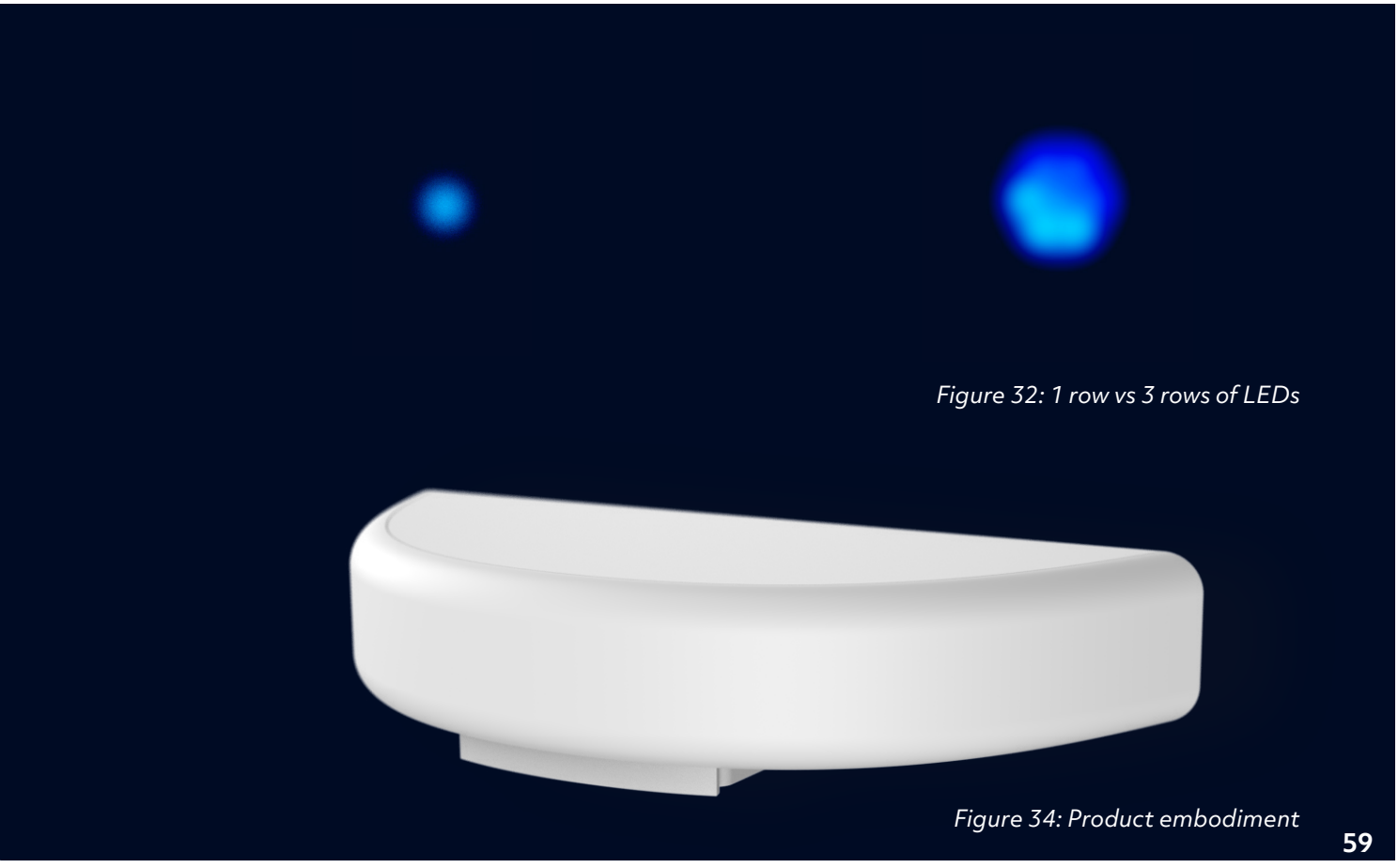


Figure 32: 1 row vs 3 rows of LEDs

Figure 34: Product embodiment

11.8 Costprice

With all components known a cost price and retail price estimate can be made. For this the cost price calculation sheets by Thomassen (2013) were used. The retail price comes down to approximately 300 euros, when a production batch of 5000 units is made. The complete collection of calculation sheets can be found in Appendix 16.22. Because the product is not production ready yet, this price remains an estimation.

Production cost price		€101,79
Overhead costs company	15%	€12,00
Overhead sales costs	5%	
Profit margin	25%	
Total factor	50,9%	€51,85
Factory price		€165,63
Margin brokers	30%	€49,69
Wholesale retail price		€215,32
Margin webshop	25%	€53,83
Netto retailprice		€269,15
Taxes	21%	€56,52
Retail price		€325,68

Figure 35: Cost price calculation

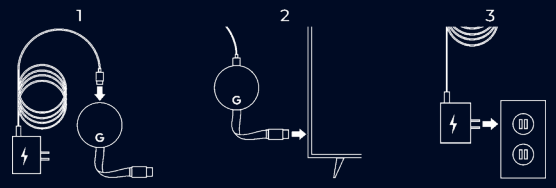
11.9 In-office use

The product has two types of users; the users in the office and the ones in remote locations. The in-office users use the product by receiving the visual information that the indicator gives about the online person. The users in the office are also the ones that install the product.

Use instructions

The product will automatically turn on when a remote user connects to it. After the meeting, when all users disconnect, the product will go back into sleep mode. When the product is in sleep mode its power usage is greatly reduced.

The first time the product is installed it has to be connected to the office WiFi. The system receives eye tracking data through the internet, so this is crucial to its function. The connection steps are explained through the web browser on a laptop or phone. This customer journey is similar to that of a Google chromecast.

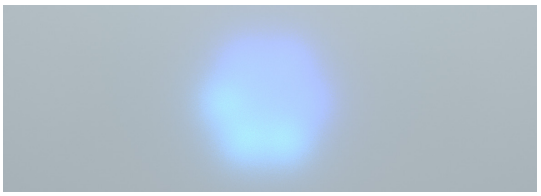


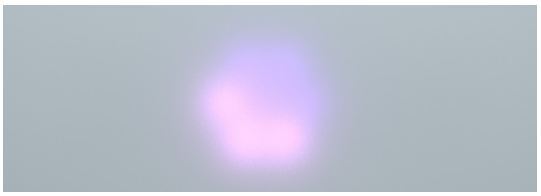
Indicator on and off

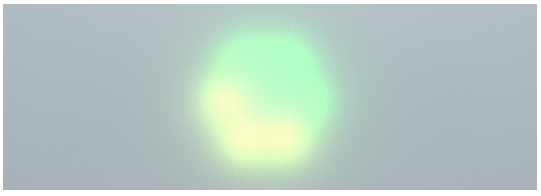
The indicator is not on all of the time, it only turns on when an online attendee speaks and stays on until he or she is done speaking. This is because an indicator that is always on can result in a constant awareness for the remote user that people can see what he or she is looking at. Online meetings have already proven to be more energy draining than face-to-face meetings, as was found in chapter 2, because of the constant awareness of being visible. Leaving the indicator on at all times could increase this effect, which does not align with the goal of empowering the online participants.

Taking turns

When multiple remote participants are connected to the product during a meeting the gaze direction of the online person currently speaking will be visible. To make clear that different users are controlling the product different colors can be used. Each online participant is automatically assigned a color when connecting to the product.







11.10 Remote use

The other category of users are located anywhere outside the office building, in the office ecosystem. They connect to the product through an internet connection and control the indicator by just looking at the people on the screen.

Eye tracking application

These users use the product by running the eye tracking application on their computer while enabling access to their webcam. The customer journey of someone using this application is similar to that of Mmhmm (a video presentation tool). You download the software on your computer. The software is recognized as a separate webcam by the video conferencing software (being Zoom, Teams, and more). By switching to the new webcam the eye tracking functionalities are enabled. For this to work the software needs to be running in the background. If the user did not yet start up the software, the webcam preview will tell it to do so (see figure 36).

Calibration

Before the meeting starts the eye tracking needs to be calibrated. This is done by looking at different dots on the screen while moving your mouse over them (see figure 37). This needs to be done before every session, but will only take about 10 seconds. It might be possible to make calibration unnecessary eventually, for example with the use of machine learning to improve accuracy.

Positioning

If during the meeting the head of the remote user significantly changes position this can negatively affect the accuracy of the eye tracking. When this happens the software will notify the user of this by showing the preferred location for the eyes within the frame (see figure 38). If the eyes cannot be tracked, due to bad lighting or sudden movement for example, the indicator in the office will show a small blinking dot until the problem is resolved. The indicator shows this small blinking dot in the center to communicate to the in-office people that no gaze direction can be shown, but the system is working properly. If the indicator would turn off instead, this could give people the idea that the product is broken or malfunctioning.

CPU power

The eye tracking software is not expected to require a high percentage of CPU usage. By using the activity monitor on a Macbook the usage of similar applications was measured. The web based eye tracking software from RealEye (2017), which has a similar functionality, takes up about 5% of CPU usage. The application mentioned before, Mmhmm, demands a 50% CPU usage, which is about the same as a Zoom meeting does. Its functionality is not similar to, and more extensive than, the eye tracking, but the form of the application is (activation through webcam settings in video conferencing software). With these results taken together it is expected that the CPU usage of the eye tracking will not be a problem.

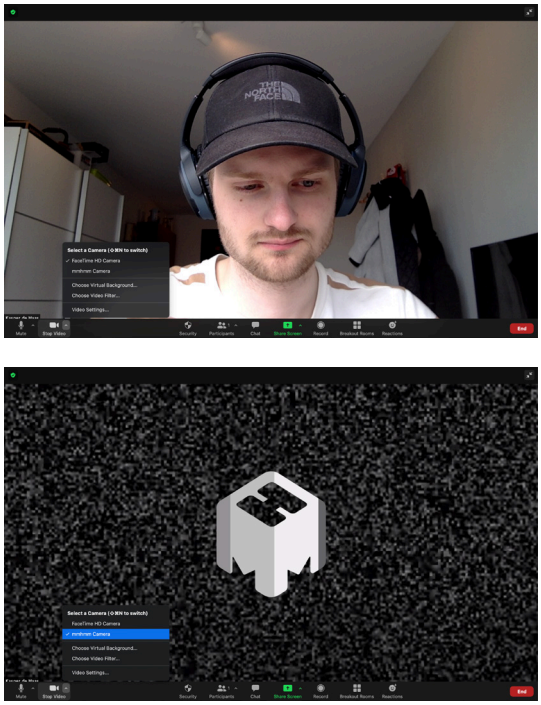


Figure 36: Use the software (top: select the new camera. bottom: application not yet running)

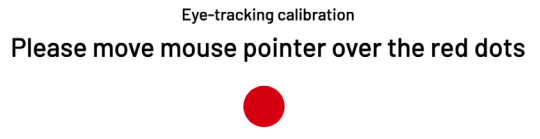


Figure 37: Eye tracking calibration

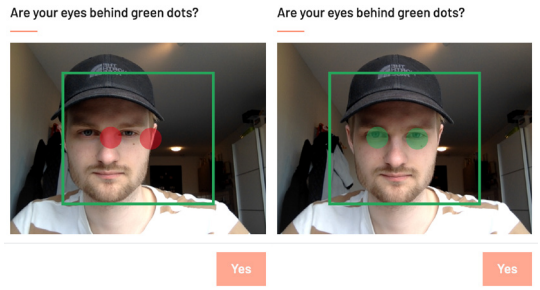


Figure 38: Eye location reminder

11.11 In-office effects

The goal for the indicator is to evoke similar effects to face-to-face eye contact. In chapter 6 the effects from the literature research were already discussed. Here the list of effects for the in-office users is expanded through research and testing.

Effects literature research

- Interaction improves (Taylor & Rowe, 2000)
- Turn taking frequency increases (Vertegaal, 1999)
- More attention towards remote participants (Colburn et al., 2000)
- Higher feeling of co-presence in the office (Garau et al., 2001)

Effects literature research

- Feeling of being addressed
  - This effect was validated through experimentation with the first version of the prototype. The full description of the experiment can be found in Appendix 16.15.
- Increased self awareness
  - This result also comes from the experiment in Appendix 16.15.
- Attention confirmation
  - This effect was found in the second experiment, using the second version of the prototype. The full research paper of the research can be found in Appendix 16.16.
- Handing out turns
  - When an online participant is asking a question, the direction of the indicator was experienced as a tool for handing out turns in the office (research Appendix 16.16). This effect of handing out turns is found to be caused by eye contact, as described in chapter 6.

All of these effects can also be found in literature on face-to-face eye contact. This shows the simulated gaze, created by the product, successfully triggers similar effects in interaction. For now it can be assumed that other benefits and effects caused by eye contact could be recreated by this product as well. Future research will have to validate this.

11.12 Remote effects

Here the effects for the remote users are listed. Again, the existing list of effects from literature research are expended.

Effects literature research

- Feeling more valuable
- Not breaking conversational flow

Effects literature research

- Interaction improves (Taylor & Rowe, 2000)
- Turn taking frequency increases (Vertegaal, 1999)
- More attention towards remote participants (Colburn et al., 2000)

11.13 Functional prototype

During the project different prototypes have been built and tested. The goal for this project, as agreed on in the mid-term meeting, is to deliver a proof of concept. This means the core principle of the product is proven to work. For this product the core principle is controlling a directional indicator through eye tracking. This technology has been successfully built using an Arduino Uno Wifi in combination with Python. The three LEDs turn on and off according to which direction the user is looking; left, right or center. The LEDs will only turn on when the remote user is speaking. The different versions of the prototypes throughout the project can be seen in figures 39 - 42.

Figure 39: Prototype v1

Figure 40: Prototype v2

Figure 41: Prototype v3

Figure 42: Prototype v4

11.14 Followup research

Within the boundaries of this project only a limited amount of research could be done. If the development of the product continues after the graduation deadline, these are the tests that would be valuable to do next. These followup recommendations are listed below and briefly supported in Appendix 16.21.

- Is the indicator accurate enough?
- What do different visual indicators do with the perception of the remote participant?
- How to nudge attention to online participants?
- Can we create more nuance in turn taking?
- Should the technology be implemented in a conference camera?

11.15 Conclusion

The main research questions were:

1. What will the indicator look like? (Main RQ)
The indicator is a colored dot on the front face of the product, which consists of 7 WS2812B LEDs spread over 3 rows. Different colors can be used to communicate the gaze direction of different remote users in the meeting.

2. What will the product look like? (Main RQ)
The product has an embodiment that is corporate, valuable, and friendly.

3. What will the use of the product in the office be like? (Main RQ)
The product is placed on top of the monitor in the conference room using the clamping mechanism. The product is connected to the office WiFi, and will automatically turn on or go to sleep mode depending on whether a user is connected to it or not. During the meeting the indicator will only turn on when the remote user is speaking, making it easy for multiple remote users to share the product.

4. What will the use of the product from a remote location be like? (Main RQ)
The indicator on the product is controlled by the data collected through a software application on the remote user's computer. The software is running in the background during the meeting and tracks the gaze direction of the eyes.

11

Concept detailing

11.16 Experiment 3

Experiment 4	Does the product work?
I believe that	The MVP improves the hybrid communication between coworkers in different locations.
In order to test I will	Perform a user test in which the prototype is used in a hybrid meeting.
And measure	The feedback and experiences mentioned in the discussion afterwards.
I'm right when	The participants mention some of the effects from the literature research.

Result

Different experiments and user tests were done with different versions of the prototype. Afterwards the experience was discussed.

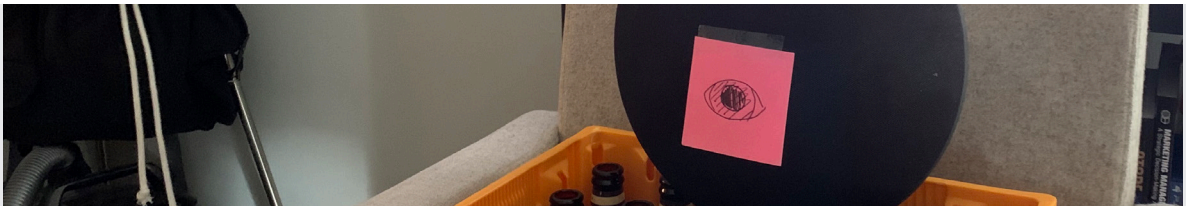
The following experiments were performed:

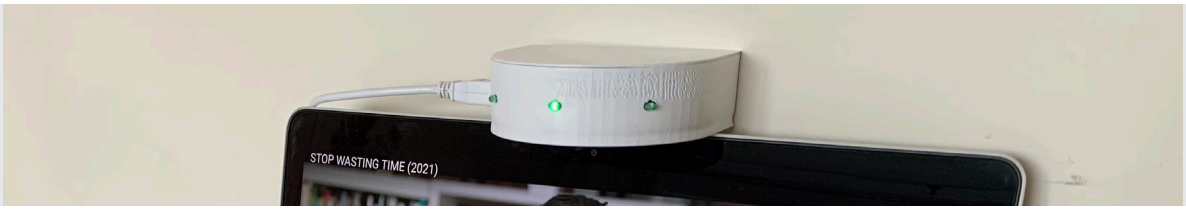
- Experiment with ad hoc prototypes. 2 Participants. (Appendix 16.12)
- Experiment with first prototype. 3 Participants. (Appendix 16.15)
- 2 User test with second prototype. 8 Participants. (Appendix 16.16)
- Pilot with final prototype. 4 Participants. (Appendix 16.24)

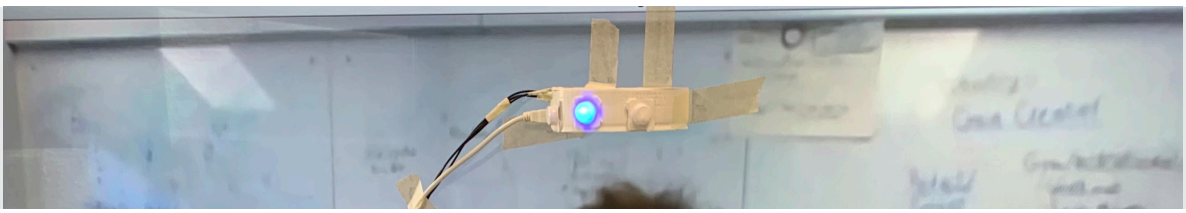
When a participant mentioned an effect that is also found in the literature research on eye contact and selective gaze, this is used as validation.

The validated effects of simulated eye contact are:

- Increased self-awareness when being looked at. (As found by Jarrett, 2017)
- Verbal interaction closer to face-to-face communication. (As found by Vertegaal, 1999)
- Better experience for in-office participants. (As found by Vertegaal, 1999)
- Attention confirmation. (As found by Holler et al., 2006)
- Gaze as tool for handing out turns. (As found by Auer, 2018)
- Better connection with online participants. (As found by Garau et al., 2001)
- More attention towards online participants. (As found by Colburn et al., 2000)




STOP WASTING TIME (2021)



12

Evaluation

12.1 Whether the product presented in the previous chapter can be considered a successful solution depends on different levels of evaluation. In the next chapter the last important evaluation will be done: a pilot round with a company.

12.2 Method

Research questions

1. Does the product meet the requirements? **(Main RQ)**
2. How does the product score on the rules of Innovation Adoption?

Approach

In this chapter the product will be tested with the list of requirements, the rules of innovation adoption and a payment intent experiment.

Methods

Pugh's checklist for generating design requirements (Boeijen et al., 2014). This checklist helps generate a complete list of requirements.

Checklist from "Productontwerpen, structuur en methoden" (Roozenburg & Eekels, 1998)

14.3 Requirements

The list of requirements states all requirements that the product should meet. Now that the product has been developed into a conceptual state (not production ready), it can be scored on some of the criteria matching this stage. The list of requirements can be found in Appendix 16.23. Because the product is in an early development phase most requirements are not numerical and have not been validated yet. The below overview shows what criteria are met, and which ones cannot be tested yet.

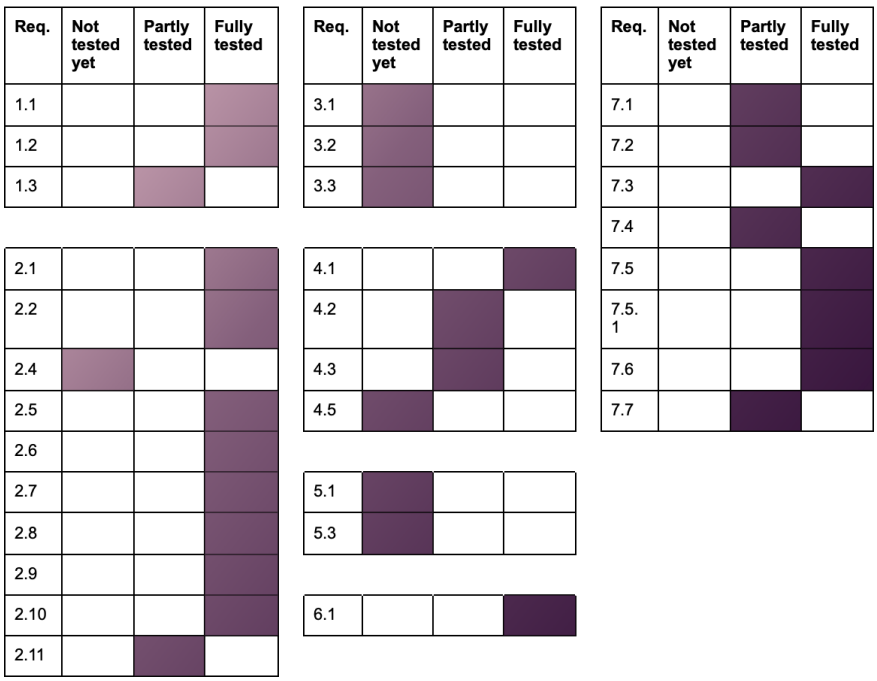


Figure 43: Scores on List of Requirements

12.4 Innovation adoption

In the book Diffusion of Innovations (2003) five characteristics of innovations are defined, which all influence the adoption of the innovation. Considering these rules helps speed up the adoption process of a new innovation. To get an idea of the innovation adoption of this product it is given a score from 1 to 10 on each rule.

1. Relative advantage

The relative advantage refers to the way the innovation is perceived compared to the existing solutions. If this is significantly better the new product will be adopted faster.

Score: 6-8
The perceived advantage of the product will greatly depend on the upcoming pilot round. Until now two test groups have experienced the product, of which one did not perceive a lot of value and the other did.

2. Compatibility

The more compatible the new product is with existing factors such as values, experiences and needs, the better its adoption will be.

Score: 8
The product does not differ much from existing video conferencing equipment, such as cameras and speakerphones. From the conversations with companies during this project it also became clear they care about values such as good communication and employee satisfaction. All in all this product is compatible with existing factors.

3. Complexity

If a product is difficult to understand it can be a hurdle in the adoption of it. It is important to be aware of how complex your product is perceived by the users, and how this can be minimized.

Score: 8
The product is designed to be intuitive, so the natural conversation can be preserved. The information transmitted by the indicator in the office is easy to understand because of the behavior similar to that of an eye. The rest of the product experience is not that different from other video conferencing equipment. The complete product experience has yet to be tested.

4. Trialability

Trying out a product can be a positive contributor to the decision whether to buy it or not. If something is new people may want to try it out first.

Score: 7
The product claims to improve hybrid interaction, which is hard to measure and quantify. Because of this experience the product plays a large role in the decision making process. The product is small and easy to install, making it easy to offer potential customers the opportunity to try the product out. They for example can get a trial period of a week, after which they can decide whether to keep it or not.

5. Observability

If the effects of an innovation are visible to others this helps understand the added value of the product at a faster pace.

Score: 4
As noted in the previous rule, the effects of this product are hard to observe, it is something you have to experience. You could observe that a meeting where this product is being used leads to a dynamic interaction with both in-office and online participants. It is however often not possible for a company to see what meetings in another company look like. Thinking about ways to make the product and its effects more notable are a design challenge worth working on, especially if the innovation adoption would prove to be unsatisfactory.

12.5 Conclusion

Answering the main research questions:

1. Does the product meet the requirements?

The requirements that can be tested with the current state of the product are positive. There are no requirements that are not met, making this product an acceptable solution. The list of requirements will be further extended and concretized as the product is further developed.

13

Context

13.1 The final evaluation step in the timeline of this project is the pilot, where the final version of the prototype will be tested in the intended context and with the intended users. The goal of the pilot is to validate the problem solution fit, and take a first step in validating the product market fit.

13.2 Method

Research questions

1. What effect does the Be There One have on the involvement of an online attendee in a hybrid meeting? (**Main RQ**)
2. What effect does the Be There One have on the group dynamics in a hybrid meeting? **(Main RQ)**

Delta Capita

Approach

Participants
The participants in the pilot are 4 employees from Delta Capita, a technology consultancy located in Amsterdam. The company has around 300 employees and is one of Europe's 1000 fastest growing companies in 2020 and 2021.

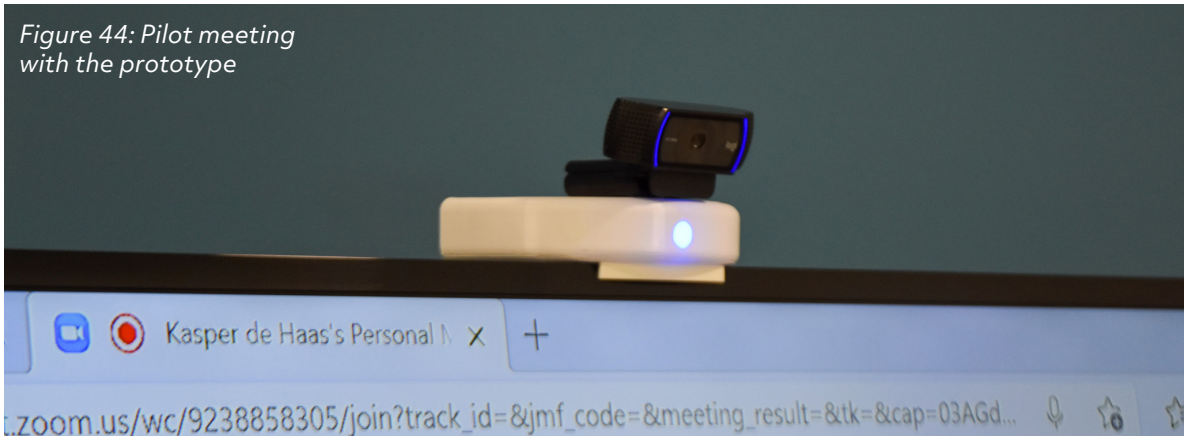
3 Participants will form the in-office group of the meeting, while the 4th participant will join the meeting through Zoom. All 4 pilot participants are present in the office since the current version of the prototype works on WiFi. The "remote" participant will sit in a separate room.

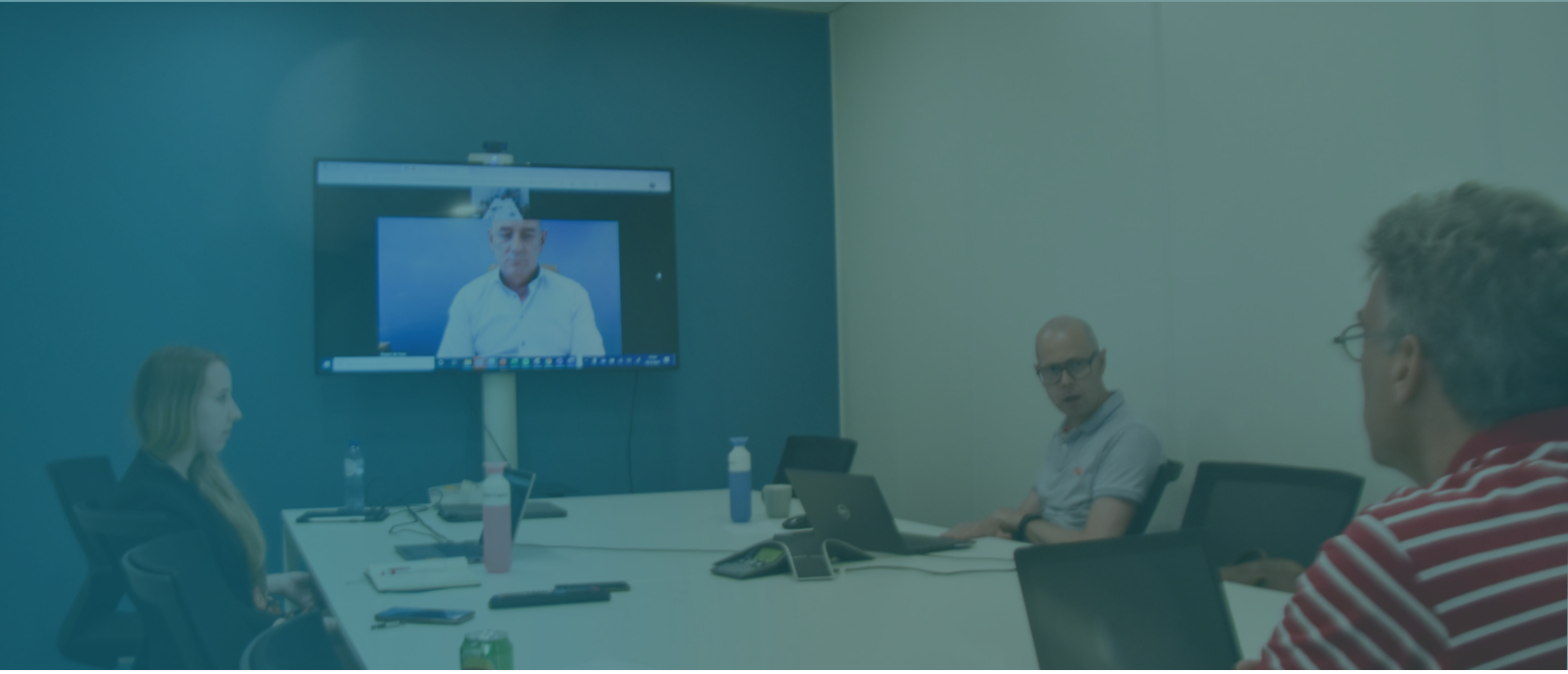
Stimuli
The meeting during the pilot was an actual meeting that was already planned by the employees. The meeting agenda and slides prepared by them were used to guide the meeting.

The prototype of the Be There One was used to test the effects of the product. The product consists of 2 components: hardware and software. The hardware component was placed on the top of the monitor in the conference room, as seen in figure 44.

The remote meeting attendee used the provided laptop, equipped with the software that informs the product in the conference room what to do.

Figure 44: Pilot meeting with the prototype





13.3 Results

The most important findings from the pilot are discussed in this chapter. The full research paper about the pilot can be found in Appendix 16.24.

Improved feeling of connection

The product added something to the meeting, is the first thing they mentioned after being asked how they experienced it. The in-office participants agreed on feeling more connected to the online participant.

> **"You really feel something when he looks at you."**

"You associate the product with having a connection with someone", because the participant at the head of the table started feeling uncomfortable when the indicator would point in his direction for a long period of time. (The prototype did this often when the online participant was not speaking.) He said it felt like staring.

Higher involvement for online participants

The group in the conference room felt more connected and felt like they involved the remote participant more because of that.

The participants realized they would look to the screen more because of the product, to see where the online participant was looking. Looking to the screen more often makes it easier for the online attendee to give input and feel involved.

Participant and input perceived the same

The group did not feel like they experienced the remote participant and his input differently. They just felt more connected to him.

Problems when combining with slides

Because slides were shared on the screen the online participant got a full screen view of the presentation. For this product to work the office view has to be full-screen (because of the eye tracking software). In Zoom there is a function that lets you choose which window you want to see full screen, in MS Teams (where this meeting was hosted) this feature is absent. We eventually had to switch to a Zoom meeting because of this. Also, making the office view large, and the slides small, made it impossible for the online user to read the slides.

The meeting was mainly one person walking through certain topics, supported by presentation slides. The presentation slides were shared on the large screen in the conference room. Because of this the online participant was not visible for the larger part of the meeting.

Indicator turning off associated with closing eyes

When the indicator was off for a while one of the in-office participants said

> **"Can you open your eyes again?"**

This showed that it felt like the online participant was tuning out when the indicator turned off.

After a while a participant from the office group asked the online participant if he is still with them, and if he can open up his eyes. This was because the online participant had spoken a couple of times without the indicator turning on. When checking it turned out the software had returned an error and had stopped. After relaunching the software this was fixed.

Leaving the indicator was beneficial

The product should not show the indicator when the online user is not speaking, but the prototype sometimes did (unexpectedly). This did give the people in the room the feeling the remote person was listening and paying attention.

One participant even found it unfortunate that the indicator turned off when people in the room were talking. She did not know what the remote attendee was doing at that point. This effect was of course strengthened by the fact that you could not see this person on the screen.

Eye tracking should cope with head movement

The online participant moved his head quite a bit when talking, this made it hard for the eye tracking to stay accurate.

13.4 Conclusion

The main research questions were:

1. What effect does the Be There One have on the involvement of an online attendee in a hybrid meeting?

The product resulted in an improved feeling of connection with the online participant for the in-office group. This led to them trying to involve that person more.

2. What effect does the Be There One have on the group dynamics in a hybrid meeting?

The group dynamics was not notably improved during this pilot. The meeting was mainly led by the meeting facilitator, which largely determined the dynamics of the meeting. Possible effects of the product on the group dynamics should be further investigated in future research.

14 Business

14.1 The goal of the project is to develop a product with startup potential, making it important to consider business related elements such as revenue streams, key activities and resources. Such elements are considered in this chapter.

14.2 Method

Research questions

1. What is the market size?
2. What market gaps can be identified?
3. What is the company's vision and mission? **(Main RQ)**
4. What is the value proposition of the product? **(Main RQ)**
5. What are the customer segments? **(Main RQ)**
6. What does the revenue stream look like? **(Main RQ)**
7. Can the technology be patented? **(Main RQ)**
8. Do the intended customers show payment intent? **(Main RQ)**

Approach

The process of creating a profitable business model is guided by the topics in the Business Model Canvas. Deciding on how the topics are filled in was done by researching similar products and companies and learning from their ways. Also two (patent) attorneys were consulted to evaluate the patent potential of the gaze direction technology.

Hypothesis

8. Potential customers from the target group are willing to pay the retail price.

See paragraph 14.10 for the experiment results.

Methods

TAM SAM SOM
The theory used for splitting the market into different layers is the TAM SAM SOM method. This method gives an overview while also giving insight in the obtainable market.

Business Model Canvas
The Business Model Canvas is the ideal tool for considering all important business aspects of your product and company, while creating a simple and structured overview (Strategyzer AG, 2010). This method was chosen because it allows you to create a complete overview in a relatively short amount of time. It also provides handles for validating different elements of your business.

Revenue Model Flowchart
The Revenue Model Flowchart is a tool developed by the Board of Innovation (Board of Innovation, 2021). The flowchart allows you to discover different revenue models from well known companies and startups. Researching these examples helps develop your own model.

WOW-Statement Generator
This is a canvas created by pitch expert Viki Pavlic. The canvas guides you through different elements that together form a convincing value proposition statement (Pavlic, z.d.). This method is used because a clear value proposition is crucial in communicating the value of your product, and this will be done frequently in the upcoming phase (pilots & funding).

14.3 Market

When launching a new company it is important to know what the market is like. How big is the playing field, who are key players and what are the competing products? The extended market research can be found in Appendix 16.25. In this paragraph the key conclusions are listed.

Market size

The **Total Addressable Market**, the Global video conferencing market, has exceeded 14 billion dollars in 2019 (Wadhwani & Gankar, 2020).

The **Serviceable Addressable Market**, the hardware segment, is good for 2.24 billion dollars (Wadhwani & Gankar, 2020). The hardware products in the video conferencing market can be divided into two sub-categories; codec and USB systems. The USB subsegment, in which the product from this project can be placed, is growing 34% each year, compared to the 3% in codec systems (InfotechLead, 2020).

The **Serviceable Obtainable Market** can only be calculated with conversion rates from large batch experiments. To give an idea; if 1% of the market could be obtained the SOM is 22.4 million dollars.

Market gaps

Having analyzed competing products and companies allows market gaps to be identified. These gaps are visualized with the use of a market gap matrix. Identifying market gaps was done before the ideation phase of this project, so the opportunities could be leveraged in the ideation sessions.

A useful market gap was found when focussing on products that support rich communication. In the context of this project the meaning of rich communication is communication where more information is transmitted and received than just verbal and facial (as supported by current equipment). Because companies of all shapes and sizes are currently transforming into a hybrid form there will be a demand for more affordable products. (See figure 45)

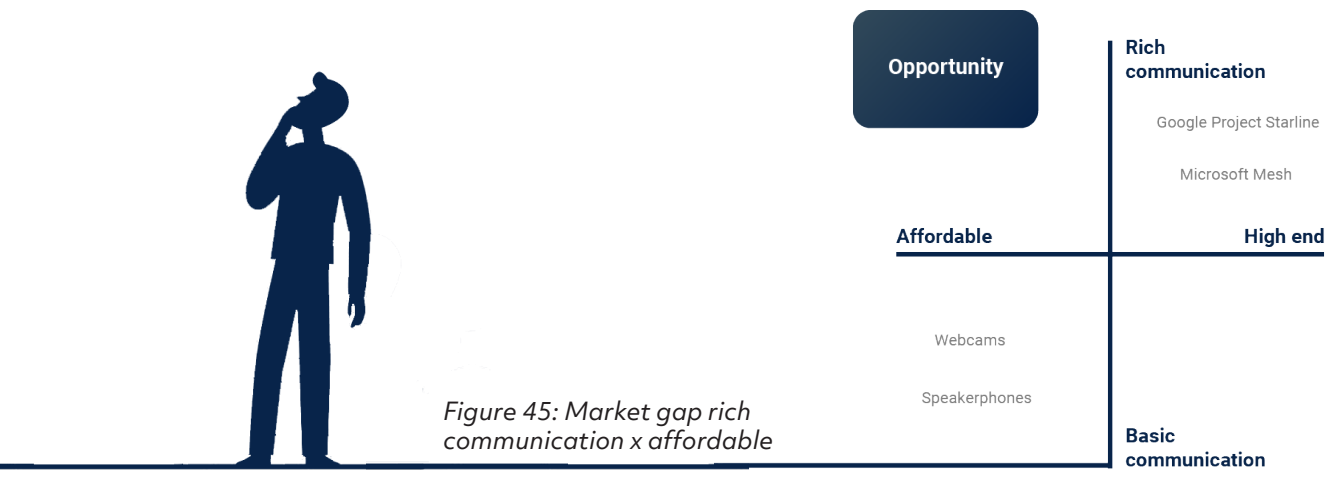


Figure 45: Market gap rich communication x affordable

14.4 The company

A company is more than an organization that sells a product to customers. A company has a specific identity, culture and most importantly a vision and mission. To communicate what the company stands for, with the product developed during this project as the first way of realizing this, the first version of the vision and mission are formulated. The company and product also got a name that suits them well.

Company name: Be There

The company's name is derived from the famous saying "be there or be square", which in the context of the product can be taken literally. When there is a meeting in the office you can decide to be there, or to join through Zoom and literally be a square (on the screen). Be There, the company, provides products that create a presence and participation for remote meeting attendees that is better than just the square in a video call. Now you can choose Be There, instead of being square, without being required to travel to the office.

Product name: Be There One

The product developed during this project is the first step in unleashing the potential of hybrid meetings. This is underlined by calling it the Be There One. There will be many more versions and products that bring companies closer to dynamic, productive, natural and equal hybrid meetings.

Vision

A world where flexibility and autonomy form the basis for increasing company performance and employee satisfaction.

Mission

Be There wants to enable natural and equal communication between participants from different locations in the office ecosystem.

14.5 Business Model Canvas

Some of the most important elements from the business model canvas are discussed here. The "golden triangle" of the BMC are Value Proposition, Customer segments and Revenue Stream. Key Resources and activities are also added because it reveals insightful information. The full canvas can be found in Appendix 16.27.

Value proposition

One liner: An artificial eye contact device in hybrid meetings for better involvement and dynamics.

Handshake statement: The Be There One is an artificial eye contact device for hybrid companies. Remote meeting participants are no longer excluded and invaluable because of the valuable connection that can be made with them.

Customer segments

The product is created for the target group:

> **Medium and large hybrid companies with high employee autonomy who frequently have interactive meetings with mid sized teams (4-10 people).**

The full target group research can be found in Appendix 16.26

The employee is the user of the product, experiencing the direct effects. The goal for the employee is to be included in hybrid meetings.
Selling a product to a business is way different from selling to individual consumers. In a company multiple people from different departments are involved in the decision making process. To better understand who is involved in this process, and thus who to convince in the sales process, an interview was done with Mara de Haas, marketing professional at Dept. She was able to set apart three parties involved in purchasing a product such as the Be There One. These decision makers are described in figure 46.

In the marketing and sales strategy for the product all three of these parties will have to be considered. Each of them has to be convinced that there is a problem, and that this product is the best solution. To make sure the decision making process goes smoothly and efficiently every party can be targeted separately. Three different marketing plans can do exactly this. If all people involved in the decision are already aware of the product and its values, every contact moment between these three parties inside a company will be optimal. Of course the amount of parties participating in the decision making process can differ between organizations. Smaller companies will most likely have only one or two departments involved.

Figure 46: Decision makers

Team leader

The team leader is the one that organizes most meetings, meaning he or she will experience the problems in hybrid meetings. The team leader is also in contact with the employees in the team. If they experience problems they will inform their manager. The goal for the manager is to have a team that performs well.

HR Professional

The project manager will notify the HR professional of the problems experienced in the hybrid meetings. The HR professional will look for solutions and approach a decision maker from the management department. The goal for the HR professional is to create a high employee satisfaction.

Management

The decision maker from management will have to give permission for the purchase of the solution proposed by the HR professional. Most of the time HR will then be the party purchasing the product. The goal for management is to decrease costs or increase profit.

Revenue streams

The retail price calculation done in chapter 11 resulted in an estimation of €300,-. The profit margin in this was 50% (over the cost price), which comes down to €42,-. These numbers are based on an initial production badge of 7500 parts.

When the production is ramped up to 100.000 units the cost price is €13,46. With the same profit margin this would result in a retail price of €50 with a profit of €7 per unit.

Key resources

There are different types of resources needed in order to make this business model work.

Financial
Most of the financial resources are needed for the manufacturing of the product with manufacturing partners. According to the cost price calculation done in chapter 11 the cost of this is €200.000. This mainly consists of the making of the molds.

Human
In an innovation startup a strong R&D department is key. The product has to be developed to a market ready version, after which improvements and new features have to be created (further described in Key Activities). Software developers are needed to build the software component. Product engineers are needed to develop the hardware component.

Intellectual
A patent can be the most valuable resource a technology startup has. It creates a first mover advantage that can be protected and preserved. It is also a crucial asset in fund raising, since investors prefer startups that have a patent (Forbes, 2015). More on patents later in this chapter.

Key activities

The key activities of the company will be R&D, since innovating is the way it creates value. There are plenty of opportunities in improving hybrid communication. Creating more awareness will also be a key activity since the company and product are completely new. Introducing potential customers to the product and collecting testimonials from lighthouse customers help build this awareness and credibility.

14.6 Possible pivot

When considering different revenue models, through the Revenue Model Flowchart, the question was raised if the product can generate valuable data. Since the product is present at all hybrid meetings, and is in contact with both the online and in-office participants it does show great potential in doing so. The product could collect data such as the amount of speaker turns, speaker duration, online-office conversation balance, amount of eye contact towards the online attendees, etc. All this data can be used to provide insights in hybrid meetings, such as dynamics and involvement scores. The data should of course be anonymous, it should only share the overall conclusions. Offering a dashboard with these insights would mean the product / service can be sold as a subscription model.

If the scores on different aspects of the hybrid meeting are low this opens up room for improvement. All improvements start with awareness. The platform could even provide some tips for improving the hybrid meeting scores.

Since hybrid working, at a large scale, is new to the majority of companies, insights in their performance and handles on how to get better at it could be valuable. The project timeline does not have enough time left for this pivot to be tested and validated, but the potential of it makes it worth doing after the project deadline.

14.7 Patents

Patents can be a startups best friend, but understanding how this legal landscape works is a condition. Patents are formal documents that need to be written by patent attorneys. The value of a patent can prove to lie in the very details of the way your invention is described. In order to understand how patents work, what a patenting process looks like and whether the technology from this project can be patented two attorneys were consulted. Maurits Westerik is an attorney with experience in creating and managing patent strategies for large companies. Jasper Groot Koerkamp is a patent attorney who writes patents for inventions with both soft- and hardware components.

First of all, an invention can be patented if it meets the following criteria: the invention needs to be new; the invention needs to be a technological solution for a technological problem; the invention needs to be able to be marketed. According to Groot Koerkamp the gaze direction technology from this project can be patented. The patent research I did shows no similar patents out there. Of Course the research from a patent attorney can bring more similar patents to light, so no guarantees can be given.

Secondly the patenting process was explained. The two main topics are costs, in total around €8000,-, and the Invention Disclosure Form. The IDF is a document that describes your invention in detail, along with the newness research you have already done. This document is where the patent attorney starts his process. Westerik was kind enough to provide me with his, single-use, IDF format (for which you usually need an attorney) which I have completed and can use in the potentially upcoming patent process.

14.8 Payment intent

An important step in the validation of the business potential of the product is the payment intent. This shows if the intended customer is willing to pay for the solution you are offering. Two validation experiments were done, both showing commitment from the target group.

First the product was pitched at a few companies. The focus was on the value of the product and the call to action was to sign up for the pilot round. Signing up shows that the company is interested in the product and wants to try it out. This is not the same level of validation as actually paying money, but there is some kind of commitment; time. The amount of companies that signed up for the pilot was measured and a conversion rate was calculated.

The number of companies pitched to is 3. This number is purposely kept small because of the patent risk, as adviced by the patent attorneys. Every person joining the pitch had to sign an DNA, but there is still a slight risk of information leakage. The more companies pitched to, the bigger this risk gets.

The result is 3 companies who received the pitch and 3 companies that signed up for the pilot. This leaves us with a conversion rate of 100%, which means there is confirmed interest from companies in the product.

The next step in the validation process was done at the end of the pilot. The participants, including a decision maker, were asked about what they think the product is worth and if they are willing to purchase it.

The group guessed the price at 250 euros, which is close to the calculated retail price of 300 euros. Since they are convinced of the added value of the product, and agree with the price, the company is willing to sign a letter of content, stating that they are seriously committed to buying the product when it is officially launched.

> **"For 300 euros this is a logical addition to any conference room"**

14.9 Conclusion

The main research questions were:

3. What is the company's vision and mission?

Vison: A world where flexibility and autonomy form the basis for increasing company performance and employee satisfaction.

Mission: Be There wants to enable natural and equal communication between participants from different locations in the office ecosystem.

4. What is the value proposition of the product?

One liner: An artificial eye contact device in hybrid meetings for better involvement and dynamics.

5. What are the customer segments?

The product is created for the target group:

Medium and large hybrid companies with high employee autonomy who frequently have interactive meetings with mid sized teams (4-10 people).

The employee is the user of the product. The product is purchased by the decision makers in the company, which consists of the Team leader, HR professional and management.

- **Employee** (wants to be be included in the hybrid meeting)
- **Team leader** (wants his team to perform well)
- **HR professional** (wants high employee satisfaction)
- **Management** (wants to make or save money)

6. What does the revenue stream look like?

The revenue stream comes from the sale of the hardware product.

Retail price of €300,- with a profit margin of 50%, resulting in €42,- profit per unit

7. Can the technology be patented?

According to the conversation with patent attorney Groot Koerkamp the gaze direction technology can be patented. Whether this prediction holds depends on the official newness research.

8. Do the intended customers show payment intent?

The market potential was validated by testing the commitment of the pilot company to purchasing the product. The company signed a letter of intent, indicating that they are seriously committed to purchasing the product after its launch.

Business

14.10 Experiment 4

Experiment 5	Will people pay for the product?
I believe that	The target group will pay the retail price of the product.
In order to test I will	Do a pilot and ask the pilot company to sign a Letter of Intent.
And measure	If the company is willing to sign.
I'm right when	The company signs the Letter of Intent.

Result

After the pilot at Delta Capita the HR partner was asked about their willingness to sign the Letter of Intent. Based on their experience with the product they were happy to sign.

Obviously with a batch size of 1 this experiment is not yet concluded. More pilots will have to be done, either with strict NDA agreements or a patent.

**

Final Remarks

Now that the project has come to an end a brief moment of reflection will shine light on the process and outcomes.

The design brief was created in a rather unique context. Our lifes were faced with many changes and uncertainties, but in all changes lie opportunities. The world of remote working was explored, with a vision of the future of work as a result. This vision was shared with today's companies who were already making plans for the future.

Through extensive user interviewing an understanding was created in the challenges of hybrid working. With a focus on hybrid meetings the communication research revealed the causes behind these challenges.

The quick and iterative way of working during this project, based on the Lean Startup method, was responsible for good choices being made during the development phase. Eventually a new technology was invented, which proved to be successful in improving hybrid communication.

Finally the product's business potential was validated through pitches and a pilot. This is a first step, with more steps to follow after the deadline of this project.

It is currently unknown what the next steps in the roadmap will lead to, but it is certain that the end result of this project offers enough potential to go find out.

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Appendix

See attached file