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Effectiveness of Collaborative Virtual Reality for Remote Teams

A Qualitative Study of the Influence of Media Capabilities and Users' Prior Experience

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Effectiveness of Collaborative Virtual Reality for Remote Teams: A Qualitative Study of the Influence of Media Capabilities and Users' Prior Experience

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ABSTRACT (MAX. 200 WORDS):
The number of remote teams has increased in recent years and this upward trend may persist. The growth is partly enabled by advancements in Information and Communication Technology (ICT) and globalization. Although organizations benefit from certain advantages that remote teams introduce, inadequate communication amongst remote team members can lead to project failures. Since technology has an impact on performance of remote teams, it is important to investigate emerging collaborative tools such as the ones that Virtual Reality (VR) facilitates. This study explores the role of VR in enabling effective collaboration amongst remote team members through the lenses of Media Synchronicity Theory. The results indicate that collaborative VR can be effective for tasks that require rapid transmission of spatial and more abstract information, and individuals' shared understanding of the information. Secondary results reveal issues with accessibility to VR due to expensive hardware and health-related issues associated with the use of VR for a prolonged period of time. Lastly, Mixed Reality (MR) and Augmented Reality (AR) are proposed as potentially better alternatives for certain collaborative tasks performed by remote teams.

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Abbreviations

AR - Augmented Reality

CET - Channel Expansion Theory

IS - Information Systems

MR - Mixed Reality

MRT - Media Richness Theory

MST - Media Synchronicity Theory

VR - Virtual Reality

XR - Extended Reality

1 Introduction

1.1 Background

The number of organizational teams whose members are not located at the same physical location (i.e., remote teams) has been increasing in recent years (Garro Abarca, Palos-Sanchez & Rus-Arias, 2020). The increase is argued to be positively influenced by advancements in Information and Communication Technology (ICT). For example, technologies such as video conferencing improved communication of such teams (Oprean, Simpson & Klippel, 2018). The growing opportunity to create remote teams in organizations has several benefits. Organizations are not limited to the local market and can take advantage of offshore outsourcing (Wu et al., 2019). In addition, the organizations' performance can be improved by finding new members of remote teams from a larger population of professionals with required expertise (Garro Abarca, Palos-Sanchez & Rus-Arias, 2020). That makes organizations also more adaptable to changes in the market. Furthermore, remote teams can save time and money due to the reduced need for transportation to their workplace (Garro Abarca, Palos-Sanchez & Rus-Arias, 2020).

However, achieving good team synergy in remote teams and ensuring that team members collaborate effectively is not a straightforward process. There are various ways to approach these challenges. Previous research shows that technology has an influence on performance of remote teams (Garro Abarca, Palos-Sanchez & Rus-Arias, 2020). At the same time the technology enabling Virtual Reality (VR) became more popular thanks to improvements in hardware, usability and lower price in recent years (Moore, Geuss & Campanelli, 2019; Oprean, Simpson & Klippel, 2018; Kuchera, 2020). Since VR enables users to share a common digital space without the need to be physically collocated, it has a potential to be used as a communication medium by remote teams. VR has been gaining traction as a potential medium for remote collaboration within and between teams. Moreover, there are many startups that specialize in integrating VR into many different scenarios (WeVR, 2022; Surgical Theater, 2022). Compared to traditional communication media, such as e-mail, text chat, audio conferencing and video conferencing, VR also enables the transfer of more nonverbal information (e.g., gaze, hand gestures, body posture), which is an important aspect of communication (Wen & Gheisari, 2020).

Additionally, with the introduction of other new technologies like 5G and Edge Computing, many of the information transfer intensive technologies, like VR, are becoming more accessible not only for private users but also for business users as well (Ethirajulu, 2020). This technological enablement, coupled with the large investments from some of the most influential tech companies like Meta and HSBC, should push the academic world to investigate and advise on the strengths and weaknesses of the technologies (Dang, 2021; Daga, 2022). Moreover, the world has not fully recovered from the devastating pandemic and some even question if the world would ever return to the "traditional workspace" (Gerdeman, 2021). If that is the case, then it would not be unreasonable to assume that most technologies that facilitate remote collaboration would find application in the future. Regardless of the scale of their individual

impact, it would still be important to pay attention to and explore their strengths and weaknesses in order to uncover their potential benefits for remote teams.

1.2 Problem Area

The number of remote teams is growing and nothing suggests that the trend will revert in the near future. With the increase, it is crucial to explore how remote teams communicate because misunderstandings in communication can cause difficulties in collaboration (Gilson et al., 2015) and even lead to project failures (Nikas & Poulymenakou, 2006). Traditional communication media have only limited capabilities to transmit nonverbal expressions like in face-to-face communication, which may have a negative effect on project success (Morrison-Smith & Ruiz, 2020). For example, with absence of nonverbal expressions, communication participants need more time to deliver a message (Holtgraves, Fussell & Setlock, 2014), and trust within remote teams is harder to be developed (Morrison-Smith & Ruiz, 2020). Therefore, VR needs further research as an alternative communication medium with more capabilities for remote teams.

Although VR is entering the mainstream, the VR medium is still underexplored (Gilson et al., 2015; Schouten, van den Hooff & Feldberg, 2016). The current thesis aims to contribute to the field of Information Systems (IS) by exploring how VR fits as a medium for collaboration according to the experience and opinions of both members of remote teams that use VR and VR experts who specialize in VR implementation. We believe there is a lack of research on how people use the technology in work settings, and we can evaluate VR in terms of its ability to support remote teams in achieving effective collaboration. The current thesis defines 'effective collaboration' as an action or a set of actions that benefit not only individuals but the collective team as well in achieving a mutual goal. Furthermore, through the insights provided in this thesis, a better understanding could be obtained for the place that VR technologies may take in the work environment.

Furthermore, previous research on remote teams lacks sufficient exploration under real-life conditions. Garro Abarca, Palos-Sanchez and Rus-Arias (2020) and Gilson et al. (2015) claim that most studies on remote teams were conducted in laboratory conditions. In addition, the studies focused mostly on traditional media as opposed to VR (Gilson et al., 2015). Another limitation of previous research is the participants involved in the studies. Namely, collaboration is examined mostly only between two participants (Ens et al., 2019), which does not necessarily follow a real scenario where a larger group of team members need to be involved. For that reason, the current study aims to explore collaborative VR through subjective perception of remote team members and VR experts who have experience with the technology in real-life scenarios.

1.3 Research Question

We identified a knowledge gap in the use of VR as a medium for collaboration of remote team members. Thus, this thesis focuses on personal experience and opinions of individuals from remote teams and VR experts with the VR technology. The following research question is partly investigated through the lenses of MST in order to explore the potential influence of

the VR capabilities on the use of the technology for remote collaboration. In addition, the current research is open to findings outside MST since it may not hold up well with the modern media. In summary, this thesis attempts to answer the following research question:

What is the role of VR in enabling effective collaboration amongst remote team members?

1.4 Purpose

The purpose of this study is to examine the role of VR for collaboration within remote teams. We aim to identify how VR is currently used for this purpose, and how members of remote teams can benefit from the use of VR by employing it for certain types of communications. In addition to members of remote teams, we believe our research can be also useful for managers who look for innovative ways to engage their teams and consider implementing VR for remote collaboration. Lastly, the current research is partly guided by MST, a theory that was previously used primarily for media other than VR, and therefore, our findings can reflect on some of the characteristics of the theory originally proposed for traditional media.

1.5 Delimitations

The purpose of the following section is to clearly set the boundaries for the current thesis. For example, there are studies related to exploring the effects on collaboration between culturally remote teams (Del Gatto & Mastinu, 2018). Other studies, like the one by Dey et al. (2017), explore the effects of reducing the emotional remoteness of individuals using VR technology. However, for the purposes of the current study, exploring the effect that VR would have on cultural or emotional remoteness would be beyond the set scope. The current research is interested in exploring remoteness in the sense of physical distance between individuals. That alone could also imply measuring the effectiveness of collaboration in VR when participants are working remotely in different time zones. While the current study acknowledges that individuals who collaborate in different time zones could experience issues with mismatches of psychological or social clocks (Sarker & Sahay, 2004), it also sets this phenomenon outside of the current scope. Another important distinction that should be drawn is the type of collaboration that this study explores since collaboration can be used also for malicious intent. For example, collaborative dishonesty/cheating (Conway-Klaassen & Keil, 2010) could be facilitated by the capabilities of certain media for information transfer. In addition, a study by Furner and George (2012) applied MST to explore the media choice for deception. However, for the purposes of the current study, exploring VR for facilitating collaborative dishonesty is beyond the scope. To explore collaboration, we have decided to go with a fundamental definition of the concept and avoid malicious intents.

2 Theoretical Background

To assist with the exploration of our research topic and to gain a better understanding of the supporting theory, a thorough literature review was performed. The first subsection of our theoretical background aims to help navigate the commonly used terminology and avoid ambiguity by providing hopefully clear definitions of the main terms. The next sections talk in detail about the VR technology, the intricacies within remote teams, how remote teams have used VR before, the supporting media theory of this research, and finally how the media theory relates to VR.

2.1 Definitions

In order to avoid ambiguity in the current research, the present section aims to provide clarification on the more prevalent terms used in the paper.

A remote team: *a group of physically distributed individuals working towards a common goal with the use of technology for communication and collaboration among the team members* (Gilson et al., 2015; Moore, Geuss & Campanelli, 2019).

Communication: *an exchange of both verbal and nonverbal information using common symbols and media among participants who attempt to process and understand the information* (Wen & Gheisari, 2020).

Collaboration: *"the common effort of a group of people to create something"* (Pinikas et al., 2016, p.1).

Conveyance: "*the transmission of a diversity of new information ... to enable the receiver to create and revise a mental model*" (Dennis, Fuller & Valacich, 2008, p.580).

Convergence: *The mutual agreement of achieved shared understanding of a particular information among communication participants (Dennis, Fuller & Valacich, 2008).*

Synchronicity: *"a shared pattern of coordinated behavior among individuals as they work together"* (Dennis, Fuller & Valacich, 2008, p. 575).

High synchronicity media: *Media whose capabilities support high levels of shared coordinated behavior among individuals as they work together (Dennis, Fuller & Valacich, 2008).*

2.2 Virtual Reality

Benefits of VR technology have been the subject of many studies over the years, related to learning (Bricken, 1990), civil engineering (Gannon & Tan, 1994; Sampaio, Henriques & Martins, 2010), rehabilitation (Schultheis & Rizzo, 2001) and others (Youngblut, 1998). While many of these studies note that the technology is an emerging one, the recent investments from large and influential tech companies are unprecedented events in the history of

VR (Young, 2022). Further, these events underpin the underlying assumptions of the current study since in order for the technology to be successfully implemented into business processes, its strengths need to be understood. Fundamentally, VR could be summarized as a technology that simulates experiences and intentionally presents them to users' senses (Trost et al., 2021). According to Mütterlein (2018), there are three key characteristics to VR, which the author has dubbed "the three pillars of VR" - immersion, presence and interactivity. The literature on the topic of VR often describes immersion and presence. However, these concepts are rarely specified clearly in research (Oprean, Simpson & Klippel, 2018), and are often used together and interchangeably (Mütterlein, 2018). Therefore, they need to be defined as they are used for the purpose of this study. Oprean, Simpson andKlippel (2018) describe immersion as "'submerging' a [sic] user's senses (visual, audio, etc.) into a digital (synthetic) environment" (p.422), i.e., immersion is the use of technological hardware capabilities for engaging the user's senses and the level of digital freedom they allow (Ryan, 2015; Trost et al., 2021). VR technology focuses primarily on employing visual sense via a wide field of view supported by VR displays. Other senses such as hearing and touch are also often engaged, however, smell and taste are not very common (Berg & Vance, 2017). Steuer (1992, p.6) defines presence as "the sense of being in an environment" in his research on telepresence in VR. Furthermore, Lombard and Ditton (1997) describe presence as the artificial sense, which a user has in a virtual environment, that the environment is unmediated. *Co-presence* is another related concept that describes the feeling of being in and sharing an environment with others (Oprean, Simpson & Klippel, 2018). Lastly, for *interactivity* the current research assumes the following definition - the degree to which a user can interact and change the VR environment.

2.2.1 VR Equipment

It is crucial to discuss the role of equipment used for VR because it highly affects the spread of VR and the overall VR experience. Although the first VR headset, foundationally similar to modern VR headsets, was introduced in the 1960s (Mehrfard et al., 2019), only recent technological advances allow broader adoption of the technology. The progress in technological development of VR devices and their lower price have increased the interest of both private and business consumers (Angelov et al., 2020).

A display capable of showing a virtual environment is the minimum requirement for using VR. VR devices can be divided into three groups according to the type of display, i.e., *desktop-based VR* (Figure 2.1), *smartphone-based VR* (Figure 2.2) and *immersive VR* (Figure 2.3). Firstly, desktop-based VR uses only a desktop screen to display a 3D virtual environment (Wang et al., 2018). Users can control applications for this type with a computer mouse and keyboard. Desktop-based VR is cheaper than other VR technologies since no special VR device is needed. Second, smartphone-based VR allows the use of a smartphone as a display mounted in a special case including lenses. In this case, the smartphone is used as both a display and a computing device, and therefore, offers an inexpensive option (Won et al., 2017). For that reason, smartphone-based devices are largely accessible to consumers (Steed et al., 2016). However, these devices do not provide a way to map real hand and body movements onto avatars in the virtual world, which prevents the body ownership illusion (i.e., when objects that do not belong to one's physical body are perceived as their physical body) and the feeling of presence (Steed et al., 2016). Some of these devices include, for example, Samsung Gear VR (Samsung, 2022), Google Cardboard (Google, n.d.) and Google Daydream (Google, 2022). Lastly, immersive VR employs special hardware for a more engaging experience. With

this type of VR devices (e.g., Oculus Rift (Oculus, n.d.), HTC Vive (HTC, n.d.)), users can use head-mounted displays (HMDs), sensor gloves, motion tracking devices and sensors, game controllers, and other devices to create a virtual environment with visuals and sounds, in which users can move and interact with (Wang et al., 2018).

Figure 2.1: Desktop-based VR (Spashett, 2009)

Figure 2.2: Smartphone-based VR (Wijnants, 2017)

Figure 2.3: Immersive VR (National Institutes of Health, 2016)

Immersive VR devices can be further divided into two categories - *standalone* and *tethered* (Angelov et al., 2020). Standalone devices include all necessary parts to create the VR experience. On the other hand, tethered devices are dependent on another computer that provides computational power. With regards to their advantages and disadvantages, tethered devices are less flexible than standalone devices, but their computational power is only limited by the computer they are connected to (Angelov et al., 2020).

Quality of VR headsets and, consequently, the quality of VR experience can be evaluated according to several metrics. According to Angelov et al. (2020), a display used in a VR headset is a key factor that consists of the technology used to make the display (LCD or OLED), refresh rate, field of view and pixel density. Precision and speed of movement tracking of the device also influences the perceived quality of VR experience. Another crucial element of VR headsets is the controllers that can be used with the headset. The last factor that Angelov et al. (2020) used for evaluation of VR headsets is ergonomics. Since it can be a subjective metric, they used weight for comparison. Angelov et al. (2020) evaluated HTC Vive Pro as the best VR headset out of the five popular headsets (Oculus Rift S, HTC Vive Pro, HTC Vive Cosmos, Valve Index, Samsung HMD Odyssey+) considered in their study. Mehrfard et al. (2019) used similar evaluation criteria, namely, image quality (e.g., resolution, field of view), user comfort (e.g., the headset weight) and secondary features (e.g., integrated audio, setup complexity). Their evaluation of VR headsets also concluded with the HTC Vive Pro as the best VR headset given the mentioned metrics.

2.2.2 Limitations of the technology

In a previous study a concern was raised about the ability of potential collaborators to focus on the business at hand, rather than the systems in use (Fraser et al., 2000). While the article provides good reasons for this concern, like the lack of haptic feedback from the VR technology, it is worth noting that the article is more than 20 years old and could be considered as

outdated given the technological advances since then. For example, one of the other limitations pointed by the article was the network delays due to the high bandwidth usage of VR, which should not be an issue nowadays given the greater speeds of the 5G infrastructure. Nevertheless, the question of whether users of VR are focused on the collaborative task or find some elements of collaborating through VR distracting is an important one.

One of the commonly encountered issues with the hardware, that is required to access VR environments, is that it may create motion sickness in users (Dziuda et al., 2014; Moss & Muth, 2011). While it is likely that some collaborative business assignments could require prolonged usage of communication technology and could therefore expose workers to higher risks of developing motion sickness, the current study would not go into details about the health effects of using VR for collaboration.

2.3 Remote Teams

Due to the widespread use of the Internet, advancements in Information and Communication Technology (ICT), globalization and growth of digital culture, communication is increasingly conducted online, e.g., via video conferencing and audio conferencing (Garro Abarca, Palos-Sanchez & Rus-Arias, 2020; Holtgraves, Fussell & Setlock, 2014; Oprean, Simpson & Klippel, 2018). That enables and improves collaboration of geographically dispersed teams as a result. The number of organizational teams collaborating from different locations is further increasing (Garro Abarca, Palos-Sanchez & Rus-Arias, 2020). For example, it is common for teams in the architecture, engineering and construction industry (AEC) to work with remote team members (Wu et al., 2019). These teams are not bound by the same space or time zones. On the other hand, more direct characteristics of a team (e.g., trust and communication) become more important (Garro Abarca, Palos-Sanchez & Rus-Arias, 2020).

Literature mostly calls this type of team a virtual team. However, the term for a virtual team varies across the extensive number of literature contributions. The systematic literature review by Garro Abarca, Palos-Sanchez and Rus-Arias (2020) reveals that different authors also call it "distributed teams, remote teams, computer-based teams, online teams and cross-site teams" (p. 168924). In order to avoid any confusion between Virtual Reality and virtual teams, this thesis uses the term *remote teams*. Moreover, several criteria can be used for defining a remote team, i.e., geographic dispersion (team members are not collocated), asynchronicity (team members do not work at the same time), temporality (a portion of team members' work time does not overlap), boundary spanning (team members do not work in the same organizational unit), cultural diversity and the use of communication technology (Schweitzer & Duxbury, 2010). Although the complete list of criteria for the definition of a remote team is debated, Gilson et al. (2015) and Moore, Geuss and Campanelli (2019) suggest that the two most important characteristics of a remote team are physical distance and the use of technology for communication and collaboration. Therefore, for the purpose of this study, we focus only on geographic dispersion and technology, which means that a remote team in our investigation is defined as: a group of physically distributed individuals working towards a common goal with the use of technology for communication and collaboration among the team members. Furthermore, Schweitzer and Duxbury (2010) propose that virtuality of teams lies on a continuum – a team can be fully virtual (i.e., team members never meet in person for work), fully proximate (i.e., team members always work in person), and somewhere between these two extreme categories. In our study, we include all remote teams that are not fully proximate.

2.3.1 Opportunities

The use of Information and Communication Technology (ICT) in remote teams enables global collaboration and supports offshore outsourcing (Wu et al., 2019). For example, a significant number of the US companies supported by engineering design works in remote teams due to offshore outsourcing (Nayak, Taylor & Asce, 2009). Garro Abarca, Palos-Sanchez and Rus-Arias (2020) mention several benefits of remote teams. In general, working in remote teams enables one to hire team members who have a sought expertise from a larger talent pool, which can enhance the organization's performance. Additionally, a remote team can improve creativity and allows organizations to be more agile in terms of market changes.

Members of remote teams can collaborate without the necessity to share the same physical location. As a result, according to Morrison-Smith and Ruiz (2020), remote teams can save financial and time resources due to the reduced commute. Moreover, U.S. Department of Energy Advanced Research Projects Agency Energy (ARPA-E) (2017) announced that approximately 8% of energy is consumed for passenger transportation for the reason of having face-to-face communication. In order to significantly decrease the overall energy consumption, it is proposed to use a digital communication medium with low energy consumption instead.

2.3.2 Challenges

Remote teams face several challenges compared to fully proximate teams. Technology used by remote teams limits the number of cues, especially nonverbal ones, it is capable of transmitting. For example, media like video conferencing usually do not capture the entire body, which results in a lack of nonverbal messages. Moreover, participants cannot maintain eye contact like in face-to-face communication and social presence becomes diminished (Smith & Neff, 2018). For that reason, Smith and Neff (2018) describe face-to-face communication as the gold standard with superior capabilities. Face-to-face communication is clearly better especially for tasks that need to convey spatial information (e.g., design tasks) or where participants need to negotiate (Smith & Neff, 2018). Moreover, information sharing can be more difficult in group communication (Moore, Geuss & Campanelli, 2019).

Furthermore, if communication participants cannot use nonverbal cues, their verbal expressions tend to be longer (Holtgraves, Fussell & Setlock, 2014). According to Garro Abarca, Palos-Sanchez and Rus-Arias (2020), remote teams commonly encounter challenges due to a lack of gestures (e.g., hand gestures). Morrison-Smith and Ruiz (2020) mention that the lack of facial expressions, body language and other nonverbal cues hinder the development of trust in remote teams. It is important to mention because trust in remote teams is a crucial factor that influences success and failure of the team (Gilson et al., 2015). In order to improve trust and avoid conflicts, it is suggested to use communication technology that can transmit nonverbal cues (Morrison-Smith & Ruiz, 2020). Furthermore, a lack of perceived team unity or absence of the feeling of team membership may weaken team performance (Garro Abarca, Palos-Sanchez & Rus-Arias, 2020).

Remote teams may experience further difficulties with collaboration due to communication misunderstandings (Gilson et al., 2015). Asynchronous communication is a potential reason for misunderstandings because a collaborator does not get a response immediately and without the possibility of an immediate feedback (Morrison-Smith & Ruiz, 2020).

Misunderstandings caused by communication deficiencies in the project management can even contribute to a project failure (Nikas & Poulymenakou, 2006).

According to the results by Schweitzer and Duxbury (2010), the degree of encountered difficulties influencing performance of remote teams is affected by three main factors: 1) a high proportion of work time spent together virtually; 2) a high proportion of team members working virtually; 3) a long physical distance between team members.

2.3.3 Research Limitations

Previous research with focus on remote teams has several limitations. The most common constraint seems to be the conditions under which the research is conducted, i.e., the research often does not reflect field-based conditions. Most of the studies use laboratory settings instead (Garro Abarca, Palos-Sanchez & Rus-Arias, 2020; Gilson et al., 2015; Schweitzer & Duxbury, 2010). However, the trend seems to be changing in recent years and about 50% of the more current studies take place in real-world settings (Gilson et al., 2015). The research on remote teams could further benefit from practical field-based conditions. Furthermore, Gilson et al. (2015) show that most studies on remote teams focus on more traditional technologies such as e-mail and chat, which is one of the reasons for the importance of this study.

2.4 VR for Remote Teams

Both technology for remote collaboration and foundations of VR can be dated back at least to 1968. Engelbart and English (1968) presented the first text editor and video conferencing tools for remote collaboration, which is currently also known as *"The Mother of All Demos"* (Ens et al., 2019). Furthermore, Sutherland (1968) demonstrated the first application of a head-mounted display (HMD) for three-dimensional images. Since then, VR has been an interest of various studies. For example, the use of VR for engineering and process design was examined already in 1993 (Berg & Vance, 2017). Then, the official report from 1999, by the US military for training distributed military teams using VR, calls the approach "revolutionary" and considers the VR technology to be a crucial element of training remote teams, even for tasks such as coordination and decision making (Ramesh & Andrews, 1999).

These technologies have been researched over decades and due to the technological advancements, the present research can focus on the process of collaboration rather than development and support of technical elements (Ens et al., 2019). In the bibliographic analysis for the keywords *"virtual team"* from the period between 2015 and 2019 by Garro Abarca, Palos-Sanchez and Rus-Arias (2020), *"virtual reality"* was the most frequent keyword found in the search after *"virtual team"*. The increased traction of VR for communication in recent years is also supported by Moore, Geuss and Campanelli (2019).

Research indicates that technology is a crucial aspect that affects remote teams, and that VR is a key component that can improve communication in remote teams by bringing team members closer to the gold standard of face-to-face communication (Garro Abarca, Palos-Sanchez & Rus-Arias, 2020). This may be even more important to some cultures than others, for example, Duranti and de Almeida (2012) indicate that Brazil favors video conferencing more than the US.

2.4.1   Opportunities

More cues. VR technology can be more beneficial than other media as it can transfer more cues, e.g., hand gestures, facial expressions, posture, gaze, and also spatial information. For example, a three-dimensional virtual environment is suggested to be more suitable than text-based media due to the capabilities to transmit more communication cues (Schouten, van den Hooff & Feldberg, 2016). Hand gestures are an important element of communication because they can deliver information that needs to be otherwise expressed verbally. With the absence of gestures, tasks usually take more time to be completed (Holtgraves, Fussell & Setlock, 2014). Moreover, eye contact affects how communication is conducted, e.g., in the number of words used and pauses between exchanges (Holtgraves, Fussell & Setlock, 2014). If a medium does not provide a communication element such as visibility (e.g., in phone calls), participants need to substitute the missing element, in this case, with just words (Clark & Brennan, 1991). A study by Smith and Neff (2018) shows that performance of a remote team can be comparable to the one with face-to-face communication when nonverbal cues are transmitted with the use of VR avatars. Although VR avatars seem to have a positive effect on performance, results of the experiment by Moore, Geuss and Campanelli (2019) suggest that VR technology has a strong potential as a team communication and collaboration medium even when no avatar is available thanks to other spatial information. The available spatial view can support more effective communication, which may lead to improved performance in comparison with other communication tools such as audio, text and images (Wu et al., 2019).

Presence, co-presence. Several studies show that the feeling of presence and co-presence has a positive effect on remote teams. Co-presence is especially important for tasks that require manipulation of physical objects (Holtgraves, Fussell & Setlock, 2014). Increased social interactions in immersive multi-user VR yield positive outcomes in medicine, education and therapy, and improves project communication (Du et al., 2018). The feeling of presence can be raised by enhancing realism of the VR environment, which can further increase communication efficiency as a result (Wen & Gheisari, 2020). A higher level of presence and co-presence in a VR environment is important for the sense of being part of the team (Wu et al., 2019). Collaborators feel more included in the team and may be more committed as a result (Berg & Vance, 2017; Oprean, Simpson & Klippel, 2018).

2.4.2   Challenges

The use of VR comes also with a set of challenges. Development of VR software is difficult because it requires special skills and takes a substantial amount of time due to the complexity of the three-dimensional environment (Wen & Gheisari, 2020). Moreover, it is not clear if VR is a preferable medium for long-term communication and collaboration. Luse, Mennecke and Triplett (2013) researched the acceptance of virtual worlds for collaboration in business organizations over time with a longitudinal study. The results show that the users were less likely to use the virtual world technology as they become more familiar with it, which contradicts the expectations. However, we assume that it could be caused by the absence of immersive VR technology.

2.4.3 Research Limitations

Most studies on collaboration using technologies supporting VR focus only on a group of two individuals and in laboratory conditions, which does not reflect real scenarios where a larger team collaborates simultaneously (Ens et al., 2019; Schouten, van den Hooff & Feldberg, 2016). Furthermore, research lacks studies on hybrid remote teams where some participants collaborate remotely and others are collocated (Ens et al., 2019). In addition, although the real number can be higher, Gilson et al. (2015) found only 5 articles with a focus on three-dimensional virtual environment published in a 10-year period.

2.5 Theory

The following section provides background on Media Synchronicity Theory (MST), the theory used for the thesis. The current study recognizes that the theory itself has limitations and would therefore not fully anchor itself to strictly following it. The reason for using this theory is to frame the interviews and the subsequent findings for VR in the concepts of media capabilities, i.e., "transmission velocity", "symbol sets", "parallelism", "rehearsability" and "reprocessability" as proposed by MST.

2.5.1 Media Synchronicity Theory

MST has its roots in a conference proceeding from 1999 (Dennis, Fuller & Valacich, 2008; Dennis & Valacich, 1999). It originally addressed the limitations of Media Richness Theory (MRT), which theorized that tasks which require information exchange should be more effectively resolved when they are paired with a medium whose richness matches the needs of the task (Dennis & Valacich, 1999). However, MST argues that no medium has an inherent advantage over the others and depending on the situation or the context, different media could be more suitable. Furthermore, Dennis, Fuller and Valacich (2008) argue that most tasks are not homogeneous but rather composed of sub-processes which require different media capabilities to be effectively addressed. Therefore, coupling media, like using both emails and video calls, should be beneficial for solving collaborative tasks.

Additionally, according to Dennis and Valacich (1999), the focus of MST is on group communication processes and studying them through their component communication processes - conveyance and convergence. Conveyance is defined as "the exchange of information, followed by deliberation on its meaning", while convergence refers to "the development of shared meaning for information" (Dennis & Valacich, 1999, p.5). Media synchronicity as defined by Dennis, Fuller and Valacich (2008) expands on the initial concepts from 1999. The current paper will focus on MST as defined in 2008.

The main reason for including MST into the current research is to examine collaborative VR through the lenses of the following concepts. Firstly, MST addresses capabilities of media and their effect on communication performance, which is suitable for our study that concerns effectiveness of the VR medium for collaboration. Second, MST is also applicable to newer media such as VR due to the theory's focus on features of media rather than a specific medium (Dennis, Fuller & Valacich, 2008).

Below are outlined the 5 media capabilities, which according to Dennis, Fuller and Valacich (2008) influence the way in which individuals can *transmit* and *process* information. In communication, an individual needs to be involved in both *information transmission* and *information processing*. Information transmission is an activity of preparing, sending and receiving information performed between individuals, and is affected by transmission velocity, symbol sets and parallelism. Information processing involves a process of building an understanding of the information within an individual, and is influenced by the two other media capabilities - rehearsability and reprocessability.

- Transmission velocity — the speed at which a medium can convey a message from a sender to intended recipients
- Symbol sets—the set of ways in which information can be encoded for communication
- Parallelism—the number of simultaneous conversations or communicative acts that can exist effectively
- Rehearsability—the extent to which a medium allows for the sender to rehearse or fine-tune a message before sending it
- Reprocessability—the extent to which a transmitted message can be re-examined or processed again.

The individual media capabilities can either increase or lower the media synchronicity ("shared pattern of coordinated behavior" (Dennis, Fuller & Valacich, 2008, p.576)) of a medium. The MST suggests that the right level of media synchronicity should be matched with the communication processes (conveyance or convergence). As a result, the right fit between media synchronicity and a communication process can positively affect communication performance. Further, below in Table 2.1 are outlined some of the media from the 2008 paper, alongside their capabilities and how they are evaluated.

Table 2.1: Media capabilities for different media (adapted from Dennis, Fuller & Valacich, 2008)

	Transmission Velocity	Parallelism	Symbol Sets	Rehearsability	Reprocessability	Information Transmission	Information Processing	Synchronicity
Face-to-face	High	Medium	Few-Many	Low	Low	Fast	Low	High
Video Conference	High	Medium	Few-Medium	Low	Low	Fast	Low	High
Telephone Conference	High	Low	Few	Low	Low	Fast	Low	Medium
Synchronous Instant Messaging	Medium-High	Low-Medium	Few-Medium	Medium	Medium-High	Medium	Low-Medium	Medium
Synchronous Electronic Conferencing	Medium-High	High	Few-Medium	Medium	High	Medium	Medium	Low-Medium
Asynchronous Electronic Conferencing	Low-Medium	High	Few-Medium	High	High	Slow	High	Low
Asynchronous Electronic Mail	Low-Medium	High	Few-Medium	High	High	Slow	High	Low
Voice Mail	Low-Medium	Low	Few	Low-Medium	High	Slow	Medium	Low

In addition, the fit can be influenced by appropriation factors such as past experience. According to MST, positive prior experiences and social norms can influence the likelihood that media will be "appropriated faithfully" (Dennis, Fuller & Valacich, 2008, p.588). The current thesis includes questions in the interview guide about media appropriation and users' perception of VR to better illuminate this point. As a continuation of that point, MST also claims that there is a relation between the user of the medium, the medium itself and the final result. More specifically, if a user needs to arrange a meeting, they can decide to use a highly synchronous medium like phone call, however, if they feel like they need more time to edit their message, then they will opt for using an email since that medium offers higher rehearsability. The current research includes this subjective experience as well, and attempts to include questions in the interview guide specifically related to investigating how subjectivity plays a role in VR and how that knowledge can prepare future managers to make more informed decisions about implementing VR for remote collaboration. Moreover, MST claims that novel concepts benefit from high synchronicity media.

An overview of the above mentioned concepts of MST is illustrated in the figure below (Figure 2.4). It is an adaptation of the original figure by Dennis, Fuller and Valacich (2008).
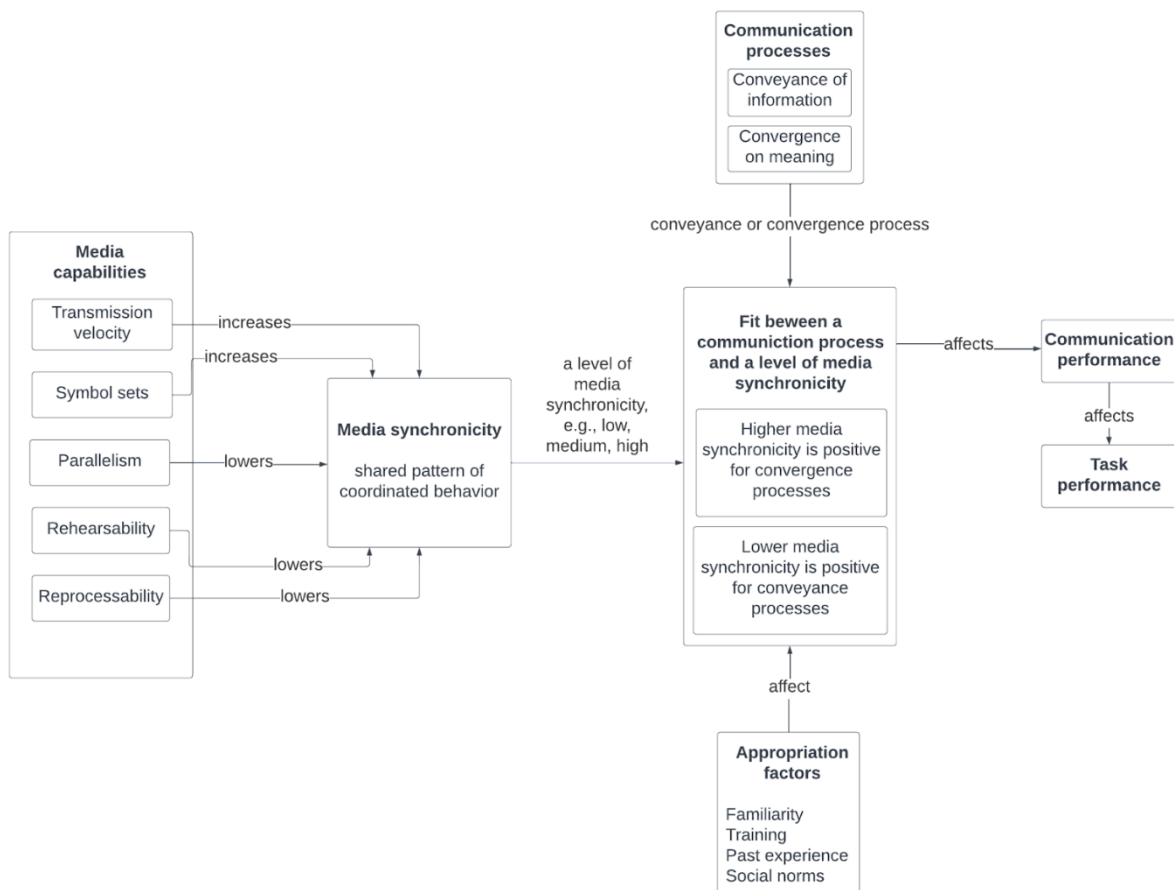
Figure 2.4: Media Synchronicity Theory (adapted from Dennis, Fuller & Valacich, 2008)

MST investigates the effectiveness of media for fundamental communication processes (conveyance/convergence). Given the general nature of our research aim – to investigate whether VR could be applied for effective collaboration, the current research excludes focusing on specific tasks where VR could be applied, just like MST. Rather, the current study wants to give pointers to areas where VR could be a good medium for collaboration without going into

the specifics of pointing exactly which tasks benefit the most from VR. This was decided with the rapid development of the technology in mind and the fact that any current analysis might not be applicable some years down the line.

The authors of MST also include many theories related to communication and social presence. For example, Kock's (2004) psychobiological model, which proposes that the perceived "naturalness" of a medium is what determines the ease of use of a medium of communication. However, findings from a recent quantitative study by Mütterlein, Jelsch and Hess (2018, p.12) claim that "media naturalness could then have no significant effect on immersion", which they state to be an important factor for effective communication. The current research would not attempt to take a side in this argument about the effect of the perceived "naturalness" of VR and whether that has a significant impact on collaboration and communication.

Another interesting postulation is that the more a certain media is used, the less cognitive effort is required to extract the most from the media capabilities (Kock, 2004). It is one of this thesis' assumptions that with the increased usage of VR by generation "Z" (Hackl, 2020), when the generation enters the workforce, it may be more adept at it and VR would experience wider business adoption. Therefore, the need for studies that explore use cases and applications of VR could be exacerbated with time.

Although the paper on MST from 2008 noted that it does not explore the ways the theory can be applied for studying deception, a study by Furner and George (2012, p.1428) used MST to "develop a model of media choice for deception based on espoused national culture". The current study notes that VR could be used as a medium for collaborative dishonesty (Conway-Klaassen & Keil, 2010), but studying that application could be beyond the scope of the current study and a good starting point for further research.

Lastly, another IS media theory was considered for this study - Channel Expansion Theory (CET), which claims that the perceived richness of a medium would depend on the users of the technology (Carlson & Zmud, 1999). While this claim raises a good point for the participants' potential bias towards VR, seeing how most of them have good experience with the technology, the current thesis will not pursue CET's other claims and concepts. In addition, research with CET has investigated mainly media choice, especially for traditional media (D'Urso & Rains, 2008), as opposed to media performance (Dennis, Fuller & Valacich, 2008), which is less related to the current topic.

2.6 VR in MST

MST has been criticized for not being very inclusive of modern media, however, that criticism applies to the research that incorporates MST and the lack of it regarding newer media, it does not extend to the applicability of MST to modern media (Fox, Leicht & Messner, 2010). This somewhat limits the intersection between the available academic work which includes MST and VR. However, it again makes for a good case for why research like the present one is important.

There have been some studies which used VR and MST to provide better context for social phenomena. One such study is the one performed by Windeler and Harrison (2018), whose main goal was to explore how MST changes when the assumption of cooperation is relaxed.

One of the study's findings was that MST lacks explanatory power when communicants' goals are not perfectly aligned (Windeler & Harrison, 2018). Furthermore, the authors of the study note that goal alignment is an important factor when it comes to communication effectiveness (Windeler & Harrison, 2018). Although an argument could be made that the article's definition for cooperation somewhat overlaps with the definition for collaboration, the above finding supports the requirement of a shared goal for effective communication. Something that the current study has included in its definition of collaboration. The research by Windeler and Harrison (2018) was a laboratory experiment and used VR in one of the interaction conditions to provide better control over the social presence of the participants.

A different study by Hassell and Limayem (2010) explored the link between job satisfaction and media synchronicity. The authors used VR as an example for a medium with high synchronicity and compared it with email communication as a medium with low synchronicity. The results from the study suggested that a link between the usage of higher synchronicity media and job satisfaction could exist, however, other factors like potentially low mental strain by high synchronicity media, should be also explored (Hassell & Limayem, 2010). While the article itself does not use MST directly since it claimed that the theory at the time lacked empirical validation, it did use the same definition for what "synchronicity" is. Moreover, one of the arguments of MST is that convergence benefits from the use of higher synchronicity media (Dennis, Fuller & Valacich, 2008).

Kahai, Carroll and Jestice (2007) propose a research agenda for any future studies whose purpose is to investigate collaboration between remote teams using virtual worlds. The paper does point out the importance of virtual worlds for the future of work, however, it also has some limitations. Firstly, it focuses both on leadership emergence and team collaboration in the context of virtual worlds, which do not necessarily happen simultaneously - in other words, teams could work remotely in a virtual world without developing a clear leadership structure (Johnson, Heimann & O'Neill, 2001). Second, the article proposes the use of MRT and then states that "it is not possible to place virtual worlds as a single point on any of the media dimensions proposed by MRT or Media Synchronicity Theory" (Kahai, Carroll & Jestice, 2007, p.63). This contradicts MRT's propositions since MRT claims that media can be ranked, with face-to-face providing the highest level of richness (Daft & Lengel, 1986). There are other inconsistencies in the paper but they are beyond the scope of the current research.

3 Methodology

The following chapter is concerned with the research strategy used for this thesis. It includes sections on participant selection, conducting interviews, data analysis, research quality and ethics. It aims to show the approach taken to answer the previously set research question.

3.1 Research Strategy

Before the study can be conducted, it is crucial to select a suitable research approach, taking into account several properties of the study. Furthermore, the selection of the right methodology is an essential step in research design. According to Recker (2013), characteristics of the research problem have an influence on what research approach is better for undertaking the research study. In addition, the research question also impacts what research approach is more suitable for a given study (Recker, 2013).

Based on the definition of the research problem analyzed in this study and the formulation of the research question, which we attempt to explore and answer, qualitative approach is considered to be more optimal than quantitative approach for several reasons. Firstly, the area of study is underexplored and existing literature provides knowledge on the subject area only to a lesser extent. Recker (2013) points out that qualitative approach is more common for research areas which are not sufficiently mature, require exploration and lack definitions for foundational concepts. In addition, the qualitative approach has the capability to explain more complex phenomena (Recker, 2013). Second, qualitative methodology can provide deeper explanation of the underexplored subject area compared to quantitative approach (Patton, 2015). This approach presents an opportunity to gain insights into the emerging topic of collaborative VR for remote teams. Moreover, it may uncover elements previously unknown in the area of interest. Third, social sciences, such as Information Systems, adopted qualitative methodology to explore phenomena in detail within the environment in which the phenomena occur (Recker, 2013). This study is concerned not only with technologies related to VR, but also relations between the technologies and users of the technologies, i.e., members of remote teams in the context of organizations directly in real-life settings. Fourth, we recognize the philosophy of interpretivism as the appropriate means to get a better understanding of the examined topic, therefore, qualitative interpretive methodology appears to be appropriate according to Patton (2015). This research study aims to explore what role does VR have in enabling effective collaboration in remote teams. Qualitative approach allows researchers to explain how participants make decisions and reason about the researched topic (Recker, 2013). In summary, the participants' knowledge, experience, opinions and individual perceptions are more meaningful at present as the research topic is still only emerging.

Although MST is used for guidance in this research, with regards to the type of reasoning, this study is conducted with inductive reasoning as the subject area is not adequately researched yet. Thus, we attempt to generalize observed and analyzed relations in the study area as described by Recker (2013). For the same reason of the relative topic novelty, this study applies exploratory research (Recker, 2013).

In our opinion, a qualitative interpretive approach is the right design research foundation for the described research problem and research question. However, we acknowledge several

disadvantages of this approach. The interpretivist nature of qualitative methods is criticized for a higher possibility of introducing bias by researchers and for complicated or even impossible reproducibility (Recker, 2013). Another potential disadvantage is a low level of generalizability due to the specificity of cases and environments under study (Recker, 2013).

3.2 Data Collection

3.2.1 Literature Review

In order to understand the current knowledge of the problem domain better, existing literature on the research topic had to be examined. A literature review is necessary for investigating theories, models, frameworks and general concepts related to the research area and identifying potential gaps. That allows us to contribute to the cumulative body of knowledge with new findings (Recker, 2013). In addition, the process of conducting a literature review can lead to finding relevant authors and experts, disciplines adjacent to Information Systems and other previously unknown elements. We used several research databases such as Google Scholar, LUBsearch (the Lund University libraries' resources) and AIS eLibrary for the literature review. Based on the problem domain and research questions of this study, we defined search queries that should adequately cover extensive literature:

- ("virtual reality" OR "VR") AND ("virtual team" OR "remote team" OR "distributed team")
- ("virtual team" OR "remote team" OR "distributed team") AND ("communication technology" OR "collaboration technology")
- ("MST" OR "Media Synchronicity Theory") AND ("virtual reality" OR "VR")
- ("virtual reality" OR "VR") AND ("equipment" OR "hardware" OR "headsets")

3.2.2 Interviews

Previously we established the qualitative interpretive approach as the foundation for research design of this study. Subsequently, we selected interviews as a data collection method because it allowed us to acquire deep insights and opinions from subjective perceptions of people interviewed in this study (Recker, 2013). In addition, according to Recker (2013), interviews are the most applied technique for qualitative research. With regards to the interview format, we conducted semi-structured interviews because they gave us the opportunity to be led by a set of prepared questions and also ask additional questions based on interviewees' answers in order to better understand the reasoning of respondents (Patton, 2015). Moreover, the semi-structured format creates an environment for a more natural bidirectional conversation between the interviewer and interviewee. Using less structured interviews, respondents are more likely to talk about the topic freely and the conversation becomes more fluid (Recker, 2013). Lastly, thanks to the prepared key questions, we could ensure that important topics are not skipped by accident during the interview. The semi-structured format is also the most common one in Information Systems (Myers & Newman, 2007).

On the other hand, interviews may have certain disadvantages such as reflexivity (Recker, 2013), which may make respondents answer in a way the interviewer wishes. In order to

minimize our influence on the participants, the prepared questions were designed in such a way as to not lead respondents to specific or limited types of answers. For that reason, our interview questions are open-ended, which provides participants with a way to include a wider scope of responses (Recker, 2013). Moreover, we did not express any judgmental attitude towards the participants during the interview. Another potential drawback is an insufficient time allocated for the interview, for which the interviewees could feel rushed with their answers (Myers & Newman, 2007). As a result, the collected data would not be completely reliable. We mitigated this issue by allocating more time for the interview than it is designed to take.

Lastly, the current thesis paid extra attention to the length of the interviews to make sure participants were not discomforted and remained motivated to contribute to the study. All of the conducted interviews had a duration of less than an hour, so it is assumed that no interviewees experienced fatigue or loss of concentration and disengagement (Clark, 2008).

3.2.3 Target Sample

This study is concerned with VR for collaboration and remote teams. Thus, VR experts and members of remote teams who have experience with VR have been selected as an appropriate population for the study. Since we consider participants' expertise with VR for collaboration important for the study, we used expert sampling to select a narrower sample from the mentioned population (Bhattacherjee, 2012). Although Bhattacherjee (2012) suggests that a higher number of respondents increases generalizability, we aimed to interview 7-10 participants due to the time limitation of the study.

3.2.4 Selecting Respondents

When selecting respondents, the current study adhered to the previously set standards and got in touch with people with interest and experience in either collaborating in remote teams using VR or in the technology in detail (experts). The table below (Table 3.1) outlines all of the interviewees considered for this research alongside their position within their respective company, the date of the interviews and interview duration:

Table 3.1: Interview respondents

ID	Position	Date	Duration
P1	Consultant	4/20/2022	36 mins
P2	Consultant	4/21/2022	27 mins
P3	Project Manager	4/21/2022	30 mins
P4	Manager in Consulting	4/25/2022	42 mins
P5	Senior Consultant	4/26/2022	18 mins
P6	Manager in Consulting	4/28/2022	38 mins
P7	Senior Manager in Consulting	4/28/2022	40 mins

| P8 | Senior Manager in Consulting | 5/2/2022 | 29 mins |

P1 - Consultant

P1's experience with VR begins with their master's degree based in the field of MR/VR. Their current occupation is related to migration and management of virtualized and containerized environments in relation to cloud architecture and governance. Furthermore, they had experience in designing VR environments in Unity.

P2 - Consultant

P2 developed AR and VR applications with Unity3D to assist with manufacturing data visualization as part of their master's degree. Currently, they are part of the cloud solutions team within their company.

P3 - Project Manager

P3 has experience with development of VR applications from higher education. Furthermore, P3 has worked as a VR developer and also a project manager in companies with focus on VR, AR and MR for over four years.

P4 - Manager in Consulting

P4 is an organizational psychologist and digital learning consultant who specializes in the future of work technologies. Their main focus is exploration of the way VR can provide immersive learning and leadership development. They have an interest in VR and have been actively exploring the technology for over 5 years.

P5 - Senior Consultant

P5 was part of a team that explored disruptive technologies and their implementation for over 6 months. Further, they were working directly with analyzing the strengths and weaknesses of VR at that time. They did note that their experience could be outdated as they have not worked with the technology actively for the last 4 years.

P6 - Manager in Consulting

P6 has worked in many different sectors and has professional experience of over 18 years. They specialize in corporate security, organizational resilience, business continuity and digital learning. They have also led the development of over 30 e-learning courses across operational disciplines, alongside learning programmes that have been deployed in the UK and sub-Saharan Africa. They hold an MBA and a PhD in technology adoption. They have used VR to create simulated training experiences, supporting people in manufacturing or working with machinery.

P7 - Senior Manager in Consulting

P7 has led teams on a variety of pioneering projects, within his company, in the field of VR, 3D printing, Machine Learning, AR and Internet of Things. They have over 8 years of experience in their current position as Chief Disruptor, where they work with new technologies to demonstrate where they can be used effectively by building minimum viable products or proofs of concept. They were recommended by P4 as an expert in the field of VR for their organization.

P8 - Senior Manager in Consulting

P8 was also recommended by P4 as an expert in VR. They have 6 years of VR/AR production development experience and in-depth knowledge of the Digital Reality Space. They have also assisted companies in different industries and sizes to build custom content solutions and pipelines for these new media. They started their career building AR applications for historical figures at national heritage sites. They have been involved in the production of multiple award-winning VR/AR experiences featured at festivals such as Sundance, Tribeca, SXSW and others.

3.2.5 Interview Guide

An interview guide helps researchers navigate through the conversation during an interview. Since we selected the semi-structured interview format for its higher flexibility, the interview guide helped us keep the conversation within certain boundaries of the topic area (Patton, 2015). Two different interview guides were used since the experience and expertise of VR experts differ from remote team members (see Appendix A, Appendix B). The key questions in the interview guides are based on the concluded literature review in a previous step. Moreover, the structure of the interview guides follows guidelines for interviews by Myers and Newman (2007) with minor changes. We divided the structure into 4 distinct parts: opening, introduction, key questions and exit. In the opening, participants are informed about the general aim of the study. In the introduction, general questions about the participant are asked. In the part with key questions, questions about the topic and further sub-questions are discussed. In the exit, participants can add any final remarks, researchers can ask for permission for a follow-up and they can also suggest sharing the study results with the participants. Furthermore, we used the snowballing technique to find more participants for the current study, and P6 and P8 were recommended by P5.

3.2.6 Conducting Interviews

During an interview, we took notes so that respondents were not interrupted whilst they were expressing their views. The notes also helped us capture important details which could be otherwise missed in the mere verbal expression. Furthermore, all interviews were recorded by at least two devices, for example, a laptop and a phone. That was done to reduce the possibility that data was lost due to technical issues and interviews did not have to be repeated.

3.2.7 Transcribing

The recorded interviews were transcribed, i.e., transformed from the raw audio speech into text format. Transcribing for this thesis was done with Otter.ai (Otter.ai, n.d.) - a software for transcribing. However, the automated transcripts were manually checked for correctness. The

time after interviews was allocated specifically for transcribing and correcting them as Kvale and Brinkmann (2009) recommend in order to include potential contextual information and decrease the chance of information loss. In transcripts, private information is replaced with special words such as [CompanyName], [ColleagueName], [City], etc., to protect the privacy of participants and also partly maintain the original meaning. Long pauses in a conversation were noted as [long pause] to indicate that the participant took a longer time to think their response through. This was done to ensure that some level of nonverbal information, like the participant's hesitation, was reflected in the transcripts. After the interview was finished, the participant was asked if they agreed to be contacted again in case further clarification on some of their points would be needed. That was done with the intention to ensure a more correct interpretation and validity of the data.

It is also worth mentioning that the interview transcripts include both terms - *virtual team* and *remote team,* and they are used interchangeably. The term *virtual team* was replaced in the interview guides after a few interviews because some of the interviewees seemed to be more familiar with the term *remote teams.*

3.3 Analysis

3.3.1 Coding

In order to better navigate and extract more meaning from the qualitative data we have obtained, it was decided to proceed with coding the available transcripts in order to better interpret and discuss the actual findings (Patton, 2015). An inductive analysis was applied since this thesis is only guided by MST, and therefore, it is flexible to reveal emerging themes. According to Basit (2003), coding has an important role in data analysis. It is characterized by subdividing the qualitative data and assigning different categories to match the general themes of the study (Dey, 2003). The following thesis follows the practical suggestions outlined by Dey in his book *Qualitative data analysis: A user friendly guide for social scientists* (2003). As suggested by Dey (2003), the practical level of coding involves copying data from the original data source and placing them in a designated category - a mechanical task which is suitable for an automated software. The following study employed Nvivo - a software to assist with the coding needed for qualitative data analysis. As O'Connor and Joffe (2020) suggest, the content of interviews was coded individually by the researchers and then differences in coding were discussed and explained among the researchers to clarify the disagreement in interpretation. As a result, the individual coding increases the interview analysis quality.

According to Dey (2003), it is considered a good practice to view qualitative data in context, despite the inherent paradoxicality of grouping observations into separate categories, which removes the context for the data. To mitigate this issue, the current study attempts to make the categories meaningful both internally, with regards to the data from the original context, and externally, with regards to the comparison data (Dey, 2003).

Another important point to conducting adequate data categorizing is showing flexibility in extending, modifying and discarding categories (Dey, 2003). The same quality is also emphasized by similar studies (Deterding & Waters, 2021; Lu & Shulman, 2008). The current thesis took note of the importance of flexibility when coding and followed the best practice of

modifying categories to fit with the complexity of new data or discarding the ones, which could not accommodate the changes (Dey, 2003).

Lastly, the below common injunctions, as advised by Dey (2003, p.118) for creating categories were adopted to assist with the coding for the current research:

- Become thoroughly familiar with the data

- Always be sensitive to the context of the data

- Be flexible - extend, modify and discard categories

- Consider connections and avoid needless overlaps

- Record the criteria on which category decisions are to be taken

- Consider alternative ways of categorizing and interpreting data

We obtained the following data after coding the interviews. Firstly, below is a figure showing the segments of codes, ordered by size and showing each of the respective sub-codes and their overall contribution to the overall theme (Figure 3.1).

Next, in the Appendix K is an outline of the coding tree which contains all of the codes obtained after transcription (Figure K.1, K.2, K.3, K.4, K.5). Furthermore, the automatic coding service provided by Nvivo did not generate meaningful codes, so all of the final ones were produced manually. Both researchers first did coding individually and then merged their findings into the resulting final product. However, not all sub-codes had significant or interesting coverage, therefore, only the ones which had good support in multiple interviews or provided an interesting insight were reported in the findings and analyzed in the discussion.
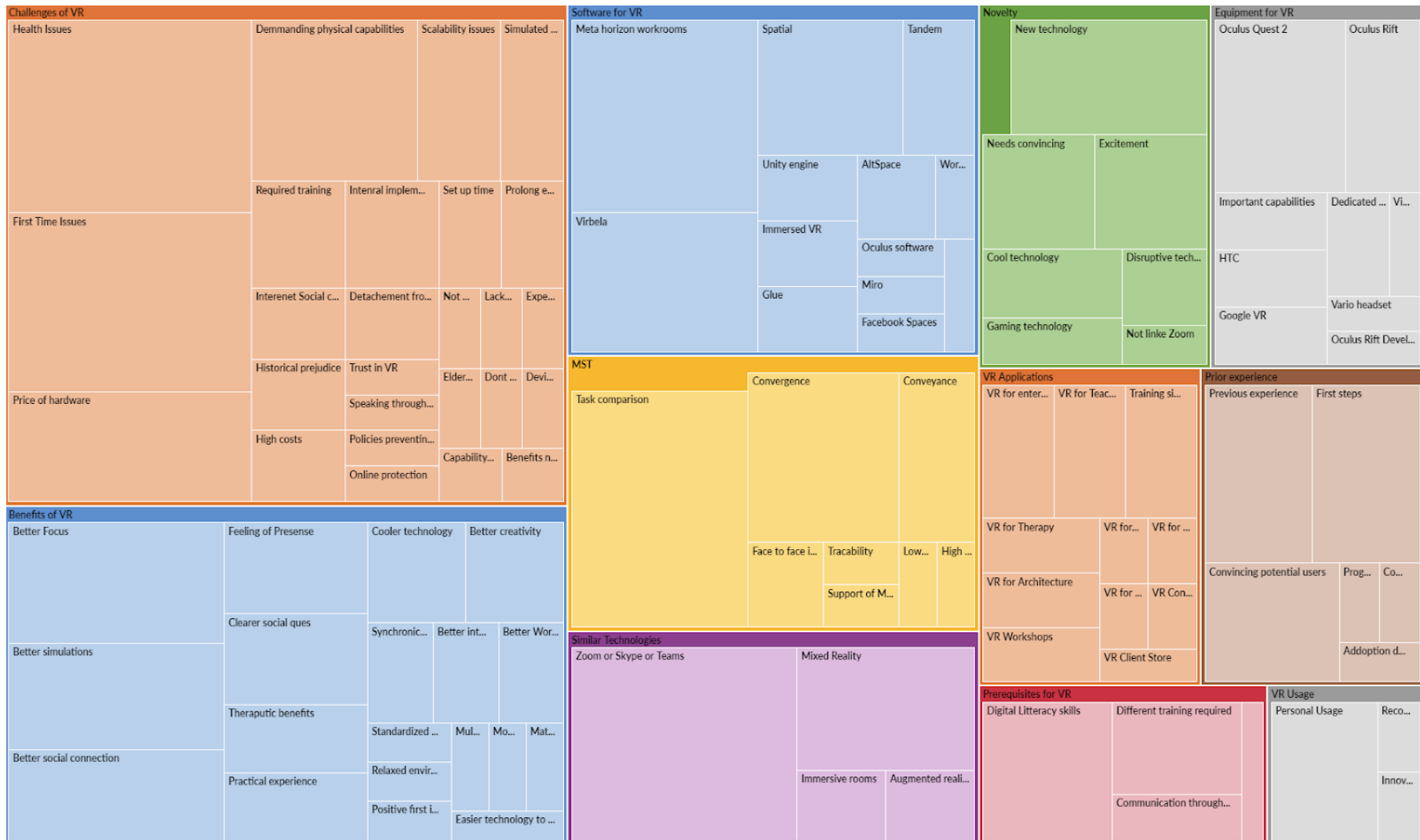
Figure 3.1: Code distribution

3.4 Research Quality

According to Fossey et al. (2002), the methodologies of a study, regardless of how sound they might be, are insufficient to ensure the quality of the overall research. Therefore, there is the need for additional evaluation criteria based on the paradigms and aims of the study (Fossey et al., 2002). For the purposes of the current qualitative study, reliability, predictability, transparency and validity have been identified as pivotal evaluation criteria.

Reliability/Credibility

According to Leung (2015), in regard to quantitative research, reliability focuses on making the findings of a research replicable. However, in qualitative research which studies social phenomena, replicability is difficult because of the challenges involved in reproducing the exact conditions when evidence was first obtained (Leung, 2015). Furthermore, Strauss and Corbin (2012) suggest using the term "credibility" in the context of qualitative research. This way the findings are

> *trustworthy and believable in that they reflect participants', researchers', and readers' experiences with a phenomenon but at the same time the explanation is only one of many possible "plausible" interpretations possible from data (Strauss & Corbin, 2012, p.62).*

Transparency

In its fundamentals, transparency is the notion that research needs to be clear, explicit and open about any assumptions made during the preparations and the research itself (Tuval-Mashiach, 2016). Furthermore, this quality is in line with one of the main purposes of this study – to investigate the role of VR in enabling effective collaboration in remote teams keeping in mind that the role might be negligible. Transparency is important because it is often taken for granted, however, it should not be assumed or implied from other qualities like reliability (Tuval-Mashiach, 2016). Throughout the study, great attention is paid to ensure processes are thoroughly documented and no ambiguity is present.

Validity

According to Kaplan and Maxwell (2005), specifically for validity in qualitative research, the scientific quality addresses the "subjective" nature of data collection and analysis. Being mindful of the fact that researchers are an integral part of qualitative research is an important part of the way this study was conducted. Furthermore, the researchers' backgrounds, developed relationships with interviewees and personal experiences have been examined and to the best of our abilities, accounted for. Moreover, the separation of interview data into first-order (i.e., participants' inputs) and second-order (i.e., researchers' interpretation of participants' inputs) conceptions has been examined to exactly distinguish participants' and researchers' contributions to the study, thus increasing validity. Lastly, Kaplan and Maxwell (2005) note a tradeoff for qualitative studies between reliability and validity due to the inherent flexibility and individual judgment of interpretative research. This flexibility is something that the current study aims to take advantage of.

3.5 Ethics

According to Recker (2013), ethics in philosophy is concerned with forming the distinctions between "right" and "wrong" or "good" and "bad", and other questions related to morality. This study aims to adhere to the Association for Information Systems' Code of Ethics and Professional Conduct (AIS, 2019). While all sections of the code of conduct have been taken into consideration by the researchers, below are outlined the ones deemed most suitable to the current study:

Avoid harm

According to Orb, Eisenhauer and Wynaden (2001, p.93), "harm can be prevented or reduced through the application of appropriate ethical principles". The authors further point to three key principles, which can be referred to when conducting qualitative studies – mainly autonomy, beneficence, and justice. For the purposes of the current study, strong emphasis has been placed on beneficence, as defined by Orb, Eisenhauer and Wynaden (2001, p.95) – "doing good for others and preventing harm".

Be honest and trustworthy

Honesty and trustworthiness are both particularly important ethical values, especially as part of the strive for transparency as one of the core scientific qualities of the current study.

Respect the work required to produce new ideas, inventions, creative works, and computing artifacts

This ethical quality refers to plagiarism and the use of proper referencing. Throughout the study, extra attention was paid to make sure the proper citations were used when referring to someone else's work. Furthermore, the LUSEM's Harvard Referencing Style Guide (2nd Edition) (LUSEM, n.d.) was used as a referencing guide for the study. Lastly, the issue of plagiarism has been noted by the IS community as still relevant (Kock & Davison, 2003; Recker, 2013).

Respect privacy

The right to privacy, especially nowadays, is an essential part of any research involving willing participants (Marelli & Testa, 2018). The current study acknowledges this and does not make efforts to collect any additional information beyond the one necessary for the analysis. Furthermore, participants were informed that any personal information about them would be fully anonymized, which is a practice recommended by the literature (Recker, 2013).

Honor confidentiality

Alongside privacy, confidentiality is also taken seriously by the current study. By ensuring and honoring confidentiality agreements with participants, the research minimizes the risks of causing harm to individuals – either by sharing their honest feedback about a process that later causes problems for them with their career development or similar cases.

Strive to achieve high quality in both the processes and products of work

Although the authors acknowledge their lack of experience with conducting and documenting qualitative research, one of the main drivers for this research, as also noted in the research motivation section, is the feeling of importance of expanding the currently available literature around VR technology's ability to support effective collaboration for remote teams.

3.6 Limitations

We acknowledge that this study has certain limitations. As previously mentioned, the choice of qualitative interpretive approach creates a lower level of reproducibility and generalizability (Recker, 2013). However, we consider its benefits to be greater than its disadvantages. Furthermore, the overall number of interview respondents for this qualitative study is sufficient for exploring the area of interest adequately (Kvale & Brinkmann, 2009). On the other hand, the number of interviewed members of remote teams who have a long-time experience with VR for collaboration is low, therefore, this study uses a considerable amount of secondary information from VR experts. In addition, all the participants seemingly had high digital literacy, which could potentially introduce selection bias to the study results (Patton, 2015).

4 Findings

This chapter presents the first-order findings from the semi-structured interviews. The data is structured according to the previously outlined themes within the codes used for analysis. Emphasis was placed on including mostly the shared points between multiple interviewees, although some interesting/significant points raised by single participants were also included. Lastly, a summary of the findings is also provided.

4.1 Benefits

4.1.1 Better Social Connections Due to Co-Presence

Participants mentioned several benefits of VR for collaboration that they have experienced. The most frequent benefit was the feeling of presence and co-presence. Co-presence seems to be more important to the participants, which could be expected since this study is concerned with collaborative VR, i.e., it requires more than one person. P6 (14) even suggests that collaborative learning in VR cannot be called collaborative if users can only interact with the same VR environment but not with each other. In some cases, the level of co-presence can be high. For example, P2 (18) compares the VR experience to a face-to-face interaction: "You can see each other, it feels like we're in a room together." The high perceived presence and co-presence could be induced by the wide range of visual and verbal symbol sets that VR is capable of transmitting, and high transmission velocity.

As a result of co-presence, it is indicated that social connections among users could be improved because it feels more personal. For example, P1 (8) said: "you have the opportunity maybe to see the person like you were in presence, so it's like a deeper type of contact." P4 (12) claims that "[p]eople feel more connected to one another" and later adds "So I would say bonding, creating friendships and creating better connections and also having a much more open mind were the results of that" (P4: 28). P5 (32) also mentions that a meaningful collaborative VR would bring more people together. P6 (16) suggests that synchronous communication in VR is positive for socializing. In addition, P6 (26) thinks that collaborative VR could have social and psychological effects on the team and their success:

> *[T]he thing that…we just haven't really been able to test is that being present with your team actually has positive, like psychological and social effects that we haven't really properly studied yet ... there are a lot of very subtle psychological effects that in the context of collaboration and working in a team are actually, you know, really vital. And I mean, if you add them up over the course of the whole project, like they can make or break the project.*

Furthermore, P3 (18) argues that users are more communicative in VR due to presence:

> *And as soon as they see what benefits it has from actually feeling like you are present, feeling that you are contributing, feeling that you are heard,*

> *because a lot of times when you have, for example, Zoom meetings, some people tend to not speak up because they don't have that physical presence.*

Moreover, several participants (P1: 8; P3: 18, 30; P4: 12, 28; P5: 32) mentioned the social benefits of co-presence in the context of the recent COVID pandemic. For example, P3 (18) said:

> *[I]f we will have anything happening, like the COVID pandemic, it's the physical presence which you have inside of the collaboration with the virtual reality. You don't have to be in front of the computer, you don't have to be, you know, somewhere on your phone and just calling, you have that actual feeling that someone is there with you.*

4.1.2   Clearer Social Cues

According to several participants (P1: 20; P2: 10; P7: 18), VR is capable of providing more social cues (e.g., gaze) than audio conferencing and video conferencing. P1 (20) claims that VR is advantageous because a user in VR is represented by an avatar:

> *[I]f you just make a call on Teams, you don't see even the photos, there are just some names and so it's a lot impersonal. With the VR it's more personal because ... it's mandatory, of course, to select an avatar.*

The use of 3D avatars and its benefits were mentioned also by P7. From the experience of P7, users in VR are more likely to greet each other: "if someone walks into a room as an avatar, people will just naturally say hello because it's much closer to a standard human experience." (P7: 18).

P2 (10) describes how users in VR can see what other users are looking at (e.g., at the whiteboard, in the eye) when they are having a conversation, which can imply that the user is paying attention.

In summary, the use of 3D avatars for representing communication participants seems to be accepted positively because it enables the transmission of visual symbol sets.

4.1.3   Improved Focus

Due to the immersion of VR, users tend to focus only on the VR environment when using it, and they ignore the real world around them (P8: 12). P2 (12) also claims:

> *[W]hat is also important is that when you are inside VR, you are focused on the task ... you can't hear anything from outside, mostly. You can't see anything. So you focus on what's in VR.*

P2 (18) also mentions that users may be more focused in VR because the experience in VR feels like the users are sharing the same physical space. Additionally, P4 (16) describes the same experience with regards to increased focus:

> *Because when you're in VR, you only focus on being there, and you filter out everything else that's happening because it's just too much.*

The improvement in focus indicates the capability of VR to support synchronicity. Furthermore, P3 (18) argues that the VR immersion and increased visual perception in VR can improve productivity even when compared to face-to-face interaction:

> *When we are talking about the collaboration on some mind mapping, brainstorming and things like that, there is so many different tools which are so visually appealing, which motivates people to go and, you know, give the 10 extra percent, which they would not if they meet in like in the real world.*

P3 (34) also claims that users are likely to remember more due to the rich visual experience in VR compared to the real world:

> *[P]eople tend to remember a lot more from this sort of meetings because they are so visual and so different. So your brain is actually able to comprehend and save a lot more information than when you have a normal discussion.*

4.1.4 Enhanced Creativity

It was indicated by some participants (P4: 12, 28; P5: 26; P7: 16) that VR could be beneficial for collaborative tasks that require creativity. P4 (12, 28) and P7 (16) specifically used a whiteboard session as an example. P4 (12, 28) said:

> *If you want to do a brainstorm, if you want to prepare a workshop, if you want to create a slide deck together, then either you want to be in a room with those people having a whiteboard or you can go into Workroom Horizons ... So creativity is a big one that is limited in Zoom sessions ... creativity, putting things together that really shows its benefit there.*

P7 (16) similarly identified the type of creative tasks like a whiteboard session as a suitable use case for VR:

> *I guess more interactive collaboration and because, you know, that's what a whiteboard session is. It's obviously much more interactive, you know ... it's much more tangible, you can illustrate the ideas more in a more tangible way. So we definitely see it as like the, as sort of a remote whiteboard thing*

Moreover, P5 (26) mentioned that teams that work with design could benefit from using VR for collaboration as well.

4.1.5 3D Simulations

Simulating 3D objects was another important benefit of VR mentioned by several participants (P1: 8; P2: 22; P6: 28; P7: 24; P8: 12). As with the use of 3D avatars, most participants see the general capability of the richer 3D symbol sets beneficial for collaboration. The capability to work with 3D objects was pointed out by P2 (22). P7 (24) further argues that the advantage of 3D visualization is huge:

> *[I]f you're collaborating on a building, then like, yeah, it's no contest. Like, obviously, doing it in VR ... versus doing it on a 2D plan, VR trumps it 100% like [it] isn't even, yeah, not even close.*

P1 (8) and P6 (28) describe that simulated 3D machinery and mechanical elements in particular are advantageous. For example, P6 (28) mentions the VR content that can be useful to share with others:

> *Where you need to interact with something for a procedure, so you need to, like, I do machinery-based simulation at the moment. So where you need to be aware of spatially how big a machine is, you need to know which button to push or which lever to pull*

In addition, P7 (24) mentions 3D virtual visualization as a positive element of virtual story-telling.

4.1.6 Therapeutic Use

Besides benefits mainly related to collaborative VR for remote teams, a potential therapeutic use of VR emerged in some interviews (P1: 2; P2: 30; P4: 2). P1(2) mentions how VR can be used for a treatment of post-traumatic stress syndrome. P4 (2) shares a personal story about the use of VR for improving public speaking skills and how it helped several people in a pilot project:

> *And it was really, really impactful. Some people cried because it was the first time [when] they were able to…take some steps in overcoming their fears. And to give you an idea, those people were struggling with public speaking to such an extent they were considering leaving [CompanyName] or not taking a promotion to manager just because they were afraid of public speaking. So, they really felt the big sense of release that VR as a technology actually helped them to overcome that fear.*

Furthermore, P2 (30) claims that the right VR environment can help users relax using an enjoyable virtual environment.

4.2 Challenges

4.2.1 Health-related Issues

By far the most common point, which majority of the participants made, in regard to the limitations of the technology are the health issues associated with VR. For example, P1(10, 32, 34) raised an interesting point about people who due to issues with detachment from reality should avoid engaging with VR. The following extract best captures that point:

> *[F]or some of them, detaching from reality was an experience that they really don't enjoy because their stability comes from specific things of the real world. So it's like if they have a person that is with them and it gives them security. So maybe detaching from it would not be a good thing. (P1: 34)*

In addition, some interviews mentioned motion sickness or nausea as a potential health-related issue. However, the effect was noted to be the strongest during the first few VR sessions and to not necessarily affect every new user (P3: 4, 8; P4: 16; P6: 16; P7: 6). Lastly, some more severe concerns regarding issues like epilepsy, coming from the high refreshment rate of the devices, were also raised (P1: 34; P3: 4).

4.2.2 Requiring Additional Physical Assets

In addition to the hardware for working with VR, some of the participants also noted that a dedicated space is also required to make sure that users do not injure themselves or cause damages in the physical world, while they are in the VR environment (P3: 38, 40; P6: 18). Further, P6 shared a point about making sure that the right physical assets like stable and fast broadband connection, access to stable electric power and device availability are in place prior to implementing VR (P6: 18).

4.2.3 Price of Hardware

Another common limitation of VR, pointed out by the participants, was the price of VR hardware (P3: 14; P5: 6; P6: 18). The point was best summarized by P3 (14) in the following extract:

> *Well, first of all, you have to think about the expenses. If you want to have someone joining you for the VR conference, for example, you have to make sure that that person actually has the VR headset. And that means that they will have to either buy it yourself [sic] or you will have to ship it to them and that is probably the biggest drawback which I see also with the partners or people who want to get inside of this technology, it's the cost which is prohibiting them from trying it out.*

4.2.4 Other Key Points

Both participants P4 (14) and P6 (6) mentioned scalability as a challenge for VR, with P6 (6) mentioning issues with economies of scale and lack of device agnosticity, in regard to their experience with creating online learning environments. P2 (14) raised a point about simulating computer monitors inside VR environments and the limitations associated with that. Mainly that the current technology could not simulate sharp enough monitors in the virtual environment and could therefore have limited applicability for remote collaboration (P4: 14, 24; P5: 32). Another point was also raised by the participants about the prolonged usage of VR. P2 (18) mentioned that after using a standard headset for longer periods of time, they experience discomfort. Additionally, P4 (6) suggested that the activities in VR determine what could be considered a healthy amount of time spent with the technology. Lastly, challenges with internet culture were also expressed by P3 (14), mainly with the way personal distance is perceived in the virtual world and what effects that might have on new users.

4.3 Nature of the Task Appropriate for VR

4.3.1 Appropriate Tasks

Participants described several general and also concrete tasks when the use of VR can be appropriate. For example, P1 (8, 20), P6 (28), P7 (24) and P8 (10) pointed out the advantageous capability of VR to display spatial 3D objects that resemble real-world objects. In that case, team members can work on developing a 3D object (e.g., a building) together in the virtual environment (P7: 24). Compared to other media, according to P6 (26), VR has the advantage that remote team members can interact with each other, and the same environment and content. P5 (26) also suggests that VR could be beneficial for design teams.

Another group of examples includes mostly creative work and work that requires more than just mere transmission of information among users. In MST terms, participants do not identify VR as advantageous for tasks that need primarily conveyance processes. For example, P7 (16) compares the use of collaboration in VR with the use of a real whiteboard session when team members need to exchange ideas in detail after an earlier conversation among team members:

> *[W]hen you're in the office,…someone will…send you a message on Slack or…you might get an email, and then you might send someone a Slack message. And then you might have a little bit of a chat on Slack. And then they might give you a call…and then they'll come over and discuss it with you…And then if you want to, like really get into it, you'll go into another room where there's a whiteboard…and you'll start to really get into like, understanding the problem...So like for a remote team, you know, it's the same sort of thing is, it's not that you're spending your whole time in VR, in the same way that you don't spend your whole time standing in front of a whiteboard. It's another context that you use in order to effectively collaborate …*

Similarly, P4 considers brainstorming (12), preparing a workshop (12, 28) and creating a slide deck (12) with other users as the appropriate applications of collaborative VR. P7 (18) also mentions all-hands events to be better in VR than in 2D environments like Zoom. In addition, P4 (28) claims that VR can make users think more outside of the box and have much more open minds.

Decision-making is another activity that requires a discussion and achieving an agreement among team members. P3 (30) provides an example of how they used a VR meeting for making decisions: "we were able to progress much faster through the information than what we have been doing before, for example, Zoom or Skype".

From a social perspective, P4 (28) claims that immersive VR collaboration can be used for improving social bonds.

4.3.2 Inappropriate Tasks

According to several participants, in some cases, VR is not an ideal medium for collaboration. Most of the tasks that participants described as inappropriate for using VR are more associated with conveyance processes. For example, P4 (12, 32) mentions "transactional intellectual

work" and "transactional tasks" as something that can be easier to do with other media like Zoom and Teams:

> *I would say just some transactional tasks like going over numbers, checking if you have all the documents in the right folders, or having a brief status update like where are we in terms of this project…I would say don't over-complicate it, don't lose your time with setting up the VR environments (P4: 32)*

With regards to a brief status update mentioned by P4 (32), P7 (20) also claims that using VR for stand-up meetings is potentially not the right target of VR application: "the problem that you're trying to solve with a stand-up is not necessarily the problem that you're trying to solve with…VR".

Moreover, mere transmission of information seems to be an insufficient reason to use VR. P6 (26) argues that

> *If you're just going to talk to each other, you could do it on Teams… the advantage has to be being able to get together with other people and with content.*

P6 (28) also adds that a one-way interaction, where one person just shares information with others, does not benefit from using VR and could be done with other media.

Furthermore, the synchronous nature of VR is not always beneficial. Both P3 (26) and P7 (24) mention that information discussed in a VR meeting can be lost if someone in the VR meeting does not have the role of a "scribe". These claims point out the low reprocessability of VR:

> *a lot of people prefer to have some sort of traceability. So, if I send some sort of message, I can still go and see it later on. Well, when you're inside of the VR, usually you don't have access to the recording, so you cannot go and throw back. So, unless you have some sort of facilitator … who is taking notes and making sure that all the important decisions have been noted, then you can kinda lose this information. (P3: 26)*

> *it's about the exchange of ideas, but also about being able to capture those ideas as effectively as possible … we've had kind of scribes who have been alongside the sessions in order to kind of capture ideas effectively (P7: 24)*

In addition, P7 (24) argues that capturing and grouping ideas is possible in VR but it is more effortless in a different collaboration software like Miro or in real life.

P6 (16) mentions the lack of VR's rehearsability as another disadvantage of synchronous VR, namely, users cannot consider their response well before replying. Especially, when a user needs to speak a foreign language and can feel uncomfortable as a result, which could cause them anxiety.

4.4 Prior Experience

4.4.1 Positive Prior Experience

In regard to prior experience with the technology, P4 (28) shared a personal example with a colleague of theirs, where they opted to collaborate specifically in VR since both of them had experience with the medium and felt a limitation with the other existing media. The exact phrasing is stated below:

> *A personal example is where I was preparing a workshop with another person in the Netherlands and I was in Prague. So we were on ... Teams trying to do the workshop preparation. And after 20 minutes, we felt we hit a wall like ... we weren't able to take it further. But we weren't finished. And I knew he had a VR headset, I had the VR headset. So we decided to go into Horizon Workrooms and we continue ... on the whiteboards, putting ... our ideas together. And after another 20 minutes, we basically were okay, that's it. We're done. We're ready. And then he came to Prague, we delivered the workshop, and it worked.*

Additionally, P7 (8) made an interesting point about people with experience in representing themselves through avatars. They argued that people, who have been playing multiplayer games and are more familiar with communicating through a representation of themselves in a simulated world, would have an easier and richer experience in VR (P7: 8). Lastly, P7 (18) also mentioned that younger colleagues, who had experience with communicating via mediums like Slack or Discord, have easier time collaborating through VR.

4.4.2 Negative Prior Experience and Skepticism

The entry to the first VR experience is often met with skepticism. P4 (2) describes his attempt to introduce VR to his team as: "It was something that people were getting excited about, but they didn't really saw [sic] the business potential". P5 (12) had a similar experience when promoting VR: "it's just the idea that VR is associated with gaming and not being able to see the business applications". P3 mentions that VR from recent years was targeted mainly at games as well: "there was not that much being developed besides the games themselves".

However, both P4 (2) and P5 (8, 12) claim that the skeptical attitude of completely new users have changed after they tried to use VR with VR headsets on for the first time. P5 (12) describes the experience:

> *it was just full of kind of men in suits, who were just kind of ... scoffing at this VR stand ... it was only once they actually got in...it was like the little kids at Christmas ... they would stay in for a long time, just like playing around ... Then when they lifted their masks up, it was like little kids at Christmas. And they seemed very excited by the possibilities.*

Furthermore, according to P6 (18), people with previous negative experience with VR can pose a barrier to the adoption of VR. Even if their negative experience is from the time when VR was less mature. P6 (18) furthered the point by explaining that the technology has existed

in some form or another for over 30 years and past failed implementations could be what formed the associated historical prejudice.

4.4.3 Initial Positive Experience

The initial users' impression of VR for collaboration seems to be positive. P3 (30) mentions that "people were very excited" after they had a meeting in VR. P4 (20) also claims that people who use VR for collaboration "are really excited about it". Due to the novelty aspect of VR, P4 (12) argues that VR allows users to get a break from more traditional video conferencing, which is more engaging. In addition, P3 (32) also points out that VR could be used to "spice up" meetings by using VR as "something different" from common meetings. P1 (26) agrees that people may like to use VR initially, however, he argues that "people could get bored in some weeks". Another disadvantage of the VR novelty is that the VR environment can be distracting as P3 (16) describes:

> *people just tend to wander off because they get interested in the surrounding 3D environment. And they just don't pay attention, especially when it's the first time they are trying things like this ... and you have a person giving the conference speech, and nobody's paying attention because everybody's admiring, like, little flowers or pictures or whatever you can find in there.*

4.4.4 Initial Negative Experience

A common point among the participants was the varying types of first-time experiences users had with VR. As people have different backgrounds and knowledge, some users may initially struggle with navigating the VR environment (P2: 16; P4: 2, 20). Emphasis was placed by some of the participants about the importance of having someone with experience in VR being present to guide new users (P7: 6; P3: 8). Also some level of digital literacy is also noted as required prior to implementing the technology, which could somewhat limit the scope (P3: 30). This point is best summarized with the extract below:

> *I am a person who plays games a lot. So for me, moving around is something that is extremely easy because it's just, you know, ingrained in my brain. But when I saw the partners who are like 56 years old, and they were like, "I have no clue how to move", and you have to explain, you have to press the 'W', you have to press this and you have to... So it was a nightmare to facilitate. (P3: 30)*

In addition, carefully selecting the first time experience for new users was also noted to play a key role in shaping the first impressions, since some experiences were more likely to make users feel sick or put them in danger (P3: 8; P4: 2; P7: 6).

4.4.5 Training for VR

Many of the participants talked about how VR requires certain elements to be in place before being successfully implemented in companies. Both P3 (30, 32) and P4 (16) mentioned that allocating specific time for training prior to implementing VR is essential. Furthermore, P4 (16) gave a detailed explanation of the way they would conduct the initial training of new

users. Also, P4 (16) recommended that simplified controllers and experiences might be more suitable for users without prior experience. On the same note, emphasis was placed on having digital literacy skills (P4: 16; P5: 20).

4.5 VR Novelty

4.5.1 Maturity

VR was described by many participants as a technology that is still very novel. P1 (2) claims that VR devices made "a magic leap" in recent years. Similarly, P5 (2) worked with VR in a team that was in charge of exploring "disruptive technology". P4 (24) also argues that "VR is already the last frontier for a lot of people". In terms of maturity of the VR technology, the opinions of participants differ. For example, P1 (36) claims that VR devices are not mature enough and need further development. On the other hand, P4 (10) mentions that "VR environments, both from a platform's perspective and an experience perspective is mature, definitely mature enough". In addition, P4 (18) argues that the novelty of VR is an advantage for learning to control the technology, compared to a technology like the laptop, due to the focus on design thinking for newer technology. Although several participants agree on the VR novelty, P3 (34) claims that VR can become adopted similarly to the phone in the future.

4.5.2 Hype

Due to the novelty and the fact that VR is still not very commonly used, P3 (20) and P4 (14) suggest that some companies may only be using VR to stand out from others. For example, P4 (14) said:

> *It also helps for their personal branding because they're the cool guys around the block when they post something on LinkedIn that we had a meeting in VR.*

4.6 VR Hardware

VR hardware is a crucial element to consider when implementing VR into remote teams' processes. A broadly mentioned piece of VR equipment was the Oculus Quest and Oculus Quest 2. P2 (6) ranks the Oculus Quest 2 as the best VR headset "in terms of costs to performance". P8 (8) also points out its easy accessibility and low price compared to other VR headsets on the market. Besides the low price of Oculus Quest 2, P3 (3) argues that the Oculus headsets have other advantages. Firstly, the headsets can easily use the Oculus Store (an online store for VR games and applications). Second, they provide a pleasurable onboarding experience with explaining how to use the VR equipment, e.g., "how to use the controllers, how to navigate around" (P3: 10). Another potential advantage of the Oculus Quest and Oculus Quest 2 is that they are standalone since P5 (6) mentions how inconvenient it can be to use the tethered Oculus Rift. On the other hand, P4 (8) describes that implementation with the Oculus Quest 2 *at scale* is difficult due to complicated processes with the vendor. For that reason, P4 (8)

suggests to use the Pico Neo 3 or the HTC Vive for a case with a larger group. Furthermore, P8 (8) claims that a Varjo headset could be suitable, although it is more expensive.

Moreover, P8 (8) and P1 (4) mentioned a few smartphone-based headsets, such as the Google Daydream, Google Cardboard and Samsung Gear VR. Although this type of headsets are less expensive (P1: 4), P8 (8) do not consider them suitable for remote teams.

4.7 VR Software

Since VR, especially collaborative VR, requires special software, the findings concern this area as well. The participants have experience primarily with two specific VR applications, namely, Virbela and Horizon Workrooms.

Horizon Workrooms was mentioned by 4 participants (P2: 6; P4: 12, 28; P7: 8, 12, 16; P8: 8), which makes it one of the two most common VR applications (together with Virbela) among the participants. P2 (6) points out its easy setup compared to other VR applications, and the ability to use a virtual whiteboard that can be saved and exported to another platform, which provides reprocessability at least to a limited extent. Likewise, P4 (12) mentions Horizon Workrooms for effective use of a virtual whiteboard. In addition, P7 (12) considers it to be the best option for collaboration in VR. P7 (16) argues that Horizon Workrooms is "the closest thing to Zoom or Teams" in terms of ease of access, i.e., meetings can be shared and accessed via a link, and a VR headset is not required. P7 (8, 12, 16) assigns a special importance to the accessibility via a browser without a headset multiple times.

Virbela was brought up by 4 participants as well (P5: 32; P6: 26; P7: 8; P8: 8). P5 (32) describes its graphics as "basic" but also claims that everyone, who used it together with P5, "absolutely loved it". Moreover, P7 (14) has experience with using Virbela for doing all stand-up meetings for several weeks. P8 (8) also said that they use Virbela "regularly".

Other mentioned VR software available for collaboration includes Spatial (P4: 14; P7: 8, 12; P8: 8), AltspaceVR (P3: 30; P8: 8), Glue (P7: 8), Immersed (P2: 6), Engage (P7: 12) and Arthur Digital (P8: 8).

4.8 VR Applications

One of the most common applications for VR that participants seemed to agree on was for constructing training simulators (P3: 2; P6: 30). VR for entertainment was also a common point for participants (P4: 2; P8: 8). There was also an interesting point about VR in visualizing spatial 3D architecture and urban design (P4: 24; P7: 24). In addition, P4 (28) noted the benefits that VR provided from making interactive and engaging lectures, which inspire people to look further into the technology. This point is best captured with the following quote:

> *Another example that I told you already is this lecture, which helped ... students to be more attentive, more engaged, they asked more questions. And it inspired two of them to either do their master thesis or their PhD research on VR or on the metaverse. So I'd say ... that's a good effect as well from just having a lecture. (P4: 28)*

4.9 VR Usage

Most participants either did not actively engage with the technology or used it for less than an hour every day (P1: 4; P4: 4; P5: 4; P7: 6; P8: 4). The only exception being P2 (4) who used the technology two times per week for a minimum of 5 hours, which equated to 10 hours per week. Moreover, P4 (6) was asked and provided an interesting point about the healthy amount of time that can be spent in VR, which was according to them no more than 4 hours. Their exact phrasing is below:

> *But I would just say the visual processing happening in your brain, the eye-strain from being in a device like this, I would say not more than four hours. But I would say the same about laptops and laptops are actually even worse from a physiological point of view than VR is. (P4: 6)*

4.10 Similar Technologies

By far the most commonly mentioned technology, which most participants agreed was used primarily for collaboration in direct competition with VR, are Teams, Zoom or Skype (P3: 26; P4: 28; P8: 16). P3 (26) made an interesting point that tools like Zoom or Teams provide a level of traceability of information, which is not present in VR since VR is mostly about experiences and as of now does not natively record meetings. The point about these technologies being also more accessible was also raised (P6: 26). However, several participants also pointed towards the issue of "Zoom fatigue", which impacts some users of the technology (P4: 12; P7: 16).

Another interesting alternative to VR was noted to be Mixed Reality (P1: 18, 24; P3: 24, 36). With P3 (36) even making the claim that in terms of collaboration, they see MR as a more advantageous technology to VR. Below is the way they phrased their point exactly:

> *[F]or us Mixed Reality is the tool which we would go with and pursue. Just because you have real-time feedback, you see what the person sees inside of the real world and you are able to fix a lot of issues a lot faster without the costs of having to travel, find the accommodations and things like that. So most likely we would go with the Mixed Reality instead. (P3: 36)*

P4 (24) also provided an interesting alternative to VR in the form of an immersive room. The main idea behind these rooms is to have people physically together interacting at the same time with a simulation, which could also be applied in a collaborative context (P4: 24).

Lastly, both P4 (24) and P1 (38) mentioned Augmented Reality as an already established alternative to VR, which some companies and even the army have used for collaboration. However, P8 (22) noted that MR and AR are interchangeable terms and do not need to be separated.

4.11 Summary of Findings

The following table provides a summary of the findings above and their relation to MST.

Table 4.1: Summary of findings

Section	Summary of findings	Relation between findings and MST
Benefits	The VR's capability to visualize 3D objects including avatars creates the feeling of presence and co-presence. As a result, users' social relationships and focus are improved. Moreover, VR can be beneficial for therapeutic use.	VR has the capability to increase synchronicity with natural symbol sets (3D avatars and other objects.).
Challenges	Health related issues, like motion sickness, are still present in the technology, although to a lesser extent with the advancements in VR technology. There are also certain barriers for implementation like the price of hardware and the required training.	-
Nature of the Task Appropriate for VR	VR seems to be suitable for creative tasks such as brainstorming and designing. On the other hand, transactional tasks that involve mere transmission of information, such as one-way communication or a brief status update, are not appropriate.	The suitable use of VR is associated with tasks that need convergence processes more, as opposed to conveyance processes.
Prior experience	Both positive and negative prior experiences have been reported. However, positive initial experiences seem to prevail. Regardless, the technology is still approached with skepticism from some professionals, due to past failed implementations or other reasons.	Negative or positive first-time experiences may lower or increase respectively the chance of faithful appropriation of VR technology for remote collaboration.
VR novelty	The VR technology is still described as novel. Only one participant claimed explicitly that the technology is mature enough. Moreover, some companies may be using VR for meetings only to stand out from others.	-
VR hardware	The benefits of the Oculus Quest 2 were mentioned most frequently. Some of them are good performance, low price, pleasurable onboarding experience and the	-

	standalone headset. On the other hand, it was argued that it could be hard to implement at scale. Other hardware mentioned - Oculus Quest, Oculus Rift, HTC Vive, Varjo, Pico Neo 3, Google Daydream, Google Cardboard, Samsung Gear VR	
VR software	Horizon Workrooms is the most known software among participants. Its main benefits are easy setup, easy access and a virtual whiteboard that can be saved and exported to non-VR platforms. Other software mentioned - Virbela, Spatial, AltspaceVR, Glue, Immersed, Engage, Arthur Digital.	Horizon Workrooms provides reprocessability to some extent with a virtual whiteboard that can be stored.
VR applications	VR was noted to be useful in constructing training simulations and entertainment. It was also noted as beneficial in brainstorming, creating better workshops and prototyping.	VR excels in communicating novel concepts, which require high synchronicity
VR usage	Although the participants were mostly VR experts, they did not have many business processes which included longer usage of the technology. The participant who used the technology the most used it for about 10 hours per week.	-
Similar technologies	The most common technologies mentioned by interviewees are Zoom, Teams and Skype. Their benefits over VR are better traceability and easier access. Specifically in the context of remote collaboration, AR and MR solutions were suggested as potentially better alternatives to VR.	VR is reported to be an inappropriate choice of technology for collaboration on tasks requiring rehearsability and reprocessability.

5 Discussion

The following chapter presents the second-order data in this research, namely the analysis of the first-order data by the researchers. It aims to enhance the reported findings with the supporting theory and reflect on the end result.

5.1 VR's Media Capabilities

5.1.1 Symbol Sets

MST describes how physical capabilities of a medium influence the potential to support synchronicity in communication processes (Dennis, Fuller & Valacich, 2008). The most noticeable VR's medium capability among participants was symbol sets, i.e., the number of ways in which a sender can encode information before sending it to a recipient. For example, P1 (8, 20) and P2 (10, 18) mention the benefit of individuals seeing others in the virtual environment similarly to the real environment with the use of 3D avatars, which enables the transmission of *natural* visual symbol sets. According to MST, media that provide more natural symbol sets are better at supporting synchronicity (Dennis, Fuller & Valacich, 2008). In addition, Smith and Neff (2018) claim that avatars improve remote team's performance due to the transmitted nonverbal cues. Besides the avatars, VR enables simulating other 3D objects that users can interact with and use them as a way to provide information to others. These objects can vary greatly, e.g., a whiteboard (P4: 12), a building (P7: 24), machinery (P6: 28). Based on the participants' experience (P2: 22; P6: 28; P7: 24;), the VR's capability to visualize various 3D objects can be well-suited to visual collaborative tasks, which can further improve synchronicity (Dennis, Fuller & Valacich, 2008).

5.1.2 Transmission Velocity

Transmission velocity impacts how fast information can be delivered from a sender to a recipient, and how fast the recipient can reply (Dennis, Fuller & Valacich, 2008). P2 (18), P3 (18) and P7 (18) mention that communication in VR is close to simulating face-to-face communication in terms of presence and co-presence. Since such an environment enables conversation among individuals, it can be argued that VR's transmission velocity is fast and, as a result, VR's transmission velocity can support synchronicity (Dennis, Fuller & Valacich, 2008).

5.1.3 Parallelism

Although the concept of parallelism (i.e., the number of simultaneous information transmissions over a medium (Dennis, Fuller & Valacich, 2008)) was not identified directly by the participants, we can infer its value for VR to some extent. As mentioned previously, a few participants (e.g., P2: 18; P7: 18) claimed that the VR environment may resemble conversation in a physical room, therefore, the estimated VR's parallelism can be comparable to the parallelism of face-to-face communication, i.e., medium parallelism. However, the VR environment is not limited by physical space and, consequently, parallelism of VR can be higher

than the one of face-to-face communication. Therefore, we suggest the parallelism value of VR to be medium-high. MST claims that a higher value of parallelism negatively impacts synchronicity (Dennis, Fuller & Valacich, 2008), however, no participants mentioned issues related to parallelism of collaborative VR.

5.1.4 Rehearsability

VR's rehearsability (i.e., the capability to modify a message before sending it in such a way that the recipient can decode its meaning more precisely (Dennis, Fuller & Valacich, 2008)) was mentioned particularly by P6 (16). It is argued that the VR's *low* rehearsability can be disadvantageous, namely for communication if participants do not feel comfortable having conversation in a foreign language due to the absence of ability to correct their message before sending it.

5.1.5 Reprocessability

Reprocessability of a medium allows both senders and recipients to review a message in the decoding phase multiple times (Dennis, Fuller & Valacich, 2008). The VR's *low* reprocessability was described by P3 (26) and P7 (24). They claim that a specifically assigned facilitator is needed for "*taking notes*" and "*capturing ideas*" in VR, otherwise the discussed information gets lost and cannot be reexamined. However, some VR software supports a virtual whiteboard and information noted on the whiteboard can be stored and exported, which provides a limited built-in reprocessability (P2: 6).

5.1.6 Information Transmission, Processing and Synchronicity

Table 5.1 shows media capabilities of different media as illustrated in MST by Dennis, Fuller and Valacich (2008). In addition, the table is expanded with the VR medium based on the characteristics of media capabilities mentioned by the participants as described above. The values assigned to the media capabilities (low, medium, high) are further used for inferring values of VR's information transmission and information processing. MST claims that transmission velocity, parallelism and symbol sets positively impact information transmission, whereas rehearsability and reprocessability are significant for information processing (Dennis, Fuller & Valacich, 2008). Therefore, based on the identified media capabilities, VR enables fast information transmission and only supports low information processing. Consequently, we can infer that VR is highly capable of supporting synchronicity.

Table 5.1: Media capabilities for different media including Virtual Reality (adapted from Dennis, Fuller & Valacich, 2008)

	Transmission Velocity	Parallelism	Symbol Sets	Rehearsability	Reprocessability	Information Transmission	Information Processing	Synchro-nicity
Virtual Reality	High	Medium-High	Few-Many	Low	Low	Fast	Low	High
Face-to-face	High	Medium	Few-Many	Low	Low	Fast	Low	High
Video Conference	High	Medium	Few-Medium	Low	Low	Fast	Low	High
Telephone Conference	High	Low	Few	Low	Low	Fast	Low	Medium
Synchronous Instant Messaging	Medium-High	Low-Medium	Few-Medium	Medium	Medium-High	Medium	Low-Medium	Medium
Synchronous Electronic Conferencing	Medium-High	High	Few-Medium	Medium	High	Medium	Medium	Low-Medium
Asynchronous Electronic Conferencing	Low-Medium	High	Few-Medium	High	High	Slow	High	Low
Asynchronous Electronic Mail	Low-Medium	High	Few-Medium	High	High	Slow	High	Low
Voice Mail	Low-Medium	Low	Few	Low-Medium	High	Slow	Medium	Low

5.1.7 Conveyance and Convergence Processes

MST proposes to evaluate effectiveness of a medium in terms of conveyance and convergence processes as opposed to the broad term of tasks used by previous media theories (Dennis, Fuller & Valacich, 2008). Moreover, MST claims that although most tasks need both conveyance and convergence, some tasks require a higher proportion of convergence while others need more conveyance. Based on the participants' experience, the use of collaborative VR is appropriate for tasks that involve a higher proportion of convergence. For example, an interactive brainstorming session with a virtual whiteboard (P4: 12; P7: 16), collaborative decision-making (P3: 40), all-hands events (P7: 18) and other creative, design tasks (P5: 26). On the other hand, a few tasks, where more conveyance needs to be performed, were identified as inappropriate. For example, a brief update (P4: 12) like in a stand-up meeting (P7: 20), sharing raw information like documents (P4: 32), and one-way communication that does not involve a rapid exchange of information between communication participants (P6: 28).

5.1.8 Communication Processes and VR's Media Capabilities

One of the core propositions of MST claims that communication performance depends on the fit of the medium's capability to support synchronicity and the communication processes (i.e., conveyance and convergence) (Dennis, Fuller & Valacich, 2008). As discussed above, the findings indicate that VR can support high synchronicity. In addition, participants described tasks that need more convergence as appropriate for collaborative VR, and tasks that need more conveyance as inappropriate. Therefore, it can be argued that the MST's proposition is valid, i.e., the VR's high synchronicity positively impacts communication performance for tasks that require convergence. On the other hand, communication performance does not benefit from the use of VR if the performed tasks need more conveyance.

5.2 Prior Experience

Additionally, another one of MST's propositions was confirmed based on the findings from our study. Namely, that the faithful appropriation of a media depends on the positivity of prior experiences (Dennis, Fuller & Valacich, 2008). Our research found evidence for both positive and negative prior experiences with the tendency for the positive experiences to be more common (P4: 20; P7: 6). Several of our interviewees shared a common point of how VR made people more engaged, more focused on the tasks at hand and enabled a higher degree of creativity within the teams (P2: 12; P7: 26; P8: 12). On the contrary, some interviewees reported cases where people had negative prior experiences and a certain degree of historical prejudice against VR within businesses (P3: 4; P6: 18). That point was also suggested by the literature, where people often experienced motion sickness with the hardware and would therefore, develop a negative first-time experience (Dziuda et al., 2014; Moss & Muth, 2011). Given the long history of the technology, there are also previous cases where implementations of it have failed and this makes further implementation efforts for remote collaboration more complicated. Regardless, participants did note that attitudes often change after exposure to the current VR technology. Both positive and negative prior experiences seem to impact the way VR is appropriated in the business context. For example, P3 (4) specifically talked about cases where people had a negative first experience with the technology, which made them reluctant

to try it again, whereas P4 (20) mentioned how positive first-time experiences made people eager to implement the technology in various different processes. However, the fact that there are still negative first-time experiences and some health-related risks is not a good indication for the future of the technology as a tool for remote collaboration. Such issues may be exacerbated when VR is implemented at scale for a large enough workforce. Our data also suggested ways to mitigate these first-time issues, for example, by carefully selecting the first-time experiences in VR, by having someone with more experience guide new users, or by focusing on training and improvement of digital literacy skills (P4: 16; P5: 20). Additionally, without a proper introduction to VR, users may cause damage to their surrounding physical environment or they can even harm themselves.

In addition, based on the data obtained in this study, we have encountered a variety of different applications and functionalities of VR. Thus far, there have been cases where people have used the technology as a way to brainstorm ideas in a virtual space with a whiteboard or as a way to have more engaging and productive workshops (P2: 6; P3: 18; P8: 18). These findings led us to re-examine one of MST's claims that no single medium can be universally applied and usually it is a combination of media that gives the best solution to a task, in the context of VR (Dennis, Fuller & Valacich, 2008). The example given in the 2008 paper is with a face-to-face meeting coupled with having a physical whiteboard in place to assist with reprocessability (Dennis, Fuller & Valacich, 2008). However, VR seems to have the capacity to support both avatar-to-avatar communication, which should have similar capabilities as face-to-face, if not even better in some respects (Dzardanova et al., 2021; Greiner, Caravella & Roth, 2014) and can simulate a *virtual* whiteboard, so as a medium it should provide an interesting basis for further examination. In some ways it could be thought of as a *meta-medium* since it can provide simulations of other media – as an example, avatars can call each other in the simulated world, they can send messages to each other, etc. (Dzardanova et al., 2021).

5.3 VR Accessibility

Literature claims that VR devices have become more accessible due to lower price and technology advancements in recent years (Angelov et al., 2020; Oprean, Simpson & Klippel, 2018). Although these claims may be accurate and VR has become more accessible, several participants were still concerned about expenses related to VR headsets and computers needed for implementing VR for remote teams, especially at a large volume (P3: 14; P5: 6; P6: 18). In terms of price, more affordable VR alternatives, such as desktop-based VR (Wang et al., 2018) and smartphone-based VR (Steed et al., 2016; Won et al., 2017), could be considered for implementation instead. However, their lower capability to support immersion, compared to immersive VR, needs to be taken into account (Steed et al., 2016). Regarding equipment that supports immersive VR with satisfying performance, the Oculus Quest 2 appears to be the "*best*" inexpensive choice (P2: 6; P8: 8). In previous studies, the HTC Vive Pro headset was evaluated as the best one (Angelov et al., 2020; Mehrfard et al., 2019). However, the studies were conducted before the release of the Oculus Quest 2, and they only use qualities of the headsets and controllers as evaluation criteria without including aspects related to implementation experience, such as hardware price (P3: 14; P5: 6; P6: 18), onboarding experience (P3: 3) and other problems that may arise with implementation at a larger scale for remote teams (P4: 8).

Furthermore, health-related issues such as motion sickness (Dziuda et al., 2014; Moss & Muth, 2011) and the need for physical dedicated space (P3: 38; P6: 18) for immersive VR may hinder accessibility as well. Even though the current study did not aim to put an emphasis on health effects of VR, motion sickness due to immersive VR was mentioned by four participants (P3: 4; P4: 16; P6: 16; P7: 6), which could have a significant impact. As with the hardware price, desktop-based VR could be a potential alternative for immersive VR to mitigate the issues. In order to use desktop-based VR, the software needs to support this option, for example, like Horizon Workrooms and Virbela. Other potentially important software features for accessibility, suggested by interviewees, are easy setup (P2: 6) and easy shareability (P7: 16).

5.4 VR Novelty

The foundations of VR were developed at latest in 1968 (Mehrfard et al., 2019; Sutherland, 1968). Since then, VR has been employed for collaboration in multiple contexts over decades (Berg & Vance, 2017; Ramesh & Andrews, 1999). Despite this fact, several participants still described VR as a novel technology with terms such as "magic leap" and "disruptive technology" (P1: 2; P5: 2; P4: 24). Some companies may even be using VR for remote teams only for the sake of standing out from companies that only use traditional media (P3: 20; P4: 14). Furthermore, P4 (2) and P5 (12) mentioned that people are still skeptical towards the use of VR in non-gaming contexts. On the other hand, the novelty aspect makes people feel excited (P3: 30; P4: 12).

Moreover, literature argues that VR hardware has advanced and price has been lowered in recent years (Moore, Geuss & Campanelli, 2019; Oprean, Simpson & Klippel, 2018; Kuchera, 2020) and, as a result, the interest in VR increased (Angelov et al., 2020). Nonetheless, the participants indicated that the price of VR hardware is still an issue for remote teams (P3: 14; P5: 6; P6: 18). In addition, regardless of the recent technological advancements, the participants experienced several issues related to the equipment. For example, most of the participants associated the use of VR with motion sickness (e.g., P3: 4; P4: 16; P6: 16; P7: 6). Another issue is that some elements in the virtual element are not sufficiently sharp (e.g., virtual monitors (P2: 14)). For a prolonged period of use, wearing a VR headset may cause discomfort (P2: 18). Therefore, the VR equipment needs further development to reduce the issues and needs to become more affordable in order to enable remote teams to implement it for remote collaboration.

5.5 Collaborative Mixed Reality

Our study also provided hints at the possible future of remote collaboration. Mainly, according to some of the interviewees, MR and AR solutions might be more prevalent for collaboration within remote teams (P3: 36; P8: 20). This was suggested due to several factors, which were also related to the challenges of implementing VR at scale, as an example, having a device which can easily switch between real world and virtual world was noted as important by one of the participants (P1: 38). In addition, MR and AR retain some level of real-world awareness, which for cases where work from home is required, or where a designated safe space for VR could not be made available, will be more advantageous (P1: 10). While these

reasons are valid for the general case, it is likely that VR could retain some niche applications for effective collaboration in remote teams.

6 Conclusion

This thesis set out to explore how remote teams could benefit from the use of Virtual Reality for remote collaboration by aiming to answer the following research question:

What is the role of VR in enabling effective collaboration amongst remote team members?

We obtained our findings by performing a literature review on the topic of VR for collaboration and by conducting interviews with VR experts and users of the technology who had experience with the use of collaborative VR for remote teams.

What we have discovered and argued for were several areas where VR could serve as a possibly effective collaboration tool, assuming the technology is faithfully appropriated. In addition, there are also areas where VR is expected to perform poorly as a tool for remote collaboration, based on the findings we have gathered.

The areas where VR would *not* provide an ideal solution seem to be in tasks which require mere transfer of raw information. We attribute this to the VR's capability to support rapid information exchange and interactions amongst individuals, and a lack of capabilities for reexamining sent and received information, which is not suitable for such tasks. Examples of generic tasks which require mere information transfer are brief updates, stand-up meetings, sharing documents and others.

The areas where VR could fit well as a collaboration tool, based on our findings, would be in tasks which require creativity, spatial information and team synergy. These types of tasks utilize the strength of VR to visualize both real objects and abstract concepts, and support rapid remote information exchange. Furthermore, the variety of ways information can be conveyed and visualized immersively in VR add to the overall experience of collaborating in VR. Lastly, more concrete examples of tasks suitable for VR would be in visualizing conceptual 3D design, brainstorming and supporting urban planning teams by immersively simulating urban development. However, the findings from our research also support the view that no single medium can be universally applied as "most effective", and while VR could be useful for tasks in the conceptual phase, other media could still be more effective in the other stages.

In order to extract the most benefits out of the technology, it must be faithfully appropriated and our study provides pointers as to the main hurdles along the way. For example, implementing VR for collaboration at scale, even using the most cost-effective option according to our data - the Oculus Quest 2, would require large upfront investment as the hardware for immersive VR is still expensive. More financially accessible alternatives like smartphone-based VR could be considered, however, they would not provide equal capabilities in terms of immersion. There are also potential health-related issues, which could be an issue when implemented as a solution at scale. Nonetheless, our data suggested that many users have positive first-time experiences and generally view the technology as a novelty. In addition, factors like proper training could help with the technology appropriation given the fact that VR is accessed to novel hardware compared to traditional media. Users may learn how to use controllers beforehand or use simplified ones to have much better first-time experience.

In addition, a secondary result of the study was a contribution to the knowledge around Media Synchronicity Theory. A fresh perspective on the theory was provided, which included a

modern technology in the face of VR. A modified version of the initially proposed media capabilities comparison table, which now includes VR as one of the media, was also constructed based on the findings from the study.

Lastly, our study also captured the views of industry experts about the future of remote collaboration. Augmented Reality and Mixed Reality were often mentioned as possibly better alternatives for VR, at least in terms of more general applications and reduced health-issues.

In summary, our study pointed to specific areas or types of tasks where the role of VR for remote collaboration could be significant, if implemented faithfully. Mainly tasks which require creative and synergetic teams.

6.1 Future Research

The current study focused on the effectiveness of VR for collaboration in terms of productivity and success of task completion. Since remote teams may also experience social difficulties due to the lack of sharing physical space and social interactions, future studies could investigate the role of VR in reducing social and emotional remoteness. Moreover, this study identified characteristics of collaborative tasks that could benefit from the use of VR amongst remote teams. Future research could explore the role of related technologies, such as AR and MR, that could be significant alternatives for certain collaborative tasks. Furthermore, inadequate accessibility to VR equipment for immersive VR and health-issues caused by immersive VR were recognized as critical barriers for implementation of VR into remote teams. Therefore, desktop-based VR that is more accessible and does not require full immersion could be examined as an alternative for effective collaboration, possibly in a hybrid session where some participants are fully immersed.

Appendix A: Interview guide - remote team members

Opening

- Informing participants about the purpose of the study.
- Explaining that the data will be anonymized.
- Providing definitions of a remote team and collaboration
- Verifying that participants agree with recording the interviews.

Introduction

1. Can you describe your current role in the organization?
    1.1. Can you describe how you collaborate with your team?
    1.2. Is your team fully-remote or hybrid?
    1.3. Do you collaborate with other teams?
        1.3.1. If yes - Could you describe how you collaborate with other teams?

Key questions

1. Could you describe your experience with VR in general?
    1.1. Could you tell us about your experience with VR for collaboration with other team members from the time you switch it on until you finish?
    1.2. How often do you use VR?
2. What VR software and hardware do you use in the company?
    2.1. How does the VR environment you use look?
    2.2. What is possible to do in terms of team collaboration in the VR environment you use?
3. What would you change about using VR for collaboration within your team?
4. What has changed over time in the use of VR in your team?
5. Why was it decided to implement VR for collaboration in your company?
    5.1. What did the implementation process look like?
6. Can you describe your learning process for VR?
    6.1. How do you think digital literacy skills impact the learning process for VR?
    6.2. How do you think digital literacy skills impact people's experience with VR?
7. What was your previous experience with VR before you started to use it for team collaboration?
8. What are the general opinions of people you work with regarding VR for collaboration?
9. Do you also use other media for communication and collaboration within your team?
    9.1. If yes - Why do you use the other media? What are its benefits over VR?
    9.2. If not - Do you feel the need to use other media when collaborating in VR?
    9.3. What did you use for communication and collaboration before implementing VR?
    9.4. What else did you consider to implement in order to further improve communication?
10. Could you describe some situations where VR improved collaboration?
    10.1.   Do you use VR also for informal communication in the company?
    10.2.   Where do you see the strengths of the VR technology?
11. Could you also describe some tasks where VR would not provide an ideal solution?
    11.1.   What challenges did you experience?

12. How do you see the future of VR for collaboration in remote teams based on your experience?

Exit

1. Do you want to add anything that you think we've missed and might be relevant to mention?
2. Can we contact you again if some answers need further clarification?
3. Do you know anyone who uses VR for collaboration with a remote team and would be interested to participate in the research?

Appendix B: Interview guide - VR experts

Opening

- Informing participants about the purpose of the study.
- Explaining that the data will be anonymized.
- Providing definitions of a remote team and collaboration
- Verifying that participants agree with recording the interviews.

Introduction

1. Could you describe your experience with VR in general?
   1.1. What is your professional experience with VR?
   1.2. How often do you use VR?

Key questions

1. What VR software and hardware would you suggest to implement to remote teams?
   1.1. What do you think is lacking in the design of VR environments?
2. What challenges do you expect to see after implementing VR for remote collaboration?
3. What benefits do you expect to see after implementing VR for remote collaboration?
4. What changes do you usually see in the use of VR within teams over time?
5. What is usually the motivation for the decision to implement VR for collaboration?
6. Can you describe a typical learning process for VR?
   6.1. How do you think digital literacy skills impact the learning process for VR?
   6.2. How do you think digital literacy skills impact people's experience with VR?
7. What are the general opinions of remote teams that use VR for collaboration?
      a. What are the general opinions of people you know from the VR community regarding VR for collaboration?
8. Do organizations also use other media for communication and collaboration alongside VR?
   8.1. If yes - Why do they use the other media? What are its benefits over VR?
   8.2. If not - Do they feel the need to use other media when collaborating in VR?
   8.3. What do organizations usually use for communication and collaboration before implementing VR?
   8.4. What else do they usually consider to implement in order to improve communication further?
9. Could you describe some situations where VR improved collaboration?
   9.1. Do you use VR also for informal communication in the company?
   9.2. Where do you see the strengths of the VR technology?
10. Could you also describe some tasks where VR would not provide an ideal solution?
    10.1.   What challenges did you experience?
11. How do you see the future of VR for collaboration in remote teams based on your experience?

Exit

1. Would you like to add anything that you think we've missed and might be relevant to mention?
2. Can we contact you again if some answers need further clarification?
3. Do you know anyone who uses VR for collaboration with a remote team and would be interested to participate in the research?

Appendix C: Interview Transcript – P1

BNFT - Benefits of VR = Green
CLNG - Challenges of VR = Red
MST – Media synchronicity theory = Blue
TNLG - Similar technologies = Yellow
EQP - Equipment for VR = Gray
STWR - Software for VR = Orange
NVLT - Novelty = Violet
PRQS - Prerequisites for VR = Indigo
USG - VR usage = Cyan
APLC - VR applications = Magenta

Row	Content	Theme
1	**Could you describe your experience with VR in general?**	
2	OK, well, regarding VR, my experience is due to my university, my master's degree because I started to be interested in it like in the last two years that I made in Milan. Well, in Milan and in Como. [NVLT start] I made a thesis that was involving mixed reality devices and so it was also involving some studies about all the market and all the devices in the panorama. So I've also explored some devices that are used for VR and AR. At that time it was a magic leap. [NVLT end] Also, one of the devices involved there, of course, was Oculus. Yes, in my chapters of the thesis I studied also what are the use cases of each one of these technologies and for example, regarding VR. I think, yes, one of the fields that is most commonly used is to do the conferences and to do like, yes, these different meetings which are more involving because you can select, for example, an avatar that represents you like in a human way, or it could be also a polygon. Yeah, polygons that are representing you as a person or also you can use something that is really different from you. And these can be useful also, for example, in therapeutic fields because, or maybe some people that don't want to maybe appear like he or she is. And because of maybe some health issues like this or the personality they have. [APLC start] So one of the other fields, which I think it can be really used, is also in mental issues. For example, one of the fields I went deeper in my thesis was the application of VR regarding the military, to people that are coming back from wars which have the syndrome - post traumatic stress syndrome. And with these devices they can reproduce the field there, and maybe associate the field and the feelings of war and these things maybe to more positive feelings and to elements that can somehow improve their health issues. So these are, I think, the two fields in which I feel where that is more useful.[APLC end]	EQP, BNFT, APLC
3	**And how often do you use VR?**	
4	Well, day-by-day not so much at this moment because, for example, I don't have the eyeglasses. The typical ones or also the Oculus ones. Well, the Google ones are not for VR and for AR. But yeah, it's not important and, I've done some courses, for example, in which we tried some solutions so there are solutions that still are	EQP

	affordable, like the card box. I don't remember the exact word, but it was something on paper that you can use it with your smartphone.	
5	**What software and hardware would you suggest to implement for remote teams?**	
6	Yes, [longer pause], regarding the software, maybe it's a bias because I've only used this type of technology to implement it when I did the courses. Yeah, also outside the university and also inside the university we used the framework, the Unity framework, which in my opinion, it's one of the best ways to implement something without getting too technical, and still offers a lot of functions and a lot of integrations, so with a lot of the frameworks and the platforms so you can find, for example, in Unity. Yeah, it has an integration with Android Studio and also with iOS devices. If we wanted to do some AR things. And so, I think it's the best one to use.	STWR
7	**OK, right, and what challenges and benefits do you expect to see when implementing VR specifically for remote collaboration between teams?**	
8	[MST start] For remote collaboration, for example, in a situation like we faced in these last two years, I think, it would help a lot because you would have more contact with the colleagues since, I think, I mentioned some minutes ago, you have the opportunity maybe to see the person like you were in presence, so it's like a deeper type of contact. [MST end] And, yes, for example, one thing that could be also useful is that maybe there are some things, it depends, of course, on the project that you are doing but maybe [MST start] if we take into consideration some development of mechanical things you can like instantiate an object that is representing the thing that the team is developing and all the team can see the object like if they were in the same room. So, in this case, I think it could be very good to use.[MST end]	MST, BNFT
9	**Right, and what challenges do you think there might be when working with VR?**	
10	Most of the challenges could be, for example, well, it's not easy to [longer pause] get all the people involved, to get one of these devices, for example. And also the fact that most of them are not trained maybe to use them. So, in fact, some of them, they would take time or maybe they would not join it because it's something that you put in your head. So, right, it abstracts in some way and also the fact that maybe VR with respect to MR and AR, it's so involving that you detach from reality. So maybe if you have some children, then may you are here in the room, you're like a detached from the reality and there could happen something that you don't see.	CLNG MST
11	**Yeah, that's an important point. OK, so do you usually expect to see any changes in remote teams when they implement VR?**	
12	Well, when they'll be implementing teams [longer pause]. It's difficult to foresee, to forecast if there will be some changes because in my opinion it would be something that would be a lot appreciated. Or, in the opposite way. Maybe it will be something, a complete fail. So, I think that, it depends on the team, I think, and on the project. With the projects in which it's not fundamental and they will not, and they will not give a real increase in the productivity I don't think it will be implemented and used a lot. For the other part, I think, I think it could enhance a lot.	MST, BNFT

	When we have something that, I don't know, that could make the team more productive like I said, something that you can instantiate in the virtual world.	
13	**Right, and in one of your previous answers you mentioned that in the last two years the pandemic played a role in implementing this type of technologies, but what do you think usually leads to implementation of VR for remote teams?**	
14	What is the motor behind, you mean, this type of implementation?	
15	**Yes.**	
16	Well, for a lot of time, I thought it was all associated with gaming and to virtual experiences because it's a, I think, one of the fields which would give the most because it's very very immersive. So if a user is inside a new world, a new thing, it could enhance a lot of the experience that he has. The motor behind the teams could be, I don't know, like I said, a specific implementation or specific use case in which it could be used. I don't see it like a technology that you would spread a lot in all types of things.	
17	**So you also mentioned that depending on the team, the technology can either be successful or not, and could you describe the typical learning process for VR?**	
18	[TNLG start] Well, regarding my experience in particular, I used the MR but this required also a training that I hope it's almost the same like VR because, for example, there are some gestures, especially for devices that sense the world. So they recreate the space in which they are in, for example, in the HoloLens you had to, in the first version of them, you had to learn the gestures, for example, of the pinch which you can do with your fingers and that is something that is not really, you know, easy to do for people that are elderly or maybe adult because they take some time to learn it. [TNLG end] [CLNG start] [PRQS start] Regarding VR, most of the experiences are, like, not so interactive. So maybe they can just move their head, something like that, and in this case, I think it would not take so much to get them to learn the technology. Of course, it depends if there are some gestures that they have to learn or not. [PRQS end] [CLNG end]	TNLG, MST, CLNG, PRQS
19	**OK, and what are the general opinions of remote teams that use VR for collaboration?**	
20	Well, my general opinion on it, also here is maybe, there is a bias because I like the technology a lot, so I would like them to be implemented a lot and to use them more extensively in all the meetings. And also because it's an opportunity to get together more people that are around the world and to do maybe some type of conferences that they would not be possible to do if you were in presence because maybe some of the colleagues are in another country. Something like this and maybe the fact that you can try to instantiate it to recreate a field, something like this, that resembles like, I don't know, space like an auditorium or something like this. It could be really nice [MST start] because it gives you a better idea and makes maybe the event more important. Instead, if you just make a call on Teams, you don't see even the photos, there are just some names and so it's a lot impersonal. With the VR it's more personal because you're, it's mandatory, of course, to select an avatar or something like this.[MST end] To be interesting, actually, if maybe they would implement something not to…, for privacy, not to put an avatar	MST, BNFT

	on them. But I don't know, in that case, I think it would be [long pause], I don't know, not so useful to force people, not to have a choice, for example, not to put their image because it will be impersonal like it is in Teams.	
21	**Yeah, interesting point. So, do you think that organizations also use other media for communication and collaboration alongside VR?**	
22	You mean, collaboration, you mean like some videos or something like this?	
23	**Yeah, for example, to complete a task teams usually need to collaborate, and if they use VR, should they also use another technology alongside it?**	
24	Well, regarding collaboration, if we wanted to still remain in the same field, I think that along with VR it would be really good to implement MR because you can instantiate these objects, or maybe you can see objects in your space, in your home. Maybe it's something in which you can put some indications on what to do. It's difficult to explain it, but some videos or feed are delivered by Microsoft, in which there were some people that were in remotely, they were doing the same job and one was saying some instructions to the other that was seeing this object with overlapping things, like some similar rows or something indicating which were the points to fix the problem. For example, a plumber or something like this would give instructions to some people. I don't know, it's just a silly example, but you have these instructions that overlap in view. And regarding maybe for training and for learning, so that could be very good to use. Because you can see in real time you are learning that stuff and you can see step by step in a more practical way and from your point of view. And basically I think MR will be the ultimate thing. Because it covers the span which is from AR and VR. So maybe a device that could switch from just overlapping some text information to the objects to completely virtualize the environment, in which you are, would be really good to have it even if you could take a lot of time to develop it.	TNLG,
25	**Yeah, that's interesting. And what are the general opinions of people from the VR community regarding VR for collaboration?**	
26	Well, people that are interested in this field are, I think, very few, very few, but very passionate about it. I have a colleague, for example, in Roma, which is really really interested in it and I think it would be very glad to use this type of technologies. Also myself, and what [NVLT start] I suspect is that most of people maybe, if you tell them the idea, they like it. [CLNG start] But then when they try maybe they could get bored in some weeks.[NVLT end] It depends on the passion and also on the increase of productivity they have, which I think still is not really clear.[CLNG end] For example, in collaboration, which will be the case because it depends a lot on the things that you are doing. For example, like I said that if you give some instructions to something that is physical that you can see would be good. If it is just for, I don't know, for brief talks, something like this, I don't see the improvement.	MST, CLNG
27	**Yeah, makes sense. Do you have any situations just off the top of your head where VR actually improved collaboration between individuals?**	
28	I didn't have the opportunity to test it for collaboration, and it is a hard one because we never use it in our type of team because, also, we work on the cloud so it's like a different field. At the moment I don't have any experience. Also, I have a colleague that is from another company that implements these VR solutions, but I	

	don't think they use it by now in their teams, in their spaces. Maybe, I don't know, they have some talk, some proof of concept that they are trying to do and deliver into some companies, but I think we will see in the Metaverse if it will have a success or not.	
29	**Yeah, we're all looking forward to that. Okay, so I remember you also mentioned some tasks where VR would not be an ideal solution. Could you maybe expand on that and maybe just some concrete examples of where VR would not be good to be implemented?**	
30	VR not good to be implemented, for example, in health issues. I don't know if it's on the topic or not, because maybe it's more on collaboration in companies.	
31	**Yeah, it could also be about collaboration, but because we're also exploring application of VR for collaboration, but also if somebody from the team maybe has health issues and they could not be recommended to use VR then that's also a valid option.**	
32	Ah OK, yes, well, OK, I take this specific case. For example, people with special needs that are in a company because also in [CompanyName] they push a lot for diversity, so it could be a case in which, for example, we have some patients which, I don't know, really don't enjoy and have some problems in detaching from reality. So if we detach them, they will not be associated to reality and maybe they could get anxious about it. Regarding other specific fields in business in which could not be used, let me think, [longer pause].	CLNG
33	**The people that you mentioned about who have mental issues, not issues, but are part of the diversity program and who should not be detached from the real world, that's a very good and interesting point, and I was wondering what do you think, that VR would not help in those situations? Do you think that it will affect them negatively?**	
34	Yeah, yes, of course it was part of my thesis that I have done because we worked with people with NDD, neurodevelopmental disorders. So, like some people like those ones, well, it's, I brought the spectrum of special needs, but for some of them detaching from reality was an experience that they really don't enjoy because their stability comes from specific things of the real world. So it's like if they have a person that is with them and it gives them security. So maybe detaching from it would not be a good thing. Well, the good thing about HoloLens was that even if you push it to the limit in which you virtualize all the environment, they still have some space here because the field of view is very narrow, so they can see the world and so still remain connected to the reality. Something that maybe with VR you don't have. And now I remember also an important thing. It depends also in the implementation of the technology because some people in VR experienced, like, some nausea. I don't know the term in English, but OK. [EQP start] Yeah, depending on the refresh rate of the image. So it depends a lot on the technology that you use, because if you use a good device with a refresh rate that is high, then this thing is mitigated. If you use a device that it's not so good, so the technologies are not clear and the images that you reproduce are not sharp. The problem would be that maybe you can give someone seizures to do that. So that's a really good point to take into account. Also, for people that have epilepsy. It's not very indicated, so there are a lot of things that maybe could be taken into account.[EQP end]	CLNG, TNLG, EQP

35	**And the final question from the main ones. How do you see the future of VR for collaboration in remote teams based on your experience?**	
36	OK, regarding the future, I see some implementation of them, and I think it all will depend on the device they will develop because maybe in this last year the technology is still not so mature, so good to implement in the correct way. And I know that some companies like Microsoft with their further implementation or Apple that, I think, is also trying to do a device for VR or AR and that. I remember, but still some device that could bring all this type of technologies. It could make the difference when there will be an improvement in the technology like this. Also it depends on privacy, but in collaboration, well, if you use these technologies within companies, I don't think privacy would be a problem because most of the employees would use it in a conference room or in the company itself or in their rooms. So I don't see any problems about that regarding people going around and recording stuff.	NVLT
37	**Right, OK, and we just have some closing questions. Do you want to add anything that you think we've missed or might be relevant to mention?**	
38	Relevant to mention to the study. OK, you could integrate it with some other fields, but, OK, to make I don't know a comparison, in which will be the most appropriate type of technology to use in each type of the environment because, for example, maybe to some situations also in companies would be better to implement AR instead of VR, and then also maybe in some type of things, so you could implement VR instead of AR or MR if you have a device that is capable to do that. But at the moment there is no device that is capable to do the transitions in between the two worlds.	TNLG
39	**OK, interesting and do you have any questions for us?**	
40	OK, what was the reason by which you decided to do this research and in your opinion what would be the applications also in teams but also outside collaboration and the conferences in teams maybe in a broader way.	
41	**Right, well, we decided to do the research in VR for collaboration because we started from the Metaverse. We started to look into this type of technologies and we really tried to think what it would be like in the future. And in the future if there is another such a global event like the pandemic and that sort of thing, which requires some form of isolation and especially right now since most of the companies abandoned their, I mean not most, some companies abandoned their headquarters and decided to move more towards villages and remote areas, teams still need like this physical presence and we thought that maybe VR can provide an answer to that, and it seemed like there was still some need for further research into where exactly it could be applied, like what are the limitations, what are the strengths in terms of collaboration, because collaboration is part of the things that businesses look out for and they implement. They invest a lot in efficiency improvement software. So perhaps under that umbrella, maybe they will decide to invest in VR and we wanted to assist that decision by providing a better overview of strengths, weaknesses and opportunities of the technology.**	
42	Yes, in fact I really agree on that, because from companies it starts all the technologies. From war and from the companies. So I also saw that the HoloLens were sold to the US Army like some years ago and then they are trying to implement a	EQP

version of it. So it's like implementing in companies would lead also the consumers part to spread a lot and to give a maybe a device that is more able to use them also in context that are not the company ones. But just because the price also of the devices would decrease if the companies buy a lot of those. Also in the future maybe it's probable that I've heard about the news that they would try to implement some haptical sensors or something like this, in which maybe the interactions you said that the virtual world would be more physical. Maybe you can touch a person and you can sense, something like this. If it's just, I mean, I think it would be just a vibration like it was a gamepad from the PlayStation. And then when in the virtual world, in the unity when you implement the colliders, I think you can just activate the vibrations. It could not be the same as the real world, but maybe it's just a little step in the future.

Appendix D: Interview Transcript - P2

BNFT - Benefits of VR = `Green`
CLNG - Challenges of VR = `Red`
MST – Media synchronicity theory = `Blue`
TNLG - Similar technologies = `Yellow`
EQP - Equipment for VR = `Gray`
STWR - Software for VR = `Orange`
NVLT - Novelty = `Violet`
PRQS - Prerequisites for VR = `Indigo`
USG - VR usage = `Cyan`
APLC - VR applications = `Magenta`

Row	Content	Theme
1	**Could you describe your involvement with VR?**	
2	Yeah, so I did my bachelor thesis on VR topics. And what we did was create an application to help create a VR paint job. So this new painters who joined the company can test the skills or to create new one in this application. And my part was creating virtual and virtual hosts, which was connected to the I don't know what's called this little thing in your hand. And do the synchronization between a real life house and this one in Virtual Reality. And yeah, and also, for my private life, I use VR for gaming, to meet my friends now. And also for project, software, I'm doing so for collaboration too.	APLC,
3	**Okay, so how often do you think you use VR during the week?**	
4	Minimum two times a week, for about five hours a day, so like 10 hours a week.	USG
5	**Right. Right. That's very good. Okay. And what VR software and hardware would you suggest to implement for remote teams?**	
6	Yeah, so I think the best device in terms of costs to performance is Oculus Quest 2. So this is what I use, because it's quite cheaper than other devices, but also has the ability to work without cables. I can stream my games to this authentication too. So I would recommend this one and for software. I can't tell what's the best one. I can tell what I'm using. So what we tried out was Immersed - it is this application where you can create multiple views of your desktop and not views, more desktops, so you can work with monitors. So this was pretty cool because the monitors were really sharp, so you can really work with that. But the collaboration setting to set up took so long that we just switched the program to Facebook's or Meta's Horizon Workrooms and is pretty simple. And we still work with that. The benefits of it for us is that we can draw on a whiteboard inside the application. Afterwards, you can save our whiteboard on their own platform for that application and extract this to our platform. We were using it's kind of complex structure, but for our organization we use the notion it's like a one note embed and not one not like this oneNote. Yeah, I think OneNote? More properties you can set up.	STWR, EQP,

7	**And do you find the VR environment just aesthetically pleasing? Or they still have to grow? Just because there are some studies that say that the VR environment doesn't look very well, so everything is more polygons, it's a bit blocky, or does it resemble real life? Do you find it distracting?**	
8	Yeah. When you're like, two hours in, and you forget it is VR, but because you don't mention it you kind of forget that you're in VR, because you have like this feeling of presence at this time. Because your avatar has the ability to track your head movement, which is good to kinda start tracking but track your mouth against just so when you're talking, it gets the voice and tries to create the movement of your mouth. So when you do like, "oh", voice, the mouth opens. And it's a small thing, but it helps a lot. So you don't talk to a static character. It feels like you're talking to someone, but also the hand gestures. So when we are in VR, we always try to avoid using the controller. So we have hand tracking. And yet, for me, and it's really if it's like me sitting in a meeting room behind us, I think [ColleagueName]. So yeah. So it feels real.	
9	**Nice, nice. Great. What are the challenges and benefits that somebody might get from implementing VR for remote collaboration?**	
10	The biggest benefit is if you have more information from a person and when you are collaborating in VR because from my experience, we talk to each other, we look at each other. But when he's thinking about something, I can see that and because he's looking, they have looked in my eyes looking at the whiteboard. And so when you're on the Team's call, or Zoom call, whatever you like, when you when you're looking at the camera to monitor look here, we can't really say it is listening to you, to you right now. So this one big benefit. And did you, will have a standard benefit of online collaboration, that you don't have to move somewhere to meet each other. So for negative what I can say is that currently, we have some issues with so we have a screen computer screen inside of VR. And we are trying to use it but it's not perfect, and it's not really sharp. And if you can share your screen on the wall, and it's the other person's screen, do not see it very well. It's really a pixel full of pixels. So these kinds of things are hard to work with. So what we did mostly is we did our concept phase inside VR, but when we are implementing something, we try to use it to work with Teams or something.	BNFT, CLNG,
11	**Okay, and what usually is the motivation for a decision to implement VR for collaboration?**	
12	Motivation is kinda trying to get this feeling of presence of the people. So that. Yeah, it's like a kind of different feeling when you're standing next to one and you see this character, or in person. And when it's like, in what next, so in a box to the box, so like a camera, I think there's a big difference. So that's a big motivation to get this. But also, what is also important is that when you are inside VR, you are focused on the task, so you don't get your focus your turn, you hit your in VR headset on, you can't hear anything from outside, mostly. You can't see anything. So you focus on what's in VR. And it's, I think, also the motivation.	BNFT
13	**Right, right. And can you describe a typical learning process for working with VR?**	
14	How'd we get into VR?	

15	**Yes. Usually for new users, do they find it easy? Do they find it frustrating? Do they have troubles with this sort of thing?**	
16	That's a little bit hard to say for me because I'm more into tech. So some concepts are like on every application is like kind of same concept. So you know how to configure something, or to, how do you move around simply like the basic concept. So for me, it was not that hard to create an environment except for Immersed was pain. But inside like Horizon Workrooms, it was easy to get all the functions, it's not that much. So learning, first of all, we set up an environment for us. So afterwards, we just joined the room. So it's pretty simple. And there's no tutorial, some things may be difficult if you're new to VR. Some basic concepts are like how you navigate through menus. So if I'm giving someone new my headset, and he tries for the first time, he doesn't know how to use the controllers. How to accept something by clicking on buttons. Sometimes it will not know how they can move them, they just stand like this. And can't even navigate. So it can be pretty hard to cycle to get the VR right now.	PRQS, CLNG,
17	**Right, right. Okay. And what are the general opinions of remote teams that use VR for collaboration? So do they like the technology? Or do they prefer something else? Or are there some things that they find frustrating about it?**	
18	It's hard to say for me, I can only talk for myself. For me, it's a really good one. So the best thing that I did to help me is like, do you have to focus? You can see each other, it feels like we're in a room together. So for me it is a benefit. And if it wouldn't be possible somehow to get more comfy with the headsets because I've only the standard without any additions to my headset. So after some hours, it hurts a little bit. But it's still okay. We use it for our conception phase, and it works. We're good. We get some architecture, we get some ideas, the brainstorming and everything inside VR and it works really well.	BNFT, CLNG,
19	**Great. And do you usually use other mediums for communication alongside VR? So is it just VR or is it VR plus something else?**	
20	Yes, for the project we used VR for the conception phase and Teams. Okay, actually, it's Telegram video chat, because it has a better quality. It's a little bit but it's like standard communication software. And for developing, and yes, some tools. So you can collaborate better and say he uses it, do you know what Extreme Programming is? Yeah, select two people sitting next to each other and group program one on one task, two on one task. And we have like a tool for that. So we can work inside one environment without being next to each other. So great.	
21	**Could you describe just the situation where VR could improve collaboration? Just like an example or something?**	
22	Um, yeah, [APLC start] I think in workshops a lot. As you have more, yes, have the ability to work with people, you can see themselves, you can use 3D objects, or create 3D objects you can use, people can interact with them. So like for it, I think an Agile workshop would be really fit in it that could work in VR really well. [APLC end] So everything you can learn can also work on the average. Nice, I think. So because you have the like hands on thought having really hands on. So this could also work very well.	BNFT, APLC
23	**Great, good. And you mentioned the extreme programming world where basically people have to be next to each other to collaborate on a single task.**	

	How would you do that? If you're working remotely? Do you just get on the same video call? Would you use VR for that?	
24	Same video call. So we'd like to use VR, but currently, devices support it, but it's hard to get this kind of experience because I need a sharp monitor. And it's not sharp enough for us. And it's kind of handy. It's kind of not working. It's not really working. And for this, we use standard collaboration tools.	CLNG,
25	**Okay, and you gave really good examples for situations where VR could improve collaboration. But can you also give examples for situations where VR would not be an ideal solution for collaboration?**	
26	On quick meetings, and things like stand-ups, maybe where you have only 15 minutes to talk to each other, it may be getting creative. You call it overhead. So everybody has to use a headset to turn it on. And it takes a little more time to get everything done to get into VR for everyone without any problems, then just meet each other in Teams or Zoom or whatever. So just click you're in. So it does take more time to get into VR.	CLNG,
27	**So it takes more time to initialize the process. Okay, great. And last question from the main ones. How do you see the future of VR for collaboration in remote teams based on your experience?**	
28	Based on my experience, I think the future will be bright. Because some concepts which are implemented right now, well, really working out really well. It's really good because I can describe it and present it later to you. But this concept is really good. And some other concepts, so some awesome problems. And when they fix that, I think that we can. I can expect it sometimes some of us will use some workshops in VR. So I think the first part workshops could be done in hours. So I hope that it will be good.	APLC
29	**Okay, great. And just a few more closing questions are, do you want to add anything that you think we missed and might be relevant for our study?**	
30	I think most things are said, maybe like just as kind of relaxing feeling when you and your environment is a nice one. So yeah, like sit in the sun, everything. So can help to relax little or to get to feelings, and you're not in the full Earth bureau with old people. And you're more able to talk to, let's say, your opinion on some topics.	BNFT

Appendix E: Interview Transcript - P3

BNFT - Benefits of VR = Green
CLNG - Challenges of VR = Red
MST – Media synchronicity theory = Blue
TNLG - Similar technologies = Yellow
EQP - Equipment for VR = Gray
STWR - Software for VR = Orange
NVLT - Novelty = Violet
PRQS - Prerequisites for VR = Indigo
USG - VR usage = Cyan
APLC - VR applications = Magenta

Row	Content	Theme
1	**Could you describe your experience with VR in general?**	
2	Well, my very first experience was back when I was having my AP degree and I started to work with the technology back in the time, it was quite new. And there was not that much being developed besides the games themselves. I was also using it as a final thesis for my AP degree where I have created a job interview simulation using the connection to the Google ASR. So it was for the purpose of creating a job interview for people who are not native speakers. So for immigrants to learn the languages, and then try it out in the VR itself. It was fine, the development process was nice, and of course, like many young people I have also detoured from only using the VR for the school purposes. And I also use it for personal things like trying the VRChat and the games and seeing what everything can be done using this technology. So yeah, whatever I could explore has been explored. So I have worked with the virtual reality, [longer pause], for almost five years now. And we have used it for a lot of different things, we have used it for collaboration, as well. We have used it for developing training simulators, for creating solutions, which are explaining some more...how to describe it, more abstract things, and also to use it as an onboarding process for people who are not in the same country. So that's in a nutshell how and what I have used virtual reality for.	NVLT, APLC
3	**Okay, and could you describe your role in the VR projects?**	
4	I was mainly the project manager and the project coordinator for those. But I have also worked as a developer. So I have the both, kinda, aspects from it. The projects on which I worked are European Union funded, meaning you have a lot of different people from different countries. So the very first project [APLC start] I have been working on was the Work-VR project [APLC end], which I can send you the link after. So you can have a look if you want to. And we have collaborated with people from Italy, Germany, Cyprus, and France, and then us as Denmark as well. And so I had to explain to the partners who have never used this technology before on how to use it properly, and how to onboard how to try it for the first time. Because a lot of people, especially trying the virtual reality for the first time, can have a lot of different negative health effects on you, especially if we are talking about things like motion sickness, things like epilepsy and things like that. And it's rather difficult. The other part of working in projects like that is that [MST start]	STWR, CLNG, MST, APLC

	you work with people who are usually of an older age, and they're already reluctant to use the new technologies as such. And so trying to get them to understand why this technology will be useful and will be used in the future was one of the first tasks we had to tackle.[MST end] I had to teach them how to use the virtual reality in a safe controlled manner. So they will not expect something what is too much out of the scope, what we can develop, but also to make sure that the very first experience is the pleasurable one. I have had a few partners who have tried the virtual reality before but mostly for leisure. And some of them had a really bad experience by experiencing the motion sickness, that's one of the most common side effects which you can have and that made them very reluctant to go and try it again because they have not been explained on how to move in there and how to basically prepare your body to go inside of the virtual reality.	
5	**When you now touched upon learning with VR, could you elaborate on a typical learning process for VR?**	
6	You would have to go a little more into detail what exactly what you'd like to know.	
7	**Alright, you said that some people get something like motion sickness because they are not properly trained. So how could they be trained so they have better experience with VR?**	
8	[MST start]Well, we have another project running right now, which is called [ProjectName], it's basically teaching the teachers on how to use it and how to provide information to the students themselves. So what we are developing is a sort of manual which explains first of all, to the teacher or the trainer themselves, to understand how to use it, what it is and what they need to be aware of. One of the first things which we are declaring is the things like this is the things you should be aware of, in regards of the health, this is what you have to be aware of, in regards of the physical space in which you are, so you don't go and bump inside of the wall or anything, which happens quite often.[MST end] And, and yeah, and as soon as they have that, we call it the first lesson. That's for the students specifically who have not tried Virtual Reality before. So you go with explaining and showing the little video, this is what will be inside. And you are going to go through this little experience, it can be whatever experience you want to pick. There is one which is under the ocean where you have whales going around or like playing some fun games. [MST start] So you should explain what is expected of you to be inside of the virtual reality. After that, you help them to put the virtual reality hardware on and you guide them through the whole process. Before you start the actual experience, you always have to mention that as soon as they start to feel sick, or if they start to feel that something is not right to just let the person know so you can take the VR headset off, take a 10-15 minute break, drink some water, get some fresh air, and then you can try again.[MST end] I personally struggled with the motion sickness the first three-four times I have tried in the virtual reality because I did not use the teleportation point, meaning that you just like point and spawn in front, where you kind of expect it with like the blackness and darkness of the screen. But I have been in a game which was moving to by moving the controllers. So your brain is basically not able to comprehend the VR moving without physically moving. And that's what makes people sick. So to avoid that, we highly recommend starting with experiences and things which actually have the teleportation point on because then you are less likely to feel sick.	MST, CLNG, APLC,

9	**Okay. And now we'll get more into VR for collaboration among virtual teams. What VR software and hardware would you suggest to implement for virtual teams?**	
10	Oh, that's a very hard question. Because that's, you know, like selecting either you go Android or iOS. So it's a very polarising, I personally started with HTC. So I am a big HTC fan. And you know, you cannot teach the dog new tricks. And then I tried also the Oculus Quest and Oculus Quest 2, and those are fine. But still, you know, like the first one, is always the first one. But if you speak development-wise, and actually seeing some progress in the hardware improvement, [STWR start] I would definitely recommend Oculus, just because they have everything set up with the Oculus Store,[STWR end] they have the whole onboarding process, they have a very nice first experience when you learn how to use the controllers how to navigate around. And so far, I have to say that it was one of the most pleasurable, but I know that there are hundreds of different hardware, which you can currently get, like the list is endless. And more and more companies are trying to deal with them. But I would go with Oculus, just because it's something what has been there for quite long, and they understand what they need to provide so that people have an actual pleasurable experience.	STWR, EQP,
11	**And by Oculus, do you mean hardware and also software?**	
12	Yes, definitely.	
13	**Okay. Then what challenges do you expect to see after implementing VR for remote collaboration?**	
14	Well, first of all, you have to think about the expenses. If you want to have someone joining you for the VR conference, for example, you have to make sure that that person actually has the VR headset. And that means that they will have to either buy it yourself or you will have to ship it to them and that is probably the biggest drawback which I see also with the partners or people who want to get inside of this technology, it's the cost which is prohibiting them from trying it out. Secondly, it's the internet connection and a technical difficulty skill. So of course, you will run into some little bumps and issues with connecting and things like that. And if people don't have the information about that, they just get very, very, very angry and annoyed. And it's not fun to try to fix it outside of the VR. Another thing, which I think might be a little is the personal space, some people do not understand that if you have an avatar in some sort of, let's say, Altspace [AltspaceVR] or VRChat, they are kind of not understanding that you can be invading their personal space when you move your avatar way too close. And some people freak out, some people get scared that you get so close because you don't have that physical barrier, or the physical presence in your brain. Same is with the etiquette or proper way on how to behave inside of the VR, you can meet a lot of different people, mostly younger generation who tend to be a little weird around you when they are using the virtual reality. So since there are no written rules, it is like basically the same thing on the internet, you just feel anonymous, so I can do whatever I want, because I don't have the repercussions. And that might be one of the things which you can also experience if you have different people from different religions, different countries, or different cultural backgrounds. So these little niches are the things which can be very restrictive when you are using the virtual reality. And a lot of people don't actually talk about things like that because you don't expect this behavior inside. But you still work with people.	CLNG,

15	**And would you expect this kind of behavior with regards to personal space and etiquette also when it is used for remote collaboration in companies?**	
16	Then you go back to the whole thing of having different cultures. If you are using the remote collaboration globally, then of course, you can meet some people who are collaborating, and they do not mean to, you know, like either offend you or to like invade your personal space. But since there is like no proper contact on the spacing on how far you should be from the person and things like that, it might be really beneficial for people to know when they are getting in, like, try to avoid getting too close, try to stay polite, do not yell because your microphone can be a little higher setting than the other ones and things like that. And those are happening in the remote collaboration as well, or [NVLT start] [MST start] people just tend to wander off because they get interested in the surrounding 3D environment. And they just don't pay attention, especially when it's the first time they are trying things like this. Because they're like, oh wow, there is this thing, like I want to see closer, and you have a person giving the conference speech, and nobody's paying attention because everybody's admiring, like, little flowers or pictures or whatever you can find in there.[MST end][NVLT end]	CLNG, NVLT,
17	**Now, on the other hand, what benefits do you expect to see after implementing VR for collaboration among remote teams?**	
18	Well, if we will have anything happening, like the COVID pandemic, it's the physical presence which you have inside of the collaboration with the virtual reality. You don't have to be in front of the computer, you don't have to be, you know, somewhere on your phone and just calling, you have that actual feeling that someone is there with you. So it can increase the productivity as well. When we are talking about the collaboration on some mind mapping, brainstorming and things like that, there is so many different tools which are so visually appealing, which motivates people to go and, you know, give the 10 extra percent, which they would not if they meet in like in the real world, I would say. [NVLT start] And definitely, it's the novelty, especially now for the VR, for people willing to try. [NVLT end] And as soon as they see what benefits it has from actually feeling like you are present, feeling that you are contributing, feeling that you are heard, because a lot of times when you have, for example, Zoom meetings, some people tend to not speak up because they don't have that physical presence. So that is one of the benefits of the virtual reality and then definitely connecting people from so many different countries and places, which you would probably not be able to meet up.	BNFT, NVLT,
19	**All right, then. What do you think is usually the motivation for the decision to implement VR for collaboration?**	
20	That's a really good question, I think for most companies is, we're talking strictly company wise, it's novelty and innovation. Those are two big buzzwords in whatever company you are going to be working with. It's that benefit, the other thing which you can add like, Hey, we are using VR for meetings. So yeah, I think those are the two most common things why would people do that.	NVLT,
21	**And what do you think the general opinions of virtual teams that use VR for collaboration?**	
22	That is very hard to answer because as I am a person who works with this technology for quite a long time. I don't see it from the fresh eyes of the general public. And I think like I have tried..., my mom has tried it when she came to visit me.	CLNG,

	And she was first confused. Then she was a little scared, and she was very excited. So it was like a mix of emotions. [MST start] I think you can split it into like two groups, either you want to try it, or you don't want to try it. If you don't want to try it, it's because you don't like the technology, you don't like trying new things, you are either scared, you don't know what to expect or things like that. And with the people who want to try it, it's because it's awesome. [MST end] What can I say?	MST
23	**Okay, that was with regards to virtual teams. And now, what are the general opinions of people from the VR community regarding VR for collaboration?**	
24	Well, standing from our company standpoint of view for the collaboration we would probably not pick virtual reality. The reason why is that, yes, it gives you that meeting, that physical presence kind of thing. But it misses a lot of things on why you would do the remote collaboration in the first place. So what we are working with is mixed reality working with HoloLens and RealWear, which is some sort of glasses where you can have picture in picture, and that person can see what you are seeing. These ones are really good for people who are working in technical jobs where they can... you can have an expert from Asia helping people, for example, in Sweden fixing issues, which they don't know how to fix. And what they do is they put the HoloLens glasses on, and you can actually see the problem and fix the issue in the real world using a mixed reality tool. And that is why we are more interested in this technology because it provides such a higher level of versatility of the uses and the use cases which we can pursue, rather than using the virtual reality.	TNLG,
25	**Okay, and do you know if organizations also use other media for communication and collaboration alongside VR?**	
26	Oh, yeah, [TNLG start] a lot of people are still sticking to the emails, email communication, and then sorts of chats and channels like Slack, Zoom, Teams, and all of these, which have some sort of written, kinda, aspect to it. Mostly, [MST start] because a lot of people prefer to have some sort of traceability. [TNLG end] So, if I send some sort of message, I can still go and see it later on. Well, when you're inside of the VR, usually you don't have access to the recording, so you cannot go and throw back. So, unless you have some sort of facilitator who is taking notes and making sure that all the important decisions have been noted, then you can kinda lose this information. [MST end]	CLNG, MST, TNLG,
27	**And before, you said that companies are sometimes motivated to implement VR because of novelty and innovation. Do you know what else they consider to implement in order to improve communication even more?**	
28	Ah, that would be really nice to know, as you know, a lot of companies keep their trading secrets for themselves. But from us, we are sticking to the things which are working right now. So I have no clue how to answer this question.	
29	**I think you already answered this, at least partially, but could you describe some situations where VR improved collaboration?**	
30	Well, it was when we had the very first tryout for the Work-VR project. It was when the COVID pandemic hit its peak, so we were not allowed to travel. Usually with these sorts of projects, you meet at least every six months in person to make the most important decisions together. Since we were not allowed to do that because most of the countries had closed borders and you were not able to go and	STWR, PRQS,

	travel, we have used AltSpace to meet up and to actually try out if it will be something that will work for us. So we did it and it ended up exactly how I imagined it would, people were very excited. And the reason why we enjoyed AltSpace was because you don't necessarily only need a VR headset, you can also use your own personal laptop, so it's kinda sort of a gimmicky gamification point of view in there. And so, we have done that, and we have met together in Altspace, and it was a lot of instructions going on, on how to move, what to use. Because usually these people, you know, like [CLNG start] [MST start] I am a person who plays games a lot. So for me, moving around is something that is extremely easy because it's just, you know, ingrained in my brain. But when I saw the partners who are like 56 years old and they were like, "I have no clue how to move", and you have to explain, you have to press the 'W', you have to press this and you have to... So it was a nightmare to facilitate. [CLNG end] But overall, the partners were very excited after the meeting because since you were not able to meet in person, we managed to have this conversation and making the final decisions which we had to make. [TNLG start] And we were able to progress much faster through the information than what we have been doing before, for example, Zoom or Skype.[TNLG end] [MST end]	CLNG, MST, TNLG,
31	**What would you say were the main reasons why you stopped using it?**	
32	[CLNG start][MST start]Time, definitely time management, it's, as I mentioned, you have to prepare the people to use the virtual reality, if they don't have that onboarding, then you suddenly have a meeting with 5, 10, 15 people, sometimes 100 people, and they have no clue what to do, how to move, how to mute themselves, when to speak, when not to speak, how to use the tools which are inside of the software. And so that was one of the main reasons why we have not pursued it in detail. It's just so much preparation going into it that it was not worth it at the moment.[MST end][CLNG end] Nowadays, I would probably switch it to little as most of the partners have their experience with the virtual reality. And they would like to meet but now all of the restrictions have gone down, so we prefer to meet in person. [NVLT start][MST start] But if we would have a case that we would like to, you know, just like spice up one of the monthly meetings which we have, to have something different, we would definitely use VR now when all of them have the actual equipment, they know how to use it, and they know how to navigate themselves.[MST end][NVLT end]	BNFT, PRQS, CLNG, NVLT, MST
33	**Okay, so do you think people would like to use it more if they got some training in advance?**	
34	Yeah, definitely.[MST start] It's the same with the phones, like 50 years ago using the phone was such a novelty and a lot of people were like confused on how to use these things, so they were reluctant. But nowadays, when you see those benefits and everything what a mobile phone can give you, you are more likely to use it because you are used to it. And I think that's what is going to happen with virtual reality as well. As soon as people have those first experiences and they know how to navigate and learn how to use the new software which is being deployed, then you're more likely to have people actually go and try because it's exciting, it's new, it's different.[MST end] And, another benefit, which I have found out, is that people tend to remember a lot more from this sort of meetings because they are so visual and so different. So your brain is actually able to comprehend and save a lot more information than when you have a normal discussion. [NVLT start]Just because it's a novelty kind of thing. I do believe that in like 50 years time when, you	BNFT, NVLT, MST

	know, the VR is long forgotten, there are new technologies which are going to be developed, it is going to be exactly the same as using the phones.[NVLT end]	
35	**Speaking of future, how do you see the future of VR for collaboration in virtual teams?**	
36	Not so well. I would say, as I mentioned, for us Mixed Reality is the tool which we would go with and pursue. Just because you have real-time feedback, you see what the person sees inside of the real world and you are able to fix a lot of issues a lot faster without the costs of having to travel, find the accommodations and things like that. So most likely we would go with the Mixed Reality instead.	TNLG,
37	**Would you like to add anything that you think we have missed and might be relevant to mention?**	
38	[EQP start] Make sure that the space where you're going to have the virtual reality, especially when you talk education wise, or like the collaboration, to have a dedicated space. That's mostly for the setting up of the hardware and making sure that people are not going inside of the walls, destroying the controllers, which they have in the hands. So if you are thinking about implementing virtual reality as your remote collaboration, to definitely have in your office a setup space, which is kind of static, which you can use for a quick load up of whatever software you have and like easier and faster connecting.[EQP end]	CLNG, EQP,
39	**How do you think it should be done if people want to use it at home?**	
40	[EQP start]Well, if you are using a home office, I don't think you are able to dedicate a three meters by three meters space. So using it at home, it's probably a little difficult because as you know, one of the biggest drawbacks is the actual physical space which you have available. If you don't have physical space available, you can do the sit-down, basically sitting on a chair, but then you don't have the movement. And then if you're sitting in front of the table, you tend to knock things over, definitely not personal experience. And so, for home, I don't know. It very much depends on what space you have, what hardware you have, and how aware you are that you are not only in virtual reality, but you're also in the physical world.[EQP start]	CLNG, EQP,

Appendix F: Interview Transcript - P4

BNFT - Benefits of VR = Green
CLNG - Challenges of VR = Red
MST – Media synchronicity theory = Blue
TNLG - Similar technologies = Yellow
EQP - Equipment for VR = Gray
STWR - Software for VR = Orange
NVLT - Novelty = Violet
PRQS - Prerequisites for VR = Indigo
USG - VR usage = Cyan
APLC - VR applications = Magenta

Row	Content	Theme
1	**So could you describe your experience with VR, just in general terms?**	
2	Uhm, yeah, sure. I guess my experience starts five years ago, in 2017, when I went to my first VR conference, and I hadn't really heard about VR before, then let alone try it. [APLC start] And the first thing I tried was playing football with some trackers and I kicked off one of the trackers. So then they put me in a safer experience. And then I became an eagle flying through Paris. [APLC end] And through that experience, my brain was really like, Whoa, my mind was just blown, blown with a lot of the options and opportunities that I saw. As a bit of context, I was working for [CompanyName] in Belgium back then, as an organizational psychologist and a team that was called learning solutions. So my job was to create e-learnings and to also help clients with learning strategy. So everything was around learning. But everything we were doing was basically PC learning. If we got really fancy, it was mobile learning. So you can imagine how my mind was like, Whoa, when I when I saw VR, and since then, just something ignited in me. I became very passionate on bringing this technology into my team. We had back then a team of about 40 people doing this, doing very similar work in this learning solutions team. [NVLT start] And to be honest, I had a pretty hard time because right then, VR wasn't really adopted or seen as a huge opportunity. It was something that people were getting excited about, but they didn't really saw the business potential. [NVLT end] So after one and a half, two years and a lot of conferences and speaking to people and reaching out to people creating a lot of slides to explain my ideas. I'm connected to a partner in Czech Republic. And she has been here for about 25 years in [CompanyName], she was working for Tax. So something completely different than VR. But she kind of went through a similar discovery as I did. So we partnered up, she had me come to Prague for, for a workshop of two days figuring out how we could use VR. [APLC start] The idea was to use it for coaching and presentation skills, basically to help people overcome their fear of public speaking. And she [ColleagueName] was a partner, she already did a pilot with 12 people in Czech Republic in [CompanyName]. And it was really, really impactful. Some people cried because it was the first time they were able to step to take some steps in overcoming their fears. And to give you an idea, those people were struggling with public speaking to such an extent they were considering leaving [CompanyName] or not taking a promotion to manager just because they were	BNFT, CLNG, NVLT, MST, APLC,

	afraid of public speaking. So, they really felt the big sense of release that VR as a technology actually helped them to overcome that fear. [APLC end] And so that's basically the starting point. Long story short, I resigned from [CompanyName] in Belgium, got a new contract in Czech Republic. After me, [ColleagueName] and I created our business case for the CEO here in Vienna. And she saw what we wanted to do using technology in general, but also reading a lot of VR, to support leaders and in leadership coaching, and to create work from a place where people come to work for surviving into a platform where people can thrive, where we where we are able to overcome our fears, where we are able to create a more healthy and inclusive and safe environment for people to grow as individuals to grow as professionals. And we were looking into how technology could help with that. And we were both really passionate about VR. So basically, the scope for us broaden to leadership development, more than learning. And technology is still re-ally important components of what we do with leadership development. So we're a new team, we're just three people, but we plan to expand. But that's basically where I come from. And I guess the reason why people say like I'm the VR guy and the VR expert is because I've been really active for the past four years. [MST start] And getting people in a headset, after I realized slides, we're not going to do the trick. You just need to put people in a headset. [MST end] And I've set up an experience lab for that in the biggest meeting room of our building. We have a few VR headsets, we have a few AR headsets, we invite clients, we invite [Company-Name] people to let them experience where technology, but especially immersive technology, can support them in transforming their business. What are the oppor-tunities in hybrid work and hybrid learning in manufacturing and retail in healthcare. So I've just been running around like the passionate crazy guy giving lectures, giving workshops and moving this lab. So I guess that's why, that's where I earned my reputation from.	
3	**Great, great. And how often do you use VR?**	
4	Me myself, like how often I go into my own headsets? I would say it's with ups and downs. And I pre-ordered the first Quest. And that came out in April 2019, I believe, or 18. And in the beginning, I was just in there like maybe two hours of the I was pulling my friends into it. And after a while I did nothing for some time. And then I go back into it. And then I grew tired of it. Right now I would say on average maybe two or three hours a week I would spend in VR. And most of it is business related. Because after a while I know what Beat Sabre is about, once you are on expert, expert plus, it gets a bit boring and the zombie games that after a few years, I've seen the entertainment and I moved more into business. So I would say right now it's about two to three hours a week.	USG,
5	**Right. And just an additional question, what do you consider the healthy amount of hours in VR per day or per week?**	
6	That's an interesting question. [USG start] I would say even half an hour could be detrimental. [APLC start] If all you're doing is shouting at people in VRChat or doing nothing then looking at VR porn. I mean, if you do meditation in VR, which is also available, then I would say there is not really a limit. [APLC end] Before you're like there would be a limit for your brain to process all these experiences are highly immersive. Visual processing that needs to happen, I would say, not more than four hours a day as a maximum, as like, I'm just making this up on the spot. [USG end] But I would say that's a healthy amount, if like, on the condition that you're doing stuff that is healthy for you. In VR if you're doing stuff because	CLNG, USG, APLC,

	you're getting into an addiction of gaming or anything, then probably you shouldn't be spending your time at all in VR because there's just a technology that then undermines your mental health and reminds your body. But I would just say the visual processing happening in your brain, the eyestrain from being in a device like this, I would say not more than four hours. But I would say the same about laptops and laptops are actually even worse from a physiological point of view than VR is.	
7	**Interesting point. Okay, and what VR software and hardware would you suggest implement for remote teams?**	
8	For remote teams. So this is in a professional context, which say, you are at an interesting time regarding hardware. The Quest 2 is very interesting. If you do it for a few individuals, if you want to implement it at scale, in a business, Facebook Meta is a really difficult company to deal with the admin portal, the Oculus for business is, I wouldn't wish it on my worst enemies. To be frank, it's a pain in the ass. And so, the either Pico, the Pico Neo 3, or the Vive, the HTC Vive, they are better alternatives for business. And probably depending on what kind of software you will use, which we can get to in a minute. That will mostly inform the choice of of hardware for business at scale, I would recommend Pico and HTC. And not Quest. If it's for experiments, Quest is the way to go because it's cheaper, and there is less admin and platforms you need to deal with.	EQP,
9	**Okay, and do you think there is something lacking in the design of the VR environment in general? So when you go in, do you think that the VR environment has matured enough to be used for collaboration?**	
10	Yes, I would say so, definitely. I would say the VR environments, both from a platforms perspective and an experience perspective is mature, definitely mature enough. And the main struggle is the internal implementation, both from a change perspective getting people to use VR. And for companies, for big organizations, the IT infrastructure and security measures. That's where the real bottleneck is. And that's why we haven't seen a big adoption yet. I've tried to implement it in [CompanyName] as well. And those are the exact same things that I keep hitting the wall, IT infrastructure, integration, security, but then also the, the usability or the accessibility of VR, for the standard employee, most of them may be traded one or two times, most of most of them didn't. [MST start] And if you have a meeting, you need to get accustomed to setting up a meeting on your PC, making the bridge to the VR headset, you need to have a headset ready, get into it know how to operate it. And that's just it's too cumbersome of a process. There's too many steps for like the muscles of workers to get into that.[MST end]	CLNG, MST,
11	**Okay, and what benefits do you expect to see after implementing VR for remote collaboration?**	
12	People feel more connected to one another, for sure. It's much more connecting, then looking at squares to the squares on your PC. So I guess people with me feel more comfortable and more safe, more connected, which is a huge issue during COVID and home working from home. So that's a big one. Another big one is creativity, for having status updates, for having financials, for having very intellectual work, [MST start] I would say Zoom, Teams is enough for transactional intellectual work. [STWR start] If you want to do a brainstorm, if you want to prepare a workshop, if you want to create a slide deck together, then either you want to be in a room with those people having a whiteboard or you can go into Workroom	BNFT, STWR, NVLT, MST,

	Horizons, for example, and you can stand at a whiteboard, you can plug in your PC, and you can actually walk or slide around, teleport around the room. [TNLG start] So creativity is a big one that is limited in Zoom sessions, we just need some kind of medium to write, to collaborate [STWR end]. So that's a huge one. I would also say engagements, Zoom fatigue is a widely spreads phenomena.[TNLG end] It's also been researched a lot over the past few years. And VR is just more immersive, it's more engaging, it's more fun. [NVLT start] And it also has this novelty aspect to it. So it is also something nice for people and it gives them a break from from Zoom meetings. So I would say connection, creativity and engagement are probably the most important ones.[NVLT end][MST end]	TNLG,
13	**Okay, very interesting. And what changes do we usually see when VR is being used within remote teams?**	
14	I haven't seen it used at scale. Like there's a few case studies and you're aware of them, you're doing research about it. There is a few companies that implemented it at scale. None of them apart from Accenture, probably our global big corporations. The benefits that I've seen, in my circles, when people are experimenting with it is like basically the main point is that, I told you, in its purest creativity, people feel more connected, it's more fun. [NVLT start] It also helps for their personal branding because they're the cool guys around the block when they post something on LinkedIn that we had a meeting in VR. [NVLT end] One of the, one of the benefits as well is that when you do a speaking engagement, when you give a presentation to people in virtual reality, it's something that is really cool. And people are much more engaged, they're much more interested and they engage more in the topic. My personal experience in that is that I have been teaching two lectures for students, the Faculty of Economics in [City]. And I used Spatial as a tool on the PC, but I also had some headsets where people could go in. So it was kind of a hybrid session, and the engagement and the appreciations for those lectures were much higher than any of the other lectures they had been given. So it's again, engagement, it's attention. And it's also just building a personal brand, building some excitement around your meetings, around your presentations, where I see the main benefits, but those ones are not at scale. Those ones are mainly like one of events or therefore the innovators. It's not something that has been that I've seen deployed at scale within [CompanyName]. Accenture is the only firm that I know of that is implementing it at scale for onboarding, learning and collaboration. But they are very scarce on providing insights.	BNFT, STWR, CLNG, NVLT,
15	**Yeah, yeah. Okay, great. And could you describe a typical learning process for a new user of VR?**	
16	[PRQS start] Yeah, so the, I can just take you through the journey that I see with people time and time again, first thing is, I ask them the question: "have you ever been into VR?" when the answer is "no", which is what your question is about new users. I first explained them like "Okay, you're going to experience something you have never seen before. It's okay, I am here". So they feel confident and comfortable. That's a very important step. So they are open to learning, they don't feel like they have to prove themselves, like they have to stress about the controllers. There's a very first important step to feel comfortable and to feel supported. Then the second one is when they actually get into VR, they take a bit of time to learn, then to get accustomed to just the menu and the immersiveness of VR. And then I start explaining to them the basics of the controllers, like just look around, you can look everywhere, you can turn around, you can even walk with your feet and you	BNFT, PRQS, CLNG,

	can step in the environment. And then you can use the controllers to select things you can use your trigger buttons, your thumbs, like the usual stuff. And then either I put them in the experience myself, or I guide them towards getting into the app into the experience, explaining them how they can there. And the best thing, the best scenario is when I am with those people in the room, if they are there with themselves and I'm on the phone or on Zoom, it gets really messy. Because when you're in VR, you only focus on being there, and you filter out everything else that's happening because it's just too much. So the learning process in the beginning, the, I would say, the only acceptable scenario for me is when there's an experienced person with them physically present to help guide them. And then after a while, depending on how technology savvy the person is, and how well their body deals with VR, that is, if they don't get nauseated, if they don't get overwhelmed, which happens to about five to 10% of people most, and most of them are female, for a great variety of reasons, then if they're comfortable, then typically they find their way, if they're really, if they're a little bit tech savvy. If they don't, then the process takes a little bit longer. But it's basically like teaching your grandmother how to use a smartphone, you just have to repeat it more. But after a while you can get the basics explained to people. The issue is when people are not really comfortable with VR, they have to take it off. And they just have to opt for a screen instead of the immersive environment. So that's why it's important for having like multiple platforms, multiple technologies, like smartphone, tablet, PC and VR available for the experiences you want to use for collaboration. [PRQS end] But I'm already deviating a little bit of your question.	
17	**You actually mentioned a very important point for the next question. You said that it's like teaching your grandma to use the smartphone, what would you say is the importance of digital literacy skills when people are learning VR?**	
18	It definitely helps. It definitely helps, the more people are comfortable and knowledgeable about how technology works and software works. You can see how menus on a PC are kind of the same setup in the same way as in VR. So it really helps if you already have some digital literacy, if you don't have it. And that's fine. So all will take you some more time. And I always use this example of having having a person that's 90 years old. And let's see we have two persons and we teach one person in how to work with a computer and the basic stuff, emails, internet's sending a picture on Facebook, or you teach another person of 90 years old, how to use virtual reality and the basic stuff. And I'm pretty sure that learning how to use virtual reality is much easier than learning how to use a laptop. [NVLT start]Because virtual reality is a newer technology, we have more people thinking about experience design thinking, about accessibility. And when people were designing computers in the 70s, 80s, they were mostly thinking about engineering, programming, not really about user experience. So I would say VR is a more intuitive technology to learn. But people are just less patient nowadays than they were 30 years ago, or 40 years ago.[NVLT end] So I would say the digital literacy skills really help. But anyone can learn how to use VR, there are a few tricks you can use like simplified controllers, simplified experiences. But a lot of work in VR is being done with elderly people having them revisit their place of birth where they already grew up with really, really good results, or even some fitness work in VR with elderly people. And all you need to do is just simplify it. And they adapt to the experience itself really well. And the controllers just need to be a little bit more simple.	BNFT, PRQS, NVLT,

19	**Very interesting. Okay. And what do you think are the general opinions of people who use VR for collaboration, if you know any?**	
20	So people who already use VR for collaboration, right? Okay. So they don't need to be convinced anymore. In that case, I would say people are really excited about it. And because it's something new and they feel it helps them to a certain extent. Typically, I see that they are becoming champions or they want to become, they are preaching the words and they are inspiring other people to become part of it. So the people that I've seen that already took the lead, they are kind of the early adopters, but they also see that it has certain benefits. And the more people get into those platform forums with them, the happier they are, because then this, they can see how the advantages spreads to more people. And it also makes it easier for them to find people in VR for collaboration. So I see them as the passionates, as the preachers, and the people who take other people by the hand, and try to put them in those collaborative experiences. That's about 80% of the people that I see using VR for collaboration. Maybe let's say another 20 percent tried it once and doesn't really integrate it. They think, like, "Okay, this is really cool, but it's over my head. I'm not the right person to do this. It's too much innovation for me, and I'm happy to go back to my PC". So that's people who feel a bit less comfortable with trying out new stuff, or are not really sure how to integrate it into their work. But in general, they like the experience, they're impressed with it. But it's then making the jump to the to the work, or even applying for themselves where they are like, "it's a bit much for me. I'm good as I am. But thank you for the experience was really cool." So that's, those are the two groups that I can see.	BNFT, CLNG
21	**Great, great. And do organizations also use other media for communication and collaboration alongside VR?**	
22	Are using what, sorry?	
23	**Other, other media for communication and collaboration? So is it just VR? Or is it VR mixed with something else?**	
24	So in terms of what people are and companies are using nowadays, I would say there's very little experimentation. I think VR is already the last frontier for a lot of people. That is, as far as I've seen people go. But when I look at, at startups and experiments that are happening, there's certainly a lot of work being done and a lot of exploration being done with green screen rooms, and avatars, and immersive rooms. So you don't have to have a headset on your face, you can have an immersive room, where you come in not just as an individual, but as, as a team of colleagues, or maybe a team of partners outside of your organization, we're actually looking into building an immersive room ourselves here in [CompanyName] in Czech Republic, as another way of collaborating as another way of simulating experiments and simulating decision making. So, for example, take smart cities, and you invite the mayor of Prague, who invites CEOs of technology companies and transportation companies, and businesses, and they come together and they make decisions and how they want to build the city of the future. So they allocate their budgets. And then they say, "Okay, we've taken a few decisions. Now let's put, let's push the time travel button to 2029 or 2050, and see how our decisions play out with the best of our knowledge of research." And then you create the simulation and you actually challenge their decision making. And you let them reflect on how their decisions are impacting the future. So that's already for immersive rooms. I've seen a few of examples that are already doing this, not just on smart	NVLT, TNLG,

	cities, but in general, some research institutions as well that are looking into the psychology of human decision making. So immersive rooms is a very interesting one. And it's, I would say, even more collaborative because people are not confined to being alone by themselves and their headsets. And it's easy. It's, it feels more natural. That's why I see moving from VR into immersive rooms, I think that there's some really powerful stuff. But the experimentation is very limited to just a few people in the world. Then there is augmented reality, which is also happening to some extent, I would say it's more around learning and collaborative design. So you have 3D models which work really well in augmented reality, there are some really good apps that support it. And then you can have some experts coming in either architects or car manufacturers, the engineers, designers, astronauts for building space rockets, but it's some very specific use cases. The army also uses it for running simulated experiments. They use some adapted holo lenses, or VR headsets, because it's easier to take that action into a real space and then having some 3D augmented visuals in it. But it's not like I don't see that very likely technology to become scalable at big organizations anytime soon. But it's happening, and it has certainly some really valuable use cases too.	
25	**You mentioned the immersive rooms, would you consider that? More mixed reality? Or is it closer to virtual reality?**	
26	It's certainly not virtual reality. I would say it's, yeah, depending on which term you prefer mixed reality, hybrid reality, immersive reality, extended reality. You're still in a room with people. And you can still introduce some, some real life data and visuals like a city. But in the end, it's still virtual, and it feels more immersive than a computer screen. Because, I mean, it's an immersive room. And, like, to what extent do we consider computers to be extended reality? That that's where we become like, and that what is reality? You know?	
27	**Sure. Okay, great. And can you describe some situations where VR improved collaboration with probably some some example will be, will be preferable.**	
28	[MST start] A personal example is where I was preparing a workshop with another person in the Netherlands and I was in Prague. So we were on [TNLG start] [STWR start] we were on Teams trying to do the workshop preparation. And after 20 minutes, we felt we hit a wall like we we weren't able to take it further. But we weren't finished. And I knew he had a VR headset, I had the VR headset. So we decided to go into Horizon Workrooms and we continue it's on the on the whiteboards, putting our our ideas together. [STWR end] And after another 20 minutes, we basically were: okay, that's it, we're done, we're ready. And then he came to Prague, we delivered the workshop, and it worked. So that's a very personal example, on a on a small scale. But it's again creativity, putting things together that really shows its benefit there. [TNLG end] [MST end] Another example that I told you already is this lecture, which helped for students to be more attentive, more engaged, they asked more questions. And it inspired two of them to either do their master thesis or their PhD research on VR or on the metaverse. So I'd say that's, that's a good effect as well from just having a lecture. You could call it collaboration with with a little bit of a stretch. That proved some success. Trying to think about other ones. Yeah, a colleague of mine in Singapore, who I hadn't been talking to for two years, we decided to try something fun and new to get into VR. That was about two years ago. And we want we wanted to see how we could use VR for business and collaboration. So we met in VR. And before we went we went into VR. [STWR start] Immersive.io I think was one of those apps that we	BNFT, STWR, MST, TNLG, APLC,

	used.[MST start] [APLC start] We went to Burning Man because Burning Man couldn't happen in person because of COVID and they boot it up in VR. [STWR end] So we first went there, we had a really nice bonding experience, we really caught up and I even got to know him better. And we became better buddies. And then we went into the VR app for just setting our meeting. And we were just having a much more inspired meeting. [TNLG start] And we were thinking much more outside of the box than we would usually do on Zoom or Skype or Teams. [TNLG end]So I would say bonding, creating friendships and creating better connections and also having a much more open mind were the results of that. Like immersive collaboration, VR collaboration.[APLC end][MST end]	
29	**Great. And could you give some examples of tasks where VR would not be an ideal solution?**	
30	Yeah. Specifically around collaboration, or…	
31	**Around collaboration.**	
32	So there's collaboration on a lot of different levels. If you look at collaboration where you have to be working with a person at the same time, not as increasing as synchronously, then I would say just some transactional tasks like going over numbers, checking if you have all the documents in the right folders, or having a brief status update like where are we in terms of this project. And, like, if you need a lot of transactional information like timelines, numbers and documents, things that are typically stored on a computer or in slide decks, I would say don't overcomplicate it, don't lose your time with setting up the VR environments, but just do what you need to do. And stay with your PC. If you want to add a little bit more depth or open thinking or brainstorming or, or really human connection, then go to VR, if it's really just transactional, you can stick with your computer. And I could even argue that maybe in a later stage when the integration of files and computers and just interaction with with files is more integrated in VR, I would say you could still do that in VR and have the personal connection, a deeper layer of personal connection on top. [CLNG start] But VR is just a little clumsy and handling spreadsheets and adapting presentations. But if VR would be up to that point at some day, I would say screw the computer and just do what you have to do in VR. And as a bonus, you get a deeper layer layer of human connection on top of it.[CLNG end]	CLNG, MST
33	**Great, great. And one final question of the of the main ones. How do you see the future of VR for collaboration?**	
34	Now we're talking. But I believe first of all, VR is not going to be just for VR, we are talking about VR, separate from MR. Separate from AR, separate from computers because we have a separate headsets. And even the Quests already are a little bit of mixed reality because they have four cameras. They're just not using it so much. For plenty of reasons, I see that in the future. We have much more accessible integrated devices, let's say we all have free events, or even contact lenses with much more vision on our face, and we just live our lives. And we have those virtual objects as part of our of our workflow. We don't have to put on a device to go into a different reality. We could choose in a more easily accessible way. Maybe with voice comments, maybe with our hands, maybe it's looking with our eyes or blinking. Or maybe even we're just thinking like Facebook is looking into that as well with control lips. Just really scary, but also really exciting. So I guess the interaction with our devices and the way that it's integrating with our day to day life	EQP,

	will be advancing quite quickly over the coming five to 10 years. And that will have an effect in how we how we connect with data, how we connect to people, and how much more immersive our lives will be. And the only way we call VR immersive is because it is basically a simulated environment that's all around you. And you see nothing else apart. On the dark in the headset where your field of view is not covered, but I would argue that even those pixels we see, even the displays we see are still a physical world there, it's still hardware, it's still something you can touch it still the photons coming on your, on your retina, why we think it's not part of the real reality of the physical reality is just because it's simulated its programs. But is it less real? I don't think so. Is it less physical? Yes. Is it more similarly edible? Or is it more adjustable? For sure. So I guess the future will just be a reality which we live in, which is more adaptable to us, which is more influenceable and will just become much more of an integrated part. And to try to answer your question a bit more precisely in collaboration, I would say people will have even less obstacles in connecting to people in a deeper level than we are used to on a PC. Because it will just be more accessible. And it will be more common use for people to call a person in Singapore, in the Netherlands in Australia, and have meetings with them in a way that is more immersive that is more connecting, then the computers, which is a technology we use now. And even the computers our own are a huge jump from writing letters or having a phone conversation with someone and see the technology is just maturing and the collaboration will just happen at the more human level in the future. Because the technology just evolves and as more accessible is more integrated. And it's more believable. It's not just a fake avatar, we could actually see a photometric scan of those persons. And our brains would actually believe we are in the room with a person. So I guess just the boundaries, the obstacles will come down because he because the technology evolves. without replacing face to face and human contact. Let me be really clear. I don't think we'll be living in a Ready Player One World anytime soon, or even at all, at any point in time. I guess there's just so much technology can do. And it can do a lot that probably won't replace, like real human contacts. But they can get creepily and excitingly close.	
35	**Great, great. And those last few questions or just closing questions, they're not really super related to the main ones. So do you think that there is anything that we've missed, and that is anything you would like to add in relation to our study?**	
36	What I find interesting, if you're looking at collaboration as defining what is collaboration, especially for the scope of your research, I get the feeling it's mostly synchronous collaboration where you meet with people, you talk to people and you respond to them. Collaboration can be much more when you as a synchronously work with people, I'm working with some maybe hundreds of people together right now, whether I know it or not, like you can get to a very broad or a very narrow definition of collaboration. So it can be interesting to look at the like your definition and see if this is the one that is useful to your research. Or maybe there are some other technologies that can come to mind and some other implications that come to mind if you look at different versions of the definition, without having to re direct your whole research, which is not at all what I would suggest you to due. But it could it might spark some other ideas by thinking about what is collaboration, really, and how can technology help with certain aspects of collaboration? I guess it's just an interesting question to ask yourself and your research and good catches some extra inspiration.	

Appendix G: Interview Transcript - P5

BNFT - Benefits of VR = Green
CLNG - Challenges of VR = Red
MST – Media synchronicity theory = Blue
TNLG - Similar technologies = Yellow
EQP - Equipment for VR = Gray
STWR - Software for VR = Orange
NVLT - Novelty = Violet
PRQS - Prerequisites for VR = Indigo
USG - VR usage = Cyan
APLC - VR applications = Magenta

Row	Content	Theme
1	**Could you please describe your experience with VR in general?**	
2	Yeah, of course. So, as I said, when we were chatting before, I haven't actually worked directly with VR for probably about four years now. The way that I got into it was when I started my first professional job at a consulting company, I was put into a team that looked at disruptive technology, one of which was VR. So I kind of got a baptism of fire crash calls in VR, so that I could then preach the Word and seeing the benefits to clients and internal teams. So to try and kind of upskill them and make them aware of the potential of VR and its different applications. So yeah, and I did that for about six months. So whilst I was kind of really indoctrinated into that world for a short amount of time, it's been quite a while since I've really been involved.	NVLT,
3	**And do you use VR right now?**	
4	I actually have an Oculus Rift that I've been meaning to return to my workplace for about a year now, I was loaned it right at the start of the pandemic, by my very, very not old in years, but old in duration, haven't worked with him for a very long time. But he was looking for people to lend the kit out to when we were obviously trying to transfer into this remote way of working. And he gave me an Oculus Rift to take home. And I tried to help him with a couple of experiments. But other than that, I haven't really used it. I've shown it to friends a couple of times. But other than that, I haven't used VR recently. I need to return itself. So if I get told off.	EQP,
5	**You mentioned that you're using an Oculus Rift, is that the hardware that you would suggest to implement for remote teams if, say, they want to implement it at a large scale at the company?**	
6	I mean, with my little working knowledge of VR at the moment, I would still say no, due to the fact that [EQP start] the Oculus Rift requires quite an expensive and bulky gaming laptop to power it effectively. So I would definitely recommend one of the untethered headsets that actually is functional just through the headset, with the built in computer etc.[EQP end]	CLNG, EQP,

7	**And when you were working, basically, you said that you were upskilling and trying to promote the usage of VR. What challenges were you aware of back then? For using the technology within teams?**	
8	So yeah, we're talking kind of end of 2017, first half of 2018. [NVLT start] [MST start]The biggest challenges I encountered were people not really taking it seriously, especially people who had been in their working careers for many, many years, just did struggle to see the application. And it was only then once they put the headset on, and they saw kind of this magical world of virtual reality that they were slightly more open to the ideas, I think it's, I think one of the biggest things would be the hurdle of actually getting people onboarded. [MST end][NVLT end] But I guess, once they sort of saw a few of their colleagues doing it...if it was applied in the right way, and it was successful, then hopefully, it would be kind of bringing everyone else along the journey. And they would be more bought into it, I think it's that kind of first leap was quite a barrier.	CLNG, NVLT, MST,
9	**So would you say that these were the benefits of implementing VR, like people will become more engaged, more connected?**	
10	Did I say those are the benefits of implemented? Yeah. No, I think I think there are. There are lots of benefits of VR, but I actually, I'd like to see it in practice myself, like the different tools. I mean, when I was on the team, we used to kind of stress test different organizations that would send over there. I don't know whether you'd call it software or the environments that they've built. I haven't been in the metaverse yet so I don't actually know kind of what the full experience is like that, um, I do see it bringing benefits. I just don't really know what they are yet. I kind of bought into the idea before I've actually seen it in practice.	
11	**And you said that it's challenging to actually get people inside VR headset? What challenges do you usually see when you try to promote VR within teams?**	
12	Yeah, as I said, [CLNG start] [NVLT start]it's just the idea that VR is associated with gaming and not being able to see the business applications.[NVLT end] But then yeah, when when I was doing it way, way back when we were demonstrating Facebook Spaces at a conference, and [NVLT start] [MST start] it was just full of kind of men in suits, who were just kind of kind of scoffing at this VR stand. [CLNG end] And then as I said, it was only once they actually got in, and they, it was like the little kids at Christmas, really, when they they would stay in for a long time, just like playing around. And I showed them like the scribing tool and can't really remember what else was in that space that they then saw the application when they would do like squiggles. And they'd be able to grab them and see them in 3D and rotate them. Then when they lifted their masks up, it was like little kids at Christmas. And they seemed very excited by the possibilities. [MST end][NVLT end] But I was very early in my career. So I wouldn't, I wouldn't put it down to VR. But there was always kind of excitement after lifting the glasses. But we never, it was very, very rare that we actually kind of engaged in meaningful long term conversation. I'm sure my manager did, but I just can't remember any of that. So I think people were kind of struck in the moment but then quickly forgot about it. But that's probably because we were still very office-based at the time, no one really saw the need for a new way of collaborating in a digital world.	STWR, CLNG, NVLT, MST,
13	**And could you go into a bit more detail into the typical learning process for VR? So how would a new user of the technology interact with it?**	

14	Sorry, could you ask the question slightly differently?	
15	**Just the typical learning process for VR for a new user?**	
16	As in what are the steps they go through?	
17	**Yes, just the common steps, common impressions.**	
18	Yeah, I was. I mean, I'm really kind of putting my mind back here. But I would say, definitely, with the Oculus Rift, it was the buttons. So I would always as I was putting the, what do you call them the controllers on their wrists, say, like, make a ball with your fist, put the safety strap on, try and get them use the buttons when they've actually got the headset on so that they can see how the sensors correlate with their hands in the digital world, that it was definitely the learning to pick up objects while simultaneously grabbing the sensors. [EQP start] I guess spatial awareness, orientation, because they would get very confused as to where they were facing in relation to the Oculus sensors. [EQP end] Yeah, I think that's pretty much it. And then I think people were normally away once they can learn how to interact with objects and also orient themselves. They're good to go really.	CLNG,
19	**And do you think that digital literacy skills might help with that technology? Or is it not really close to any other technology, so digital literacy skills could not help with it?**	
20	Well, I think it would if you think about someone navigating a menu, the kind of tacit knowledge that you have when you think about iconography to indicate menu items, and like information architecture hidden between, behind menu items, I think digital literacy definitely does help.	
21	**And one question regarding additional technologies to VR. Do you think that for collaboration, specifically, VR is enough as a tool or should be used alongside another technology?**	
22	What kind of technology is it as an example?	
23	**For example, in other interviews, we were told that maybe mixed reality, or augmented reality could also be used alongside VR or maybe some other software.**	
24	Yeah, I'm trying to think about the application of augmented reality and collaboration. I think for me, in my very, very limited working knowledge, augmented reality is you outfit if an individual wants to go about a task that can be augmented, I don't see how colleagues input into that in the moment. So yeah, I'm struggling to see how that could work. But I'm sure people who are much smarter than I am and much closer to it, know what they were thinking there.	
25	**Right, okay. And could you describe a situation where you think VR might help to improve collaboration?**	
26	Yeah, it's a good question, because I used to get asked this all the time. And yeah, I think I need a much better practical understanding of the metaverse, but I guess in my limited understanding, I would say if remote teams needed to, you know, I just want to be completely honest. I love the idea of VR for collaboration. But I guess it's in teams that are very different to mine. [MST start] I guess for, yeah,	BNFT,

	definitely designing, design teams where there's kind of a creative element where it's not just words on the page or PowerPoint. I think there's definitely practical applications there.[MST end] But kind of within my context of my day to day, I do find it difficult to see how, how VR could really kind of level up that experience. But there definitely is a place for it for other teams.	
27	**And you actually touched upon the next question, which is, are there any tasks where VR would not provide an ideal solution?**	
28	I guess if it's kind of trying to force the solution where there isn't a need. [TNLG start] At the moment, I think, if we'd had this conversation a year and a half ago, where I was on a client team, where they were kind of struggling with Zoom, and everyone felt quite fractured, and they didn't feel that togetherness, then I think, perhaps I would have been more inclined to say, I could imagine it working on all teams. But I think now everyone's really got into that rhythm of remote working. Everyone understands video conferencing technology. We're all very familiar with Teams and kind of co-designing a document, which actually is something that I wasn't doing like a year and a half ago, I wasn't kind of co-editing a PowerPoint at the same time as my colleague. So at that point, I probably would have felt like virtuality might have been the key to that kind of working. But because I feel like nearly all of our needs have been fit by just kind of current kind of digital interfaces, then I don't see Virtual Reality working for just like very run-of-the-mill.[TNLG end]	CLNG, MST, TNLG,
29	**And at that time, were you using the Oculus Rift?**	
30	No, no, I wasn't, I was, as I said, the only reason I had the virtuality was to help my old manager with some experiments, it wasn't part of my kind of day to day working.	
31	**Okay, and one final question, how do you see the future of VR for collaboration in remote teams based on your experience?**	
32	I would love to see a future where it was used more, where colleagues especially in regional offices, because I think we do have an issue where regional offices. Yeah, so in the UK, we have like [City1], [City2], [City3], [City4], within [CompanyName] as regional offices. And I know there's a real issue because there is a policy where once a month they can expense a train fare down or travel down to the London office. But that's not really enough for them to feel well connected. I have someone on my team that's been here nearly a year and he's never met any of his colleagues in the flesh. So I think [CLNG start] if there was but obviously that requires not only them to have a headset, but lots of other people in London to have a headset as well to enable that [CLNG end] but I think it definitely would work, I mean, at the start of the pandemic we tried this thing called Virbela which is like this really, it's not basic but the actual kind of graphics of it look really basic. So it's kind of like you've gone back in time but in the future it's kind of weird, but everyone I absolutely loved it because I was already kind of have that mindset but people that have never done anything like that before, where they were avatars and they're walking around it was a really magical experience, people got very excited. So I think if we were able to replicate that and more meaningful, rather than people just having a party on a beach, more meaningful way than I think it would be, be great and definitely bring more people together. It's just the lead time and the journey that everyone would have to go on to get there. But once we got there, I think it would definitely be a nice touch.	BNFT, STWR, CLGN,

33	**And which application did you use for this virtual meetings?**	
34	It was called Virbela. And it was, it's like you download it, it works as a desktop. But it's uh, yeah, it's a funny, funny place. But it's kind of like Sims really. But you are actually it's like, you're the perspective of your avatar. And yeah, we did it. My old manager arranged it so that everyone can have what we call third Friday, which like the third Friday of the month, where we all get together, we could all have that together, because we haven't all seen each other for at that point, it was a couple of months, which seems crazy now, given that it's been two years, but it was the first time that we all walked around, and it was like we're at third Friday, and you kind of bumped into an old colleague, and you can have a conversation. And when you're in a certain radius at them, it would pick up their microphone, etc. So yeah, it was interesting.	
35	**Do you think that there is anything that we've missed in the questions and that you would like to add, that you might think it's relevant to the study?**	
36	Yeah, I guess, we haven't discussed and I really don't know the answer to this, but like, what would be the process of if a company decided, okay, well, VR for collaboration is something that we want to pursue seriously, what would be the process from like a change management perspective to get employees up to speed? So I guess there'd be like, acquiring headsets, rolling them out, keep having some kind of training and onboarding, then having some kind of, I don't know, like, buddy system or so, that would be an interesting thing to actually think about that kind of practical rollout of this technology. I'm sure you have thought about it. But asking people who has maybe thought about it as well.	

Appendix H: Interview Transcript - P6

BNFT - Benefits of VR = <mark style="background:green">Green</mark>
CLNG - Challenges of VR = <mark style="background:red">Red</mark>
MST – Media synchronicity theory = <mark style="background:#6699cc">Blue</mark>
TNLG - Similar technologies = <mark style="background:yellow">Yellow</mark>
EQP - Equipment for VR = <mark style="background:gray">Gray</mark>
STWR - Software for VR = <mark style="background:orange">Orange</mark>
NVLT - Novelty = <mark style="background:#7a5299">Violet</mark>
PRQS - Prerequisites for VR = <mark style="background:indigo">Indigo</mark>
USG - VR usage = <mark style="background:cyan">Cyan</mark>
APLC - VR applications = <mark style="background:magenta">Magenta</mark>

Row	Content	Theme
1	**Could you please describe your current role in the organization?**	
2	Yep. So I lead learning technology in [CompanyName], UK, which is part of our human capital or HR offering. What does that mean? That means I look at the strategy and transformation. But then within each of those within a strategic implementation, I would look at interfacing which could be mobile through to VR or AR. That's how learners would access content, then the next stage would be content itself. What is that content? We think about content for learning, you can do learning needs analysis, and then you would design something which would then be a particular style of content, it could be e-learning, it could be simulation. The next stage would be platforming ecosystems, landscapes, what SaaS needs to support, the scaling of that content to whatever the learner population is. And then the tail end of that would be what data is collected. So depending on whether it's e-learning, or all the way through to simulation, you might collect a different type or breadth, or corpus of data. And that data can be used for different things. It could be business intelligence, training intelligence, all the way through to looking at how you adapt a learner journey, and provide that recursive step to then adapt a learner's content, depending on what it is they do within the learning experience or within their curated learning pathway. That's the spread of what I do.	
3	**All right. And do you work in a team? And if so, how do you collaborate with your team?**	
4	So I work in a number of teams so in [CompanyName] generally, we have project teams. So thinking of clients engages us to do a particular scope of work, we would coalesce the right team for that. And so I currently lead a team for simulation-based learning for our clients. And the other type of team is the practitioner team or the practice team. So I lead a team of learning technology. People at various grades who would then go off and do different parts of what I've just described for different client engagements. How do we collaborate? Or how do we communicate? I think that was your question. So within each of those, <mark style="background:yellow">we collaborate and communicate basically in the same way we use Microsoft Teams primarily. Because we're all working remotely. Occasionally now after lockdown has dissipated, we are interacting a little bit more in the office. So we have the occasional face to face, workshop or face to face meeting. But primarily, we use Microsoft</mark>	TNLG,

	Teams for communicating in terms of chat, having calls like this, video calls primarily, it's pretty rare that we have only phone calls. And then using it as a sort of shared repository for documents that we can link to each other, that we can collaboratively work on, for example, PowerPoints or Excels, which open in the Office applications, but you would store them on Teams, you have SharePoint in the background, which is facilitating this. And it allows things like version control, but it allows that sort of consistency and making sure that everybody has that shared workspace, which is primarily Microsoft Office based.	
5	**All right. And could you tell us about your experience with VR in general?**	
6	So my experience with VR is, it's not my primary thing that I go to. And the reason for that is that if you think about what I said earlier about sort of strategy and transformation, most of what I'm doing in the Digital Learning Space relies on a couple of key things as drivers. So driving born for an organization is economies of scale or scalability. Scalability tends to rely on things like device agnosticity, in that whatever people have in their pocket is probably the best thing for them to use to access something. The idea of scale tends to rely on minimal marginal cost per learner. So if you develop something you have capital cost, and that capital cost is then offset by a slightly lower cost if you add a single learner to the population, and that brings organizations benefits. So if you're relying on that as a benefit, is that always true for VR? So your capital costs for VR tend to include things like hardware, tend to include facilities and with a lot of digital and what one of the selling points is that you remove the constraints around having a learner in a time and space event. If you move to e-learning, for example, you've removed that constraint because a learner can access on any device in any place at any time. That is just not true for VR generally speaking. You need to constrain yourself to a time and space event, maybe you need to book into a facility where they have a headset, and the right computing power to be able to access whatever the construct is, the construct may be fairly bandwidth heavy if you're accessing it live, or if you can have a downloaded environment that accesses something else, that's also possible. But what I'm saying is that the facilitation conditions, you might also need the facilitator for safety to make sure that somebody is not falling over things, or knocking into a wall or whatever. I'm talking specifically about VR within a headset because you can also have VR on a desktop, which is it really VR? So it depends on your terminology, right? You can have a virtual environment that is accessed on a desktop, and it has all the attributes of scalability that I've just mentioned. But once you go into a headset environment, you start to tie people to a time and space event. So in terms of my experience, usually I'm advising a client to say these are the kinds of things that you would want to do. And usually VR drops out at that stage. I have, let's see, three times, three different engagements, I've developed simulated environments, a simulated environment that has things within it. So those things would be interactions with particular assets, or particular bits of machinery, or occasionally a virtual character. And that virtual character would be able to support the learner in one of the procedural, whatever procedural scenario they're completing within that. The VR that I've made in the past has been up to about 10 minutes of learning time. So completing a single procedure, and also accessible on desktop. So we're talking about effectively panoramic environments.	CLNG,
7	**And what did you use to create this VR environment?**	

8	So, Unity is the tool of choice, in the past I have used, what did I use? Virtual, I forgot the name of it, something like it's a creator that you can use, you can stitch together photographs of an environment, use this together and all. It was a UNC-based tool, I want to say it was a VTS, virtual training software or something like that. This was a few years ago, and, but I have also done it directly in Unity.	STWR,
9	**Alright. Just to make sure, you have used VR also for collaboration with a team right?**	
10	No. So when I said I have used VR to create things, when I said earlier, you have learner content, so I deal with learning, specifically, rather than communication collaboration. So I've used these tools to create a learning content or learning environments or procedural scenario or something like that, which can be accessed on a platform by learners using an interface and that interface was a headset, but it could also be a desktop.	
11	**Alright, so if you were to create VR for team collaboration, what software and hardware would you suggest to use?**	
12	That's a great question. Not something I'm massively informed about to be honest, the collaboration tool, the way I would usually do, I would reach out to my colleagues at [CompanyName]. And they would start to work on that kind of thing. I have a couple of colleagues who do extended realities for things like collaboration, I guess, they would be the experts in this space rather than me.	
13	**So can you imagine some benefits that you would expect to see after implementing VR for remote collaboration?**	
14	Yeah, so I guess the immediate benefit is that everybody has access to the same environments. And I assume when we're talking about collaboration, we're talking about multi-player engagement. So that would be, you have more than one person in the same environments and they're able to interact with each other. Because you can have more than one player in an environment, but they're only able to back interact with the environment, which is I guess not what we're talking about when we talk about collaboration. Right? It doesn't matter. Right? Okay. So if I split this out, you have one player in an environment, they interact with the environment, you have two players in an environment, they both interact with the environment, but they can't interact with each other. And then you have two players in an environment that can interact with the environment, and they can interact with each other. So those are the scenarios that I would probably think about. The first scenario is not collaborative. So let's not talk about that. So the second two scenarios, interact with the environment, if both players can interact with the environment and not each other, is that collaborative? So I would say collaborative needs to involve elements of social learning. Because I deal with learning, rather than strictly communication. [MST start] If there's no elements of social learning, I probably wouldn't say that's collaborative learning from a learning point of view. So is that useful? Not to me, but maybe to others. [MST end] The third element, where people can interact, and they can interact with each other requires some form of communication. What was your question? How would I do that? Or do I think it's useful?	BNFT, MST,
15	**You know, just what benefits would you expect?**	

| 16 | So, the benefits of this, from my point of view, are about social learning. So when we break up learning, it's basically three points, learner-content-interaction. So in this case, that would be learner-environment interactions. And then you will have learner-learner-tutor interactions, those are social learning. So there are a couple of different kinds of benefits that I would see in that space. Benefit one would be two learners going into a situation and being able to talk through a problem. So that would be learning together around what possible solutions might be for a particular scenario. And that is usually going to be beneficial from a learning point of view. It's like in a classroom, where you have group activities, you have the opportunity to talk to each other, and reason out why you're doing a certain thing. The other aspect of that would be learner-tutor interaction. So that would be in a classroom, or in an elearning, or in a virtual environment. It actually doesn't matter, but the principle is that a learner is supported by somebody who is more knowledgeable than they are, somebody who can guide them, somebody who can give them hints and tips, and support their discovery journey. So the learner is still in charge. It's like if you're in a gym and somebody's spotting you, right? They're not lifting the weight for you, but they're helping you get that extra little bit for you. Where you might struggle, they will support. And that is one of the benefits of a collaborative environment for learning, in that you have the support of somebody who might know a little bit more than you do, that might allow you to stretch what you can do in that environment. So from a social learning point of view, those are what I think are the benefits. The benefits from, I guess a tactical or logistics point of view, are that [longer pause]. So I'll say this, but then I'll put a disclaimer on it, right? Some of the benefits are around remote learning. So you might say that people who are in disparate parts of geography, different parts of the world, can interact with the same thing in a standardized way because they're all having the same experience with the same environments. And therefore, there is little room for confusion. That might be a benefit for collaborative VR. But it's not a benefit that's only for collaborative VR because other collaborative platforms whether that's on mobile or desktop, or even dialing in on my phone would still give me the same benefit and we're experiencing the same thing at the same time. Therefore, we have a standardized experience. Is there another benefit? So [MST start] there's a benefit and disbenefit of synchronicity, which is being a little more...Right now, you and I are together in a digital space, but we're together at the same time. If we think about forums, you know, internet chat and all of this thing. We're together but we're not together at the same time, so you can post a response and then a day later I can post a response. And we're not together in the same place at the same time. The benefits of that is that it allows me to consider my response. And this is very good for people who aren't speaking the same language because you might need time to translate, you might need time to consider what you're saying. And in a classroom scenario, online classrooms, there's some literature out there on this, which says that in English speaking university settings, foreign students tend to experience anxiety when it comes to synchronous interactions because they have to translate in real time and then think about what their response is and then translate again. And that's slightly different from native speakers. Whereas if you separate that out in terms of time, you remove that anxiety and it allows everybody to learn at their own pace. Now, that is not going to be a benefit for synchronous VR because it's not only about chat, it's not only about text, it's also about, potentially, voice, audio and visual stimulation as well. And therefore, if you're synchronous, it's a good thing from a standardized point of view. It's a good thing from a socializing point of view. But it's not a good thing from an anxiety point of view, in terms of learning.[MST end] Was there anything else? I expect you're about to ask me about these benefits, but I'm straying into that topic anyway. The other thing is, | BNFT, CLNG, MST |

	I guess, with VR, there's always concerns about things like motion sickness or psychomotor effects, which are studied to some degree, prevalent to some degree as well, but don't affect everybody, but they may affect some people. And when you have a mass event, you're always going to get a certain percentage of the population are affected by these kinds of things. I think modern VR tends to account for that in terms of image stabilization. But it's something worth noting. Okay, let's stop there. You can carry on with questioning.	
17	**Okay. I mean, you already mentioned a few, but can you think of any other challenges that you see when you implement VR?**	
18	Yeah, so two of the challenges, if we think about context, right? So, context is likely the social context and the physical context. [MST start] Social context first, [NVLT start] VR has been around for 30 something years, and has not always been adopted? Why has it not been adopted? There's a history of social challenges there. Some of those are socio-economic, so hardware is expensive. But some of that is around things like development cost, not everybody can develop for VR, it's an expensive thing to do. It's a skill that requires technology to support it, that's becoming more common now. But in terms of adoption of any learning technology, you would have social elements of that. In an organization, for example, you pull on something, VR, let's say, but it could be anything else, the principle is the same. You would have senior people champions, people who are advocating for implementing VR, you would also have people who are saying, "you know, we tried this 20 years ago, it didn't work, it's not really worth our while, we shouldn't be investing our money in this, it's going to be difficult to get out there and not everybody's going to use it, we should do something that's slightly different". So you have that sort of that idea of social capital, what you need to overcome with something like VR because it's got a history of not only poor implementation, but also people will have negative prior experience about it. And those people now might be quite senior at organizations and they might have an opinion on that, that is not necessarily the way forward. [NVLT end][MST end] The second thing is about physical infrastructure. So with any, again, with any learning technology implementation, there's going to be a reliance on having the right connectivity, the right device availability, the right power networks that can support this, the right physical spaces that can support VR. And in terms of democratization, you know, I live in the UK, I have access to a space, which is technology-enabled, I have good WiFi, I have good power, and it's stable, it never comes out. But I have also implemented learning technology in countries where none of that was true. And the power kept cutting out and nobody had access to a device and the WiFi needed upgrading. And you know, you couldn't load it because it was too bandwidth heavy and you only have this much bandwidth. And all of these things are going to be true in different parts of the world. And what we're talking about today is VR for collaboration, people who are remote, i.e. in different locations. Whenever you have people in different locations, they will have different levels of physical infrastructure that they can rely on. And therefore, they will have different capabilities of actually being able to connect with others in a virtual space. While I think about it, there's probably another set of things, which is not not technical or social, but it's its policy or regulatory. And I'll give you an example. So I was working with a client in West Africa. And one of their policies was, because they didn't have much broadband capability, one of their policies was that they restricted who had access to the network, some people had access, some people didn't. Why? Because if everybody had access and everybody had the capability in terms of devices to do whatever they wanted to do, then some people would be checking football scores	CLNG, NVLT, MST,

	and that would drain the bandwidth capability for people who were doing whatever they were doing for work. And those that fear, even whether the field was grounded in anything or not, that only relieved itself a little bit after a broadband upgrade was completed. And then you could allow the population of the workforce to access the internet. And then you could do digital learning. That's one example of the policy, right? But the policies, so another policy, another client that somebody would, people don't have the freedom to access things like VR training or digital learning without their manager booking them on. Right? And it's an example of a policy where somebody else controls your learning journey. And if that's a policy, then most likely the manager would book themselves on the VR, but they might not book, you know, other people until they've had a go. And then you have, I'm gonna keep talking now. So this is two examples of the policy. But the third thing, and I'll say and tell me if you understand what I say, right. In terms of technical terms, in terms of learning, right? You have the pedagogy of scarcity and the pedagogy of abundance. And there are two different things. Pedagogy is about teaching strategies and methods. And mostly in organizations, the way training is structured, the way the entirety of governance and policy around training happens based on scarcity. We have a limited number of classroom spaces, we have a limited amount of training time, we have a limited number of handouts we can print out, but something something, whatever it is, they're all limited, we've only got 10 PCs, for people to access, everything is limited. And when we think about digital learning, back to what I said about, you know, minimum marginal cost, learner flexibility and all that stuff. The way learning can be designed relies on the pedagogy of abundance, everything is unlimited. You don't have to think about limits in terms of classroom spaces, teacher time, finite physical spaces. And in terms of a continuum of digital learning transformation, organizations would usually go from classroom through to elearning, digital learning on desktops and mobiles. And then to move to VR, where we have to claw back and go to the pedagogy of scarcity again because we have a limited number of headsets, we have a limited number of facilities, we have only these many facilitators who can do that. We don't have high powered computing everywhere, we've only got it in these particular machines that you put in a backpack, and you've got to wear it and all of this stuff, that's quite a journey to go through for organizations and the policy environment. And the economics of that might not stack up. So that I think might be another challenge. I'll stop there.	
19	**Okay. And could you describe situations where VR improved collaboration?**	
20	Potentially. Let's think a little bit about our definition of VR first, right? So, right now we are in a virtual environment. We're talking in a virtual environment. I'm sitting in a physical environment and you're sitting in a physical environment, we have a digital space in which we can talk. Is that part of what you're talking about when you say VR?	
21	**Probably not, because I would say that we would need something more 3D, or something that can be perceived more as 3D.**	
22	Okay, so we're talking about a simulated environment in which we both... Are we talking about headsets or we're talking about desktops? Or both?	
23	**I would say desktop-based VR and also immersive VR with headsets.**	
24	Okay, so something like Second Life, Virbela, these kinds of tools, right?	

25	**Yeah. We can talk about both.**	
26	So I mean, there are lots of those kinds of tools in the market. But that style of tool is...there are benefits to collaboration in those spaces. So I'll give you a couple of examples of things that I've either worked on in the past or things that I've, you know, been involved in bids and proposals, or that kind of thing. But the benefits are around having a common space for teaching and learning. So, what I said earlier, I talked about interaction equivalence, so that is learner-content, learner-learner and learner-teacher interactions, and how those interactions need to come together meaningfully to provide a learning experience. And typically, when you digitize, you sacrifice one for the other, and you need to compensate. I need to think about compensating across a learning or teaching strategy. But when we think about the environments that we're talking about now, you have potentially a virtual space for getting people together for teaching, for presenting, for conversation, for talking, for a group activity, all of these things are possible within a virtual environment. But that's not necessarily an advantage because you could get together in the, you know, out in the garden, right? [TNLG start] [MST start]The advantage is a) for remote workers to experience the same environment and to interact with each other. Still, not really an advantage because you could do that on Teams. If you're just going to talk to each other, you could do it on Teams, why would you do it in VR? Right, the advantage has to be, and yeah, thinking this through logically, the advantage has to be being able to get together with other people and with content.[MST end] In terms of those three interactions that I just mentioned.[TNLG end] Now, if you think about Virbela or any of these sorts of virtual teaching or communication environments, you have the opportunity to get people together in a space that might have a lecture theater or something like that, to talk about content while interacting with each other, or to interact with virtual characters, also interact with scenarios or interact with virtual machinery, all of the things that were mentioned that you might create as part of your digital journey. These are all assets that you can embed in a virtual environment and teach at the same time, or communicate or do group activities or any of the things that I've mentioned. And if I was to segment it right down, that is the USP, for a unique selling point, for a virtual environment. Because you can collaborate with others using Teams, and I don't think that's, I think that's becoming the norm, having remote workers, different locations, coming together under an environment and talking. I would do that in Teams, it's much more accessible. If I wanted them also to interact with a virtual character or some virtual machinery or some virtual content in any way, then a VR environment might be the way to go. And, again, I will caveat that with saying that could be access to a headset, or it could most likely be accessed on a desktop or some other, you know, 2D screen, flat screen. That's what I think.	BNFT, STWR, MST, TNLG,
27	**What kind of content do you think is worth sharing in VR? You know, compared to, for example, Teams?**	
28	So the content that I on a day to day tend to work with is where we're going beyond didactic methods. So, if you think about a classroom, somebody may, like, disseminate information. That's a one-way interaction, somebody's talking at you and you're writing things down, you're absorbing it like a sponge almost. And there are a lot of interactions like that in the teaching or learning space, which are, you know, it doesn't really matter if you do that in VR, that makes no difference. [MST start]Where you need to interact with something for a procedure, so you need to, like, I do machinery-based simulation at the moment. So where you	BNFT, MST, APLC,

	need to be aware of spatially how big a machine is, you need to know which button to push or which lever to pull or where there's a particular light coming from or where there's a bell. That's an environment that, you know, 30 years ago in a teaching scenario, you would get everybody to stand around a bit of machinery and somebody would talk about: this lever does this and that lever does that. That is something you could do in a virtual environment. And you would get the same experience, but everybody would be remote. [MST end] The thing, obviously, you don't get the repeatability that you would do get if you video van, and people can watch it. So there's a trade-off between immersion and scale in that space. The same is true for virtual characters. So, if you have a virtual patient, for example, in a medical setting, and that patient is exhibiting symptoms, if you think back to, you've probably seen this kind of thing on TV, but when you have walk arounds, so a senior doctor would have medical students and they'll be talking about a patient, this patient has the symptoms, the symptoms are presenting, how do we diagnose, how do we treat, and that's a teaching moment, that's a teaching environment. And the way you do that is through group discussion, somebody leading that but you have something to interact with, you can ask the patient questions, you can examine the patient. Again, you can do that in a virtual environment where people being remote. So those are the kinds of interactions I'm talking about.	
29	**And how do you see the future of VR for collaboration, you know, for virtual teams?**	
30	So I think the future has to hold something...so the future first of all, it has dependencies, and it has to, those dependencies are going to be on the physical infrastructure, like I mentioned. And also, in terms of hardware. There's a lot happening right now about things like the metaverse and is that Is that a thing? Or is that not a thing? I'm not going to predict whether or not that's going to be scaled, or whether there's going to be mass adoption of that kind of thing. But I would say there are also dependencies in that space, things like privacy, security, trust. These are all things that prohibit people from interacting with the metaverse and those issues, whether it's the Facebook version of this or whether it's, you know, another company, it doesn't really matter. The point is that, to interact and to trust. The population is going to need to be assured on things like privacy and security. And I think that's going to be a lot more important. Where the future is likely to be... What do I think the future is? [NVLT start] I don't think it's going to change that much. Frankly, I think VR is going to still be a niche tool that some organizations use, it doesn't have widespread consumer adoption because there are costs associated with headsets and things like that. Mostly, there's going to be fairly niche consumer adoption around, you know, gaming, for example, console based VR, and those kinds of environments. [NVLT end] In terms of teaching, potentially, organizational teaching would be still potentially one to one or one to many in terms of things like military simulations, where you might be in a bit of machinery, you might be in a plane or you might be in a you know, tank or something like that. Transport simulations as well. You know, commercial airlines, rail. You can see some of the stuff on Steam already, right? In terms of, you know, train simulation that was an attractive simulation I saw the other day. All of these things are fairly, they're still on the gaming environment, but they're bleeding from the game environments into the corporate training environments. And some of those are being done by VR. Some of them are being done the physical simulators like, you know, with the screens around you, that kind of thing. [NVLT start] But the future of collaborative VR and the future of non-collaborative of VR is kind of in the same boat for me. And that adoption is slow, because there are lots of factors in the	CLNG, NVLT, APLC,

	physical space that are preventing adoption. And those factors are probably unlikely to very quickly go away because headsets still have a cost, there's still a physical bit of equipment, somebody needs to maintain it. [NVLT end] And a lot of the clients that I've spoken to who have had little ventures in the space. It's probably 50:50, whether or not they have an adventure with VR, and then the headset sits in a cupboard for two years without anybody maintaining them versus whether it's something that they use on a continuous basis. So these are the challenges whether we're talking about collaborative or non-collaborative VR, I think these are the challenges that will prohibit wide scale adoption. But if we do get wide scale adoption, then the kinds of things we're looking at the future are more and more realistic environments that will potentially be...have the same kind of problems, as you know, multiplayer online games, where you know, you have things like servers falling over because you've got too much demand in a particular area. And then you start to leave yourself open to different kinds of security issues where you have, you know, people being unscrupulous, stealing things, you know, you have people coming in and cheating the system and trying for monetary gain. So all of these things also need to come into play when we're talking about collaboration. But yeah, I think it's...if we see widespread adoption of this in the next few years, I'll be surprised. But you can come back to it on that.	
31	**And now we are reaching the end of the questions, but would you like to add anything that you think we have missed and might be relevant to mention?**	
32	So I guess the question is, you're looking at VR for collaboration. Are you also considering the literature in the space of other collaborative tools, the adoption of those tools, the benefits of those tools. We have fairly defined critical success factors, benefits cases, and readiness, inventories for things like digital learning fairly broadly. Have you reviewed those, any good findings from those?	
33	**Well, there is some previous research on other collaborative tools, but not much on VR. So yeah, that's why we decided to...**	
34	That's the gap, yeah. Very good. Have you considered language as well, or culture? Because when you bring people from remote or different geographical areas, they might have different language capabilities, they might have different cultural, you know, ways of working that would be very interesting in this space.	

Appendix I: Interview Transcript - P7

BNFT - Benefits of VR = Green
CLNG - Challenges of VR = Red
MST – Media synchronicity theory = Blue
TNLG - Similar technologies = Yellow
EQP - Equipment for VR = Gray
STWR - Software for VR = Orange
NVLT - Novelty = Violet
PRQS - Prerequisites for VR = Indigo
USG - VR usage = Cyan
APLC - VR applications = Magenta

Row	Content	Theme
1	**Could you describe your experience with VR in general?**	
2	Yeah, sure. So I started working in this field in 2015. I was, so, we originally kind of started experimenting with it, we very quickly started to look at this for, is kind of a tool for immersive learning. And that was kind of our primary use case for a certainly long time. And then as collaborative experiences started to appear, we then were looking at it for collaboration. So that was, again, kind of probably the second primary use case. I mean, we did we were looking at it as kind of a tool for engagement as well, but I think less. And we also used it for kind of architectural modeling as well. So actually, that was something that we started doing pretty early on, too. So we've, yeah, and so that was kind of for design. And then I think, latter we've we've kind of started to look at it to simulation more. So, you know, they're kind of digital twins. And that's sort of been linked to learning as well. But yeah, and so as I say, I've been working on it pretty much constantly since 2015. We, I mean, actually, I guess one of the first examples we did build was, was a re-tail store. And in VR that we dealt with Adobe. So actually, that was that was, that was a client engagement or customer engagement, sort of example. So yeah, I think we have, I mean, I guess my main interest was definitely immersive learn-ing.	APLC,
3	**Alright, and how often would you say you use VR yourself?**	
4	Not as often as I would like, but I would, I would like to use it every day, but I probably use it. I probably use it, like, five, four or five times a week.	USG
5	**For how long? Approximately?**	
6	I mean, it depends. I've I've never had a I've never had a problem with kind of VR sickness. So I, I haven't been, yeah, I mean, I remember the first time I played the first time I played Half Life in VR, which was in 2015. I fell after doing that, but that was because it wasn't optimized. And I think also some of the settings. So my Dk2 went, right. So I did I did feel like as soon as that, yeah. And but since then, I've never had a problem with long sessions. So yeah, I mean, you know, I will usually use it maybe for about an hour or something like that. It's, it, to be honest, it's quite rare. I've used it to less than an hour, if I was going to if I actually finally	CLNG, USG, EQP,

	get the chance to forget the chance to use it or use it for quite a long time. Speaking of motion sickness in, you know, as I say, I think the only time the only time I've had it was the only time I've had it really was when was right at the beginning. And I remember it very vividly because it was it felt horrible. But again, I think that was a that was a Dk2 issue and also playing on the Dk2 was quite an aggressive proposition. So yeah, that's that's been the only time I've had that, that that issue. I know that we, you know, obviously I do a lot of demos with people. Interestingly, like our head of [ReportName], so someone who's should be very kind of you know, is obviously quite influential in this space. He unfortunately got sick one of the first times he used it, and he's been kind of quite anti VR ever since but I I've actually found the number of people who have experienced motion sickness from an experience is really low. And I mean when we started, we were demoing AirDressed, which is, was a brilliant experience, still probably the best wingsuit flying experience in VR. I think I've ever I've ever done. And yeah, so we were demoing something that should have made people feel sick if if they were gonna feel sick. And we, you know, we had a handful out of hundreds and hundreds of demos. So I think done, like done, right. If you if you demo a bad experience, it can I mean, it's very easy to make someone sick in VR. But if you design it right, then it's it's not with the current hardware. It's it's not a problem. And it's not something to be to be honest, I haven't had an issue with it in a demo for a long time.	
7	**Okay. And speaking of hardware and then VR design, what VR software and hardware would you suggest to implement to remote teams for collaboration?**	
8	Yeah, so so we use, we use Spatial, Horizon, which is our kind of two primary tools for this. We have also, we did quite a comprehensive review, at the start of the start. Well, I mean, we did, we did a couple of comprehensive reviews, we did one comprehensive review before the, before the pandemic. And then we did another review. At the start of the pandemic, of the kind of the hardware available, oh, sorry, there's software available. And our two leading contenders were Glue, and Spatial, for a variety of reasons. But the, we went with Spatial, even though we liked Glue better as a company, the flexibility of Spatial by having it accessible via the browser was just too big. It was, it's just, it just made it so much easier, and so much more likely that we'd get a successful session. With with Spatial, so we have, yeah, kind of stuck with, we'd like to use Glue, but we just haven't been able to because it just isn't quite as accessible. And I think that that point is really important, because when we did our first assessment, we were very much like focused on the idea of, well, you know, like this is for for a couple of years down the track. And so everyone will have a headset, so we're kind of reviewing things, or it's going to be some very small numbers of people where we'll be able to get everyone on a headset. So we're doing stuff purely on the basis of kind of headset focus. I think it's actually in February, February, March 2020, before lockdown happened, [PRQS start] [MST start] I tested Virbela, the kind of the Virtual Campus software and I think that moment, and I think I was already pivoting in this direction. Anyway, I realized that actually, it was important to give people an on-ramp because trying to get them to go from video-based communication to avatar-based communication in a headset was taking two big steps in one go. Where and so actually my realization was as soon as we started to test this, this was borne out by the tests was the actually letting them do avatar-based communication in a browser or desktop-based, immersive collaboration environment first, and then, you know, enhancing that experience with a headset was a much more sensible way to go than trying to just dump them straight into a headset. So because because getting	STWR, PRQS, CLNG, MST,

	used to being an avatar is something that unless you've grown up with you know, multiplayer gaming is not something that a lot of people are used to. [MST end] [PRQS end] So I think and it's not even gaming, it is specifically multiplayer gaming, because it has to be you have to be used to speaking through an avatar. Yeah, all of that kind of stuff. Like it's it's quite an unnatural. It's not a natural but it's it takes a little bit of getting used to. And so, so yeah, we so actually, the primary platform was used in terms of numbers has been has been developed and Um, so the [CompanyName] virtual campus, which you can access via VR, but that has been, the vast majority of our users have access to it via their desktop. And that we had, we've had around five, six thousand people who have used that, at least once from [CompanyName] during the years since we since we got a full size campus in September 2020. We've had around that, that that many people basically.	
9	**And could you repeat names of the companies that you evaluated?**	
10	Sorry, the names of the companies were evaluated?	
11	**Yes.**	
12	So the two main ones that we, the two prime contenders for us at the end were Glue and Spatial. We chose two even though we had found it harder to collaborate with them than we did with Glue. But it just the browser based the browser accessibility just trumped it for us. And I think we've been proven right, to be honest, it was very, it was also very flexible in terms of how you how you can customize the spaces. And actually, that was really key. So yeah, we've used Spatial a lot, basically. But then, then, in terms of the other platforms that we evaluated, at the same time. We were also looking at Engage, so Engaged VR was quite high up on our list. And we liked Engage, and we probably will, I mean, we're doing a joint bid with them at the moment. It's learning based, but obviously, it's collaborative learning. So you know, it counts as kind of immersive collaboration. So there's so, so yeah, there's there's Engage as well. And wait, there was oh, and obviously Horizon Workrooms in terms of like, for collaboration, actual kind of collaboration, like this style of meeting Horizon Workrooms is, is yeah, by far the best. So that's the one that we use if everyone has a headset. I mean, to be honest, [MST start] if it's just about internal collaboration rather than about a workshop, we'll just just use Workrooms, so that we only use Spatial if it's with a client. And you know, there needs to be like a workshop element where you're creating an environment in order to do the, to do the session. If it's a case of just doing a presentation, or just having a chat, then Horizon Workrooms is what we use. [MST end]	STWR, MST
13	**Okay, so you have experience also with like using VR for collaboration with your team?**	
14	Yeah, absolutely. Yeah, we've been doing that. Since we're very early on. We wanted to eat our own dog food. So yeah, we've we've used it a lot. We did for a while, we actually did. All of our, all of our stand-ups in in VR. So we've had some like weeks where we've done all of our stand-ups in VR, we've had weeks where we've done all of our stand-ups in Virbela. So yeah, most of our team have VR headset, so it's very, it's very, it's relatively easy for us to collaborate in VR. I mean, you know, we should probably do that. More still. But the Yeah, we do.	STWR, APLC,
15	**Okay, so in that case, could you tell us about your experience, you know, with VR for collaboration? You know, from the time you switch it on until you finish the meeting in VR?**	

| 16 | Yeah. So, from so so as in during the process for like a meeting? Yeah, well, so I'd say there are kind of three, three categories of the collaboration, three main categories that we see. [MST start]So one is kind of a meeting like this one, or stand-up for like a regular meeting. In this format, as I talked about before, where we would use Horizon Workrooms. The other is a workshop where we want to create a space, but we're doing a workshop with say, up to about 30 people, and then the other is kind of a virtual like an event. So to a large scale event, where you want lots of informal networking, and it's like an all-hands event where it's more than 50 people. And so you want to get away from, there's a desire to get away from kind of Zoom fatigue. And this idea that you've got this one too many just being taught that for the entire time, you want to create networking connections and stuff like that. And so, at the moment, for those three platforms, wait for those three categories, we would use Horizon Workrooms, Spatial, and then there's Virbela, that [CompanyName] virtual campus, so that would be the three things we do.[MST end] So I'll just say that because obviously, the experience of using each one of those is different. Horizon Workrooms is really good. I mean, it's the closest thing to Zoom or Teams, the fact that it so I can literally just share the link and say, in the meeting invite people will click on the link, whatever device they have access to, and they'll join the meeting, and I've joined Horizon Workrooms meetings from my car hands free. You know, I and I don't have to even worry about where I'll be, which is such a key thing. Because I mean, one of the, one of the concerns about organizing a VR meeting is like - will everyone be able to join the meeting. And you know, if it's not like perfect conditions, then they won't be able to do it. Whereas with Workrooms, that's no longer a concern. So I love Workrooms. Because yeah, I mean, it's very simple. Like, I'll just join it, or I'll just join it from, I'll just join it from my, from my headset, or join it from the thing. And so like, if I'm next to my headset, I'll put my headset on, if I'm on my phone, I'll just showing that if I'm on my computer, and I don't have my headset, I just join it via the computer and like so that the fact that all of that friction is removed around, "oh, my God, this is a VR meeting, I need to somehow be more prepared for it" the fact that all that friction is, is really good, because I guess, conversely, a lot of the other meeting, not like that, because they are like, Okay, [CLNG start] I see a VR meeting coming up in my diary, I have to think about how I'm going to join this meeting because I'm not going to be able to join Spatial and contribute meaningfully to the discussion even and join it from my phone, I'm not going to be able to lead a VR meeting and Spatial from from my phone. So that that has to be a much more planned thing. Like I know, I'm going to have to have a space where I can sit down, I'm going to have to have a good internet connection, I'm going to have to have all of those all of those kinds of things.[CLNG end] This meeting where obviously I'm still on a train, and I was to joined it and you know, to be honest, if this was in Workrooms, I still would have joined this meeting, which is cool. But if it was in Spatial, I'd have been pretty much screwed, I would have been screwed. Actually, it's, there's no way this would have worked in Spatial. And then, but yeah, again with Spatial, it's nice. I mean, the format is nice, because I can just open the app, if I've joined the room before or if the room has been shared with me, it's just there in the menu. So my time to from like, from putting on the headset to being in Spatial is, is pretty low, I'd say it's probably less than if the headset is powered on already. It's probably less than two minutes to be in the in the space. Cuz I did that the other day. We were demoing it to some clients actually. And yeah, and it was it was really quick. And so yeah, I think that's I think that's been really, that's been really good. The, and then, and then with the Virtual Campus, again, it's a bit of time to set it up. Like where I would like to get to. I mean, interestingly, I just share a couple of links in that are not linked but names | BNFT, STWR, CLNG, MST, TNLG, |

of products. Because one of the things that where I would like to get to with with, like the virtual office so the Virbela [CompanyName], Virtual Campus where I'd like to get to is that it was, it was like an always on virtual office where I could just, yeah, I could just dip in and out. And if someone comes into the room, it's like it's very, like so Tandem, which is Tandem is our favorite virtual office that we use. I don't know whether you've come across it before. But yeah, I mean, this is the interesting thing about your kind of immersive collaboration is that it's there's obviously a sliding scale. And Tandem is immersive in the sense that I can see what everyone else is doing. Even though it's audio only, I will actually know there is video now. But I mean, the the interface is text-based in the sense that I can just see people's names and what they're working on. So that is, it's a very, it's sort of a very streamlined way of creating that office environment. As I, as I mentioned, the things that you're probably should have started with this. But I mean, [MST start]the things that you're trying to capture with immersive meetings are, you want to recruit, you want that informal ability to network and spark ideas, like it's serendipity is a word that comes up a lot when you're talking about immersive collaboration. And so you want to recapture some of that. [TNLG start] And a lot of that comes from removing friction between personal interactions. And I think that, because Zoom adds all of these other things, add friction to an app friction is a barrier to the exchange of ideas, basically, and the exchange of ideas is ultimately what effective collaboration is.[TNLG end] [MST end] So and Tandem, I think, in a very minimalist way, like has a big impact for like kind of a very minimal thing, because so the reason I'm saying this is because the problem with the Virtual Campus at the moment, for example, is that it's too intensive to processor, intensive to be able to have it running in background effectively. They also haven't nailed the status to, in the way that Tandem has. So Tandem is very good about the way that it does status, and also allows me in a way that allows me to very quickly see what the whole team is doing. So again, it's massive in that sense too, because I can see I'm immersed in everything that my team is doing, in the same way that I'm in the office, because I can see all of the conversations that are taking place. And that's really, that's really cool. So are here is so so so yeah, what I would like is I would like a virtual solution that is that that is as lightweight and as effective as Tandem. And just just to kind of develop that point. I think that one of the ways that we like to think about immersive collaboration is that we, when when you're in the office, often the way in which an interaction will go and the way in which collaboration will occur is that someone will, someone will like send you a send you a message on Slack or something like that, or even even you know, even earlier, you might get an email, and then you might send someone a Slack message. And then you might have a little bit of a chat on Slack. And then they might give you a call. And you might be like, oh, yeah, I think there's something in this idea, we should discuss this, and then they'll come over and discuss it with you, and you'll have a conversation face to face. And then if you want to, like really get into it, you'll go into another room where there's a whiteboard, or you'll go to a space where there's a whiteboard, and you'll start to really get into like, understanding the problem and everything like that. And I think what we see is that, that VR effectively, is that that is that kind of like it's like the levels in Inception. But it's like, you know, you're going down to that next level of collaboration, but being able to do that when you're remote. So like for a remote team, you know, it's the same sort of thing is, it's not that you're spending your whole time in VR, in the same way that you don't spend your whole time standing in front of a whiteboard. It's another context that you use in order to effectively collaborate and it's deeper you know, it's when you're wanting deeper, more immersed more.

	Yeah, I guess [STWR start] [MST start] more interactive collaboration and because, you know, that's what a whiteboard session is. It's obviously much more interactive, you know, you can, you can, it's much more tangible, you can illustrate the ideas more in a more tangible way. So we definitely see it as, like the, as sort of a remote whiteboard thing, [MST end] but then say, I mean, better than Miro or something like that, because I think it captures more of it, captures more of that sort of working environment. And it allows you to do that on a larger scale as well. And Miro is very good. And I mean Miro, to be honest, I should mention Miro as well, in terms of the immersive workshops that we've done, Miro has been a key tool in that, like, because it's an infinite whiteboard. And it's allowed us to do a lot of cool stuff. But I think that, yeah, we definitely see the advantages of well designed, immersive collaboration, like taking it to the next level. [STWR end]	
17	**Alright, so it sounds like you think of VR as a tool for having like the virtual whiteboard...**	
18	I think and I mean, just quickly, the I mean, the other thing, though, is then [MST start] for those large scale events, where you want to have that serendipity of like, bumping into each other, and something like that, I think is important to capture that for, for all-hands events, or something like that, I think having you, you can't do that on Zoom, none of the the 2D paradigms seem to have captured it in sort of the same way. And I mean, I think an interesting example with that is that, you know, when when someone walks into a room, like a virtual room, I think for a lot of people in a kind of tech space environment, like or just a 2D thing, I don't think there's the same sort of social cue as there is when an avatar walks into a three dimensional room. And I've definitely seen that like when we conducted conferences across the two different mediums, when we've done them, like you just don't get people, if someone walks into a room as an avatar, people will just naturally say hello because it's much closer to a standard human experience. Whereas if a little, if a dot goes from red to green on a, on a status symbol, or someone like comes into, I mean, if it's a small breakout room on Zoom, you know, people usually will say hello, in that instance. But if it's not on one of those conferencing apps, people don't necessarily feel compelled to say hello. And they also feel kind of more nervous, and it seems about going into different spaces. Whereas walking through a door, and then waving at someone who's just coming through that door, that just instinctively, there's so much kind of social training we've had that makes us do that. And, you know, again, potentially next year, I definitely find that with kind of the older, old older colleagues, but I think it holds true for younger colleagues as well because you, I mean, some colleagues have grown up on Discord and Slack and stuff like that. And so it's not. So they it for them, it is more natural to kind of make those connections, just because a status has changed, or whatever. But I yeah, I still, I think that that's still that's still a powerful, that's still a powerful reason to be using immersive collaboration at this stage. [MST end]	BNFT, PRQS, MST
19	**Okay, like, at the beginning, you said that you use it also for things like stand-up. Do you find it on that note compared to, like using it as a whiteboard or or conference?**	
20	I think for stand-up, I think I would say it didn't, you know, our motto is fall in love with the problem, not another solution. And [MST start] I think the problem that you're trying to solve with a stand-up doesn't say, you know, that was describing the experiments that we did with it. But the problem that you're trying to solve with a stand-up is not necessarily the problem that you're trying to solve with the	STWR, MST

	with VR. And so yeah, so I don't think, I don't think we necessarily found it added to stand-up in terms of what we were needing to achieve, however, I would say is the, we haven't tried running stand-ups in Horizon Workrooms. [MST end] I mean, again, you know, the advantage of Tandem because we currently run our stand-ups in Tandem, most of them. The advantage of Tandem is I can see what everyone's doing. And and Tandem is so lightweight that you can have that you can have that up and you can have all the notifications and like so I can see everyone joining a standup on Tandem. And that's really contagious. So, yeah, I think I think it didn't necessarily have that being said with Horizon workrooms because you could join from a phone. It's probably worth it. It's probably worth it, like revisiting that and trying that again. Because, yeah, I think that would be an interesting exercise.	
21	**So do I understand that correctly that you ended up in VR, just as an experiment, and you stopped using it?**	
22	Yeah, I would say we did. Yeah. I mean, we've we've, as I say, we'll still use it for meetings. But I think we now are at the stage where we use it more in the way that I was describing there as like if we need to go deeper into a topic. And we know that we can't all be there in person. And we'll use we'll use VR for that. I think we probably I think this has been a good talking about this has been good, because I think it's made me realize I probably should be stricter in terms of not stricter, but I think we should be continuing to revisit our revisit that? Because I think, yeah, the advent of Workrooms means that really there's less of, you know, some of the things that were an issue last time really wouldn't be an issue this time around. And so, yeah, I think we should, we should try it for some more regular meetings. Because I mean, as I say, it's only a problem joining a VR, if that adds additional friction, and somehow, like if you lose something from the meeting by joining it. And VR and friction, obviously, is you're losing something if you're adding friction. But I think actually now with Workrooms, potentially, we wouldn't be adding any friction. And so that would be or any, like noticeable friction. So I think actually, that would be a really interesting experiment. So thank you for doing this. Because it's prompted me to want to do like a session where we just try stuff in Workrooms, because now everyone has had that. So we can, we can easily do it. So yeah, I'm interested to see what what happens with that, actually.	STWR, MST
23	**Yeah. And in addition to stand-ups, did you find like any other tasks that were not effective to do in VR?**	
24	Well, I mean, the thing that's like the golden, the thing that like will be golden is the ability to ideate in VR as effectively as you can ideate, like capture ideas. So as I said, it's about the exchange of ideas, but also about being able to capture those ideas as effectively as possible. So, we've, we've had kind of scribes who have been alongside the sessions in order to kind of capture ideas effectively. At the moment, though, it's not quite there.Horizon Workrooms gets close to this, because you can kind of hold there, the, you know, because you can have your keyboard appear in VR, because you can have your, you can hold the controller like a pen, all of those things help bring it closer to you like whiteboarding. And writing stuff down on post. Spatial still isn't as good as it's, so that idea capture thing is really, really important and how we do that, and then because, you know, essentially, like a lot of our workshops are, talk about a topic, have a discussion. [MST start] Let's now put some ideas down on post, let's arrange those posts, let's group them, and then and then come up with some, like higher order themes from the	BNFT, CLNG, MST, APLC,

	grouping that we've done. And at the moment, you can do that in VR. But it's not as smooth as doing it in Miro, or is doing it in real life.[MST end] And so, I mean, like, that's the thing.[MST start] [APLC start] Obviously, if you're using something like Gravity Sketch or if you're collaborating on a building, then like, yeah, it's no contest. Like, obviously, doing it in VR, versus doing it on a versus doing it on a 2D plan, VR trumps it 100% like isn't even, yeah, not even close. [APLC end][MST end]So, so if you're visualizing it, if there is a spatial element to what you're doing, I mean, data visualization. Well, I still don't think I think that there's some stories that you can tell effectively in data, but like if you're going into just data, like full stop and you don't know what the [CLNG start] If you're like, oh, we need to analyze some data, that's going to be like, that doesn't necessarily make sense. Because it only makes sense if the data is, you know, kind of spatial, or I saw a really good. So Flow VR is, is quite a cool data visualization tool. And they are Flow AR or Flow XR, I'm not sure what they're, they, they're a our data visualization stuff was really good that you use it to emphasize a point in a story that you're telling about the data, like if you haven't analyzed the data already. So it's good for storytelling, but not necessarily analysis. Like if you were figuring out the answers about the data, you wouldn't necessarily use VR or AR for that.[CLNG end] But the but yeah, that. So So yeah, if there's a spatial component to it, or like, if you're designing car using Gravity Sketch or something like that, then obviously no contest, but for if it's an ideas based workshop, then then then I'd say that still, it still lags behind slightly, but Horizon work for us has massively improved with the addition of the virtual keyboard thing is, is it's you. Yeah.	
25	**You're reaching the end of the questions. But would you like to add anything that you think we have missed? And might be relevant?**	
26	I think we've covered it up. I mean, it's been good to go through it, because there's some ideas that I'd forgotten. But I mean, I think the idea of like, collaborative inception. So like going down the layers, I think that's a really important idea that I think is important to bear in mind. The idea of of doing two jumps, so making sure you go avatar-based first, and then, and then headset-based as an enhancement of that, I think that's really important as well, and something that we've discovered, I think those three categories of collaboration is important. You know, being able to kind of deliver serendipity via avatars is key, but I mean, it's, it's just making sure. The one other thing I would say is that, I guess, the thing that you get with because I mean, another tool that we use is another tool that we use, which is kind of similar and I think worth like bearing in mind when we're talking about immersive collaboration because this was kind of our main immersive collaboration tool before with the summon if you search, if you search GoBe robots with so telepresence robots, so we used to use those, well, we still do use those a lot. And they're really good. They're really good. If you've got a few people who are remote, and the majority of the team is co-located. They're amazing. They're an absolutely brilliant solution. And because the final thing, I mean, obviously what people say about VR in their ads is that sense of presence, and I think so [MST start] I guess the thing about stand-ups, the thing that it might be adding that we just haven't really been able to test is that being present with your team actually has positive like psychological and social effects that we haven't really properly studied yet. And I think that sense of, so that would be the only reason why I would say you might persist with it. Because actually feeling like you've spent time with your team, more meaningful time with your team. And obviously, the content of the meeting is obviously much more important than the medium in which the meeting is conducted, but I mean, things like audio quality play a role in how much of a connection you	BNFT, PRQS, MST

feel with someone how much you trust, someone goes down, if audio quality suffers. So there's no doubt that there's that, there are a lot of very subtle psychological effects that in the context of collaboration and working in a team are actually, you know, really vital. And I mean, if you add them up over the course of the whole project, like they can make or break the project,[MST end] so So I think that presence and connection piece, I think, is important, but like understudied at the moment, I would say because people just haven't had a chance to study it and also be quite a pain in the ass to study. But I think we should. Because like it's difficult to study for stuff. I mean, it's difficult to study even if you're looking at in person versus remote. So studying with with with VR as well would be would be complicated, but yeah, I think yeah, that would be my last point I would add.

Appendix J: Interview Transcript - P8

BNFT - Benefits of VR = <mark>Green</mark>
CLNG - Challenges of VR = <mark>Red</mark>
MST – Media synchronicity theory = <mark>Blue</mark>
TNLG - Similar technologies = <mark>Yellow</mark>
EQP - Equipment for VR = <mark>Gray</mark>
STWR - Software for VR = <mark>Orange</mark>
NVLT - Novelty = <mark>Violet</mark>
PRQS - Prerequisites for VR = <mark>Indigo</mark>
USG - VR usage = <mark>Cyan</mark>
APLC - VR applications = <mark>Magenta</mark>

Row	Content	Theme
1	**Could you describe your experience with VR, just in general terms?**	
2	I've been in the AR VR space since 2011, where I started building AR apps with a friend of mine from LA, focused on national heritage sites, and bringing history to life using augmented reality. For museums. Since then, I've been in a startup where I helped grow the startup from, you know, two, three people to 25-30 people at its height. And then after that, I joined [CompanyName] around 2018-19. And for the past three and a half, four years, I've now been with [CompanyName]. I'm currently a senior manager, I help lead a lot of our different engagements, whether they're in the commercial sector, or whether in the government, public sector, and have touched on every more or less industry that has anything to do with AR VR. Except for virtual production, probably I've had less relevant experience, but I've helped launch and build dozens of applications within the AR VR spectrum.	
3	**Great. And how often do you use VR right now and just on a daily basis?**	
4	Myself, I don't use it often at all, I use it just for clients and demos purposes.	USG,
5	**Okay, great. And now are the main questions. So what VR and VR software and hardware would you suggest implement for remote teams?**	
6	I think it depends. I think it depends on what the level of immersion they're looking for. I think it depends on how many people they would like to have in the experience, are we talking about, you know, two to three person four to five person? Conversation meeting workshop? Where are we thinking 100 People networking event? Or are we thinking 1000 person 10,000 person conference event? I think all of those will define whether a particular type of VR AR or a particular type of software should be used. So it depends.	
7	**Okay, and let's say for the large scale events, the ones that include over 100 people, what hardware would you suggest that they use and where should they meet in terms of software environment?**	

8	I think for hardware, the Quest 2 seems very easily accessible. And the price point is low. To the point where Facebook now Meta is selling it for a cheap price to increase adoption of the technology. It's kind of like the PlayStation model where they are actively losing money or selling at cost the VR headset, so people buy the headset, and then can buy more software and content, just like a PlayStation does it with their hardware, and then people end up buying spending more money in the software in the games. And then I think the Vive Focus Pro is a great headset, probably slightly more expensive. I think the Varjo headset is a great headset, but again, slightly more on or enterprise focused and expensive. So I think the Oculus Quest 2is probably the most immediately accessible and usable. Now that headsets like the Google Daydream, like the Google Cardboard, the Gear VR, those are no longer really in business products. So I think quest two is dominated the market there. And as far as I understand, now, more quest twos had been sold than Playstation in the last year. So pretty, pretty crazy fact to think about. And then I think the the, from a headset standpoint, you don't always need a headset, right? You can you can still achieve a level of immersion through the browser. I think, you know, a lot of the tools that you know, on get into next are easily also accessible from the browser, or a desktop app and native app. But it doesn't require a headset necessarily. So I think if the level of immersion isn't that key, and it's more about scale, doing it through the browser and then through a native desktop app, is usually a better way to go about it. Getting 1000 or 10,000 people to be able to interact and engage in a way that's better than zoom or teams. And then from a software standpoint as [CompanyName], we regularly work with Virbela, Virbela. Spatial.io is also a collaborator that we like to work with. Arthur Digital, we haven't worked with them as extensively but I know that they are a good large event or collaborative type experience/software. Facebook Horizon, I haven't personally used it very extensively. But I know they're also shooting for scale. AltspaceVR, my previous colleagues in some, some contacts used to own that company before it was sold to Microsoft. And so I like AltspaceVR as well, I have a lot of friends that build content in that world. And then I think, you know, when you were beginning to start looking at the web three domain now, I think decentraland is probably one of the more easily accessible and you know, builds for scale experiences that started off more as a blockchain initiative. But now it's become much more of a a Metaverse, if you will. And then you know, games are also interesting examples of Metaverse is to look beyond the specific VR software. I think, you know, Fortnight's Minecraft. All of these games are the original or World of Warcraft, even the original Hangout, Metaverse, multiplayer experiences that I think are also interesting places where you can host you know, 1000 10,000 100,000 people, and then people have been using those software for those types of purposes, more so than then before to give concerts and whatnot. You know, like Travis Scott, all those guys. So I think there's a lot you can do depends on the spectrum of immersion, from the headset to the browser, and then from the number of individuals you want and the level of interactivity Do you want to give people	STWR, EQP,
9	**Great? And what challenges do we expect to see after implementing VR for remote collaboration?**	
10	Um, I think it goes back to access. I think people just don't have enough headsets right now. So unless your company is giving you 60,000 headsets like Accenture, or actively pushing out headsets like PWC, or Bank of America or Walmart, it's hard for people to justify themselves just buying a $400 headset, because they want slightly more immersion in their working environment. But I think there are specific industries where virtual reality doesn't make sense. From a collaboration	BNFT, PRQS, CLNG,

	standpoint, the automotive industry, for example, it really does help to be looking at the same design, collectively, in an immersive space. The same applies for architecture, engineering, construction, I think, using an immersive space to collaborate and look at the same space or asset with multiple designers or workers from around the world. I think it makes sense. And I think platforms like Zoom are very much built for one to one, or one to many type dynamics. I think, you know, many to many dynamics is where VR or slightly more immersive game like mechanics thrive. So I think, you know, the the current biggest challenge, I think, is access accessibility. And also the social change associated with putting on, you know, goggles, that people are just not comfortable with. The beyond that, I think, you know, once you get get through the accessibility, and then the social, cultural norm change, probably the other biggest challenge will be connectivity, and the infrastructure that surrounds the headsets. I think in order to have true multiperson, fully immersive, 3D, interactive VR, you probably want 5G. And then if we're ever going to try and get the headsets to be smaller, you probably need edge computing and 5G to take the rendering and the compute power from off the headset onto a server nearby using the 5G, so you have very little to no latency and you have very large bandwidth. So I think those are the probably the the layer two infrastructural components that that will need to be figured out once the accessibility and and social norm things get figured out.	TNLG,
11	**And you also mentioned with the automotive industry and the architectural work, you touched upon the next question, which is, what benefits do you expect to see after implementing VR for remote collaboration?**	
12	Yeah, I think like I said, I think it's very hard to first visualize certain things using 2D tools. It's also, once again, hard to have many, too many engagements on tools like Zoom or Teams. So I think VR allows you to have much more of a real life like experience in both visualizing things, as well as in being able to communicate with multiple people at once, with multiple groups communicating at the same time. So I think those are, those are key key benefits of VR. But I think also the immersion that you're able to obtain, you know, people feel more, there's scientific evidence now that people feel more confident in applying the skills that they've learned when they've learned them in virtual reality. And then people are much more focused, and they have a lot more attention pointed in a single direction when they're in VR versus when they're on Zoom, which is usually when they're kind of checked out on mute doing something else. For example, we don't know if your Jakub is watching Pokemon right now, even though I'm sure he's not. Yeah, I think, you know, the the immersion is immersion, the ability to visualize the confidence in applying the skills you've learned in VR. Those are all key aspects of VR that make it particularly unique for remote collaboration.	BNFT
13	**Right. And based on your experience, when you are implementing VR into new teams, what changes do you usually see with people?**	
14	Could you pose the question in another way? I mean,what do you mean by what changes in the people?	
15	**So when VR is introduced in in a remote team? Is there like a noticeable change in the way people work? Is there a noticeable change in the way people interact with each other? Just some key moments or reflections about that?**	

| 16 | Yeah, I think remote collaboration, I think, once again, you know, instead of people being checked out on calls, everybody's very engaged. It feels very much like a reflection of real life. And you kind of care about what you're saying, you kind of care about who you're walking up to, and why and the conversation, whereas on Zoom, you can just go off camera, off mute, and then kind of just check out send me emails, right. So I think it's much closer to real life and requires a level of engagement that you can't obtain on Zoom, no matter how hard you try. And there's techniques to make zoom better. But I don't think that's the, that's the solution. And I also think virtual reality might also not be the full solution. I think, if you have a much more accessible, sleekly designed AR glass that I'm sure Apple will release sometime in the next couple of years. And you can actually project real life people into your own environment. I think that's when you're going to start having some very, very, I think that's that's when the true remote collaboration will probably reach the True Potential in the way that we work day to day, right. Kind of like the Kingsman film, if you've seen that with everybody sitting around the table, like that's, that's that's really where I think remote collaboration is truly going to shine. I think VR is always going to be slightly a niche product. But I think there's no real good AR headset out there at this time. You have the HoloLens two, which is moving towards government public sector with their $22 billion integrated visual augmentation system when you have Magic Leap two, which is also still slightly struggling to figure out what their enterprise strategy is. And then you have the real time where HMT one, the Vuzix M400 or the Vuzix blade, that's pretty much it from a good AR headset standpoint in the industry. Um, you still don't have a large brand that's develop a solid AR product. You know, the Snapchat spectacles isn't there, the Facebook Ray Ban collaboration is basically just allowing to film things, and change the music and the volume. There's really no true AR product that was you know, that's that's, that's been delivered in the way that AR has been promised or AR can be delivered via the phone, let's say, once you can have AR that that is very close to how the phone can operate with AR kit or AR core, on your face with glasses that are slick and easy to wear easy to use, high usability, a lot of good user experience research behind it. That's when you're going to start seeing a lot more remote teams probably be up for using this technology. I think right now, you know, still getting people the $400 headset, and then asking them to set it up in a way that's much more familiar for gamers. And then, you know, side loading contents, all of that is still very much built for a gamer type or very heavy enterprise user type industry segment. And I don't think a lot of teams are still down for that. But I am seeing a big demand towards right now is more of these Metaverse type, virtual collaboration environments that are browser based, or, you know, desktop app based. Just because people realize that things like recruiting things like onboarding, things, like training things, like learning things, like whiteboarding, you know, workshopping, those all really suck on Zoom, or on teams, it's just not the same impact, you can get so much more done in the physical one hour session with a group of 10 people or five people compared to, you know, virtual on Zoom or Teams, where, you know, you have to have like five or six calls to be able to achieve the same results, especially when you're workshopping. So I think those are all, you know, the demand signals that I'm seeing for remote collaboration teams, and some of the issues that the industry is facing in regards to adoption. | BNFT, TNLG, |
| 17 | **Okay. And could you describe some situations where VR improved collaboration?** | |

18	Yeah, I mean, I think I think the, there's probably a lot of different cases where VR improves collaboration, right? If you look at any of the automotive sector, clients, a lot of them now use VR for design reviews in collaboration. Once again, same for AC, the construction engineering, architecture industry. Same for, you know, workshops, and collaboration. A lot of teams use product like, you know, Engage VR spatial.io all help companies create more immersive environments for people to collaborate, and, but once again, I think, you know, it doesn't have the level of adoption that it probably will have in the future. Because you know, the $400, device sale, and then the loading of the contents, and then the getting people into the headset, it's all still kind of tough, I think Microsoft is doing a good job at pulling teams, and then using Mesh as a team's like, collaborative product. So I do see some hope there. They're actually collaborating pretty closely with Accenture in doing that. But beyond that, you know, I think I think there's still a disconnect between VR specifically, and then enterprise teams that could really use it for collaboration. I think that's just still in the very early stages of being utilized to its full potential.	BNFT
19	**Okay, and the last question that we have, could you also describe some tasks where VR would not provide an ideal solution?**	
20	I think, you know, VR, specifically, once again, you know, if you feel you're going to have 100,000 people or 10,000 people, it's probably not going to be the best best solution for you at this time, because then you have to ask people to buy a $350 headset. Whereas if you're doing the same thing over a browser or over a native app, on your desktop, you know, then or zoom, then you are basically allowing as many people as you as the software allows for them to be able to to join. So I think that's that's probably not a good area right now for VR, like anything to do with scale is not VR's forte, anything to do with immersion, or Learning Enhancement, training enhancement. I think that's probably a better place for VR at this time. But you know, the future of extended reality, right, XR, whether that's AR or VR, I think remote collaboration will be one of the key use cases. And it's already, you know, moving in that direction, but I think the device is still needs some work. And the social norms still need some changing.	CLNG,
21	**And when you say extended reality, do you also mean mixed reality?**	
22	Yeah, I mean, to me, mixed reality is a marketing term developed by Microsoft, right? When they built the HoloLens one in 2016. I think, you know, that, they, they wanted to call it something different to differentiate in the marketplace. Over time, you know, the industry has kind of adopted the technology. And now anything to do with non 3d AR is called, you know, assisted reality. Anything to do with actual 3d recognition, and the true use of SLAM technology is called mixed reality. But you know, to be quite frank, that's, that's augmented reality, right, like augmented reality is, is, as a general term, the definition is augmenting the reality around you. And whether that's happening in a 2d way or a 3d way. I think, you know, augmented reality is augmented reality. And then virtual reality is when you're fully immersed in a space, and you can't see anything outside of the virtual space that was created. So yeah, I mean, same applies for mixed in augmented reality. I use them interchangeably often.	TNLG,
23	**Great, great. So these are all the main questions. Last may be closing question is, if there is anything that you think we missed, and might be important for our study?**	

| 24 | Yeah, I would, I would, I would also explore what people mean by the metaverse as well. You know, I would look at some of the earlier versions of remote collaboration, virtual collaboration, virtual conferencing events, you know, multiplayer, multi user experiences, because I think, you know, web three, and the metaverse in general, are probably going to play a very big role in the world of remote virtual collaboration and teams. So just an additional area to explore probably. And I think we're moving beyond just the AR VR, MR spectrum. And we're now looking at a lot of infrastructural components, and kind of stealing, if you will, different working aspects of different industries like gaming, like blockchain, to create much more, you know, much more effective experiences. So I think Metaverse and web three should definitely be included in the research that you guys were doing. | |

Appendix K: Coding Tree

	Name	Files	References
⊕	Name	▲ Files	References
⊟ ○	Benefits of VR	3	54
○	Better creativity	1	3
○	Better Focus	2	8
○	Better interactivity	2	2
○	Better simulations	3	7
○	Better social connection	2	6
○	Better Workshops	2	2
○	Clearer social ques	2	4
○	Cooler technology	1	3
○	Easier technology to learn than laptops	1	1
○	Feeling of Presense	2	4
○	Mature technology	1	1
○	More confidence in skills aquired through VR	1	1
○	Multi player engagement	1	1
○	Positive first impressions	1	1
○	Practical experience	2	3
○	Relaxed environment	1	1
○	Standardized experience	1	1
○	Synchronicity Benefits	1	2
○	Theraputic benefits	1	3
⊟ ○	Challenges of VR	3	80
○	Benefits not clear	1	1
○	Capability limitations	1	1
○	Demmanding physical capabilities	2	8
○	Detachement from physical reality	1	2
○	Device agnosticity	1	1
○	Dont force solution	1	1

Figure K.1: Coding tree - 1

Name	Files	References
First Time Issues	2	13
Health Issues	2	14
High costs	1	2
Historical prejudice	2	2
Intenral implementation	1	3
Interenet Social culutre clash	1	2
Lack of traceability	1	1
Not as good as real life	1	1
Online protection	1	1
Policies preventing VR	1	1
Price of hardware	3	8
Prolong exposure issues	1	2
Required training	1	3
Scalability issues	2	4
Set up time	1	2
Simulated computers not sharp enough	1	3
Speaking through an avatar	1	1
Trust in VR	1	1
Equipment for VR	3	22
Dedicated space for VR	1	2
Google VR	2	2
HTC	1	2
Important capabilities	1	2
Oculus Quest 2	2	7
Oculus Rift	1	4
Oculus Rift Developer Kit	1	1
Vario headset	1	1

Figure K.2: Coding tree - 2

Vive Focus Pro	1	1
MST	2	32
Convergence	2	8
Conveyance	1	4
Face to face interaction	2	2
High syncronicity	1	1
Low syncrhonicity doesnt work	1	1
Support of MST	1	1
Task comparison	2	13
Tracability	1	1
Novelty	2	24
Cool technology	1	3
Disruptive technology	1	2
Excitement	2	4
Gaming technology	1	2
Needs convincing	2	4
New technology	2	7
Not linke Zoom	1	1
Prerequisites for VR	3	13
Communication through avatars	1	2
Different training required	1	4
Digital Litteracy skills	2	6
Edge computing and 5G	1	1
Prior experience	2	20
Addoption depends on experience	1	1
Complex for formation of mussle memory	1	1

Figure K.3: Coding tree - 3

○ First steps	2	6
○ Previous experience	2	6
○ Progress in experience	1	1
○ Similar Technologies	3	25
○ Augmented reality	2	2
○ Immersive rooms	1	2
○ Mixed Reality	2	7
○ Zoom or Skype or Teams	3	14
○ Software for VR	3	41
○ AltSpace	2	2
○ Engage VR	1	1
○ Facebook Spaces	1	1
○ Glue	1	2
○ Immersed VR	1	2
○ Meta horizon workrooms	3	11
○ Miro	1	1
○ Oculus software	1	1
○ Spatial	2	6
○ Tandem	1	3
○ Unity engine	2	2
○ Virbela	3	8
○ Work-VR	1	1
○ VR Applications	2	20
○ Training simulators	2	3
○ VR Client Store	1	1
○ VR Conferences	1	1

Figure K.4: Coding tree - 4

○ VR for entertainment	1	3
○ VR for job interviews	1	1
○ VR for Painting	1	1
○ VR for stand-ups	1	1
○ VR for Teaching	2	3
○ VR for Therapy	1	2
○ VR Workshops	1	2
○ VR Usage	3	7
○ Innovation status	1	1
○ Personal Usage	3	5
○ Recommendation	1	1

Figure K.5: Coding tree - 5

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