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Virtual Onboarding - Use of the metaverse for Induction of New Employees on Remote Work

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Master's in Digital Technologies for Business

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TECNOLOGIAS
E ARQUITETURA

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Resumo

Esta tese explora a integração das tecnologias Metaverso e Realidade Virtual nos processos de integração de funcionários à distância numa empresa multinacional. O principal objetivo é desenhar e implementar uma solução baseada no Metaverso para a integração à distância e avaliar a sua eficácia em melhorar a experiência dos funcionários, particularmente no que diz respeito ao envolvimento e retenção de conhecimento. O estudo apresenta um relato detalhado do desenvolvimento da solução e uma análise empírica da mesma. Foi utilizado um Desenho Entre Sujeitos, comparando métodos tradicionais de integração à distância com a abordagem recentemente desenvolvida baseada no Metaverso, em dois grupos distintos de funcionários.

Descobertas significativas do estudo incluem uma melhoria no sentido de presença social e interação entre os funcionários integrados através do Metaverso, indicando um ambiente mais envolvente e interativo. Além disso, a pesquisa revelou uma forte ligação entre o nível de imersão experienciado no Metaverso e um aumento no envolvimento dos funcionários, sugerindo que uma imersão mais profunda melhora diretamente o envolvimento dos funcionários. Além disso, o estudo observou uma relação positiva entre o sentido de proximidade eletrónica no ambiente virtual e a retenção de conhecimento, enfatizando a importância da conexão percebida no aprendizado virtual eficaz.

O estudo conclui que o Metaverso pode melhorar substancialmente a integração de funcionários à distância, oferecendo um potencial transformador para os ambientes de trabalho do futuro.

Palavras-chave: Metaverso, Integração de Funcionários, Trabalho Remoto, Colaboração Virtual, Envolvimento, Retenção de Conhecimento

Abstract

This thesis explores the integration of metaverse and Virtual Reality technologies into remote employee onboarding processes within a multinational company. It primarily aims to design and implement a metaverse-based solution for remote onboarding and to evaluate its effectiveness in enhancing the employee experience, particularly in terms of engagement and knowledge retention. The study presents a detailed account of the solution's development and an empirical analysis of it. The study employed a Between Subjects Design, comparing traditional remote onboarding methods with the newly developed metaverse-based approach across two distinct groups of recently hired employees who accomplished the same onboarding tasks.

Significant findings from the study include an improvement in the sense of social presence and interaction among employees onboarded via the metaverse, indicating a more engaging and interactive environment. Additionally, the research revealed a strong link between the level of immersion experienced in the metaverse and an increase in employee engagement, suggesting that deeper immersion directly enhances employee involvement. Furthermore, the study noted a positive relationship between the sense of electronic closeness in the virtual environment and knowledge retention, emphasizing the importance of perceived connectedness in effective virtual learning.

The study concludes that the metaverse can substantially enhance remote onboarding, offering transformative potential for future work environments.

Keywords: metaverse, Employee Onboarding, Remote Work, Virtual Collaboration, Engagement, Knowledge Retention

Index

List of abbreviations

EPS - Electronic Propinquity Scale

GDC - Global Delivery Centre

ICT - Information and Communication Technologies

IS – Information Systems

MVP - Minimum Viable Product

SLR - Systematic Literature Review

SPS - Social Presence Scale

WES - Work Engagement Scale

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CHAPTER 1

Introduction

1.1. Overview

The transition to remote work, expedited by the COVID-19 pandemic, has presented unique challenges for companies, especially in the onboarding of new employees. The onboarding process is a critical stage in an employee's journey, influencing their overall engagement and productivity [1]. In a remote setting, this process becomes even more vital, as new hires may feel disconnected from their peers and the company culture [2].

In this research, we propose to leverage an existing metaverse technology within a multinational Information Systems (IS) company, where the author is part of the management organization, to enhance the onboarding process in a remote work environment. The Metaverse, a concept popularized by science fiction and more recently by tech companies, refers to a collective virtual shared space where users interact with each other and digital objects in a three-dimensional environment that simulates the real world [3]. The company already possesses a metaverse solution, a collective virtual shared space, currently only used in ad-hoc situations. However, this technology has not yet been utilized for onboarding new employees. Our study involves a review of relevant literature, including studies on remote work, onboarding processes, and the use of virtual and augmented reality technologies, the basis of metaverse technology. This research aims to evaluate the effectiveness of the existing metaverse solution in addressing the challenges of remote work onboarding, and its potential of bringing benefits to this process. We explore the features of the metaverse and how it can simulate the physical workplace environment, foster socialization and collaboration, and promote the company's culture. The study also considers the experiences and perspectives of new employees who have undergo the onboarding process through the metaverse.

The objective of this study is to provide insights into the potential of the metaverse as a tool for enhancing the onboarding process of new employees in remote work environment. The study underscores the importance of leveraging virtual reality technologies to address the challenges of remote work and improve employee engagement and productivity. We implemented a prototype using the existing metaverse solution in the context of onboarding, a novel application for this technology. The findings of this study will guide companies in adapting and implementing effective technological solutions to onboard new employees remotely.

1.2. Motivation

The COVID-19 pandemic has brought about unprecedented change, especially in the realm of work. The traditional office-based model has been disrupted, and companies worldwide have shifted towards remote work as the new normal [4]. While remote work offers numerous benefits such as flexibility and cost savings, it also presents several challenges, particularly in the onboarding process for new employees [2].

The onboarding process plays a vital role in an employee's entire tenure within an organization. It sets the foundation [1] for his/her productivity, engagement, and overall perception of the company. In a remote work setting, the onboarding process becomes even more critical, as new hires may struggle with feelings of disconnection and isolation from their colleagues and the organization's culture. Factors like the COVID-19 pandemic have further amplified these challenges, making it essential to address them effectively[2]. Managing remote work and the onboarding process involves implementing a series of procedures to ensure the smooth integration of new employees into the organization, even in a remote setting. This topic has gained widespread attention due to the increasing prevalence of remote work. As more companies adopt remote work, the demand for effective remote work management has grown, highlighting the urgent need for innovative solutions in remote work onboarding [5].

Despite this demand, the field of study concerning remote work onboarding still lacks comprehensive exploration of virtual technologies, such as the metaverse. These technologies have enormous potential to enhance the onboarding process and employee engagement. By leveraging metaverse solutions based in virtual and augmented reality platforms and immersive experiences, organizations can bridge the gap between remote employees, fostering a sense of connection and belonging [6].

In conclusion, the COVID-19 pandemic has precipitated a transformative shift in the way we work, with remote work becoming an established tendency. While it offers benefits, it also presents challenges in the onboarding process. Managing remote work and onboarding new employees requires careful attention and innovative solutions. Exploring virtual technologies like the metaverse can significantly improve the onboarding experience, fostering engagement and a sense of community among remote employees.

1.3. Problem and Research Questions

Influenced by the close contact with a IS multinational company, this thesis recognises the challenges posed by remote work in the context of employee onboarding. With this overall problem statement at hand, the thesis seeks to explore how the metaverse technology can be leveraged to mitigate these

challenges and improve the remote onboarding process. It sought also to understand how the metaverse can replicate and improve the dynamics of a physical workplace, enabling new hires to immerse themselves in the organization's culture and engage with their colleagues in a more interactive and immersive manner.

To operationalize these overarching goals, the following research questions have been formulated to address the central problem of the study:

- RQ1: “How can we design and adopt a metaverse experience to enhance the onboarding process in a remote work environment?”.
- RQ2: “How can we demonstrate the impact of the metaverse experience in employee engagement and knowledge retention during the onboarding process?”.

Properly answering these stated research questions broaden the existing body of knowledge on remote work onboarding and virtual technology applications, while offering practical insights into the metaverse’s potential as a tool to improve the user experience in the remote onboarding process.

1.4. Methodology

This study adopts the Design Science Research Methodology (DSRM) [7] as the primary research approach. DSRM is a well-established methodology in the field of Information Systems that focuses on the design, creation and evaluation of innovative technological artefacts to solve identified problems. The methodology is particularly suitable for this study as it allows for the iterative development and refinement of our metaverse solution applied in remote work onboarding. In Figure 1, we present the DSRM model, illustrating the stages of the methodology and the iterative nature of the process. By employing the DSRM, this study aims to provide a rigorous and systematic approach to use and evaluation of the metaverse for remote work onboarding. The DSRM process consists of six stages: problem identification, objectives definition, design and development, demonstration, evaluation, and communication.

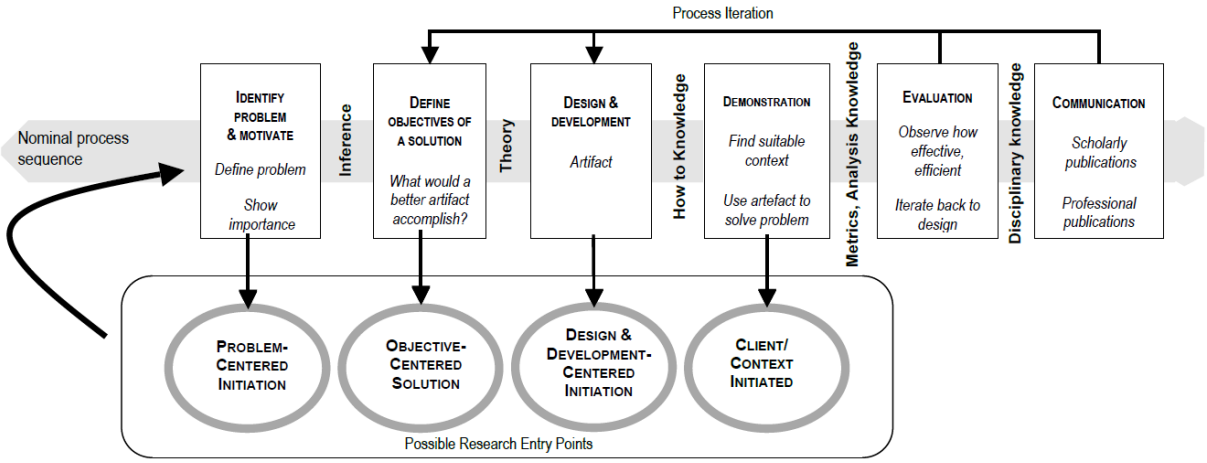


FIGURE 1 - DSRM PROCESS MODEL, PEFFERS ET AL.

1.4.1. Problem Identification and Motivation

This study commenced at the first entry point, problem identification, where the initial focus was on gaining a profound understanding of the challenges associated with remote work onboarding that our metaverse solution aimed to address. Detailed problem identification was conducted through a multifaceted approach, beginning with an extensive literature review. This literature review spanned various sources, including scholarly articles, reports, and industry publications, to comprehensively grasp the existing challenges in remote work onboarding and identify and understand the research gaps. The goal was to establish a solid theoretical foundation and identify areas where innovation was most needed. The extensive detail on the literature review can be found in Chapter 2 – Literature Review

In addition to the literature review, the research team engaged with key stakeholders of the mentioned IS company, critical to the onboarding process. These stakeholders included human resources professionals, managers within the target company, and technology experts. Through interviews, the research team gathered firsthand insights into the practical challenges and issues experienced during remote work onboarding. The research team also held brainstorming sessions with the stakeholders, where they shared their perspectives on the onboarding challenges and possible solutions. These sessions were instrumental in identifying key pain points and opportunities for improvement. In our findings, we discovered that the existing remote onboarding process for new employees primarily consisted of sessions conducted by an HR representative using Microsoft Teams, where they presented a standard slideshow.

From these gathered insights, the core problem emerged as follows: Remote work onboarding, in its current state, often leads to feelings of isolation among new hires, a lack of clear understanding of

organizational culture, and challenges in fostering immediate team cohesion. The ramifications of these challenges are multifaceted. Employees who experience such disjointed onboarding processes tend to be less engaged in their roles, which can directly impact their productivity and overall contribution to the organization. Furthermore, the time it takes for these employees to truly feel a part of the organization is extended, delaying their full integration into the team. This prolonged integration can also affect team dynamics, potentially leading to inefficiencies and miscommunications. Over time, if not addressed, these challenges can culminate in higher turnover rates, with employees seeking opportunities where they feel more connected and valued from the outset.

1.4.2. Define Objectives of a Solution

After identifying the problem, the next step was to clearly define and prioritize the mentioned research questions (RQ1 and RQ2), that need to be properly answered by our metaverse solution. This was crucial to ensure that the solution would be both practical and aligned with the overarching research goals, specified by RQ1 and RQ2. So, our solution needs to address the following detailed objectives:

- To enhance understanding and assimilation of organizational culture, we aimed to design virtual tours and interactive remote sessions as part of the metaverse solution. This objective responds directly to our first research question, exploring how virtual environments can effectively convey the essence of an organization's culture to new hires.
- To improve team cohesion and collaboration, our solution involved facilitating metaverse-based team-building activities and iterative collaborative tasks. This approach was designed to ensure that new hires felt integrated and actively involved from the beginning, addressing the second research question about fostering teamwork in a remote setting.
- To address the issue of isolation often felt by new hires in remote environments, we sought to create a sense of community, belonging, and presence through virtual interactions in the metaverse. This objective was crafted in response to the research question concerning the emotional and social aspects of remote onboarding..
- Lastly, we aimed to improve employee engagement and knowledge retention during the onboarding process. This objective was crucial in addressing the research question about the effectiveness of virtual onboarding in fostering a deeper, more lasting understanding of the job and the organization.

Throughout the research, these objectives were not static but dynamically evolved. As we progressed through the design and development stages of the metaverse solution, we continuously

refined our objectives. This iterative process, coupled with ongoing collaboration with key stakeholders, ensured that our objectives remained relevant and adaptable to emerging insights and stakeholder feedback.

1.4.3. Design & development

The heart of this study lies in the design and development stage, a phase where an existing metaverse technology was further developed, adapted, and improved, during the period of this dissertation, to cater to the unique demands of remote work onboarding. This journey, which we describe in detail in the dedicated chapter titled "Design and Development," was an iterative process. It allowed for the continuous refinement of the metaverse solution based on valuable feedback and rigorous evaluation, by a team that included the author of this dissertation, designers and software developers. At its core, this stage involved the re-design of metaverse technology to make it compatible with the context of remote work onboarding. By adopting agile software development methods, the objective was to craft, deploy and evaluate a solution that would seamlessly integrate into the existing onboarding processes, making the transition of the remote onboarding to the metaverse as smooth as possible for both new employees and the human resources department. The iterative nature of this stage was pivotal. It meant that feedback from users and stakeholders, as well as evaluation results, were not only solicited but actively integrated into the ongoing development process. This dynamic approach ensured that the metaverse solution was not a static creation but an evolving one. The chapter titled "Design and Development" provides a comprehensive exploration of this critical phase, detailing the design choices, rationale behind them, and the specific feedback mechanisms that guided the development. It is within this phase that the metaverse solution truly takes shape, and its evolution unfolds, driven by a commitment to addressing the real-world challenges encountered in remote work onboarding.

1.4.4. Demonstration

The demonstration phase of this research was crucial in illustrating the practical application and effectiveness of our metaverse onboarding solution, as well as contrasting it with the existing Microsoft Teams-based process. This phase involved a detailed experimental study, structured in two distinct stages to capture the comparative effectiveness of each approach. Initially, we conducted the onboarding process using Microsoft Teams, which represented the conventional method employed by the organization. This phase served as a baseline to understand the standard onboarding experience, focusing on the interactions, content delivery, and engagement levels in a typical remote setting. Subsequently, we transitioned to the metaverse phase of the study. In this stage, the newly designed metaverse onboarding solution was implemented. This involved guiding new hires through an

immersive and interactive onboarding experience within the metaverse, tailored to replicate and enhance the traditional onboarding process. This phase was instrumental in showcasing the capabilities of the metaverse solution in providing a more engaging, interactive, and immersive onboarding experience compared to the Teams-based approach.

Throughout both stages, we closely monitored and recorded various aspects of the onboarding experience, focusing on employee engagement, interaction quality, and the overall effectiveness of each method. The comparison between the Teams-based and metaverse-based onboarding provided valuable insights into the advantages and limitations of each approach, informing our understanding of how virtual reality technologies can be leveraged to enhance remote onboarding processes. This demonstration phase, with its comparative approach, was essential in empirically showcasing the potential of the metaverse as a transformative tool in remote onboarding, while also highlighting the areas where traditional methods like Microsoft Teams continue to hold value. The chapter “Demonstration & Evaluation” further expands on this phase.

1.4.5. Evaluation

In the field of Information Systems (IS), it is a well-established practice to employ hierarchical evaluation criteria for IS artefact s, as proposed by Prat et al [8]. This structured approach typically serves as a reliable pathway for assessing the technical and functional aspects of IS developments. While adhering to this methodology would have provided a safe and standardized evaluation framework, the primary aim of this thesis diverges from the norm. Instead of focusing on the artefact itself, the emphasis is placed on evaluating the experiential journey of new employees through the onboarding process and how that mitigates the challenges posed by the remote work.

By centring our evaluation on the experience rather than the artefact, we aim to capture the nuanced impacts of the metaverse solution on the onboarding process. This approach aligns with the intention to facilitate a broader application and adaptation within the industry, serving as a roadmap for others to replicate the experience, irrespective of the specific metaverse technology employed.

During this stage, we designed a between-subjects user study, where participants were divided in two groups, a Reference Group, that followed the conventional MS teams-based remote onboarding process that served as a baseline for comparison, and a Treatment Group, that experienced the newly developed metaverse-based onboarding solution. Data and feedback were systematically gathered from new employees of both groups. The data collection and analytics processes employed the same instruments in both groups, to measure relevant dependent variables using surveys and scales adopted from the literature, forming a comprehensive methodology that is detailed further in the upcoming "Presentation of Results and Evaluation" chapter. These tools were carefully selected to measure and quantify the impact of the metaverse solution versus the conventional remote onboarding process on

dependent variables such as employee engagement, overall satisfaction, knowledge retention and various key performance indicators, with a keen eye on the experiential dimensions of the process. Descriptive and inference statistics approaches were adopted to perform our data analysis. This approach allowed us to draw direct comparisons between the experiences and perceptions of employees onboarded via the metaverse solution and those who followed the traditional process, using advanced data analytics.

Additionally, a comparative analysis of knowledge assessment was conducted. We compared the knowledge quiz scores of employees who participated in the metaverse onboarding with those who underwent the previous process via Microsoft Teams. This assessment enabled us to determine the effectiveness of the metaverse solution in enhancing knowledge acquisition and retention from an experiential standpoint.

In essence, the evaluation stage involved a multifaceted approach that encompassed feedback collection, comparative surveys with quantitative and qualitative statistical analysis, and knowledge assessment, all through the lens of a between-subjects user study design. The results of this comprehensive evaluation, centered on the user experience rather than just the artefact, is presented in the " Demonstration & Evaluation " chapter.

1.4.6. Communication

The communication stage represents the culmination of this research journey, where the findings transcended the confines of the study to influence broader practices and knowledge. This phase was characterized by deliberate and strategic dissemination of the research outcomes, both within the organizational ecosystem and in the wider academic and professional communities.

By making our research publicly accessible, we aim to provide valuable insights and practical frameworks that can be leveraged by other organizations and researchers.

Internally, the research findings, were shared with the global HR community within the case study company. This proactive sharing was aimed at allowing replicating the metaverse solution across different sectors of the business. The response has been overwhelmingly positive, leading to a concrete plan to implement this solution across all other seven GDCs of the company, spanning diverse geographical locations from Costa Rica to China, including Poland, India, and others. This expansion plan is a testament to the solution's effectiveness and its potential for global applicability within the organization.

Externally, there is a concerted effort to contribute to the scientific body of knowledge by publishing our findings in reputable journals and conferences. This initiative is driven by the goal to enrich the academic discourse on remote work onboarding and the innovative use of virtual technologies in this domain.

1.5. Outline of the Dissertation

This thesis is organized into five chapters, each serving a specific purpose in the overall study. The structure of the dissertation is as follows:

Chapter 1 – Introduction: This introductory chapter sets the stage by providing an overview of the research topic. It outlines the context and significance of the study, introducing the central problem and research objectives, and outlines our solution approach. Additionally, this chapter details the methodology and associated steps employed in the study. It concludes with a brief outline of the structure of the dissertation.

Chapter 2 – Literature Review: This chapter presents a review of the existing literature related to remote work, onboarding processes, and the application of metaverse enabling technologies, such as virtual and augmented reality. The literature review follows the PRISMA method, ensuring a comprehensive and systematic approach to identifying, screening, and analysing relevant literature papers. This chapter also outlines the keywords identified and the research query that guided the search process for relevant studies.

Chapter 3 – Design and Development: In this chapter, the design and development of the metaverse solution for remote work onboarding are detailed. It offers an in-depth exploration of the design and development process, the solution's features and functionalities, and its adaptation for the specific remote onboarding context.

Chapter 4 – Presentation of Results, Evaluation and Discussion: This chapter presents the implementation of a prototype using the metaverse solution and the evaluation of its effectiveness and impact. It describes our user study, featuring a between-subjects design, details the data and feedback collection methods obtained from new employees who undergo the onboarding process divided in two groups (Reference and Treatment), and describes our data analytics approach to assess the impact of the solution on employee engagement, sense of presence and knowledge retention.

Chapter 5 – Conclusion and Future Work: This chapter offers a summary of the research's key findings and their implications. It reflects on the satisfaction of the research questions by our solution and the methodology employed in this study. Additionally, the chapter discusses the limitations of the research and provides recommendations for future research endeavours.

This structured framework guides the reader through the comprehensive exploration of the metaverse's potential as a tool for enhancing the onboarding process for new employees in remote work environments.

CHAPTER 2

Literature Review

2.1. Methods

To provide comprehensive insights into the research objectives, a systematic literature review (SLR) [9] following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) [10] method was conducted. The PRISMA method ensures transparency, impartiality, and reproducibility in identifying relevant studies within the research community that meet the defined inclusion criteria. The literature dataset was constructed following the guidelines outlined by the PRISMA method. This framework guided the selection of papers based on their relevance through title, abstract, and full-text screening. The search was conducted on June 30, 2023, with a time constraint limited to the previous ten years, covering the period from 2013 to 2023. This approach allowed the focus to be primarily on recent publications and scientific discoveries pertaining to the subject matter.

We initiated the SLR by conducting a broad search across Scopus [11] and Web of Science Core Collection (WoSCC) [12]. Recognizing the novelty and evolving nature of topics like virtual technologies in remote work, our search criteria were deliberately broad. We included keywords and search terms to capture studies on remote work and the use of virtual technologies. This comprehensive approach was strategically designed to encompass the full spectrum of relevant and evolving research. By initially focusing on the broader challenges of the remote working environment, we aimed to subsequently narrow our focus to the specific area of onboarding.

The following keywords were identified as crucial to capturing the relevant literature:

“metaverse; Virtual reality; Remote work; Telework; Virtual work; Home work”

To ensure a comprehensive search, these keywords were combined using Boolean operators to construct a research query. The research query used for the literature review was as follows:

Query: *(metaverse OR "virtual reality") AND ("remote work" OR telework OR "virtual work" OR "home work")*

Following the initial search, duplicate studies were identified and removed to maintain the integrity of the dataset. The remaining studies underwent an initial screening based on title and abstract, with irrelevant or unrelated studies excluded from further analysis. The full-text screening phase involved a thorough evaluation of the selected studies to determine their eligibility for inclusion in the literature review. During the whole process, we tried to capture studies that did not only focus on remote work and the use of virtual technologies, but also, when available, studies that touched on

the specifics of onboarding. Studies that were not in the English language, did not have full-text availability, or were deemed irrelevant to the research objectives were excluded.

After completing the initial phase of the SLR, we recognized the need to broaden our study's scope. This decision was influenced by emerging trends and key concepts identified during the SLR. To enrich our research, we utilized the 'identification of studies via other methods' channel within the PRISMA framework. This expansion involved two primary approaches: firstly, employing a snowball method [13] to include additional papers referenced in our initial set of studies, and secondly, incorporating papers recommended by dissertation supervisors. These steps ensured a comprehensive coverage of literature pertinent to the evolving dynamics of our project.

Figure 2, serves as a visual representation of the systematic journey undertaken in our literature review process. With these results in hand, we can now engage in a meaningful discourse on the implications and applications they hold for our research question and the broader academic community.

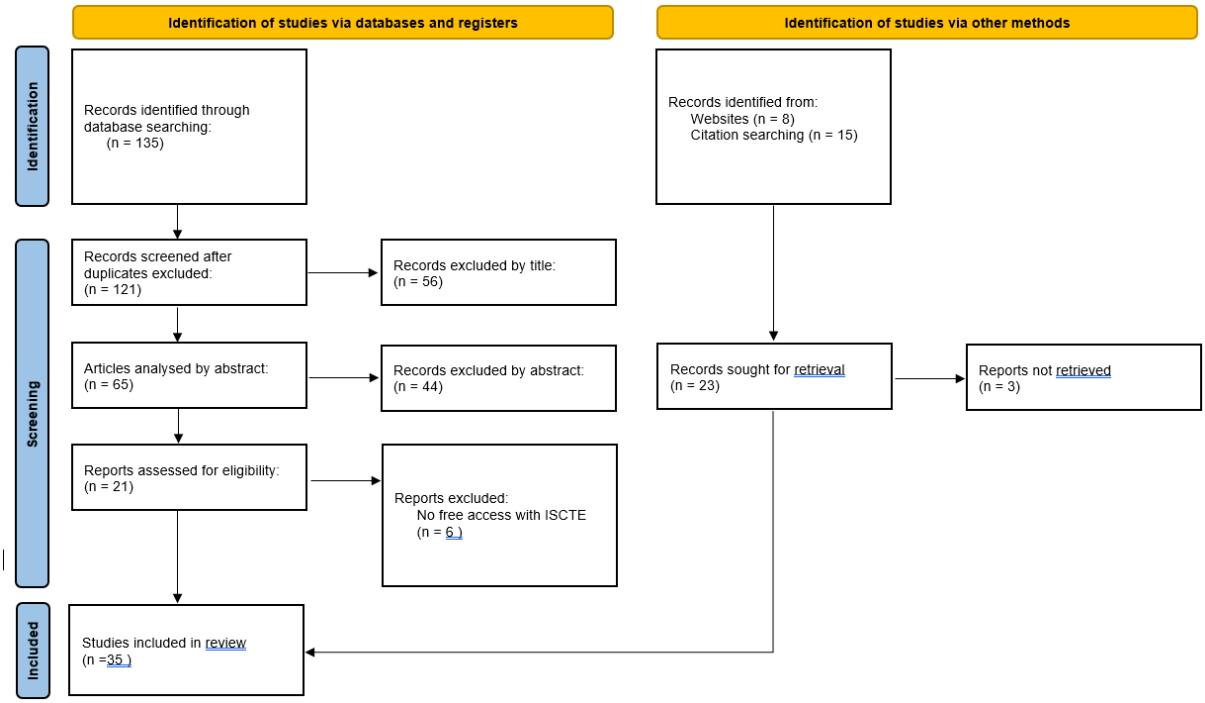


FIGURE 2 -PRISMA FLOW DIAGRAM

2.2. Results

Within this section, we'll focus on what we discovered in the articles we reviewed. Our goal is to share the main insights and key findings we uncovered. Each result we discuss here added to our understanding of the subject, which was essential for our research and contributes to the knowledge in the field.

2.2.1. Remote Work and Its Rise

Remote work, often synonymous with terms like telecommuting, teleworking, flexible work, and teleporting, has evolved significantly over the decades, closely intertwined with the advancements of information and communication technologies (ICTs) [14] [3].

Messenger and Gschwind summarize the journey of remote work as "three generations of telework" [15], as presented in Figure 3. The first generation revolved around the term "telecommuting," which encapsulated the idea of virtually commuting to work. This term originated in the US State of California in the mid-1970s and was promoted by California-based companies such as Yahoo in the 1980s. As technology advanced, the second generation, often referred to as "The Mobile Office," emerged, characterized by the increasing portability and independence of electronic devices. The third and current generation of telework transcends the need for a physical workspace. With the advent of highly portable devices, teleworking can be conducted from virtually anywhere, eliminating traditional workspace constraints.

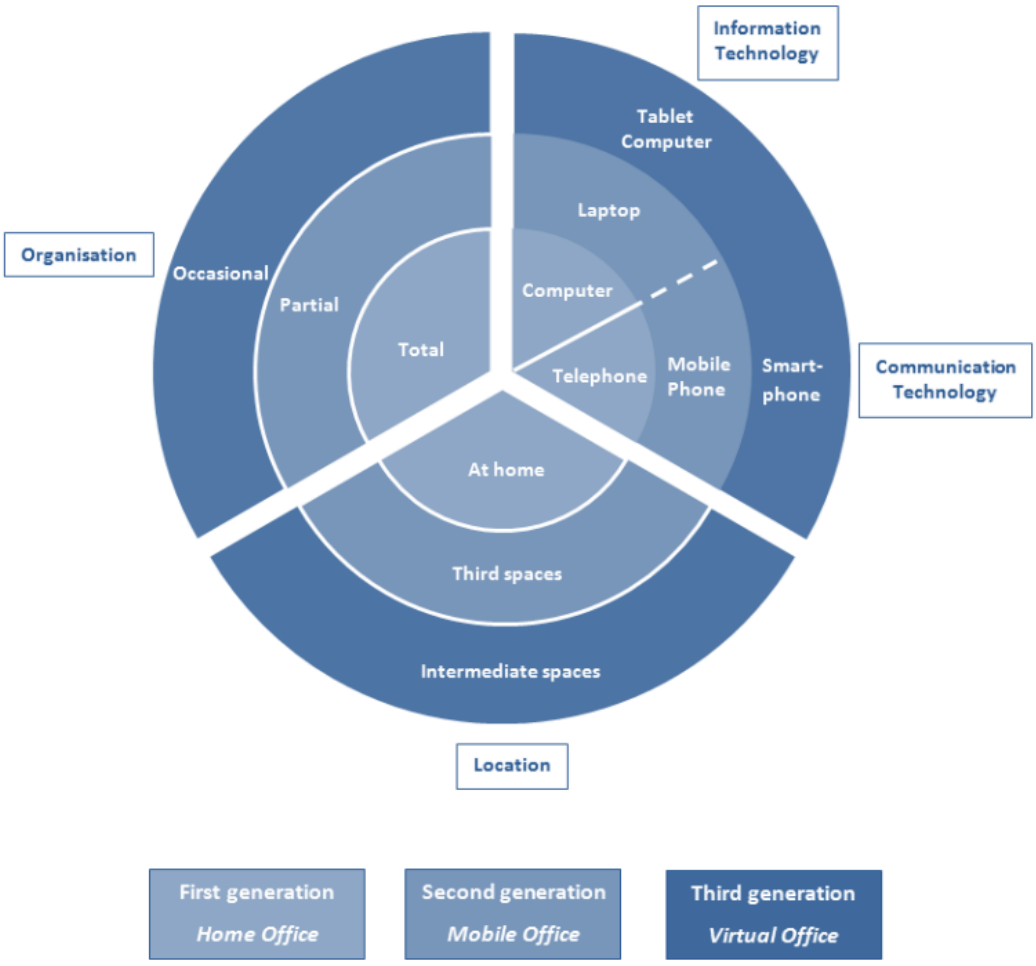


FIGURE 3 - CONCEPTUAL FRAMEWORK OF TELEWORK (MESSENGER AND GSCHWIND)

Interest in remote working has been developing ever since the transition to digital avenues of work began in the corporate world in the late 1970s [3]. The innovative technology that allows interaction and communication beyond physical boundaries is termed information and communications technology (ICT). Its capabilities have evolved remarkably, leading to significant technical improvements. As a result of the rapid growth of ICT, remote working has become more feasible and widespread [3]. One pivotal moment in the history of remote work was when major corporations, like Yahoo in 2013, decided to end their telecommuting policies. This move sparked widespread debate, highlighting the challenges remote work posed, especially in terms of fostering company culture and collaboration [16].

The COVID-19 pandemic hastened the transition from conventional office arrangements to remote work, as the virus's global dissemination disrupted typical business practices. Consequently, working remotely gained widespread acceptance among numerous companies[14] [17]. Initial data indicates that nearly 40% of the current workforce in the EU transitioned to full-time teleworking due to the pandemic. This is noteworthy, especially when considering that prior to the pandemic, only 15% of EU employees had experienced teleworking [18]. The pandemic not only validated the viability of remote work but also emphasized its essentiality during extraordinary circumstances. This worldwide health emergency emphasized the significance of adaptability and resilience when confronted with unforeseen challenges, solidifying the position of remote work in shaping the future of businesses [3]. Post-lockdown, teleworking trends suggest a lasting shift. In the first trimester of 2021, significant percentages of companies reported regular teleworking practices, with variations based on company size [18].

While remote working has ushered in numerous advantages, it also presents certain challenges. Among the notable benefits are an improved balance between work and personal life, increased overall job contentment, and reduced conflicts between work and family commitments. On the flip side, issues like diminished interpersonal interactions with colleagues, feeling restricted to one's home, and suboptimal home office setups have emerged as concerns [19].

In summary, the trajectory of remote work has been intricately shaped by technological progress, organizational choices, societal demands, and significant global occurrences such as the COVID-19 pandemic. As we advance further into the digital era, it's evident that remote work is not just a temporary shift but a lasting transformation, and the insights from its evolution will be decisive in defining the future landscape of work.

2.2.2. Employee Onboarding: Traditional vs. Remote

Employee onboarding is a pivotal process that transitions newcomers from their initial status as hires to fully integrated members of an organization [20]. This transformative phase is not just about

familiarizing new hires with their job roles but also about immersing them in the organization's culture, values, and expectations [21]. The sentiments and perspectives formed during this period can significantly influence an employee's future attitudes and behaviours within the organization [20]. Effective onboarding is not merely a formality but a strategic investment that can yield substantial returns for organizations. Research has shown that well-executed onboarding processes can lead to enhanced job satisfaction, heightened organizational commitment, and a reduction in employee turnover [22]. Jeske and Olson emphasize the importance of recognizing mutual learning opportunities during the onboarding process, suggesting that both the organization and the new employee can benefit from a well-structured onboarding experience [1]. However, the absence of a comprehensive onboarding process can have detrimental effects. New hires may experience role ambiguity, feelings of isolation, and may even contemplate early departure from the organization [22]. Caldwell and Peters highlight the ethical implications of onboarding, suggesting that organizations have a moral responsibility to ensure that new hires are adequately supported and integrated [23].

The digital transformation of the workplace, accelerated by unforeseen global events such as the COVID-19 pandemic, has necessitated a shift in how organizations onboard their new hires. Remote onboarding, or also referred in literature as Virtual onboarding, a relatively new concept, refers to the process of integrating new employees into an organization without the traditional face-to-face interactions that characterize conventional onboarding. Instead, this process leverages digital tools, online platforms, and virtual interactions to ensure that newcomers are well-acquainted with their roles, responsibilities, and the organizational culture, even from a distance [24]. One of the foremost issues with remote onboarding is embedding the company's culture. Without the tangible signals and unplanned interactions typical of a brick-and-mortar office, new hires may find it challenging to assimilate the company's principles and ethos [2] [25] . This could result in feelings of alienation and a reduced sense of belonging to the organization.

In conclusion, while onboarding is a crucial process in shaping an employee's journey within an organization, the shift to remote work has introduced unique challenges that organizations must address. As the work environment continues to evolve, it's imperative for companies to adapt and refine their onboarding processes to ensure the successful integration of new hires, regardless of the setting.

2.2.3. The metaverse: A Deep Dive

The metaverse, a term that has gained significant traction in recent years, is a hypothetical iteration of a three-dimensional virtual realm that offers virtual reality (VR) and/or augmented reality (AR) experiences in an on-line environment, where users represented by computer-generated avatars interact with each other in virtual spaces, as alternatives to the real world [3] [26]. The concept of the

metaverse was first introduced by Neal Stephenson in his science fiction novel "Snow Crash" (1992), where he described a 3D virtual-reality environment. The term gained further prominence when Ernest Cline explored it in his novel "Ready Player One" but the metaverse's popularity as finally skyrocketed when Facebook's CEO announced in 2021, the renaming of the company to "Meta", positioning it as a "metaverse Company" [27].

While an almost unknow word until recent days, the concept of the metaverse is not entirely novel. The concept borrows its ideas from virtual reality (VR) [28], augmented reality (AR), first coined by Caudell and Mizell in 1992 [29], mixed reality [30], first proposed by Milgram and Kishino in 1994 [31], and extended reality, a recent concept (2018) that integrates AR, VR and mixed reality. Additionally, many metaverse user experiences and applications do exist for some time. Second Life [32] have existed for nearly two decades (was launched in 2003), with players dedicating an average of 20 hours per week in these worlds. Modern successors such as Minecraft [33], World of Warcraft [34], and Fortnite [35] boast hundreds of millions of users and have spawned vast supporting economies [3]. Currently, the metaverse remains closely tied to its video game roots, with much activity occurring in games like "Roblox" [36] and "play to earn" games such as "Axie Infinity" [37], "Decentral" [38] and "Sandbox" [39]. Major brands like Nike, Adidas, Coca-Cola, and McDonald's have established a presence in this gaming-centric version of the metaverse, and several advertising firms have also set up offices within it [40]. Microsoft, a tech giant, has also recently ventured into the metaverse with the introduction of Mesh at their Ignite Conference in 2021 [41]. Participants can join using various devices, from HoloLens 2 and VR headsets to smartphones and PCs. Microsoft envisions Mesh as a tool to enhance remote collaboration and provide immersive training and communication tools for both businesses and consumers [42].

The metaverse does not only have the potential to transform global interaction and communication. It may also profoundly impact the global economy by introducing fresh business models and expanding the digital marketplace. According to Meta, the benefits to the global economy could reach up to US$3.6 trillion per year in additional GDP by 2035 [43]. However, while the metaverse offers a vision of a utopian future, it also presents challenges. The rapid and unregulated development of the metaverse could lead to a dystopian outcome. There's a pressing need for a regulatory governance model, especially considering growing geopolitical tensions. It's crucial to establish uniform standards and structures for the metaverse to ensure its sustainable growth [44].

2.2.4. Work Engagement in remote settings

Work engagement is a multifaceted construct that has garnered significant attention in the realm of organizational psychology. It is often conceptualized as a positive, affective-motivational state characterized by high energy combined with a pronounced sense of dedication and a robust focus on

work activities [45]. This state is not merely a fleeting emotion but a persistent and pervasive work-related mindset that is typified by vigor, dedication, and absorption [46]. Engaged employees exhibit a strong connection to their work, characterized by enthusiasm and immersion in their tasks. Such individuals not only demonstrate better in-role task performance but also contribute positively to team dynamics and organizational outcomes [47].

The transition to remote work has both facilitated and hindered various aspects of work engagement. On one hand, remote work offers flexibility, autonomy, and often a more comfortable environment, which can bolster feelings of vigor and dedication. Employees might find it easier to immerse themselves in tasks without the distractions of a traditional office setting, enhancing absorption [45]. However, remote work also presents challenges that can potentially dampen work engagement. The lack of face-to-face interactions, potential feelings of isolation, and the blurring of boundaries between work and personal life can sometimes lead to decreased vigor. Without the tangible signals of organizational culture and unplanned interactions typical of a physical office, employees might struggle to feel the same level of dedication to their roles and the organization. Furthermore, the potential for work-life imbalance in remote settings can sometimes make it harder for employees to fully immerse themselves in their tasks, affecting absorption [47] [48]. It's worth noting that engagement is not just an individual phenomenon but can also manifest collectively. For instance, when teams believe they possess the collective competence to tackle a task, levels of collective engagement are high. Conversely, when they feel ill-equipped, engagement levels dip [49]. In remote settings, fostering this collective sense of competence and engagement can be more challenging due to the lack of physical co-location.

The Utrecht Work Engagement Scale (UWES) emerges as a pivotal instrument in gauging the intricate dimensions of work engagement. Crafted by Schaufeli and team, the UWES has carved its niche as a gold standard in the domain, offering a dependable method to evaluate work engagement in diverse scenarios [50]. The inception of the UWES was driven by the imperative to accurately capture the enriching and positive state of mind associated with work engagement. With a focus on the core elements of vigor, dedication, and absorption, Schaufeli's team designed the scale to encapsulate these facets in depth.

2.2.5. Conclusion

The literature has provided a comprehensive overview of the evolving nature of the modern workplace. From the rise and establishment of remote work to the potential implications of the metaverse, we've seen how technological advancements and societal shifts are reshaping the way organizations operate and how employees engage with their roles. The significance of employee onboarding, whether in traditional or remote contexts, has been emphasized, highlighting its role in

shaping an employee's journey within an organization. Furthermore, the concept of work engagement, as a cornerstone for organizational success, has been explored in depth, emphasizing its multifaceted nature and the tools, like the UWES, that measure it.

While the literature offers extensive insights into remote work, employee onboarding, work engagement, and the metaverse, a noticeable gap emerges when we consider the intersection of these domains. Specifically, there is limited exploration around the utilization of the metaverse in the context of remote onboarding and its subsequent impact on work engagement. This presents a unique avenue for research, emphasizing the need to delve deeper into how the metaverse can be leveraged to enhance remote onboarding experiences and, in turn, influence engagement levels. As we chart our research trajectory, addressing this gap becomes paramount, ensuring that our investigations are both timely and relevant to the evolving dynamics of the modern workplace.

CHAPTER 3

Design and Development

3.1. Introduction to Design and Development

In this chapter, we turn our attention to the practical side of this research, the design and development of the metaverse solution. Here, we aim to transition from the theoretical underpinnings laid out in the previous chapters to the actual construction of a tool that can be implemented in a real-world context. Figure 4 exhibits the steps taken during the entire lifecycle of the project.

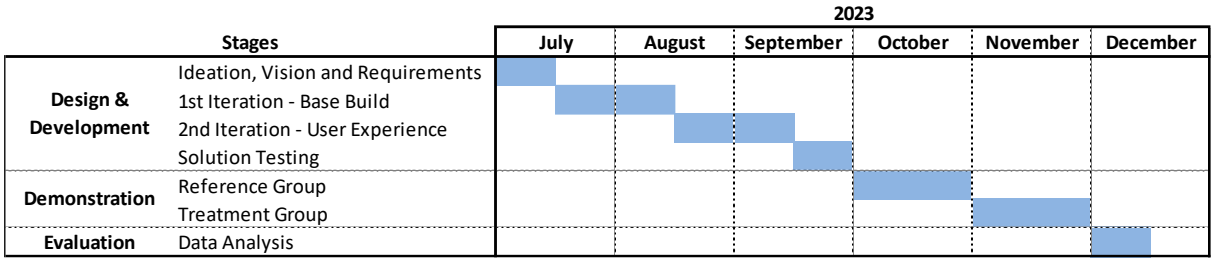


FIGURE 4 - SOLUTION ROADMAP

This chapter serves as a crucial bridge between theory and practice, testing the theoretical framework of virtual onboarding against practical demands. The aim is to validate the metaverse solution's conceptual strength and its relevance to research questions, ensuring it is both viable and effective in organizational settings. The design and development phase aims to:

- Define the user requirements clearly, ensuring that the metaverse solution aligns with the needs of new employees during remote onboarding.
- Develop a detailed system design that is both reliable and adaptable, capable of meeting the current and future needs of virtual work environments.
- Construct a prototype that allows for iterative testing and refinement, providing a foundation for evaluating the solution's effectiveness, impact in remote onboarding and its effectiveness in addressing the research questions before its broader rollout.

3.2. Organizational Context

3.2.1. Company Overview

The study was conducted within the context of a global information and communication technology enterprise with a presence in over 100 countries across the globe. For confidentiality reasons, the name of the company remains undisclosed due to time constraints in company review. Originating from Asia in the previous century, this organization has expanded its reach to become a prominent force in the IT industry, offering a wide array of advanced solutions and services. Its extensive product

range encompasses everything from computing hardware and networking equipment to sophisticated cybersecurity systems and comprehensive cloud-based services.

3.2.2. Study Implementation Group

The company's Global Delivery Centers (GDCs) plays a crucial role in the company's global operations, providing high-quality services to customers across various industries. The European GDC, located in a capital city, is one of the key centers of the company's global delivery network. It was established in 2002 and has since grown into a major hub for the company's services in Europe, providing support for customers in various sectors, including finance, healthcare, and public administration. The European GDC employs over 1500 professionals, who bring a diverse range of skills and expertise to the table. The center has a strong focus on innovation and digital transformation, with a commitment to providing cutting-edge solutions to its customers. The center's capabilities include application development, testing, and maintenance, infrastructure services, and service desk operations.

3.3. Overview of the metaverse Technology utilized

The organization had already adopted a specific metaverse platform, leveraging it for a variety of applications such as hosting events and interactive games. Notably, this technology has yet to be utilized for the onboarding of new employees. In this section, we explore the company's strategic process for selecting this metaverse tool and provide an overview of the design process, and the solution architecture, setting the stage for its potential application in the employee onboarding process.

3.3.1. Solution Selection

The company's Global Delivery Center (GDC) sought solutions in 2020 that would offer an engaging and immersive experience for events when remote participation was not feasible due to the pandemic. There are various metaverse options available in the market, ranging from pre-built platforms to custom-built solutions. Some popular pre-built metaverse platforms include Second Life, Sansar [51], Virbela [52] and VRChat [53], while custom-built solutions can be developed using game engines like Unity [54] or Unreal Engine [55]. Each option has its own advantages and disadvantages, and the choice of platform depends on the specific needs of the organization:

- Pre-built platforms can provide a quick and easy solution for creating a virtual environment, as they already have established infrastructure and user base. However, they may have limitations in terms of customization and may not fully align with the organization's branding and culture.

- Custom-built solutions offer more flexibility and control over the virtual environment, allowing organizations to create a unique and personalized experience. How-ever, they require more technical expertise and resources to develop, and may take longer to implement.

When selecting a metaverse solution for employee onboarding, organizations need to consider factors such as cost, technical requirements, customization options, scalability, and user experience. Based on the challenges and requirements identified earlier, the team at the GDC decided to build a custom metaverse solution using Unity. The rationale behind this choice was to have greater control over the platform's customization, ensuring better alignment with the organization's branding and culture. Additionally, a custom solution could be integrated with existing systems and processes, providing a seamless experience for employees. Table 1 presents a high-level overview of the various factors and scores considered when making this decision.

TABLE 1 - COMPARISON OF METAVERSE SOLUTIONS

Solution	Engagement	Customization	Cost	Scalability
Second Life	High	Moderate	Low	High
Sansar	High	Moderate	Moderate	High
Virbela	Moderate	Low	High	High
VRChat	High	Moderate	Moderate	High
Custom-built (Unity)	High	Very High	Low	High

3.3.2. Solution Architecture

The team at the Global Development Center (GDC), which included the author of this dissertation, has meticulously designed a bespoke metaverse solution using the Unity game engine. The architecture of this solution was crafted to fulfil several critical requirements, encompassing the ability to operate efficiently on limited GPU resources, ensuring accessibility for users of varying ages and abilities, maintaining robust security, and being web-hosted for optimal accessibility and compliance. As shown in Figure 5, the solution was designed to be web-hosted with a server-based backend. This configuration allows for substantial flexibility, accommodating the evolving needs of the organization. To this end, the solution was deployed on the company's Application servers, utilizing ASP.NET 7. Further enhancing its accessibility, the solution was configured to be accessible externally via the company's VPN. This arrangement ensures secure access to the virtual environment, safeguarding the data and interactions.

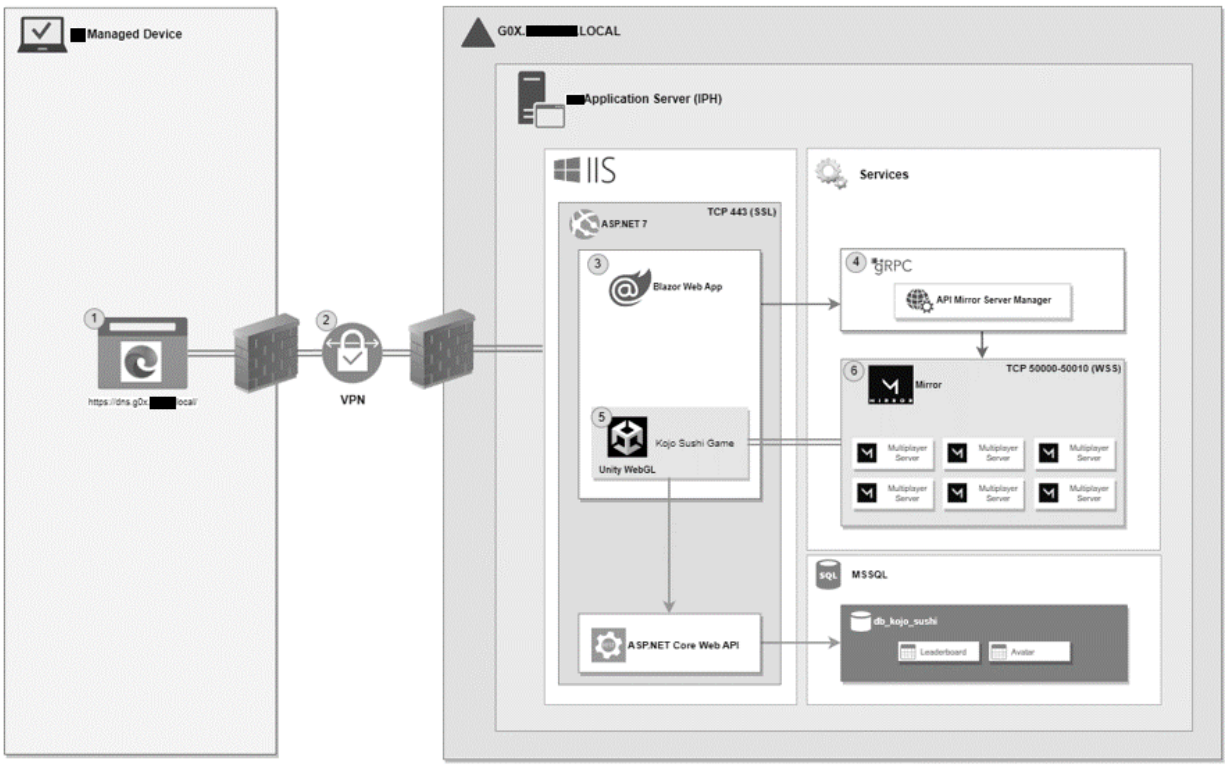


FIGURE 5 - COMPANY'S METAVERSE SOLUTION ARCHITECTURE

The solution was built with interoperability development goals in mind, including the ability to integrate with other platforms and technologies. To achieve this, the architecture of the solution was designed to be modular and scalable, allowing for easy integration with other systems and technologies. Overall, the architecture of the company's metaverse solution was carefully designed to meet the specific needs of the organization and provide an engaging and immersive onboarding experience for new employees, while also being scalable, flexible, interoperable and secure.

3.4. Design Process

3.4.1. Ideation Session, Requirements and Blueprint

The design process for our metaverse onboarding solution began with an ideation session that brought together, besides the author, 5 developers, 2 HR professionals, and 2 company managers. The author led the Design and Development processes as a Project Manager. The goal was to collectively define the user requirements and sketch out an initial mock-up of the experience. This collaborative approach ensured that the perspectives of all stakeholders were considered from the outset, setting the stage for a solution that would be both comprehensive and user centric.

The text below was the introduction to such session:

"Welcome to our ideation session! Today, we're embarking on an exciting journey to revolutionize employee onboarding by leveraging Unity to create an immersive metaverse experience. Let's

reimagine how new employees join our team, envisioning a dynamic 3D world where they can explore virtual offices, interact with avatars, and embark on engaging quests.

This session is just the beginning of our collaborative adventure. Together, we'll brainstorm and explore how Unity's tools can help us craft a unique onboarding experience that reflects our company's culture, values, and mission.

So, get ready to unleash your creativity as we set out to redefine onboarding. Let's make it not just informative, but genuinely enjoyable. This session marks the catalyst for an exciting future of employee engagement and company growth. Let the ideation session commence".

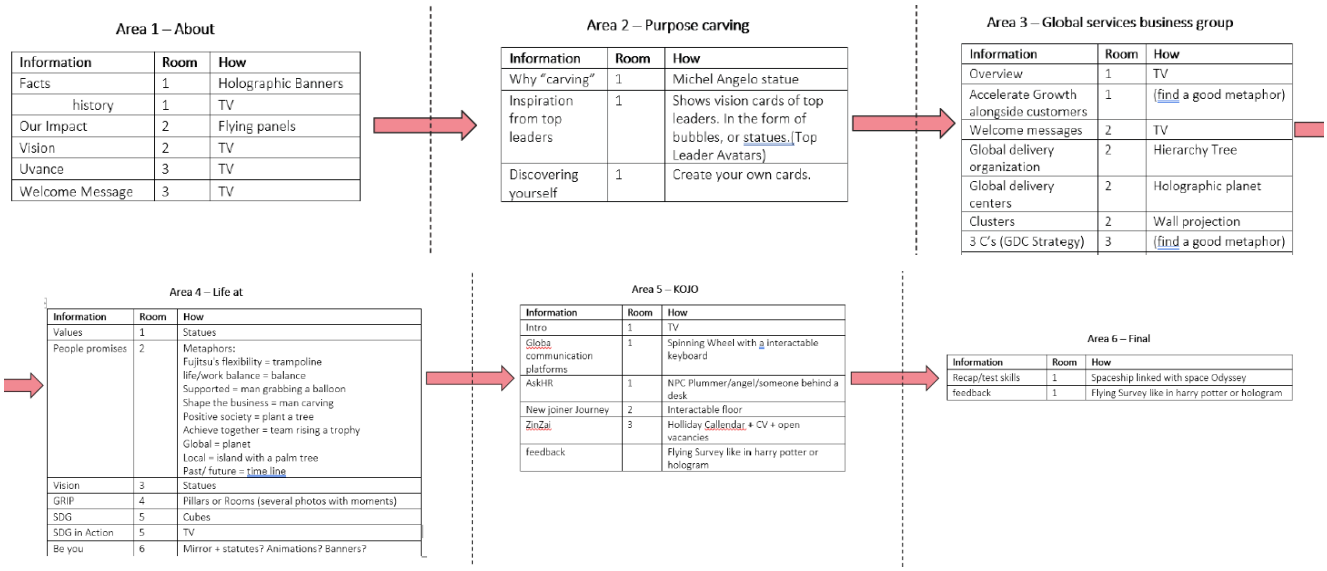
Steps Undertaken During the Ideation Session:

1. Vision and Requirements Discussion: The team began by brainstorming a list of requirements and features. The session then focused on understanding the implications of each requirement, refining them, and finally establishing priorities through a vote by all participants. Figure 6 shows the whiteboard utilized and final priority scores.

FIGURE 6 – USER REQUIREMENTS WHITEBOARD

2. Paper prototypes: In this phase, we developed a low fidelity 'paper prototype' to visually represent the initial design concept of our immersive onboarding journey. Traditionally, paper prototypes are sketched on paper, but given our IT background, we opted for a more digital approach using a whiteboard, tables, and other electronic means, while still preserving the essence of a 'paper prototype' . This prototype acted as a conceptual blueprint, converting the steps and stages of the existing induction process, which was previously conducted online via Microsoft Teams with a standard PowerPoint presentation, into a format suitable for the metaverse. This stage involved a detailed mapping of the areas and methods for effectively communicating information to new

employees. Essentially, this paper prototype was a visual guide that outlined the flow and integration of various elements into the final solution, as illustrated in Figure 7.



Area 1 – About

Information	Room	How
Facts	1	Holographic Banners
history	1	TV
Our Impact	2	Flying panels
Vision	2	TV
Uvance	3	TV
Welcome Message	3	TV

Area 2 – Purpose carving

Information	Room	How
Why "carving"	1	Michel Angelo statue
Inspiration from top leaders	1	Shows vision cards of top leaders. In the form of bubbles, or statues.(Top Leader Avatars)
Discovering yourself	1	Create your own cards.

Area 3 – Global services business group

Information	Room	How
Overview	1	TV
Accelerate Growth alongside customers	1	(find a good metaphor)
Welcome messages	2	TV
Global delivery organization	2	Hierarchy Tree
Global delivery centers	2	Holographic planet
Clusters	2	Wall projection
3 C's (GDC Strategy)	3	(find a good metaphor)

Area 4 – Life at

Information	Room	How
Values	1	Statues
People promises	2	Metaphors: Fujitsu's flexibility = trampoline life/work balance = balance Supported = man grabbing a balloon Shape the business = man carving Positive society = plant a tree Achieve together = team rising a trophy Global = planet Local = island with a palm tree Past/ future = time line
Vision	3	Statues
GRIP	4	Pillars or Rooms (several photos with moments)
SDG	5	Cubes
SDG in Action	5	TV
Be you	6	Mirror + statutes? Animations? Banners?

Area 5 – KOJO

Information	Room	How
Intro	1	TV
Globa communication platforms	1	Spinning Wheel with a interactable keyboard
AskHR	1	NPC Plummer/angel/someone behind a desk
New joiner Journey	2	Interactable floor
ZinZai	3	Holliday Callendar + CV + open vacancies
feedback		Flying Survey like in harry potter or hologram

Area 6 – Final

Information	Room	How
Recap/test skills	1	Spaceship linked with space Odyssey
feedback	1	Flying Survey like in harry potter or hologram

FIGURE 7 – LOW-FIDELITY PAPER PROTOTYPE

3. Thematic Idea Consolidation: The session concluded with the consolidation of key ideas into themes, which helped in organizing our thoughts and identifying patterns in our approach. The insights gathered from the workshop were remarkable and the user requirements outcomes are summarized in Table 2.

TABLE 2 – USER REQUIREMENTS

Requirement	Detail	Priority
Interactive Learning Zones	The experience must be modular where each room is developed separately allowing to turn rooms on and off as needed.	MUST HAVE
Collaborative Learning	The experience must create a sense of connection between participants and facilitator. As such, experience will be run for all at the same time using a facilitator who will guide them together through the predefined path.	MUST HAVE
Knowledge Testing	There should be a connection to the Space Odyssey at the end of the experience to test the efficiency of the learning.	MUST HAVE
Knowledge Testing	There could be a challenge to move from area to area. This challenge should be collaborative and could be anything (ex: quiz, mini games, etc. ideally using information available in that area).	COULD HAVE
Repeatable Learning	The experience can be repeatable so participates could revise and re-experience the educational content as many times as they desire.	COULD HAVE
Learn by Doing	The experience will have mini games that allow the participants to learn by actually doing it.	COULD HAVE
Other Discussed Requirements	Allow participants to experience it on their own, at their pace, in any order they want; Include learnings from real world experience; etc.	WON'T HAVE

Throughout the process, we adhered to the principles of the Scaled Agile Framework (SAFe) [56], which helped us stay aligned with agile best practices and ensure that our design process was iterative,

flexible, and scalable. The MoSCoW [57] method was instrumental in categorizing the user requirements for the prototype, allowing us to focus on delivering value through the Minimum Viable Product (MVP) while maintaining a clear roadmap for future enhancements. By the end of the design process, we had a clear direction for our MVP, with a focus on creating an engaging, interactive, and collaborative onboarding experience that would set the foundation for a comprehensive metaverse onboarding solution.

3.4.2. Solution Development

The development phase, a critical juncture in our project, commenced upon the initial establishment of user requirements and the conceptual framework. This phase, spanning a comprehensive period of two months, was structured around a Scrum-like methodology [58]. This agile approach was pivotal, characterized by daily synchronization meetings and concise, one-week sprints, each meticulously planned to focus on specific deliverables. This iterative development process was instrumental in allowing for continuous refinement and adaptation of the solution, ensuring that each sprint brought us closer to our envisioned outcome.

A key aspect of this phase was the involvement of our dedicated team, consistent with the composition during the ideation sessions. The team comprised five developers, who were responsible for the coding and technical aspects of the solution, and other four members who contributed through providing ongoing feedback and participating in testing. This collaborative effort was crucial in maintaining a high standard of quality and ensuring that the solution was aligned with our objectives. After the ideation phase, the development team began constructing the first iteration of the solution. This initial build was carefully assembled, considering the insights from the paper prototype and the extensive list of user requirements. Although basic and lacking polished aesthetics, this version prioritized functionality, successfully transforming abstract concepts into a concrete prototype. This crucial stage set a solid foundation for the more detailed development work that would follow.

After this initial version developed, the team's focus turned to refining the experiential and interactive elements of the solution. This phase was dedicated to refining how employees would engage with and feel during the session. It involved a thorough and thoughtful examination of the existing work by the entire team, scrutinizing each virtual space to identify opportunities for improvement. As detailed in Figure 8 and Figure 9 we meticulously marked significant enhancements and additions. These figures exemplify the kind of user-centered enhancements that were prioritized during this phase, demonstrating our commitment to extending the solution's capabilities beyond mere technical requirements to foster greater user engagement and richer interactive possibilities.

Information	Room	How	Presenter notes
Facilitator presentation	1	Pedestal 	Light must focus on the host in the moment he goes to the top of the pedestal. To ask for the attention of all new joiners it will be asked by the host, or it should be a way, like a bottom that may bring the avatars to in front of the pedestal.

FIGURE 8 - SECOND ROUND OF USER REQUIREMENTS DEVELOPMENT - EXAMPLE 1

Information	Room	How	
Evolve	1	Pillar and spinning wheel + FY24 	Proceed in a zigzag pattern. Pedestal with SG on the floor for interaction with me. Table with the SDGC (presumably Sustainable Development Goals Commission) as mentioned below. Outside, initiatives of GRIP (possibly an organization or project) already carried out. On the front wall, the pillars of GRIP. In the second part, a staircase with "evolve." Each step displays information appearing on the left, right, and front. A table with a summary of information and a wall with the final part. Start with "evolve" before GRIP.

FIGURE 9 - SECOND ROUND OF USER REQUIREMENTS DEVELOPMENT - EXAMPLE 2

3.4.3. Solution Testing

In the final stages of development, we conducted two critical tests. The first was an internal test with the complete project team, designed to rigorously evaluate the technical aspects of the solution. This included assessing stability, identifying and resolving bugs, and ensuring overall system robustness. The second test was a comprehensive dry run of the full set of activities that comprise the new onboarding experience. For this test, we invited individuals who had not been involved in the project, providing us with fresh perspectives and unbiased feedback. This group included 3 members from HR, 2 People Managers as well as 4 employees from diverse departments across the company and we did not control the gender. This simulation of an onboarding session was invaluable, offering us insights into the user experience and highlighting areas for further refinement. These tests were not merely technical evaluations but also opportunities to validate the effectiveness and the user experience of our solution. The feedback gathered from these sessions was meticulously analysed and used to make final adjustments, ensuring that our solution was not only technically sound but also engaging, natural and simple to use by the end users.

3.5. Solution Overview

At this juncture, we aim to provide an overview of the completed metaverse solution. It's important to note, however, that any description here might not fully capture the depth and immersive nature of the actual experience. Nevertheless, we endeavour to outline the key elements and structure of the solution, highlighting specific aspects that stand out as particularly significant.

3.5.1. metaverse world map

Figure 10 represents a view of the metaverse world created in Unity. This visual representation delineates how the user experience is segmented into interconnected rooms, with each room offering a distinct and unique experience. The layout is designed to guide users seamlessly through the onboarding journey, ensuring that each room contributes to the overall narrative and learning objectives.

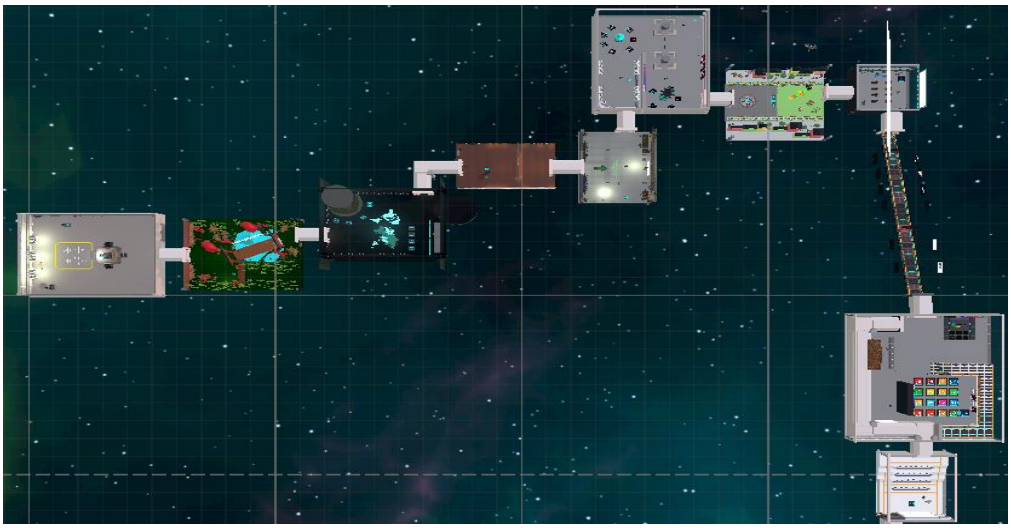


FIGURE 10 - TOP-DOWN VIEW OF THE MAP

The design of each room is intentional, with careful consideration given to how the full set collectively form a cohesive and engaging onboarding experience. The rooms are not just isolated modules but are interconnected in a way that allows for a natural progression through the onboarding process. This structure facilitates an simple and straightforward flow, making it easy for new employees to navigate the space and absorb the information presented in each area.

3.5.2. Welcome Room, Tutorial and Avatar Creation

The onboarding journey in our metaverse solution commences in a specially designed introductory room, tailored for new employees. This initial space serves as a primer, acquainting them with the essentials of navigating the metaverse environment. Crafted to be both simple and easy to use, the room ensures that even individuals unfamiliar with virtual worlds can swiftly grasp the basics of movement and interaction within this digital space. Figure 11 offers a visual representation of this

starting area, showcasing its layout and the interactive features that aid in the learning process. This room not only sets the stage for the entire onboarding experience but also instils confidence and comfort in participants, preparing them to venture into the more advanced sections of the metaverse onboarding journey. Additionally, this room is accessible to all employees before the structured onboarding session, allowing them the flexibility to familiarize themselves with the environment at their own pace, prior to the guided experience.

FIGURE 11 - LEARNING HOW TO PLAY

In the initial room, prior to the start of the onboarding session, users are also presented with an engaging feature: an avatar customization function, as depicted in Figure 12. This function allows new employees to create and personalize their avatars. Insights from our literature review revealed that such customization fosters a deeper sense of connection and ownership towards the avatar. This, in turn, enhances user engagement and immersion in the overall metaverse experience.

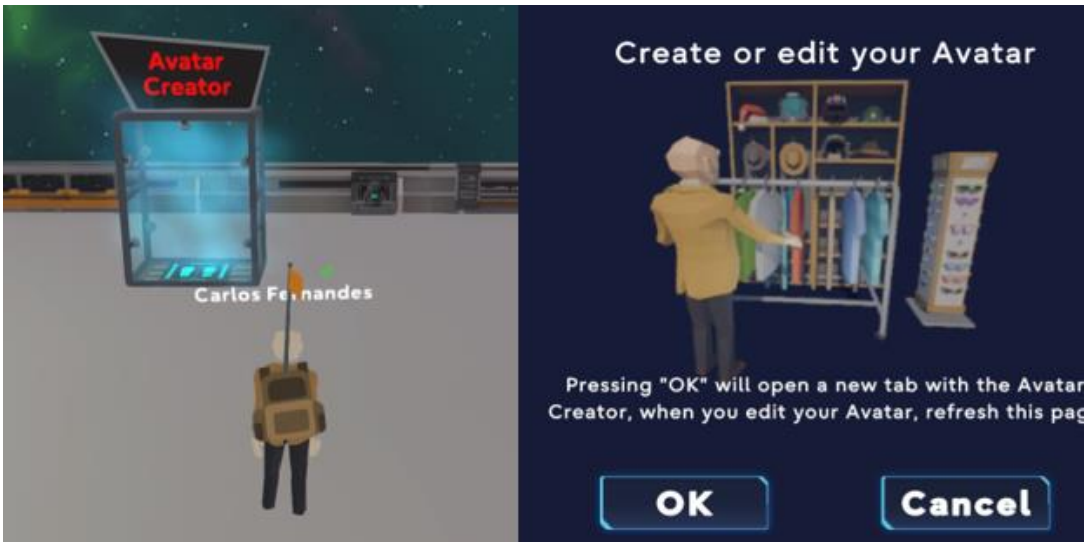


FIGURE 12 - AVATAR CUSTOMIZATION

Further enriching this personalization process, Figure 13 illustrates a detailed menu offering a variety of customization options. Users can select from an array of choices to modify their avatar's clothing, physical appearance, and other attributes. This level of customization not only adds a fun and creative aspect to the onboarding experience but also contributes to a more personalized and memorable introduction to the company's virtual environment.

FIGURE 13 - AVATAR CUSTOMIZATION 2

The personalized avatar, created at the outset of their onboarding journey, becomes a lasting digital identity for the employees within the company. It remains with them throughout their tenure at the organization, serving as their unique representation in all subsequent games, activities, and experiences facilitated through this metaverse platform. This continuity of the avatar not only reinforces a sense of individual identity within the virtual workspace but also fosters a consistent experience across various company-led immersive initiatives.

3.5.3. The immersive experience

Upon the kick-start of the guided onboarding session, employees are greeted by the facilitator, who is the same HR professional that conducts sessions via Microsoft Teams and that has also played a key role in shaping this new metaverse experience. At this stage, participants are given a brief refresher on navigation controls and an overview of the session's structure. They are informed about the interaction mechanisms within the metaverse and how the session unfolds. After the initial briefing, the onboarding journey unfolds as employees, guided by the facilitator, navigate through the various themed rooms of the metaverse map. Each room is uniquely designed to enhance the learning experience with a distinct theme. For instance, the Portugal-themed room, as shown in Figure 14, immerses employees in a culturally rich environment. This thematic approach not only makes the

learning process more engaging but also adds an element of discovery and excitement to the onboarding experience. As employees move from one room to another, they are not just acquiring essential organizational knowledge but also experiencing the diversity and creativity that the company embodies.

FIGURE 14 – THE PORTUGAL ROOM

In navigating through the metaverse onboarding map, a well-defined path is followed, offering diverse and engaging methods for information dissemination. One such method includes strategically placed videos along the journey, as depicted in Figure 15. These videos provide visual and auditory learning opportunities, enhancing the engagement and understanding of the content.

FIGURE 15 – WATCHING A VIDEO DURING THE IMMERSIVE EXPERIENCE

Additionally, interactive elements are interspersed throughout the path, presenting information in various innovative formats. An example of this can be seen in Figure 16, where interactive items not only display information but also invite active participation from the employees.

FIGURE 16 - INTERACTIVE GRAPHICAL ITEM DISPLAYING INFO WHEN PRESSING A BUTTON

The metaverse solution also integrates traditional training methods by enabling the facilitator to utilize familiar formats like PowerPoint presentations. In this setup, the trainer has exclusive control over the slide progression, ensuring a seamless flow of the presentation while the participants attentively follow along. This control is facilitated through a specialized heads-up display, accessible only to the facilitator with admin permissions. This display features additional commands and functionalities, empowering the trainer to manage the session effectively (Figure 17) with his/her unique interface, highlighting how it blends traditional presentation techniques with the innovative environment of the metaverse, thereby maintaining a sense of familiarity within the novel immersive setting.

FIGURE 17 – WATCHING A PRESENTATION DURING THE IMMERSIVE EXPERIENCE

This sense of familiarity extends beyond training methods into the design of the virtual environment. In the metaverse, we have meticulously recreated spaces that resonate with the typical office setting. An example of this is the virtual auditorium depicted in Figure 18. This space mirrors the kind of auditorium one might find in a large corporate office, yet it has been thoughtfully adapted to fit seamlessly within the unique aesthetic of the virtual world. This careful blend of the familiar and

the innovative helps in easing the transition for new employees, making them feel at home in a space that, while virtual, reflects elements of their real-world professional environment.

FIGURE 18 – THE AUDITORIUM IN METAVERSE

The inclusion of nostalgic elements like the hopscotch court depicted in Figure 19, serves to enrich the metaverse beyond its technological capabilities. While the environment is ripe for automation and digital innovation, it also embraces the simplicity of the physical world that we recall from childhood. This juxtaposition illustrates that the metaverse is more than a collection of bits and bytes but it's a dynamic space that can replicate the environment and the physics of our tangible world. It allows for traditional, "no-tech" interactions, fostering an experience that is not solely dependent on technology. This approach ensures that the metaverse remains grounded and accessible, bridging the digital with the familiar human touch. Just as the virtual auditorium is a digital echo of a corporate setting, the hopscotch court represents a timeless playground, inviting users to engage in a way that transcends the virtual, tapping into shared cultural memories and experiences.

FIGURE 19 - GAMES

This further extends into a realm where traditional learning activities are reimagined for the digital space. Trainers can leverage this versatile environment to devise innovative and engaging

methods for new joiners to assimilate information and forge connections. Interactive exercises like dynamic scavenger hunts, which can be tailored for endless variety, flash quizzes that test and reinforce knowledge in real-time, and ice breakers designed to build camaraderie, all embody the potential for "no-tech" engagement within this high-tech domain. The ability to recreate these experiences ensures that the virtual world is not just a place of work, but also a space of play and human connection, mirroring the multifaceted nature of the real world. The session culminates with a quiz that has been a mainstay in the induction process. Delivered with a space-themed narrative—complete with spaceships—this quiz retains its classic, interactive game format, echoing its original design and content. Its seamless incorporation into the session is a testament to the metaverse's dynamic architecture, which is depicted in Figure 20. The metaverse's modularity is highlighted here, showing our capability to integrate established components with ease, without needing to rebuild the entire setting.

FIGURE 20 - END OF ONBOARDING

The quiz, marking the session's conclusion, has been kept exactly as it was in previous non-metaverse inductions to maintain a consistent metric for assessing knowledge retention. Featuring a wide array of questions depicted in Figure 21, it aims to gauge the participants' ability to retain the knowledge imparted. We have leveraged the outcomes of this quiz to juxtapose knowledge retention rates from this novel immersive method, against those from previous, more conventional methods. Such a comparative analysis was pivotal in quantifying the learning impact within the metaverse's innovative framework.

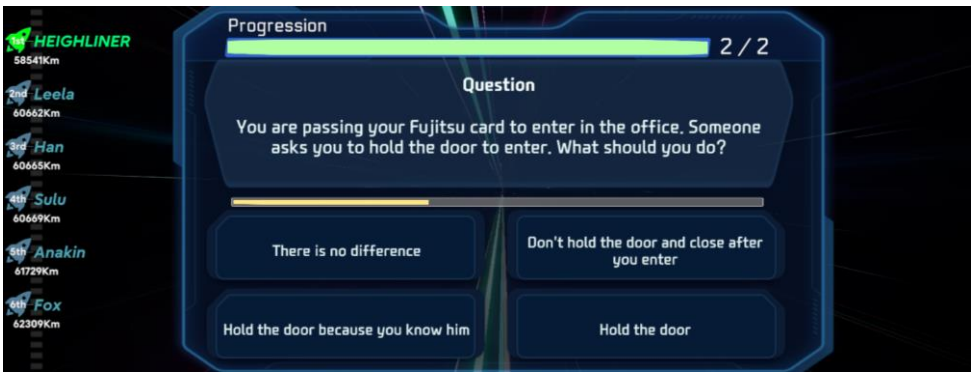


FIGURE 21 – KNOWLEDGE RETENTION QUIZ

3.6. Challenges and Considerations

Since the inception of this project, we have encountered a spectrum of complex challenges. These range from technical constraints to user adoption and system scalability, each presenting unique hurdles to overcome.

Technical Constraints:

- Processing Demands: The initial system required significant processing power, posing a challenge for smooth operation. Our development team focused on system optimization to reduce the processing load, enhancing user experience.
- Security and Accessibility: Company policies prohibits software installation on machines, prompting a shift to a web-based platform. This approach offered benefits like simplified version management but introduced its own challenges. It limited the scope of development and increased server processing requirements.
- Audio Integration Issues: Due to the web-based nature and security protocols, integrating microphones directly into the environment was infeasible. We addressed this issue by running a Microsoft Teams session in parallel, enabling audio communication alongside the metaverse experience but this meant no spatial audio capability was possible to implement in the solution, as present in other systems. Spatial audio is a technology used to create the illusion of sound propagation, reflection, reverberation, diffusion and other audio effects, in a three-dimensional space. Spatial audio can simulate sounds coming from many directions, including above and below the listener, doppler effects, distance and depth, environmental acoustics, etc. This creates a more immersive and realistic audio experience, closely resembling how we perceive sounds in the real world.

User Adoption:

- Perception of Virtual Onboarding: Reactions to the virtual onboarding concept varied. Some users found it exciting, while others perceived it as a gaming gimmick. We addressed this by emphasizing the immersive nature of the experience, steering clear of gaming terminology to mitigate any prejudice.
- Ease of Use: Familiarity with virtual interfaces varied among users. Those accustomed to gaming adapted quickly, while others faced a learning curve. To assist, we implemented an introductory tutorial and encouraged pre-session practice, enabling users to familiarize themselves at their own pace.

System Selection:

- Platform: For organizations embarking on building a metaverse world, selecting the right platform is crucial. It's important to consider the existing range of technologies, each with distinct

advantages and drawbacks. While a platform like Unity is renowned for its extensive customization and development capabilities, integrating advanced features such as spatial audio or built-in web browsers can be challenging and, in our case, was not even part of the MVP development.

- Growth: Any platform chosen for the metaverse must be capable of supporting growth in user numbers and evolving in terms of functionalities and features. Key scalability considerations include the platform's architectural design, maintenance procedures, update frequency, and the economic model that sustains it. Conducting comprehensive stress tests during the development phase is imperative to ensure the system's robustness and adaptability.

In addressing these challenges, we adopted a strategy that combined innovation with practicality. This approach ensures that our metaverse solution is not only forward-thinking but also viable and sustainable for long-term application.

3.7. Summary

As we conclude Chapter 3, "Design and Development," it's essential to reflect on the key achievements and insights gained, while also casting an eye towards the future implications of this work.

This chapter has been instrumental in bridging the theoretical constructs of earlier discussions with the practical realities of implementing a metaverse solution for employee onboarding. It stands as a testament to the successful translation of abstract ideas into a tangible, functional system within an organizational context.

A key achievement of this chapter is the delivery of an artefact , a fully developed, user-ready metaverse system. This artefact is not just a theoretical model but a functional tool, tailored to meet the specific needs of the organization. Its development journey, meticulously chronicled in this chapter, demonstrates the project's feasibility and provides a practical roadmap for others to emulate.

The focus on user-centric design and development has been a cornerstone of this chapter. By prioritizing the needs and experiences of new employees, the project has successfully delivered a metaverse solution that is engaging, relevant, and effective for onboarding. This approach has ensured that the artefact is adaptable, scalable, and capable of meeting the evolving demands of virtual work environments.

Looking ahead, the insights and methodologies outlined in this chapter have broader implications beyond the immediate scope of this project. They provide a blueprint for organizations seeking to implement similar solutions, offering a proven pathway from conceptualization to real-world application. The iterative development process, user-centric design, and emphasis on practical viability set a standard for future projects in this space.

Moving forward, the next chapter focus on evaluating the impact of this metaverse solution. We assess how well the artefact has addressed the initial challenges and measure its effectiveness against the identified indicators. This evaluation is crucial, not only in gauging the success of the current project but also in providing essential insights for future implementations in this innovative and evolving field.

CHAPTER 4

Demonstration & Evaluation

This chapter delves into the fourth and fifth steps of the Design Science Research Methodology (DSRM): demonstration and evaluation. We explore the techniques employed to demonstrate the solution and the methodologies used for assessing its effectiveness. The chapter concludes with a detailed presentation of the results obtained.

4.1. Implementation and Demonstration

The implementation of our metaverse onboarding solution was marked by its simplicity and direct approach, with the onboarding facilitator playing a crucial role in both the development and deployment phases. His deep involvement in the development process was essential, ensuring that the flow and interactions within the metaverse were specifically tailored to the unique dynamics of our onboarding process. This not only led to technological innovation but also enhanced the practicality and user-friendliness of the tool, reducing the need for extensive training or complex preparations.

For the demonstration, we decided to completely replace the traditional Microsoft Teams onboarding sessions with the new metaverse experience for a trial period of one month. This decision was based on our confidence in the effectiveness of the metaverse solution, coupled with the understanding that we could revert to the existing process if necessary.

Despite our confidence in the new solution, we maintained the traditional onboarding method as a backup plan. This was a precautionary measure to ensure we were prepared to address any unforeseen challenges that might arise during the trial period.

The dry-run exercise, conducted just before the full-scale implementation and detailed on the previous chapter, was another critical component of our strategy. This session involved individuals who had not been part of the project, providing fresh perspectives and helping to confirm that all aspects of the metaverse solution were functioning as intended. The success of this dry-run was a key factor in our decision to proceed with the full implementation.

4.2. Evaluation Method

4.2.1. Procedure

To assess the impact of the metaverse solution implementation, we conducted a comparative study involving two groups of new joiners. The onboarding process, which occurs one day each week, encompasses all new employees who joined the company since the previous session.

- Reference Group: This group followed the conventional remote onboarding process and included employees who participated in onboarding sessions in October 2023. This group serves as a baseline for comparison.
- Treatment Group: This group experienced the newly developed metaverse-based onboarding solution. It comprised employees attending onboarding sessions in November 2023.

To gather comparative data from both groups, we employed two primary methods: online questionnaires (detailed in Annex A) using Microsoft Forms and a knowledge quiz directly in Unity (described in 3.5.3). A summary of methods and timings of these assessments is depicted in Table 3. Both questionnaires included a core set of identical questions for all participants to ensure comparability. However, the questionnaire for the treatment group featured additional questions specifically designed to gather insights on their metaverse experience. These extra questions primarily serve two purposes: they provide valuable feedback for refining future iterations of the metaverse solution and contribute additional qualitative data for a more nuanced understanding of its impact.

TABLE 3 - MEASURES

Instrument	Groups Targeted	How	When
Feeling of Social Presence	Both	Survey	Same day, after the session
Electronic Propinquity	Both	Survey	Same day, after the session
Sense of Presence in Virtual Environments	Treatment Group	Survey	Same day, after the session
Knowledge Retention	Both	Knowledge Quiz	During the session, at the end
Work Engagement	Both	Survey	2 Weeks after the session

Apart from the method of conducting the induction sessions, no other variables were altered. This consistency was crucial to ensure the validity of our comparison. The facilitator, the content of the knowledge shared, and even the knowledge quiz administered at the end of the sessions remained the same. By maintaining these constants, the primary variable distinguishing the two experiences was the platform used: the metaverse versus Microsoft Teams. This approach allowed us to isolate and evaluate the specific impact of the metaverse solution on the onboarding process.

4.2.2. Sample

The sample for this study comprised new employees who joined the company between September and November 2023. These employees were divided into two distinct groups based on their onboarding month, ensuring a balanced representation in each group.

- Reference Group Characteristics: consisting of 26 employees (n=26), this group experienced the standard remote onboarding in October 2023. The age range was 20 to 56 years, with an average age of 37, a SD of 9.95 and the group was 62% male.
- Treatment Group Characteristics: This group included 21 employees (n=21) who underwent a metaverse-based onboarding in November 2023. The age range was 21 to 54 years, with an average age of 35, a SD of 10.54 maintaining the same male percentage as the Reference Group.

Selection Criteria: Employees were automatically assigned to either group based on their joining date, which provided a random assignment and helped to reduce selection bias. This method ensured that the only significant difference between the groups was the onboarding method.

Participant Involvement: In this study, participants were broadly informed that the data being collected would contribute to improving the onboarding process, without delving into the specifics of the study. This general approach was aligned with the compulsory nature of the onboarding sessions as part of the company's policy. We prioritized maintaining the confidentiality of all responses to foster a climate of open and honest feedback. Alongside the surveys and quizzes, additional data was collected to categorize the sample, such as age and gender, but this information was handled with strict confidentiality. No sensitive personal data beyond these basic demographic details was gathered. It's important to note that while attendance at the onboarding session was mandatory, participation in the survey and quiz components of the study was voluntary, allowing employees to opt out without any consequences to their onboarding process or employment status.

4.2.3. Instruments

As previously noted, in addressing the challenge of new hire disconnection in remote environments, our research utilized a metaverse-based intervention. This method was part of the Design Science Research Methodology (DSRM) and aimed to improve engagement and knowledge retention. To investigate this, we have measured specific variables (see Figure 22) during the onboarding process both on Reference Groups and in Treatment Groups. We focused on variables that assess the effectiveness of our method (like sense of presence or proximity) and monitored fluctuations in key improvement desired indicators.

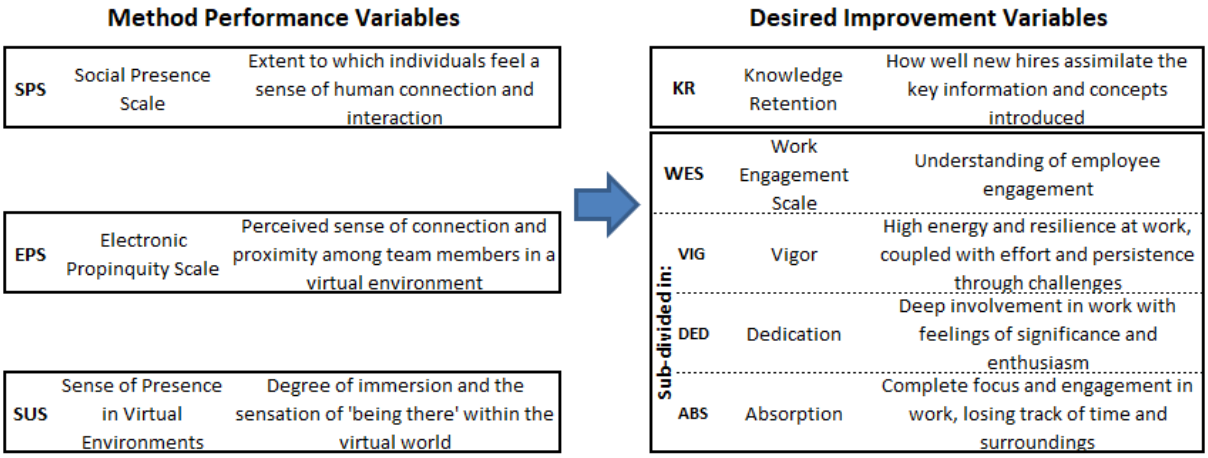


FIGURE 22 - VARIABLES MEASURED

Below is a detailed explanation of each instrument:

- **Social Presence Scale:** To effectively gauge the level of social presence experienced by new employees during our metaverse-based onboarding, we utilized a specialized questionnaire developed by C. N. Gunawardena and F. J. Zittle [59]. This tool is designed to measure the degree of social presence, a concept that refers to the extent to which individuals feel a sense of human connection and interaction in a virtual environment. The questionnaire focuses on the immediacy aspect of social presence. It comprises several items that embody this concept, aiming to capture the participants' perception of the medium as personal, immediate, interactive, sensitive, social, and warm. These dimensions are crucial in understanding how participants perceive and react to the presence of others within the virtual onboarding environment. The questionnaire's items are designed to elicit responses that reflect the participants' feelings towards the medium utilized, focusing on their reactions to other participants and activities within the group setting.

  The questionnaire comprises 12 items rated from 1 (Strongly Disagree) to 5 (Strongly Agree), contextualized for our settings (e.g., referencing Induction/Onboarding and the platforms used). Sample items include "I felt comfortable participating in the Induction" and "I felt comfortable interacting with others during the Induction".

  The reliability of the scale was assessed using Cronbach's alpha coefficient. Initially, the scale registered a Cronbach's alpha of 0,50, which did not meet the accepted reliability threshold of 0,7. In response, we conducted a detailed item analysis to determine if the removal of any of the 12 scale items could enhance reliability. It was identified that the item "Messages on Induction were impersonal" adversely affected the scale's reliability. This particular item was reverse-scored, which may have caused confusion among respondents, leading to inconsistent responses that could skew the reliability of the scale. Such reverse-scored items can often be misinterpreted or overlooked by participants, thus affecting the data's accuracy and reliability. Excluding this item

resulted in a revised Cronbach's alpha of 0,73, elevating the scale's reliability to an acceptable level. With this improved reliability, we could confidently proceed with further analysis.

- **Electronic Propinquity Scale**: In our study, we assessed the electronic propinquity among new employees during the metaverse-based onboarding process using an adapted version of the survey developed by Walther & Bazarova [60]. This survey is specifically designed to measure the perceived sense of connection and proximity among team members in a virtual environment. The survey comprises 5 items, each rated on a 1 to 5 scale, where the endpoints range from 'distant' to 'nearby', 'close' to 'far', 'together' to 'separate', 'proximal' to 'remote', and 'disconnected' to 'connected'. Lower scores on this scale indicate feelings of distance or disconnection, whereas higher scores suggest a sense of closeness or connection. By employing this survey, we aimed to quantitatively evaluate the psychological closeness perceived by employees towards their colleagues during the remote onboarding experience. Comparing the results from both the traditional and metaverse onboarding groups, our objective was to discern the metaverse's efficacy in creating a sense of team unity and psychological proximity, which is crucial in remote work settings.

  The reliability of the scale was assessed also using Cronbach's alpha coefficient. Initially, the scale registered a Cronbach's alpha of 0,667 which did not meet the accepted reliability threshold of 0,7. In response, we conducted a detailed item analysis to determine if the removal of any of the 5 scale items could enhance reliability. It was identified that the item " Select the option you think best describes your connection to facilitator and other participants while you were on the Induction session in regard to "distant-nearby" adversely affected the scale's reliability. Excluding this item resulted in a revised Cronbach's alpha of 0,713, elevating the scale's reliability to an acceptable level. With this improved reliability, the scale is now considered robust enough for further analysis.

- **Sense of Presence in Virtual Environments:** In evaluating the effectiveness of our metaverse-based onboarding, we also wanted to assess the depth of presence experienced by new employees. This concept encapsulates the degree of immersion and the sensation of 'being there' within the virtual environment. To quantitatively measure this, we have employed the Slater-Usoh-Steed (SUS) Questionnaire [61], a renowned tool in the field. The SUS Questionnaire is designed to evaluate 'stacking depth,' a phenomenon where participants perceive themselves as entering deeper levels of the virtual environment. Key factors such as the virtual world's adherence to physical laws, the behaviour of objects within it, and the scope of the visual field are all considered for their contribution to creating a sense of presence.

  The SUS comprises 6 items, integrated into the survey administered post-onboarding. Sample questions include "I had a sense of 'being there' in the virtual environment" and "There were times

during the experience when the office space was the reality for me" with responses from 1 (Not at all) to 5 (Very much). Although a 7-point scale is common, we opted for a 5-point scale to align with other measures in our study.

The reliability of the scale was also assessed using Cronbach's alpha coefficient. Initially, the scale registered a Cronbach's alpha of 0,86 which did mean a good internal consistency of data in scale. The scale was considered robust enough for further analysis.

- **Knowledge Retention**: To assess the effectiveness of the knowledge transfer, we continued the company's existing practice of administering a quiz at the end of the onboarding session. We had previously detailed it in 3.5.3 but in short, this quiz, comprising questions directly related to the information shared during the onboarding, served as a practical tool to measure the level of knowledge retention among new employees. By applying the same quiz to both groups, we were able to directly compare the effectiveness of both methods in terms of knowledge retention. This approach provides a straightforward yet effective means of evaluating how well new hires assimilate the key information and concepts introduced during their initial induction into the company. Regrettably, we encountered a system error that affected the data collection process, resulting in only 34 of the anticipated 47 participant results being successfully saved and retrieved. This technical glitch has been thoroughly investigated and subsequently rectified to ensure such an incident does not recur in future studies. Despite efforts to address this issue, it is important to note that the results which were not recorded due to this error are unfortunately irrecoverable, impacting the completeness of our data set.
- **Work Engagement Scale**: Finally, to evaluate the impact of our metaverse-based onboarding on employee engagement, we utilized the shorten version of the Utrecht Work Engagement Scale (UWES-9) [50]. The scale evaluates separately the 3 dimensions of Engagement, Dedication, Vigor and absorption. This scale, renowned for its robust psychometric properties can provide a nuanced understanding of engagement, including its distinction from burnout, making it an ideal tool for assessing the effectiveness of our onboarding process in fostering a positive and engaged workforce. The results from this scale help us understand the extent to which our immersive onboarding experience influences employees' long-term engagement and enthusiasm in their roles. we sought to gauge the impact of the onboarding experience by scoring employee engagement two weeks after they commenced their roles. The two-week interval was crucial because it marked the point at which employees transitioned from training to performing their job duties, offering a more accurate context for assessing their engagement levels. This measurement period was carefully chosen to ensure that we were evaluating the employees' engagement in their roles, directly influenced by their recent onboarding experience, while also fitting within the constraints of our project timelines. Unfortunately, since the survey was

performed later, despite issuing multiple reminders, we were able to collect only 28 replies in total, with 14 from each group, out of the 47 participants who attended the session.

The scale includes the 9 questions of the shorter version rated from 1 (Strongly Disagree) to 5 (Strongly Agree), such as “at my job, I feel strong and vigorous and “I am enthusiastic about my job.”

The reliability of the scale was assessed using again Cronbach’s alpha coefficient. The scale registered a high Cronbach's alpha of 0,86 which did mean a good internal consistency of data in scale. This scale was also considered robust enough for further analysis.

4.3. Results

4.3.1. Means, Standard Deviations and Intercorrelations between instruments.

Given the multitude of variables, the experimental design involving two groups (Reference and Treatment), and the relatively small sample size, we chose to analyse the data collectively for the entire sample pool (Table 4) as well as separately within each group (Table 5 and Table 6). The tables include the means, standard deviations, sample size and intercorrelations (using Pearson’s method for most correlations and Spearman’s on correlations with Gender). For ease of reference, values where significant correlations were found are highlighted in grey in the tables.

TABLE 4 - MEANS, STANDARD DEVIATIONS, SAMPLE SIZE AND INTERCORRELATIONS - BOTH GROUPS

		M	SD	N	1	2	3	4	5	6	7	8	9	10
1 SPS	Pearson Correlation	4.45	0.41	47										
	p-value													
2 EPS	Pearson Correlation	3.97	0.81	47	0.18									
	p-value				0.23									
3 SUS	Pearson Correlation	3.59	0.85	21	0.26	0.07								
	p-value				0.25	0.76								
4 Knowledge Retention	Pearson Correlation	77.65	13.27	34	-0.11	,358*	0.24							
	p-value				0.54	0.04	0.42							
5 WES	Pearson Correlation	3.90	0.60	28	,432*	0.18	,534*	-0.38						
	p-value				0.02	0.36	0.05	0.09						
6 Dedication	Pearson Correlation	4.11	0.74	28	0.29	0.22	0.42	-0.34	,879**					
	p-value				0.14	0.27	0.14	0.13	0.00					
7 Vigor	Pearson Correlation	3.76	0.71	28	0.30	0.05	,619*	-,442*	,798**	,575**				
	p-value				0.12	0.79	0.02	0.04	0.00	0.00				
8 Absorption	Pearson Correlation	3.82	0.73	28	,468*	0.19	0.16	-0.21	,828**	,638**	,427*			
	p-value				0.01	0.32	0.59	0.35	0.00	0.00	0.02			
9 Age	Pearson Correlation	36.02	10.15	47	0.12	0.08	0.22	0.18	0.26	0.10	0.09	,447*		
	p-value				0.41	0.60	0.34	0.31	0.17	0.60	0.65	0.02		
10 Gender	Pearson Correlation	-	-	47	0.18	0.20	0.31	-0.03	0.26	0.33	0.11	0.18	0.10	
	p-value				0.24	0.19	0.17	0.89	0.18	0.09	0.58	0.36	0.48	

*. Correlation is significant at the 0.05 level
**. Correlation is significant at the 0.01 level

TABLE 5 - MEANS, STANDARD DEVIATIONS, SAMPLE SIZE AND INTERCORRELATIONS - REFERENCE GROUP

		M	SD	N	1	2	3	4	5	6	7	8	9	10
1 SPS	Pearson Correlation	4.33	0.47	26										
	p-value													
2 EPS	Pearson Correlation	3.95	0.75	26	0.38									
	p-value				0.05									
3 SUS	Pearson Correlation	0.00	0.00	0	.a	.a								
	p-value													
4 Knowledge Retention	Pearson Correlation	76.19	13.96	21	-0.14	0.40	.a							
	p-value				0.54	0.07								
5 WES	Pearson Correlation	3.83	0.73	14	0.50	0.29	.a	-0.49						
	p-value				0.07	0.31		0.10						
6 Dedication	Pearson Correlation	4.10	0.81	14	0.49	0.29	.a	-0.45	,941**					
	p-value				0.08	0.31		0.14	0.00					
7 Vigor	Pearson Correlation	3.59	0.81	14	0.29	0.20	.a	-,647*	,808**	,636*				
	p-value				0.31	0.50		0.02	0.00	0.01				
8 Absorption	Pearson Correlation	3.80	0.85	14	,533*	0.29	.a	-0.29	,896**	,850**	0.51			
	p-value				0.05	0.31		0.36	0.00	0.00	0.06			
9 Age	Pearson Correlation	36.92	9.95	26	0.04	0.36	.a	0.40	0.41	0.31	0.16	,623*		
	p-value				0.86	0.07		0.07	0.14	0.29	0.60	0.02		
10 Gender	Pearson Correlation	-	-	26	0.21	0.36	.a	-0.02	0.17	0.32	0.02	-0.06	-0.08	
	p-value				0.30	0.07		0.94	0.57	0.26	0.95	0.85	0.68	

*. Correlation is significant at the 0.05 level
**. Correlation is significant at the 0.01 level
a. Cannot be computed because at least one of the variables is constant.

TABLE 6 - MEANS, STANDARD DEVIATIONS, SAMPLE SIZE AND INTERCORRELATIONS - TREATMENT GROUP

		M	SD	N	1	2	3	4	5	6	7	8	9	10
1 SPS	Pearson Correlation	4.61	0.25	21										
	p-value													
2 EPS	Pearson Correlation	4.00	0.89	21	-0.19									
	p-value				0.41									
3 SUS	Pearson Correlation	3.59	0.85	21	0.26	0.07								
	p-value				0.25	0.76								
4 Knowledge Retention	Pearson Correlation	80.00	12.25	13	-0.31	0.26	0.24							
	p-value				0.30	0.39	0.42							
5 WES	Pearson Correlation	3.98	0.46	14	0.21	0.16	,534*	0.06						
	p-value				0.48	0.57	0.05	0.88						
6 Dedication	Pearson Correlation	4.12	0.70	14	-0.06	0.19	0.42	-0.10	,806**					
	p-value				0.85	0.52	0.14	0.81	0.00					
7 Vigor	Pearson Correlation	3.93	0.57	14	0.01	0.03	,619*	0.14	,776**	0.52				
	p-value				0.98	0.92	0.02	0.73	0.00	0.06				
8 Absorption	Pearson Correlation	3.85	0.61	14	0.51	0.15	0.16	0.10	,694**	0.30	0.27			
	p-value				0.06	0.60	0.59	0.80	0.01	0.29	0.35			
9 Age	Pearson Correlation	34.90	10.54	21	,502*	-0.20	0.22	-0.18	0.15	-0.05	0.02	0.34		
	p-value				0.02	0.39	0.34	0.56	0.61	0.86	0.94	0.24		
10 Gender	Pearson Correlation	-	-	21	0.16	0.00	0.31	-0.04	0.52	0.33	0.31	0.44	0.35	
	p-value				0.48	1.00	0.17	0.89	0.05	0.25	0.28	0.11	0.12	

*. Correlation is significant at the 0.05 level
**. Correlation is significant at the 0.01 level

On all analyses, as expected, we can find statistically significant moderate or high positive correlations not only between the WES and the sub-variables Dedication, Vigor and Absorption, but also between those. More relevant, another correlation is identified between the SUS and WES, most specifically the vigor dimension of the scale showing an r of 0,619 and a p-value of 0,02 meaning a statistically significant positive moderate correlation. In the reference group we can also identify a statistically significant positive moderate correlation between SPS and Absorption with an r of 0,533 and p-value of 0,049 barely under the 0.05 threshold. This correlation is also present when looking at the entire data of both groups, but r drops to 0,468 while p-value improves greatly to 0,012. When looking at this potential correlation on the Treatment group, while r is 0,51 the p-value increase to 0,062 not achieving the figure of 0,05 that would allow to classify it statistically significant. Nevertheless, we must contextualize that this correlation on the Treatment group only includes a small

sample size (n= 14). A moderate correlation between age and the SPS was identified within the Treatment group, characterized by an r of 0.502 and a p-value of 0.02. This correlation did not hold as strongly when examining the reference group or the aggregated dataset of both groups. Finally, a low correlation but statistically significant can also be found between EPS and Knowledge Retention when looking at the entire sample of 34 people to whom we have the quiz results with r at 0,358 and p-value of 0,04.

4.3.2. Group comparisons

To assess differences between the Reference and Treatment groups, we analysed the mean and standard deviation for each variable, as well as the sample sizes. The results, which are detailed in Table 7, encompass a range of measures including age, gender, and various engagement indices. They provide a quantitative basis for understanding the impact of our intervention, with mean differences presented as percentages for a direct comparison.

Our analysis indicates an increase in the means of all measured variables (from SPS to ABS), with variations ranging from marginal (under 5% for EPS, WES, DED, and ABS) to moderate (between 5% and 10% for SPS, KR, and VIG). Conversely, a decrease in standard deviations across these variables suggests a convergence in employee responses, reflecting a more uniform perception or experience as a result of the onboarding process.

TABLE 7 - MEANS AND STANDARD DEVIATIONS

		Age	Gender	SPS	SUS	EPS	KR	WES	VIG	DED	ABS
Reference Group	Mean	36.92	0.62	4.33	N/A	3.95	76.19	3.83	3.59	4.10	3.80
	N	26.00	26.00	26.00		26.00	21.00	14.00	14.00	14.00	14.00
	Std. Deviation	9.95		0.47		0.75	13.96	0.73	0.81	0.81	0.85
Treatment Group	Mean	34.90	0.62	4.61	3.59	4.00	80.00	3.98	3.93	4.12	3.85
	N	21.00	21.00	21.00	21.00	21.00	13.00	14.00	14.00	14.00	14.00
	Std. Deviation	10.54		0.25	0.85	0.89	12.25	0.46	0.57	0.70	0.61
Mean Delta (%)		-5.5%	0.6%	6.7%		1.2%	5.0%	3.9%	9.3%	0.6%	1.3%

Given the constraints of a small sample size, next, we employed the Mann-Whitney U test, which is particularly effective for analysing non-parametric data from two independent samples. The results, as shown in Table 8 includes the mean ranks for the Reference and Treatment groups, their comparative analysis, and the statistical significance as indicated by Z-scores and p-values.

From the data, it's evident that mean ranks for most variables (from SPS to VIG) have seen increases, with SPS, VIG, and KR experiencing the most substantial rises. However, SPS is the only variable registering a p-value below the 0.05 threshold, denoting a statistically significant change. This suggests that the differences observed in SPS are not due to random chance and warrant further investigation to understand their implications fully.

TABLE 8 - MANN-WHITNEY U TEST

		SPS	EPS	KR	WES	VIG	DED	ABS
Mean Rank	Reference Group	20.154	23.173	16.548	14.286	12.786	14.500	14.643
	Treatment Group	28.762	25.024	19.038	14.714	16.214	14.500	14.357
	delta (%)	43%	8%	15%	3%	27%	0%	-0.020
Mann-Whitney U		173.000	251.500	116.500	95.000	74.000	98.000	96.000
Wilcoxon W		524.000	602.500	347.500	200.000	179.000	203.000	201.000
Z		-2.148	-0.467	-0.728	-0.138	-1.118	0.000	-0.093
p-value		0.032	0.640	0.466	0.890	0.264	1.000	0.926

4.3.3. Regressions between variables

For the correlations highlighted in 4.3.1, we further explored them using simple linear regressions.

- **SUS and Vigor:** The regression analysis indicates a significant positive linear relationship between Sense of Presence in Virtual Environments (SUS) scores and Vigor levels. This relationship accounts for 38.4% of the variance in Vigor scores (R^2 = 0.384), suggesting a moderate effect size. A significant regression coefficient (B = 0.385, p = 0.018) implies that for each unit increase in SUS score, there is a corresponding rise of 0.385 units in the Vigor score. This significant positive correlation is illustrated in Figure 23, where higher SUS scores tend to correspond with higher levels of Vigor.

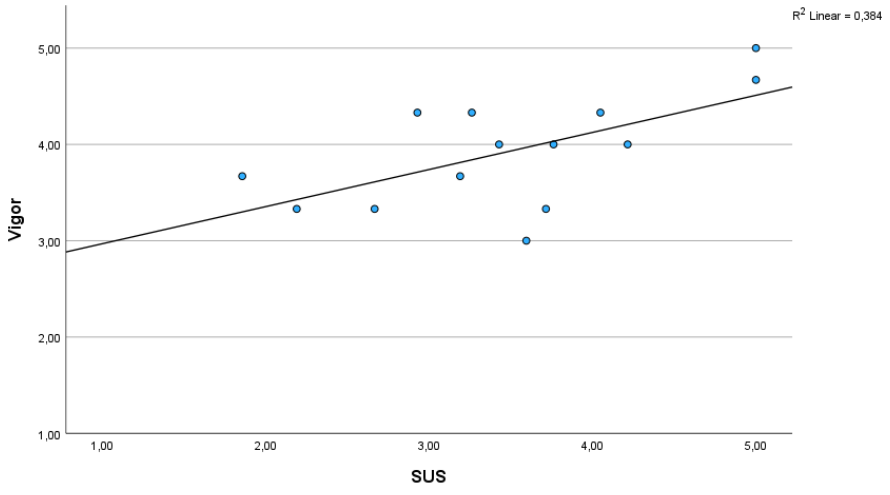


FIGURE 23 - SUS BY VIGOR SCATTER PLOT

- **SPS and Absorption:** The regression analysis showed a significant linear relationship between the Social Presence Scale (SPS) scores and levels of Absorption. The model accounts for 21.9% of the variance in Absorption scores (R^2 = 0.219), which can be considered a moderate effect size. The regression coefficient (B = 0.959, p = 0.012) indicates that for each unit increase in SPS score, there is a corresponding increase of 0.959 units in the Absorption score, denoting a statistically significant positive correlation. This relationship is graphically represented in the scatter plot, as seen in Figure 24, where a trend of higher SPS scores is associated with greater levels of Absorption.

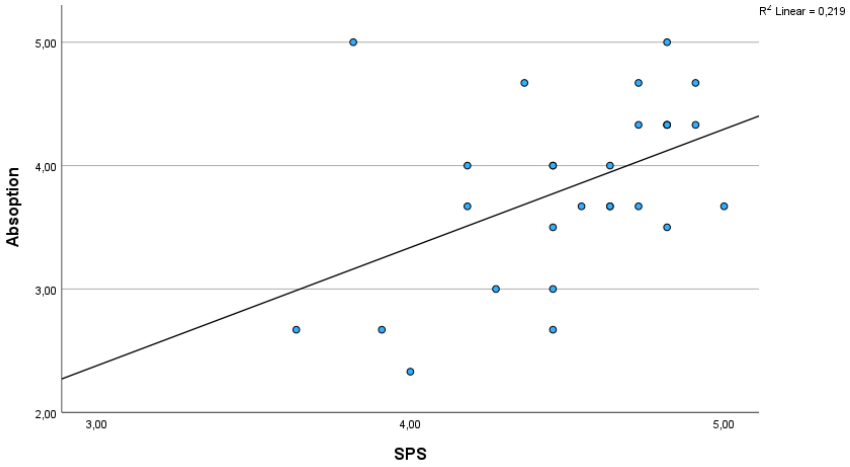


FIGURE 24 - SPS BY ABSORPTION SCATTER PLOT

- **Age and SPS:** the regression analysis revealed a statistically significant positive relationship between age and SPS scores, explaining 25.2% of the variance in SPS (R^2 = .252). The regression coefficient (B = .012, p = .021) indicates that with each additional year of age, there is an increase of .012 units in SPS score, suggesting that age is statistically significant positively correlated with the sense of social presence. This association is depicted in the scatter plot in Figure 25, with older participants tending to report higher SPS scores.

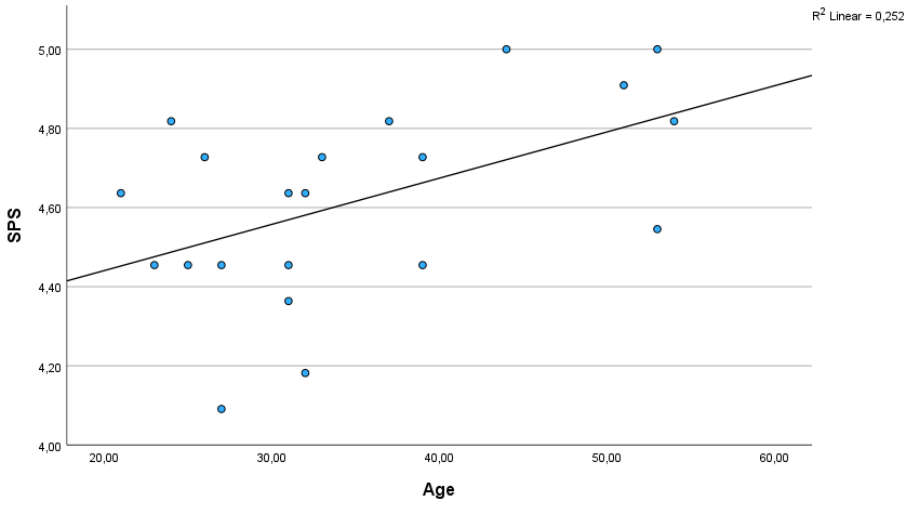


FIGURE 25 - AGE BY SPS SCATTER PLOT

- **PS and Knowledge Retention:** The regression analysis indicated a significant positive relationship between the Electronic Propinquity Scale (EPS) scores and knowledge retention. The model explains 12.8% of the variance in knowledge retention (R^2 = .128), suggesting a moderate relationship. The regression coefficient (B = 6.470, p = .038) suggests that higher EPS scores are associated with better knowledge retention. Specifically, for every one-unit increase in EPS, there is an expected increase of 6.470 points in the knowledge retention score. This relationship is

illustrated in the scatter plot in Figure 26, showing a trend where higher EPS scores correspond with better knowledge retention.

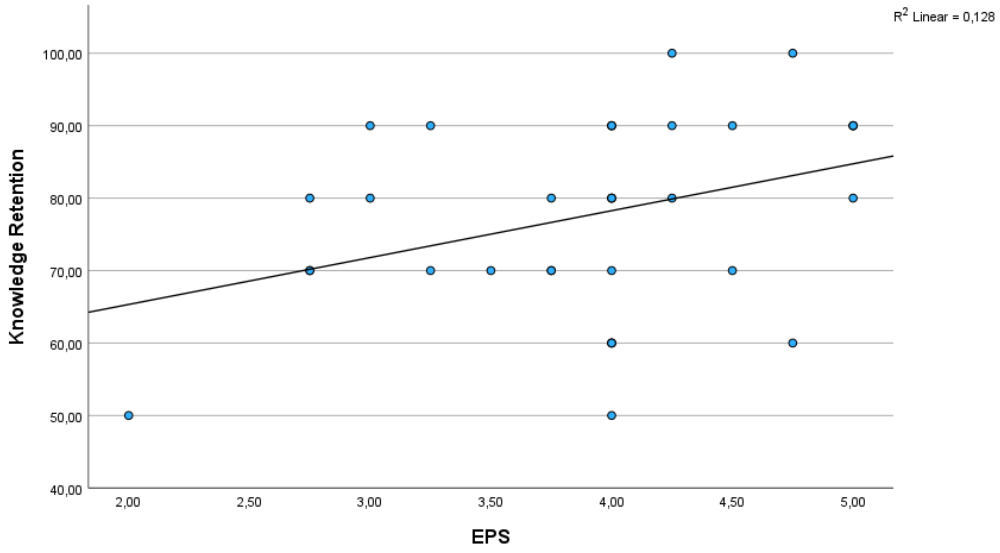


FIGURE 26 - EPS BY KNOWLEDGE RETENTION SCATTER PLOT

CHAPTER 5

Conclusion and future work

5.1. Summary of Findings

This thesis raised two main research questions objectives, each pivotal to improve our understanding and application of metaverse technology in the context of remote employee onboarding.

To properly answer the first research question, we established the objective of designing and implementing a metaverse-based solution for remote onboarding. This part of the project involved not only creating this solution but also detailing every step of the process and liaising with a team of developers and experts of the IS company. By developing and testing such solution, we were able to provide a comprehensive account that could benefit the company and the academia but could serve as a reference for other organizations seeking to adopt similar technologies in their remote work environments. Through this journey the process, from conception to execution, is thoroughly documented in Chapter 3, titled “Design and Development.” This chapter is integral to the thesis, offering an in-depth look at the practical application and the unique strategies we employed.

To address the second research question, we created another objective of this thesis, centred on exploring the metaverse-based solution's effectiveness and its potential impact on the employee experience, through a comprehensive analysis. In Chapter 4, we embarked on an exploration of how this technology influenced various state-of-the art instruments and metrics, with a particular focus on employee engagement and knowledge retention during the onboarding process.

Our analysis, following a between subject’s design, involved the examination of two distinct groups of recently hired employees. The first group, or Reference Group, followed the traditional onboarding method. The second group, the Treatment group, had the unique experience of utilizing the metaverse-based solution. This setup allowed us to make direct comparisons between the two groups' results, shedding light on the specific benefits of the metaverse-based approach.

Within this analysis, we employed two sets of dependent variables. The first group of variables concentrated on assessing employees' perceptions of the onboarding experience. To achieve this, we employed instruments such as the Social Presence Scale, Electronic Propinquity Scale, and Sense of Presence in Virtual Environments. These tools allowed us to gauge the subjective experiences of employees as they engaged with the metaverse-based onboarding process.

The second group of variables encompassed instruments used to measure factors that we hypothesized were dependent on the onboarding experience. This included an assessment of Employee Engagement, comprising variable dimensions such as Dedication, Vigor, and Absorption, as well as Knowledge Retention.

Our analysis unveiled several noteworthy findings, suggestive of the positive influence of the metaverse-based onboarding process. It's worth noting that while statistical significance wasn't consistently achieved, likely due to the reduced data sample, we observed a consistent pattern of improvement. Specifically, we noted an overall increase in the means of all measured variables and a reduction in standard deviations. These trends indicated a trend toward a better, more consistent and uniform employee experience, underscoring the effectiveness of the onboarding process. However, for a more focused examination, we direct our attention to the summary below, where we did identify statistically significant findings:

- **Increase in Social Presence (SPS):** There was a statistically significant increase in the Social Presence Scale (SPS) mean scores from the Reference Group to the Treatment group, suggesting that the metaverse-based onboarding effectively enhanced the sense of social presence and interaction in the virtual environment.
- **Correlation and linear relationship between the Sense of Presence in Virtual Environments (SUS) scores and the Vigor:** A regression analysis confirmed a large positive statistically significant correlation between the Sense of Presence in Virtual Environments (SUS) scores and the Vigor aspect of work engagement. This significant relationship highlights that a heightened sense of immersion in the metaverse environment is directly associated with an increase in employee Vigor.
- **Correlation and linear relationship between Social Presence Scale (SPS) scores and levels of absorption:** There was a moderate statistically significant positive correlation between Social Presence Scale (SPS) scores and the absorption aspect of work engagement, as per our regression analysis. This indicates that higher social presence correlates with greater levels of absorption among employees.
- **Correlation and linear relationship between age and SPS scores:** A regression analysis confirmed a large statistically significant positive correlation between age and SPS implying that older participants reported higher levels of social presence.
- **Lastly, a Correlation and linear relationship between EPS and Knowledge Retention:** Finally, a regression analysis confirmed a moderate statistically significant positive correlation between the Electronic Propinquity Scale (EPS) scores and knowledge retention. This suggests that enhanced perceived electronic proximity or connectedness in the virtual environment is associated with improved knowledge retention among employees.

5.2. Discussion

In this section, we delve deeper into the insights gleaned from two distinct yet interconnected facets of our study: the practical learnings derived from the design and implementation of our metaverse-based solution, and the interpretations of the empirical data obtained through the multiple analysis performed.

In the initial part of our discussion, we reflect on the invaluable insights gained during the design and implementation of our metaverse solution. A key realization that emerged was the dual nature of the metaverse: while it is a groundbreaking innovation, at its core, it remains a tool whose effectiveness is contingent upon its design and execution. The metaverse offers the potential to revolutionize user experiences, unlocking possibilities that were previously unimaginable. However, our journey revealed an intriguing aspect: the most profound impacts often stemmed from elements that replicated real-world scenarios. These familiar aspects, despite requiring minimal technological complexity, significantly enhanced the overall user experience. A prime example of this was the virtual hopscotch activity, depicted in Figure 19. which seamlessly blended the physicality of real-world interaction with the virtual realm. This experience also brought to light an essential lesson in the realm of technological development, the temptation of leveraging advanced features can sometimes lead us away from our primary objective of enriching the user experience. We learned that incorporating elements of familiarity in the metaverse not only made the experience more accessible but also more resonant with users. This discovery emphasizes the importance of striking a balance between harnessing the power of innovative technology and maintaining a connection with familiar, real-world experiences. It suggests that the most effective use of the metaverse might lie in its ability to complement and enhance real-life interactions, rather than attempting to replace them. This balance is crucial in ensuring that the metaverse remains a tool that is both advanced and relatable, capable of providing meaningful and engaging experiences to users.

Throughout this project, the application of agile software development concepts was not merely a procedural formality but a cornerstone of our success. Fundamental principles such as user-centric design, iterative development, and a focus on creating a Minimum Viable Product (MVP), were instrumental in shaping our metaverse solution. At the forefront of our approach was a user-centric design. This principle guided us to meticulously consider the end-user's perspective in every aspect of our design process. By prioritizing the user's needs and experiences, we developed a solution that was not just technologically robust but also, efficient, natural and simple to use. This approach ensured that each feature and functionality of the metaverse solution resonated with its intended users, thereby enhancing user satisfaction and engagement. Iterative development, a key aspect of agile methodologies, allowed us to enhance our solution continually. This approach empowered us to

dynamically adapt to feedback, make swift modifications, and evolve our solution in alignment with real-time user needs and technological advancements. Such flexibility was particularly crucial in navigating the unique challenges and opportunities presented by the metaverse environment, allowing us to fine-tune our solution to perfection. Finally, the MVP concept played a pivotal role in propelling our project forward. Initially, we concentrated on developing a basic but functional version of our solution, which enabled us to launch a prototype expeditiously. This approach was instrumental in our ability to rapidly test ideas in a real-world setting, gather valuable user feedback, and implement iterative enhancements. This strategy effectively circumvented potential issues of over-engineering and deviation from our core objectives. The focus on MVP facilitated a streamlined development process, ensuring that we stayed true to our vision while adapting to practical considerations and user feedback. These agile practices ensured that our metaverse solution was not only a technological achievement but also a practical, user-friendly tool tailored to real-world applications. Our experience and the lessons learned offer a blueprint for other organizations seeking to integrate similar technologies. These insights provide valuable strategies for successfully navigating the complexities of innovative technology implementation, underscoring the importance of agility, user-centricity, and adaptability in today's dynamic technological landscape.

In the second part of our discussion, we explore in depth the implications of the empirical data collected from our various instruments, focusing on how these findings reveal the impact of the metaverse on the remote onboarding experience.

The distinct increase in Social Presence Scale (SPS) scores for employees onboarded through the metaverse marks a significant shift in the way they perceive and engage with the virtual onboarding environment. This heightened sense of social presence embodies a deeper, more meaningful sense of connection and community within the virtual space. Such a strong presence is pivotal in overcoming the sense of isolation that can often accompany remote work settings. This enhancement in social presence has several far-reaching implications for organizational culture. It suggests that the metaverse can play a crucial role in building more cohesive teams. When employees feel a stronger sense of social presence, they are more likely to develop bonds with their colleagues, even in a remote setting. This can lead to improved teamwork, greater empathy among team members, and a more supportive work environment. Moreover, the increase in SPS scores also indicates a potential for fostering a stronger sense of belonging among remote employees. This sense of belonging is key to employee engagement and retention. When employees feel like they are part of a community, they are more likely to be committed to their organization, feel valued, and be satisfied with their job. This could be particularly beneficial for organizations that rely heavily on remote work, as it can help in creating a sense of unity and shared purpose, despite the physical distances. In terms of the broader impact, these findings challenge and reshape traditional approaches to remote work and team

integration. They suggest that virtual onboarding in the metaverse can be more than just an informational exercise, but it can be an opportunity to establish a strong organizational culture from the outset. The implications extend to how we design onboarding programs, emphasizing the creation of engaging, interactive, and socially rich virtual environments that replicate the best aspects of in-person interactions. This shift towards enhancing social presence in virtual settings could pave the way for a new era in remote working, where digital spaces are designed not just for efficiency, but also for fostering a sense of community and belonging. Organizations can harness this understanding to create more engaging, inclusive, and effective remote work environments, potentially leading to higher levels of employee satisfaction and stronger organizational loyalty.

The correlation observed between Social Presence Scale (SPS) scores and the degree of work Absorption highlights the transformative power of social elements in virtual environments. When employees experience a heightened sense of social presence within these spaces, as evidenced by increased SPS scores, there's a notable enhancement in their focus and involvement in work tasks. This connection between social presence and work absorption is not only statistically significant but also reveals a deeper psychological impact on employees. When we integrate this understanding with the previously discussed enhancement in social presence through metaverse-based onboarding, a compelling narrative emerges. The increase in SPS, facilitated by the immersive and interactive nature of the metaverse, leads to a subsequent improvement in employee absorption. This means that the metaverse's ability to create a strong sense of social connectedness and presence directly contributes to a deeper level of employee engagement and immersion in their work. It's an indication that the metaverse experience reshapes not just the method of interaction, but also the quality and depth of employee engagement. This insight has significant implications for the design and implementation of virtual work environments. It suggests that by integrating social features that foster a sense of presence and connectivity, organizations can enhance employee concentration and dedication to their tasks. This could involve designing virtual spaces that encourage interaction, collaboration, and a sense of community, much like in a physical office setting. This has potential benefits for employee well-being, as increased absorption in work can lead to a more fulfilling and satisfying work experience, reducing feelings of isolation and disconnection often associated with remote work. In essence, the metaverse's impact on increasing SPS and thereby improving work absorption represents a paradigm shift in how we understand and optimize remote work environments. It underscores the importance of designing digital workspaces that are not just functional, but also socially enriching, thus fostering a more engaged, focused, and connected workforce.

The correlation we observed between the Sense of Presence in Virtual Environments (SUS) scores and employee Vigor provides a strong case for integrating immersive technologies in enhancing workplace engagement. This finding reveals a deeper psychological impact on employees. A

heightened sense of presence in a virtual environment, the feeling of being 'there' in a digital space, appears to significantly elevate employee energy and enthusiasm levels. This increase in Vigor, a critical component of work engagement, points to more than just a boost in morale. It signals a potential shift in the overall work dynamic, where employees are not just present but are energetically involved and invested in their tasks. The implications of this for workplace productivity are substantial. Energized employees are likely to be more productive, show greater initiative, and contribute more creatively to their tasks. Moreover, this increased Vigor could lead to better job satisfaction, as employees find more fulfilment and motivation in their work. From an organizational perspective, this insight into the relationship between virtual presence and Vigor opens new avenues for designing work environments. Companies can leverage immersive technologies to create more engaging virtual workspaces, where employees feel a stronger sense of presence and connection. This could involve developing more interactive and immersive virtual meetings, collaborative projects in virtual reality (VR) settings, or even virtual office spaces that replicate the dynamics of physical workplaces. Furthermore, this finding encourages a rethinking of remote work strategies. Instead of merely replicating physical office environments, there is an opportunity to reimagine them in ways that harness the unique advantages of virtual spaces. For example, virtual environments can be designed to facilitate focused work without the distractions of a physical office, or to create unique collaborative experiences that are not possible in the real world. In essence, by embracing the potential of immersive technologies to enhance the sense of presence in virtual environments, organizations can not only improve employee Vigor but also foster a more dynamic, engaging, and satisfying work experience. This approach has the potential to redefine the concept of workplace engagement in the increasingly digital world of work.

The observed correlation between the Electronic Propinquity Scale (EPS) scores and Knowledge Retention underscores the critical role of perceived connectedness in virtual learning environments. This finding highlights a fundamental aspect of how individuals assimilate and retain new information in remote settings. Perceived connectedness, as measured by EPS, refers to the sense of closeness or psychological proximity that individuals feel towards others when interacting through electronic media. In the context of the metaverse, this translates to how effectively the virtual environment simulates a sense of being together, despite the physical distance. Our study shows that higher levels of this perceived connectedness are directly associated with better knowledge retention among employees. This suggests that when employees feel more connected to their trainers and peers in a virtual setting, they are more likely to absorb and remember the information presented. This has profound implications for the design of virtual training and onboarding programs. To leverage this insight, organizations should focus on creating virtual environments that foster a strong sense of proximity and engagement. This could involve the use of immersive technologies that mimic face-to-

face interactions, the implementation of collaborative tasks that encourage interaction, or the design of virtual spaces that are conducive to group learning and discussion. Moreover, the finding also points to the need for a personalized approach to virtual training. Recognizing that different employees might perceive electronic proximity differently, training programs can be tailored to meet diverse needs, ensuring that each participant feels connected and engaged. This could mean offering various modes of interaction within the metaverse, such as one-on-one sessions, group discussions, or interactive learning modules, allowing employees to engage in ways that best suit their preferences. In essence, by enhancing the sense of electronic proximity in virtual training environments, organizations can not only make their training more efficient and effective but also contribute to a more engaging and satisfying learning experience for remote employees. This approach could lead to better knowledge assimilation, higher retention rates, and ultimately, a more competent and confident workforce.

Lastly, building on the at first sight intriguing correlation between age and Social Presence Scale (SPS) scores in the metaverse, it is evident that older employees may experience a heightened sense of social presence in virtual environments. This phenomenon could stem from the diverse generational interactions and experiences with technology. Such a finding is particularly significant, considering the different ways in which various age groups engage with and perceive technological platforms. The metaverse, by offering a rich, immersive experience, appears to resonate more profoundly with older employees, potentially because it bridges a gap in their digital experiences or fulfils a distinct social need. Delving into the specifics, the concept of social presence in the metaverse for older employees could be influenced by factors such as a desire for more meaningful social interactions or a comfort in more structured, virtual settings. As suggested by the literature on work design and aging [62], older workers might value clear, direct communication and well-defined social structures, which the metaverse can effectively simulate. Moreover, the preference for certain types of interactions, perhaps more collaborative or mentorship-oriented, could also be more effectively facilitated in such a setting. Given these insights, tailoring onboarding experiences in the metaverse to accommodate age-related preferences becomes crucial. Customization could include varying the pace of training, the complexity of virtual interactions, and the type of content delivered, aligning them with the cognitive and social needs of different age groups. For older employees, this might mean creating more guided, interactive experiences that provide a sense of familiarity and ease in navigation. Furthermore, integrating learning styles that resonate with different age groups can make the metaverse a more inclusive and effective tool. For instance, incorporating elements that leverage the crystallized intelligence and experiential learning preferences of older employees can enhance their engagement and learning outcomes. This approach not only respects the diversity of the workforce but also ensures that the metaverse serves as a unifying, rather than segregating, platform for employee development.

In conclusion, recognizing and harnessing the unique ways in which different age groups interact with

and benefit from the metaverse can significantly enhance the onboarding and training experiences. By customizing these experiences to be sensitive to age-related preferences and learning styles, organizations can ensure the metaverse is not just a technological novelty, but a pivotal tool in fostering an inclusive, efficient, and engaged workforce.

5.3. Limitations of the Study

Our study, aiming to be thorough, still faced several challenges in both its design and implementation. These limitations are important to recognize as they offer insights for future research in this evolving area. The main limitation was the study's time frame, which was six months. This meant we could only include new employees who joined within a two-month period. As a result, our sample size was relatively small. For example, some of our surveys only received about 21 responses. This small number of responses could affect the strength of our statistical analysis. It also means that the improvements we observed might not be as significant as they would appear with a larger and more varied group of participants. Another notable challenge involved the mandatory choice of a web-based platform. While it facilitated aspects like version management, it imposed restrictions on development flexibility. Of all the technical limitations, the absence of spatial audio stood out as particularly significant. This feature, had it been implemented, could have substantially enhanced the overall employee experience in the virtual environment.

The study also encountered hurdles in data collection. A system error during the process compromised the Knowledge Retention data collection, leading to the loss of a portion of the expected data. This technical issue not only further diminished our already limited sample size but also restricted our ability to fully analyse and interpret the impact of our solution on knowledge retention among participants. These limitations highlight areas for improvement in future research and underline the need for caution in generalizing the study's findings. They also provide valuable insights into the challenges of conducting research in rapidly evolving technological domains such as the metaverse.

5.4. Recommendations for Future Research

Building upon the insights garnered and acknowledging the limitations of our current study, we propose several avenues for future research that can expand and deepen our understanding of the metaverse in remote onboarding and employee engagement. An important direction for future studies is to encompass a more diverse and larger sample size. This approach would enhance the generalizability of the findings, allowing for a more representative understanding of the metaverse's impact across various populations. It would be particularly insightful to explore how the metaverse onboarding experience translates across different industries and cultural contexts. Additionally,

examining its effects on various demographic groups could shed light on the nuances of how diverse employee segments interact with and benefit from virtual reality technologies in onboarding processes. Another critical area for further research is examining the long-term effects of metaverse-based onboarding. Future studies should aim to investigate how this innovative approach to onboarding influences key organizational metrics such as employee performance, retention, and job satisfaction over extended periods. This perspective would provide invaluable insights into the sustained impact and efficacy of virtual onboarding solutions, helping organizations understand the long-term value and return on investment of these technologies.

Furthermore, there is an interesting aspect of virtual reality that warrants deeper exploration, the degree of immersion and its effect on the user experience. Future research should investigate how varying levels of immersion in virtual reality environments influence the sense of social presence among users. This could involve comparative studies of fully immersive VR environments, where users are entirely absorbed in the virtual world, versus less immersive or semi-immersive environments (like the one designed for this study). Understanding the implications of different levels of immersion on factors such as user engagement, comfort, and effectiveness of the onboarding process could significantly contribute to the design and implementation of more effective virtual workspaces. These recommendations are aimed at not only addressing the limitations of our current study but also at broadening the scope of research in this field. By exploring these new dimensions, future studies can significantly contribute to the application and understanding of virtual reality technologies in workplace settings, paving the way for more innovative, effective, and user-centered work environments.

5.5. Final Thoughts

As we conclude this study, it presents a perfect opportunity to look back and assess what was achieved. We began this journey with a definitive purpose, to innovate the process of remote onboarding, fully acknowledging the permanence of remote work in today's world. Our goal extended beyond merely developing a new solution; we aimed to significantly influence how new employees perceive and interact with a company during their initial remote onboarding and to understand the impact of this experience on their future within the company. This research has showcased that the metaverse offers unparalleled opportunities for crafting more engaging, inclusive, and productive work environments. In an era where organizations are continually adapting to the nuances of remote work, the integration of technologies like the metaverse could be instrumental in tackling challenges related to employee engagement, retention, and productivity. With its capability to create immersive and interactive experiences, the metaverse is at the cutting edge of this technological wave, providing insights into

what the future of work could look like. However, as we move forward with these technological advancements, it's imperative to keep in mind the challenges and limitations encountered, as underscored in our study. The path to fully harnessing the metaverse's potential in professional settings is lined with the need for continuous innovation, diligent research, and a dedication to surmounting both technical and practical obstacles. As reiterated throughout our research, the metaverse is fundamentally a tool, and the success or failure of its implementation is largely dependent on the individuals behind its adoption and use.

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Annex A – Questionnaires

Social Presence Scale

1. Messages on Induction were impersonal.*
2. Teams/metaverse is an excellent medium for social interaction.
3. I felt comfortable conversing during the Induction.
4. I felt comfortable introducing myself on the Induction.
5. The introductions enabled me to form a sense of online community.
6. I felt comfortable participating in the Induction.
7. The moderator created a feeling of an online community.
8. The moderator facilitated discussions during the Induction.
9. Discussions Teams/metaverse tend to be more impersonal than face-to-face discussions.
10. I felt comfortable interacting with other participants in the Induction.
11. I felt that my point of view was acknowledged by other participants in Induction.
12. I was able to form distinct individual impressions of some Induction participants even remote.

*Reversed scale

Likert scale used: l=Strongly Disagree, 2=Disagree, 3=Uncertain, 4=Agree, 5=Strongly Agree

Electronic Propinquity Scale

1. Select the option you think best describes your connection to facilitator and other participants while you were on the Induction session in regards to "distant-nearby"
2. Select the option you think best describes your connection to facilitator and other participants while you were on the Induction session in regards to "close-far"*
3. Select the option you think best describes your connection to facilitator and other participants while you were on the Induction session in regards to "together-separate"*
4. Select the option you think best describes your connection to facilitator and other participants while you were on the Induction session in regards to "proximal-remote"*
5. Select the option you think best describes your connection to facilitator and other participants while you were on the Induction session in regards to "disconnected-connected"

*Reversed scale

Likert scale used: l=Strongly Disagree, 2=Disagree, 3=Uncertain, 4=Agree, 5=Strongly Agree

WORK ENGAGEMENT SCALE

1. At my work, I feel bursting with energy.
2. At my job, I feel strong and vigorous.
3. I am enthusiastic about my job.
4. My job inspires me.
5. When I get up in the morning, I feel like going to work.
6. I feel happy when I am working intensely.
7. I am proud on the work that I do.
8. I am immersed in my work.
9. I get carried away when I'm working.

Likert scale used: l=Strongly Disagree, 2=Disagree, 3=Uncertain, 4=Agree, 5=Strongly Agree

SLATER-USOH-STEED QUESTIONNAIRE (SUS)

1. Please rate your sense of being in the virtual environment, on the following scale from 1 to 5, where 5 represents your normal experience of being in a place.
   I had a sense of ‘‘being there’’ in the virtual environment:
   (1) Not at all. (5) Very much.

2. To what extent were there times during the experience when the virtual environment was the reality for you?
   There were times during the experience when the office space was the reality for me. . .
   (1) At no time. (5) Almost all the time

3. When you think back about your experience, do you think of the virtual environment more as images that you saw, or more as somewhere that you visited?
   The virtual environment seems to me to be more like. . .
   (1) Images that I saw. (5) Somewhere that I visited.

4. During the time of the experience, which was strongest on the whole, your sense of being in the virtual environment, or of being elsewhere?
   I had a stronger sense of. . .
   (1) Being elsewhere. (5) Being in the virtual environment.

5. Consider your memory of being in the virtual environment. How similar in terms of the structure of the memory is this to the structure of the memory of other places you have been today? By ‘‘structure of the memory,’’ consider things like the extent to which you have a visual memory of the office space, whether that memory is in color, the extent to which the memory seems vivid or realistic, its size, location in your imagination, the extent to
   which it is panoramic in your imagination, and other such structural elements.
   I think of the virtual environment as a place in a way similar to other places that I’ve been today. . .
   (1) Not at all. (5) Very much so.

6. During the time of the experience, did you often think to yourself that you were actually in the virtual environment?
   During the experience I often thought that I was really standing in the virtual environment. . .
   (1) Not very often. (5) Very much so.