Doing Business in the Healthcare Metaverse

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Abstract

Title: Doing Business in the Healthcare Metaverse – Identification of critical success factors for conducting business in the healthcare metaverse

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Our healthcare systems are characterized by complexity, high costs and operational inefficiencies. Enormous expenditure, coupled with unequal access and the misallocation of healthcare investment, present a multi-faceted challenge. The recent global pandemic has also shown several limitations of our healthcare systems and the potential role of technology in improving accessibility and overall efficiency. Innovations, including advanced digital solutions such as Virtual Reality and moreover the metaverse, promise to transform healthcare. The metaverse arises thereby as a promising technology concept but there is a need to better understand how to explore business opportunities in the healthcare metaverse successfully. This study investigates critical success factors that are essential for conducting business in the healthcare metaverse. By exploring the perspectives from several experts (n=15) with involvement in the healthcare metaverse, this study aims to provide a comprehensive understanding of critical elements required to develop business implications through healthcare metaverse services. With an integrative approach encompassing business, technology, medicine and science, the identified success factors were hardware, accessibility, affordability, adaptivity, partnerships, experiences and regulations. Furthermore, it has been observed that successful metaverse adoption in healthcare should be extended upon monetization, organizational, standardization and scientific aspects. These success factors can serve as recommendations for those doing or starting business in the healthcare metaverse. Going forward, to improve the healthcare system and to ensure fair consideration of all success factors, the study argues in favor of collaboration between the relevant stakeholders from different sectors to improve the implementation dealing with all of the critical success factors.

Keywords: healthcare, virtual reality, augmented reality, digital health, digital transformation, medtech, e-health, business opportunities, success factors, business models

Resumo

Título: Doing Business in the Healthcare Metaverse - Identificação de fatores críticos de sucesso para a realização de negócios no setor dos cuidados de saúde no metaverso

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Os sistemas de saúde são caracterizados por complexidade, custos elevados e ineficiências operacionais. Despesas significativas, juntamente com a desigualdade de acesso e a má alocação de investimentos em saúde, apresentam um desafio multifacetado. A recente pandemia expôs limitações nos sistemas de saúde e deu destaque ao potencial da tecnologia na melhoria da acessibilidade e eficiência. Inovações, como a realidade virtual e o metaverso, prometem transformar os cuidados de saúde. Este estudo tem como objetivo investigar os fatores críticos de sucesso para negócios no sector dos cuidados de saúde no metaverso, explorando as perspetivas de peritos na matéria em causa (n=15). Pretendeu-se chegar a uma compreensão mais profunda e abrangente dos fatores críticos de sucesso necessários para desenvolver soluções comerciais de serviços no setor dos cuidados de saúde no metaverso. Através de uma abordagem integradora, incluindo conhecimentos de gestão, tecnologia, medicina e ciência, foram identificados como fatores de sucesso os seguintes: hardware, acessibilidade, acessibilidade econômica, adaptabilidade, parcerias, experiências e regulamentação. Foram observadas variações, indicando que a adoção do metaverso na saúde depende sobretudo da sensibilização e monetização. Estes dados traduzem-se em recomendações para aqueles que pretendem desenvolver negócios no metaverso da saúde. Para melhorar o sistema de saúde e garantir que estes fatores de sucesso são tidos em conta, o estudo defende a colaboração entre partes interessadas de diferentes setores.

Palavras-chave: cuidados de saúde, realidade virtual, realidade aumentada, saúde digital, transformação digital, tecnologia médica, saúde eletrónica, oportunidades de negócio, fatores de sucesso, modelos de negócio.

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Table of Content

List of Abbreviations

AI – Artificial Intelligence

AR – Augmented Reality

FDA – Food and Drug Association

IoT – Internet of Things

IT – Information Technology

MR – Mixed Reality

NFT – Non-Fungible Token

NHS – National Health Service

VC – Venture Capital

VR – Virtual Reality

XR – Extended Reality

3D – Three-dimensional

List of Tables

1. Introduction

The global pandemic revealed several limitations of our existing healthcare systems. Increasing healthcare costs, shortage of healthcare personnel, aging population and lacking infrastructure have proven that our healthcare systems are unstainable for the future (*Ozili & Arun 2023*). Thus, Covid-19 has compelled healthcare providers and innovators to seek for new solutions and business models in order to treat patients outside the hospital. Consequently, new models need to be established that enable healthcare away from the hospital into patient's home with the use of new technologies (*French et al. 2021*). To revolutionize the existing healthcare systems by delivering care, reducing costs and improving patient outcomes, the metaverse emerges as a transformative technology in the digital space with significant potential in healthcare (*Chengoden et al. 2023*). The metaverse is thereby an internet-based 3-dimensional (3D) virtual world where individuals can engage in daily activities using avatars to represent themselves, utilizing technologies that open new directions for providing high-quality healthcare treatment (*Kye et al. 2021*). The metaverse has been defined for already 30 years ago by science fiction novel *Snow Crash* (*Stepherson, 1992*) and rose to prominence at the end of 2021 with investments conducted by giant tech companies (*Ghose et al., 2022; Accenture 2022*).

Mark Zuckerberg, CEO of formerly Facebook, changed the name of his company to "Meta" because he is so certain that the metaverse is the way of the future. He committed to invest 10$ billion dollars on Facebook reality labs, which work on augmented reality (AR) and virtual reality (VR) to make "online worlds where people exist in immersive, virtual worlds". Microsoft is also integrating VR offices and avatars into its "Teams" remote collaboration software (*Bobrowski, 2021*). In addition, Torbay and South Devon NHS Foundation Trust is already piloting Microsoft's HoloLens2 and Dynamics 365 Remote Assist in its Breast Care Unit where specialist nurses send real time videos to consultants to get immediate advice on patient's needs (*Accenture, 2022*).

According to Accenture's Digital Health Technology Vision report, 81% of global healthcare executives worldwide say that the Metaverse's impact on the healthcare market will have a positive impact on their organization — nearly half of it call it "transformative" or a "breakthrough" (*Accenture, 2022*). Therefore, experts believe that the metaverse is about to explode. The next evolution of the internet is revolutionizing all industries, and healthcare is no

exception according to the experts. In fact, experts call it already the mediverse, as its promise for healthcare is transformative.

Given the significant economic, social and policy implications (*Bourlakis et al., 2009*), the metaverse is about to constantly grow (*Stackpole, 2022*) with the potential to reach 13 trillion dollars market value and five billion of total users by the year 2030 (*Ghose et al., 2022*). While the metaverse holds immense promise, especially in the healthcare sector, defining the business landscape within the healthcare metaverse remains a considerable challenge.

1.1. Problem definition

Previous studies on the metaverse have mainly focused on defining the metaverse in general and highlighting the opportunities and challenges in different sectors, including tourism, health and education (*Ritterbusch & Teichmann, 2023; Buhalis et al., 2022; Dwivedi et al., 2022*). However, there is no specific validation of business factors in the healthcare metaverse as of yet. As the demand for non-face-to-face technology services is continuously increasing due to COVID-19, the VR market will grow even more rapidly in the future. As the era of VR conversion is expected to approach, the industry needs to be prepared by developing business opportunities (*Lee, 2022).*

The problem definition lies in the fact that despite the general interest in the metaverse, no tailored research has been conducted to identify healthcare business opportunities in the metaverse. Previous research has focused on the general definition and global challenges of the healthcare metaverse, while the specific requirements and opportunities remain largely unexplored. Therefore, the identification of business models in this context is crucial to make a practice-oriented contribution and provide solid insights for the development of future strategies in the healthcare metaverse.

1.2. Aims and structure of this study

This study aims to explore and understand business factors that can promote success of companies working in or entering the healthcare metaverse by leveraging a wide range of opinions and experiences of various experts from the metaverse (*Lee, 2022*). These wide range of different perspectives are from representatives in the fields of business, medicine and academia, who have the unique opportunity to shape the metaverse in such a way that it not only brings economic success, but also promotes social goals.

Thus, the study becomes an important tool to understand the interactions between the different stakeholders and to identify the critical success factors that support the implementation of business models in the healthcare metaverse. Therefore, the main research question driving the paper is: *"What are the key success factors for conducting business in the healthcare metaverse?"* which was broken down into three sub question:

- *How can the healthcare metaverse be defined for the purpose of this thesis?*
- *What success factors can be identified in the literature and broader desk research for business in the healthcare metaverse?*
- *How does a set of experts interpret and add to the suggested set of potential factors?*

To achieve this, the study follows the following design:

1. Literature and desk research to try to answer the first two questions
2. Field research with a set of interviews for addressing the third question

The subsequent sections of this paper are organized as follows: Section 2 describes the research methodology used, including the data collection process, the approach and the analytical techniques. Sections 3 provides a comprehensive literature review and desk research that allows advancing a working definition of the healthcare metaverse. It also highlights the current state of the metaverse technology implementation in the healthcare sector, identifies research deficits and potential success factors. Section 4 presents the empirical findings from an expert panel's perspectives on the potential success factors. Section 5 discusses the empirical findings from the desk research around a final set of identified success factors and their implications for the healthcare sector. Section 6 offers a set of recommendations for academics, companies operating/entering the healthcare metaverse, telecommunication companies and health policy makers as well as a concise conclusion of the contribution of the study, a discussion of its limitations and suggestions for future research.

2. Methodology

The present scientific work is divided into two different parts. As described before, section 3 carries out a literature review and a broader desk research. Section 4 of this thesis deals with the results of primary research, in which qualitative expert interviews were conducted through semi-structured interviews. The suitability of doing a qualitative study on the subject is attributed to its originality (*Edmondson & Mcmanus, 2007*). Qualitative research is widely acknowledged for its ability to provide in-depth analysis and discover novel insights (*Gioia et al., 2012*). Moreover, it offers the possibility to gain a comprehensive understanding of a phenomenon from the viewpoint of the participants (*Orb et al., 2001*).

2.1. Research Design

The purpose of this study is therefore to explore applications for business opportunity development using metaverse services in the healthcare industry. This study will aid in identification of critical success factors in order to conduct business in the healthcare metaverse. The identification of critical success factors to enable business in the healthcare metaverse, will be identified through a comprehensive literature review and supported by desk research. The use of literature and broader desk research results from the emerging nature of the metaverse topic and at the same time, ensures a high variety of different sources. This analysis included scholarly articles, conference papers, corporate studies, industry reports and other relevant resources acquired from various sources in the healthcare industry and other industries. The databases searched were SienceDirect, PubMed, Google Scholar, SAGE Journals, IEEE and Scopus with keywords such as virtual reality, metaverse, digital healthcare, telemedicine, medtech and VR business models. It should be emphasized at this point that this is intentionally a comprehensive and not a systematic literature review, as the metaverse and especially the healthcare metaverse is partially limited in terms of literature due to its cutting-edge and innovative nature of the topic. The data obtained from the literature review serves as a comprehensive basis for a preliminary list of success factors for the healthcare industry in the metaverse.

As mentioned above, this study involves qualitative interviews, and the area of study is the healthcare industry. Semi-structured interviews are used in order to accomplish methodological triangulation and improve the results. The semi-structured interviews allowed participants to share their opinions and expertise and deepen the findings from the survey.

The aim of the interviews is to gain insights, perspectives and recommendations from experts on the identified success factors. Participants were encouraged to provide feedback on the preidentified success factors and to contribute additional insights based on their practical knowledge and real-life experiences during the interviews (*Waqar, Othman, Shafq and Altan, 2023; Lin, 2022*). The discussions covered many facets of implementing healthcare in metaverse, including opportunities, likely considerations as well as challenges. The feedback and suggestions from the industry experts helped to modify and refine the initial success factors that were identified from the literature.

The expected outcomes of the interviews were to confirm, disprove and or extend the preidentified success factors from the literature for business in the healthcare metaverse by incorporating different groups of experts. Another expected outcome of the interviews was to gain deeper insights into specific requirements and challenges and to gain a comprehensive perspective in how to conduct business in the healthcare metaverse.

2.2. Research instruments

Semi-structured interviews serve as a strategic approach for collecting data in order to get insights and understanding the phenomenon under investigation. The utilization of this approach in qualitative research is widespread owing to its adaptable and flexible characteristics, enabling the interviewer to gather relevant information on the designated subject matter while also affording the opportunity to spontaneously adapt based on the acquired responses. The objective is to get spontaneous and comprehensive responses that can foster meaningful discourse. Therefore, it is imperative that inquiries be formulated in a manner that allows for a broad range of responses, as suggested by *McIntosh and Morse (2015)*. The interviews were performed in a one-on-one format, with an average duration of 40 to 60 minutes each interview. The interviews were mainly performed in the English language while a few were conducted in German as this was the interviewer's preferred language, adhering to the previously developed interview guide. The interviews were performed in a remote manner, and the researcher explicitly communicated to the participants that their personal and job information, including their names and the names of their respective companies, would not be disclosed in the research. The rationale behind this decision is associated with the principle of secrecy, which was granted in order to foster a greater sense of ease and comfort for the interviewee, so facilitating the open expression of their views and opinions (*Woods & McNamara, 1980).*

2.3. Interview participants

A number of criteria were applied in the participant selection process. Participants had to, first and foremost, work inside the metaverse domain. The analysis was to include both business organizations and individuals with a medical background. The companies from the business world included various business models such as venture capital, start-ups, entrepreneurs, technology giants and consultancies, while the people with a medical background were doctors and researchers. The individuals with an academic background were people who either teach and/or research in this field. Their participation ensured a comprehensive and cross-functional perspective on the healthcare metaverse concept, with the business decision makers formulating concepts and the medical professionals providing insights based on their direct experience with the impact of the metaverse. In addition, the metaverse phenomenon has a global presence, which necessitated an international focus from the relevant experts.

The complete investigation of the topic is facilitated by the inclusion of professionals from several sectors which ensures a diverse range of opinions. The inclusion of several sectors provides a comprehensive portrayal of the relevant economic environment within the metaverse. For a comprehensive understanding, it is essential to understand the complex dynamics between the different business models and the different requirements of the healthcare metaverse. The utilization of a holistic research approach, which incorporates several perspectives, facilitates the provision of a thorough and equitable evaluation of the difficulties and opportunities within the healthcare metaverse. This not only enhances the credibility of the research, but also facilitates the conduction of analyses that are applicable to real-world scenarios. The involvement of professionals from many fields increases the practical applicability of the results in relation to real business situations. In general, the involvement of a diverse group of experts increases the validity and significance of the results obtained in answering my research questions.

In line with the above criteria, Table 1 provides a comprehensive summary of the participants' attributes, including the company, position and industry segment, the participants are currently working in. The involvements of participants in this work is denoted by their respective identifier (AC for academic individuals, BU for business individuals and ME for medical individuals), followed by the company letter and a numeric identifier. For example, BUb-2 represents the second business expert from the company BCG. Table 2 shows the geographic

distribution of the experts while table 3 displays the distribution of the professional background of the experts. The interview script can be found in the appendix.

Identifier	**Company**	**Role**	**Industry**	**Background**
ACw-1	Woxson University	Associate Dean, Director of the AI Research Centre	Education	Academic
ACw-2	Woxson University	Teaching professor in healthcare informatics	Education	Academic
ACu-3	University of Bari	PhD Student in Management Engineering	Researcher	Academic
ACb-4	Bentley University	Professor of Computer Information Systems	Researcher	Academic
BUz-1	ZEB	IT-Consultant	Consultancy	Business
BUb-2	BCG	Healthcare-Consultant	Consultancy	Business
BUm-3	Microsoft	Hololense Go-To Market Manager (Healthcare sector)	Tech corporation	Business
BUd-4	DoBrain	CEO of healthcare company	Start-up	Business
BUg-5.	Greenfield Capital	Investment Analyst	Venture Capital	Business
BUm-6	Med-Tech World	Healthcare futurist/ speaker	Entrepreneur	Business
BUc-7	Calm/Storm Ventures	Investment Analyst at healthcare ventures	Venture Capital	Business
MEc-1	Católica Medical School	Medical Student and researcher in the healthcare metaverse domain	University	Medical
MEm-2	MedicalIP	CEO	Start-up	Medical
MEn-3	Nicklaus Children's Health System	Pediatric cardiovascular surgeon	Medical Doctor	Medical

MEa-4	Aimedis	CEO & Founder	Start-up	Medical

Table 1: Interview participants

The pool of interviewees consisted of experts from all around the world, namely from Germany, Austria, Switzerland, the Netherlands, Italy, Portugal, Korea, United States, India and the United Arab Emirates. Recordings of interviews have been conducted to showcase the gathering of information, along with the solicitation of voluntary and in- formed consent from the respondents. To ensure adequate preparation prior to the interviews, open access information was utilized to gather background information about the organizations and the interviewees.

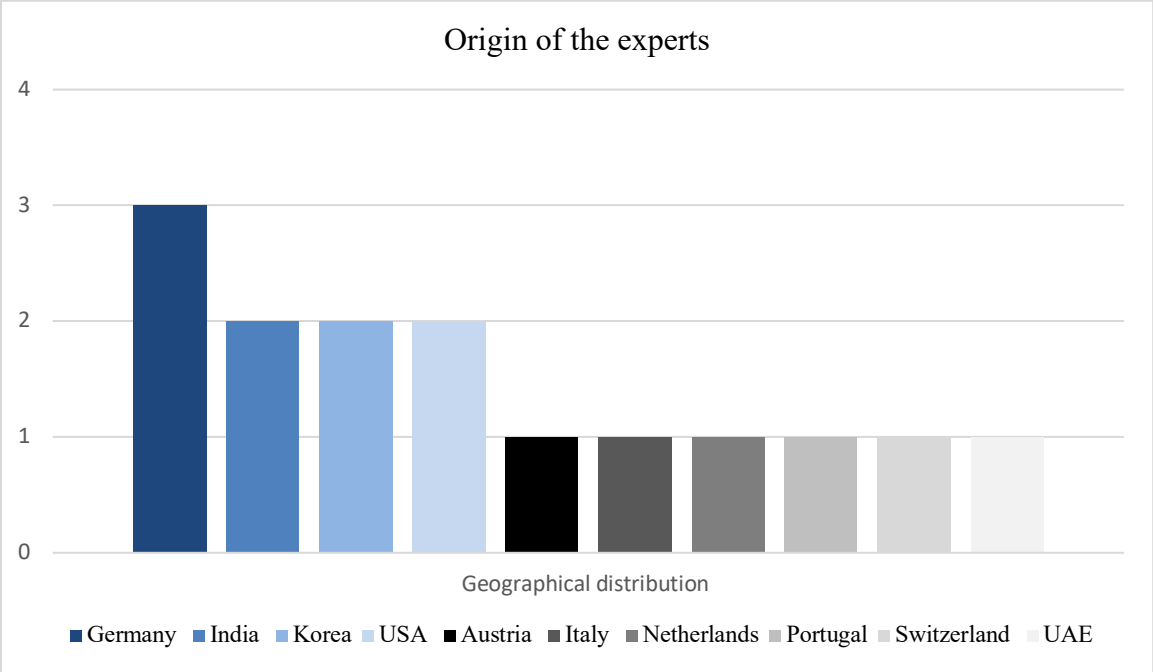

Table 2: Geographic distribution of the experts

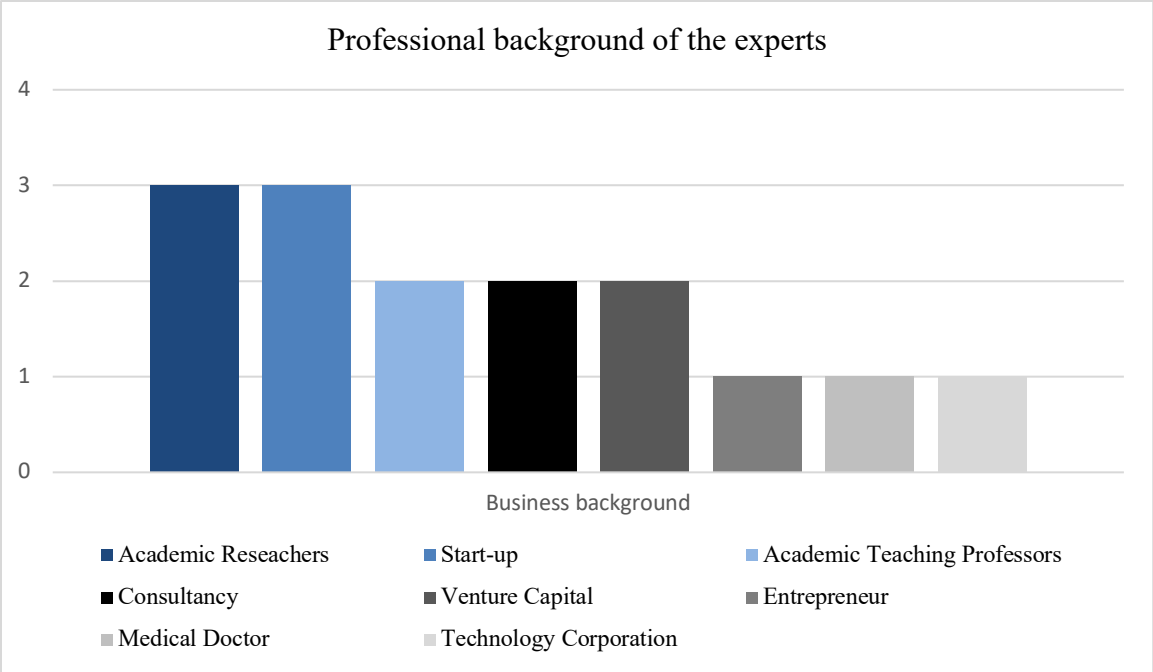

Table 3: Professional distribution of the experts

2.4. Data analysis

The data underwent an initial transcription process. Following the method outlined by *Bell et al. (2019)*, a thematic analysis was subsequently performed, wherein the researcher identified emerging themes from the collected data. According to the authors, the process of theme analysis consists of three steps, commencing with open coding in order to develop first concepts that are drawn from the data. The subsequent stage entails the categorization of these concepts into more comprehensive groupings, known as second-order themes, by means of axial coding. In conclusion, the utilization of selective coding is implemented to combine the second-order themes into aggregate dimensions, which are commonly referred to as "theoretically fertile dimensions" (*Bell et al., 2019*).

3. Theoretical Background

The development of the metaverse is driven by technology, empowered by platforms and guided by policy. Although healthcare in the metaverse is still at an early stage and theories remain limited, it's promising future impact is widely recognized (*Zhang & Ye, 2023*). To highlight the development path, this work conducts a review on existing literature which will lead to an identification of critical success factors for conducting business in the healthcare metaverse.

3.1. Metaverse

The term metaverse was firstly introduced in 1992 by Neal Stephenson in the science fiction novel *Snow Crash* which is about an immersive and alternative virtual reality, and internet-connected universe becomes reality (*Joshua, 2017*). However, the idea of people being able to conduct daily activities in a "parallel world" , can be identified in writings of the 1980s. In Gibson's (1984) futuristic book *Neuromancer,* a dystopian reality is described, where people can swing from their daily life to the Matrix, a VR environment that can reward or punish individuals for their offline behaviors.

The metaverse defined by *Lee*, is when the natural and virtual world form a coalition and carry out social, economic and cultural activities to create value. Another definition is that the metaverse is a three-dimensional virtual reality in which routine and economic activities are conducted via virtual characters representing reality (*Lee et al., 2022; French et al., 2023*).

In fact, the growth of metaverse use has already been predicted as a future trend in digital technology. There is a growing trend in the development of virtual productivity platforms, hybrid working/learning spaces and public services (*Time, 2022*). All our lives and activities have been placed increasingly in the digital space. The concept of metaverse means not only a combination of real world and virtual reality but an interaction between the two worlds. *Halloway et al*. cited that the metaverse can increase knowledge of health and they also improve the provision of care services. However, the metaverse is the 3D environment created by sensors such as headsets, glasses and gloves, requiring huge investments in network infrastructure, software and hardware.

The concretization of the metaverse has been revealed through the recent technological advancements, cost reduction in technologies, and the acceleration of the digital transformation,

particularly enforced by the Covid-19 pandemic. (*Lin, 2022; Mori Visconti, 2022; Jung & Jeon, 2022; Ghose et al., 2022*). The healthcare metaverse refers thereby to an immersive digital environment that integrates physical and virtual realities, allowing patients, healthcare providers, researchers and medical professionals to interact, collaborate and engage in various healthcare applications. With the help of AR and VR technologies, geographic and logistic boundaries can be transcended to enhance medical training, patient engagement and research efficiency, enabling virtual consultations and diagnosis of health conditions without physical presence *(Kataria, Kedia & Ravindran, 2023).* According to *Petrigna and Musimeci (2022)* the healthcare metaverse refers to the use of the virtual world for the prevention and treatment of clinical conditions education and training and research in healthcare. For the purpose of this thesis, the definition that fits to the market and this research is the following: *The healthcare metaverse is a virtual space that integrates innovative technologies such as augmented reality, virtual reality and advanced digital solutions to provide personalized, efficient and more accessible healthcare services across geographic, demographic and sociocultural barriers.*

3.2. Business in the metaverse

In order to explore how the metaverse can be used by organizations in a business context and how it will be able to engage users, it is important to understand its business models. One way to do this is by considering to which extent its business models overlap with or differ from social media platforms, social media as being the most recent "parent" internet revolution (*Longobardi et al., 2020*) The business models in the metaverse are essentially a further development of the business models from the platform economy (transaction, smart contract, etc.) and corresponds to a platform economy. What may be added are monetization methods derived from the gaming industry (reward systems, etc.), which are transferred to the business context. If one considers the metaverse as a consistent further development of today's World Wide Web, many business models can be taken into the new world. Especially the platform economies offer themselves as models to become the dominant business models in the metaverse. Global or platform-based currency systems, such as those in the crypto and gaming industries, complement today's platform economies (*Bitkom, 2022*).

Recent insights from *Accenture and Forbes* (2022) indicate that businesses are currently split into metaverse providers – platform owners or large tech companies with knowledge and resources – and all other organizations renting metaverse platforms (*Accenture 2022; Forbes 2022*). Consequently, metaverse business models will require high-tech firms to tale several

actions, such as renting online to other companies who can use it to manage remote work (and controlling features) as well as providing software that fits best to specific industries (*Marabelli & Newell, 2023).* Above all, the metaverse influences both the economy and society. Although a small portion of the existing research conceptualizes the metaverse technology and development prospects, only a few dives into business aspects (*Zhang & Ye, 2023*). Therefore, it is essential to identify success factors that enable business in the metaverse.

3.3. Healthcare in the metaverse

The metaverse has the potential to profoundly change the future of work. According to *Gal et al.,* especially in the healthcare sector, the metaverse will have great impact. The metaverse, with its immersion, customization and safety capabilities, plays an important role in the future of healthcare. With individualized, predictive and empathetic interaction models, the technology can help deliver hyper-personalized, data-driven care that could lead to earlier detection of disease and tailored interventions that result in better outcomes for patients (*Gal et al., 2022*). Numerous applications can be provided in the metaverse, ranging from research, physical examination and diagnosis to insurance. Virtual physiotherapy, virtual biopsy, virtual counselling and virtual alert response are the plausible implementations of the metaverse that might be realized in the near future (*Chengoden, R. et al. 2023*).

Other studies show that attitudes towards telepresence - using technology to be together virtually even when physically separated - have increased significantly recently, largely as a result of the pandemic. According to the study, more than 70% of consumers who had never used digital and virtual tools to access healthcare before the pandemic are now willing to use them, and consumers aged 18-24 are three times more likely to use new virtual and digital health tools. The pandemic has therefore forever changed consumer perceptions and behaviors about accessing healthcare, creating a population that is more open to receiving their healthcare at home (*Wiederhold et al., 2022).*

According to the futurist Bernd Marr and the Forbes study on “The amazing possibilities of Healthcare in the Metaverse”, the Covid-19 pandemic boosted remote healthcare services and the metaverse can offer an innovative element for the benefit of both patient and healthcare provider (*Forbes, 2022b*). Moreover, studies have examined the impact that the metaverse could have on healthcare, where increase levels of immersion and use of interactive VR

technologies and digital twins could eventually transform current health services (*Liu et al., 2021*).

Thomas states in 2021 that the healthcare systems have long been unstainable for the future especially under the pressure of chronic diseases, rising costs, lacking healthcare personnel, limited resources and an aging population. Digital health with its latest technology the metaverse, facilitating health services, could therefore change whole healthcare sector (*Petrigna & Musumeci, 2022*).

The metaverse, characterized by blockchain technology, is a suitable technology that can improve health data sharing and storage system due to its decentralization, immutability, transparency, traceability and privacy features (*Krittanawong, C. et al., 2020*). As a result, blockchain has the potential to serve as an innovative approach for encrypting patient data and ensuring adherence to medical standards in both healthcare practices and processes (*Skalidis; Muller; Fournier; CardioVerse, 2022*)

Additionally, the advent of cryptocurrency has propelled the incorporation of blockchain into the healthcare system, presenting a promising avenue for development (*Shukla, M., Lin, J., Seneviratne, O., 2022*). Within the metaverse, non-fungible tokens (NFTs) stand out as potentially revolutionary. NFTs are unique, non-interchangeable data packets recorded in the blockchain, serving as tokens to establish ownership of digital assets (*Kostick-Quenet, K. et. al., 2022).* In critical medical situations, individuals can securely store personal information and medical records within an NFT. Rather than undergoing repetitive physical tests and waiting for external documents, this NFT can be readily shared with physicians as needed (*Subramanian, H. & Subramanian, S., 2022*). This example underscores the potential of metaverse modalities in shaping the future landscape of modern medicine.

According to *Giampaolo Viglia*; *Sang-Min Park & Young-Gab Kim; Anders Gustafsso,* the transformational benefits that the metaverse could bring are about improved access to services and wellbeing implications of deeper level of social interaction with patients and healthcare providers. In fact, the metaverse has the potential to facilitate healthcare as a service through the concept of virtual hospitals, where VR and haptic interactions can offer help for counseling and physiotherapy services and disease prevention (*Sitammagari et al., 2021*).

3.4. Business in the healthcare metaverse

Doing business in the healthcare metaverse requires to understand the target market. In order to understand the target market, market segmentation is commonly used in the literature and in practice. In this study, market segmentation refers to the examination of the structure of a market as perceived by consumers to forecast the demand and identify business opportunities (*Johnson, 1971)*. Thus, in the context of the healthcare metaverse, market segmentation helps to define the potential of the target market, identifies the needs of consumers / users and formulates an appropriate market strategy (*Yi, 2018*). Market segmentation is crucial in this study, as it targets the healthcare segment using the metaverse concept as a foundation. Additionally, the study emphasizes varied implications for distinct stakeholder groups—academics, business/technology strategists, and health policy makers—within the ecosystem.. (*Johnson, 1971*).

While extensive research has focused on the potential of the metaverse in gaming, entertainment, socializing, work and commerce, the business drivers in the health sector remain relatively unexplored. However, the significant potential for healthcare organizations to adapt their models and improve operational efficiencies within the metaverse promises transformative impacts (*Sebastian SR et al., 2022; Dick, 2021; Mystakidis, 2022*). Existing studies have predominantly addressed metaverse business models conceptually and technically in various industries (*Li et al., 2021b; Martínez-Navarro et al., 2019; Moro-Visconti, 2022; Steffen et al., 2019; Yim et al., 2017*). However, there is a notable gap in the study of business models in the health sector that underscores the need to understand the business logic in the healthcare metaverse.

3.5. Business success factors

Historically, the concept of key success factors was originated in the field of management information systems and then later transferred to the field of business strategy research where it is used in different ways, corresponding to different schools of thought (*Jemison, 1981; Mintzberg, 1999*).

The concept that certain factors play a crucial role in determining a company's success, and that these factors can be identified, was initially proposed by *Daniel* (*1961*) and further developed by *Rockart* (*1979; Bullen & Rockart, 1981*) within the framework of designing *management*

information systems. By discovering that senior executives infrequently utilized management information systems, they argued that these systems should be organized in alignment with the managers' information requirements. The term "critical success factor" was created to establish the information requirements of managers and connect them to the management information system. Since a key success factor in *strategy research* is a statement about a causal relationship, between success and some cause of success, the way the key success factor concept is used varies between different schools of thought as well. For simplicity reasons, only two schools of thought will be distinguished in this work, namely the planning school and the shared experience school (*Mintzberg, 1990*).

Key success factors as a planning school: The objective of the planning school is to create planning tools that assist organizations in identifying the optimal strategy. The underlying premise is that offering advice that aids decision-makers in organizing their thoughts can enhance the quality of decision-making. Therefore, it is presumed that decision-makers possess their own subjective conceptions that connect success to its underlying causes (*Ferguson & Dickinson, 1982; Hofer & Schendel, 1978; Ohmae, 1982*). Both the theoretical basis and the measurement method are not essential to the discussion. In terms of methodology, it is preferable to use an eclectic approach, as suggested by *Leidecker and Bruno (1984)*, with a greater emphasis on diversity rather than strict validity. Strategic planning involves incorporating an analysis of critical success variables, hence enhancing the development of effective strategies.

Key success factors as a market description: The shared experiences school believes that it is feasible to determine the correlation between different sorts of strategies and corporate success across different circumstances. This school is referred as the "shared experience school" due to its emphasis on the notion that by sharing experiences related to business strategies, it becomes feasible to develop comprehensive theoretical knowledge that is based on empirical evidence. This information can then be utilized to inform the decision-making process when selecting business strategies. This school believes that corporate performance is determined by causal relationships, which are considered to be an objective reality and can be gradually discovered through research *(Luchs, 1986; Porter, 1980).* The success factors identified below are based on an inductive research methodology, whereby the success factors were identified from the literature and then understood in practice.

3.6. Business success factors in the metaverse

The identification of certain success factors makes business in the healthcare metaverse more tangible. The complexity arises from the fact that numerous qualitative and quantitative factors need to be considered when answering the question of how health services can be offered and used in the metaverse. Studies by *CBInsights (2022), Gartner (2022), Lee et al. (2021), McKinsey (2022), Accenture (2022)* and the *Council of the European Union (2022)* come to the conclusion that there is no central enabler for a metaverse. Instead, success can only be achieved through the interaction of several factors. According to the literature, the decisive success factors in order to conduct business in the metaverse are the following seven:

1. Hardware
2. Accessibility
3. Affordability
4. Adaptivity
5. Regulations
6. Partnerships
7. Experiences

A metaverse can only function in the interplay of the factors - they are therefore crucial success factors (*Büchel & Klös, 2022*).

Hardware

To operate in the metaverse, a functioning technical infrastructure is essential. This includes chips and processors, internet and 5G infrastructure, cloud infrastructure and edge infrastructure to display the large amount of data in a visually appealing way. Graphics chips and processors are especially important for the graphic display. Hardware geared towards the metaverse, such as VR headsets or AR glasses, must provide very high computing power on very small devices. For a persistent and immersive metaverse that billions of people can access in real time, the current computing power of processors and chips is not sufficient. In addition to chip and processor power, it also requires advances in 5G networks (*Verizon Communications, 2022*) and the development of networks with even lower latencies (*Deutsche Telekom AG, 2016*). Both are particularly important for fast, error-free data transmission over the internet and for

users to be able to interact continuously and without delays in high-resolution metaverse applications.

The enormous amount of data that needs to be transferred over the internet requires a particularly high network speed. Therefore, 5G/6G internet will play a crucial role in the metaverse infrastructure (*Nezami, Dohler, Shirazipour, & Blomquist, 2022*).

Accessibility

The future focus will be more and more on additional devices, such as AR smart glasses and VR headsets. These devices serve to make the user experience in the metaverse even more immersive and to represent a feeling of real presence in virtual space (*Zineb Rebbani, 2021*). The focus is clearly on the development of VR headsets (*Kozuch, 2022*).

Affordability

In the rapidly evolving landscape of healthcare technology, marked by innovations such as robotic surgeries and VR integration, the rise of metaverse-focused companies is evident. These entities actively contribute to the development of advanced AR and VR solutions, specifically enhancing the surgical environment on a global scale. For a successful integration of the metaverse into the healthcare system, the utilization of high-tech wearables, including glasses, gloves, sensors, and other hardware components capable of accurately monitoring patients' conditions, is imperative (*DelveInsightBlog, 2022).*

However, a notable challenge arises due to the high cost associated with these wearables. To harness new capabilities, continual investment in updated equipment aligned with technological advancements becomes a necessity. Moreover, given the metaverse's demand for high-end connectivity throughout the operational spectrum, the infrastructure costs for healthcare providers are substantial. At the forefront, the adoption of the metaverse in healthcare, achieved through the transformation of traditional practices with modern wearable technology, appropriate software, and robust hardware infrastructure, proves to be a financially demanding endeavor. It's crucial to underscore that the factor of affordability stands out as a critical success factor in navigating the complexities of conducting business within the healthcare metaverse (*Ameen, 2022*).

Adaptivity

The metaverse is a complex notion that is challenging to demonstrate without hands-on involvement. In an era characterized by rising healthcare costs, there is a growing trend toward the use of preventive measures and digital health which is why an ease of use of these technologies must be ensured (*IW, 2022*). It can be expected that young users will rapidly adapt to these new settings but especially the vulnerable groups of society, people with chronic diseases and elderly people, won't adapt that fast and easily to these technologies. On the one contrary, older people might be left behind by these innovative technologies while children might interact with harmful virtual touchpoints. Purposeful, customized design with 'built-in' controls by platform providers and technology companies could potentially address these concerns. Some factors are understanding the needs and generational differences that promote or hinder users' intent to use metaverse for business purposes, as it is usually considered a recreational activity (*Chandra et al., 2012; Shirish et al., 2016; Srivastava & Chandra, 2010*).

Regulations

Despite the considerable research relating metaverse technologies, little attention has been drawn to compliance with regulations governing privacy, rights, and tax manners in the metaverse. As on various online platforms, security and privacy are critical factors in the metaverse. Intentional users may monitor and collect real-time metaverse user behavior (e.g. interaction with other users, purchase transactions) and biometric data (e.g. facial expression, voice pitch) that could be used to identify the user. Therefore, in order to provide appropriate services to users in a secure and ethical manner, it is necessary to take cyber security and data protection into account, as the metaverse is built in a digital environment. This should provide several methods and solutions to ensure that users and systems are protected from potential threats and vulnerabilities (*Zhang et al., 2022; EY, 2022*).

Security and (data) privacy or in general regulations are crucial success factor in the metaverse because these fundamental components should be managed continuously through all phases of the metaverse environment (*Amazon Web Services, 2015*). This requires, that all products (software, hardware, network, content, infrastructure) and services should be designed and implemented to ensure key security properties such as confidentiality, availability, integrity, authentication and accountability. In fact, advanced protection technologies like automated, flexible, encrypted control for data access using artificial intelligence as a necessity. In summary, the metaverse, with its similarity to online platforms, still needs its own customized

security and privacy strategies that consider the unique characteristics of the metaverse, rather than to apply existing security measures (*Dwivedi, Y.K., 2022*).

Partnerships

A sustainable metaverse platform would need essential partnerships with multiple service providers. These service providers would be complementary service providers (hardware or software or both), as it may be challenging for a particular organization to provide all the services on their own. There are challenges in setting qualifiers for partnership agreements and getting the right technology partner, especially because organizations are cautious about signing long-term contracts. Organizations would need to partner with metaverse firms to advertise their offerings since most metaverse consumers will invest most of their time on these platforms (*Dwivedi, Y.K., 2022*).

Developing metaverse monetization systems requires a wide range of capabilities, devices and respective infrastructure. Since it would be a massive task to secure all these tasks internally, it is important to build an ecosystem that allow your organization to focus on its core capabilities while partnering with other companies for non-core capabilities (*EY, 2022*).

Experiences

The success factor of experience is usually not about how the metaverse can function technically, but also about which products and services are actually worthwhile, how they are demanded in society and what experiences have already been made with them (*Büchel & Klös, 2022*). Accenture's study on Digital Health Technology Vision 2022 also stresses the importance that healthcare organizations strive to address experiences and outcomes of healthcare services in the metaverse as 73% out of 3,000 people across the US, Canada and the United Kingdom had definite interest in health and wellness applications in the metaverse, but do not have the experience in accessing and using services in the metaverse (*Accenture, 2022b*).

4. Results

This section explores and presents the 1st-order concepts and 2nd-order themes identified through the qualitative data analysis of the semi-structured interviews, organized and structured into 3rd- order aggregate dimensions.

1st order concepts	**2nd order concepts**	**3rd order concepts**
Metaverse	Definition	**Adoption of metaverse concept on healthcare**
	Use cases	
	Business models	
Healthcare	Existing system	
	Metaverse as a solution	
Metaverse success factors	Hardware	**Technical requirements**
	Accessibility	
	Affordability	
	Adaptivity	
	Regulations	**Legal requirements**
	Partnerships	**Social network effects**
	Experiences	
Outlook	Drivers of the healthcare metaverse	**Transition into current systems**
	Opportunities/concerns	
	Transition into existing systems	

Table 4: Data structure of the thematic analysis in line with Bell at al. (2019)

4.1. Adoption of the metaverse concept on healthcare

The primary category of the metaverse identified by the experts pertains to the concept of the metaverse and its adoption on healthcare. In order to relate the concept of the metaverse to healthcare at all, there must first be a certain level of awareness of the technology and an understanding of the current healthcare system. As the experts all came from different sectors, it was revealed that those with a technological and medical background are more familiar with the metaverse technologies (AR, VR, XR) because they have more hands-on experiences with the metaverse technology as the experts with a business or academic background who were often more familiar with only the theoretical concept. However, since all experts not only have theoretical or practical experience with the technologies behind the metaverse but also have exposure to the healthcare sector, common pain points of our health systems like the lack of personnel, the high costs, the not unified health system, the not adequate and missing digital infrastructure were repeatedly pointed out. Therefore, the urge of the metaverse as new technology in healthcare was clear to all experts. By emphasizing that *"the urgent need",* all experts highlight important adoption of the metaverse concept in the healthcare industry in order to reduce the cost-intensity, increase the accessibility to care and to relieve the physical needed health system. Otherwise, according to the experts, the rising healthcare demand of the aging population can no longer be met in the future and the system will collapse. There was also equal knowledge among the experts about current use cases of the metaverse, with examples of retail, entertainment or real estate sector being mentioned more frequently. In line with the expert's opinions, these are important initial use cases from sectors that help to create awareness in society and can then be projected onto the healthcare sector. However, many experts highlighted healthcare as a key use of the metaverse. This is because they have specific experience in this sector, and they believe it holds the most potential for society, especially those directly involved in healthcare.

4.2. Technical Requirements

According to the respondents are the success factors of the *hardware, accessibility, affordability* and *adaptivity* all linked together and ultimately refer to the technical requirements of the metaverse. Above all, it is emphasized that the first two of these factors are essential for using and entering the healthcare metaverse. However, it should also be noted that precisely these factors will become less important in the future. In a fast-paced world with quick tech changes,

ACw-1 suggests that simpler, everyday devices will eventually be introduced to make the healthcare metaverse work better and provide services in that space. ACw-2 also confirms this by explaining that *"right now we still need VR headsets and AR glasses, but in the long term we will be able to use metaverse services by smartphones and normal glasses."* With regard to affordability and adaptivity, the experts also refer to smartphone life cycles: *"Currently, the high prices and the unfamiliar adaptivity are factors that make the (healthcare) metaverse intangible, but these factors will also become less important."* In the long term, as with any technical innovation, prices will decrease with the increased number of users, which will result in more investment in better adaptivity and UX.

Experts from the business segment in particular also emphasize that adaptivity is already less relevant than requirements such as hardware, as "as with every innovation, adaptivity is always difficult at the beginning." Bub-2 suggests that initial adaptivity might not be simple, but early adopters will embrace the technology regardless of its price or adaptivity. MEc-1 also underscores this by saying that *"the adaptivity factor or user friendliness gets more important when you want the healthcare metaverse for mass adaption to make it accessible and easy to use for everyone."* The only one who does not fully agree on that is BUm-3 who works for Microsoft and sells the HoloLenses in the healthcare domain. With his technical background, he strongly mentions that *"nobody will afford devices you cannot use because technology and its adaptivity needs to help and not hinder."* However, the majority of experts all agree on the fact that, at least in the long term, an intuitive, simple use of metaverse technologies is necessary to enable healthcare in the metaverse for the masses. In fact, according to MEc-1, it must develop into a "local language". As the older and chronically ill parts of the population in particular have a greater need for healthcare, simple adaptivity of the healthcare metaverse is essential. Young, tech savvy people have grown up with new technologies, which is why they can also easily adapt to the healthcare metaverse, according to the experts. In the long term, using the healthcare metaverse must be as simple and convenient as using a smartphone.

To summarize, the experts' opinions on the importance of technical requirements differ. While individuals with a technical background consider this factor to be highly relevant, experts from the fields of medicine, academia and business rate it as less important, explaining this with rapidly changing technology lifecycles.

4.3. Legal Requirements

In the healthcare metaverse, experts widely agree that regulatory frameworks play a crucial role and are, collectively by all experts, recognized as one of the most important success factors for conducting business in the healthcare metaverse. All experts also agree that regulations are non-negotiable. If these are not sufficiently regulated, the basis of healthcare in the metaverse is not fulfilled. Furthermore, BUz-1 cautions that there is a risk of eroding societal trust that might lead to the outcome that society will not make use of healthcare in the metaverse. According to the experts, it can therefore be said *that "health data or medical records are the enabler for the healthcare metaverse"*.

Furthermore, MEm-2 points out that technology improves quickly, but government laws change slowly, taking about three years. This mismatch with technology lifecycles makes it crucial to adapt regulations promptly for successful business in the healthcare metaverse. BUm-3 highlights similar challenges in government regulations, especially in Europe and Germany, emphasizing the need for a legal framework to keep pace with healthcare metaverse development.

However, *Regulations* are not only considered to be one of the most important, but also one of the most concerning success factors. Experts often have concerns in the area data protection, as health data is our most sensitive data and the population is particularly skeptical about this. Therefore, it is crucial to establish a certain degree of confidence by handling the data with ultimo care. As the "regulations" success factor is considered to be important and indispensable, the experts are also already highlighting solutions and best practices. ACw-1 highlights the importance of simplifying policy standards and privacy rules in order to facilitate the transition of the healthcare metaverse. According to him, this would increase the number of users and their level of acceptance of the healthcare metaverse at the same time. ACu-3 is also optimistic, emphasizing that *"we are in the early stages of the healthcare metaverse and legislation will move in parallel with technological progress"*. She backs this up with the fact that several countries, including South Korea and Switzerland, have already created legal frameworks and laws. This shows that these countries already recognize the great importance of the metaverse and already form the legal basis. Bub-2 and BUg-5 support her view that there are solutions to protect health data and store it in an appropriate manner. They mention the blockchain technology as a solution, which will be the most secure way to store data which is why governments are already working on this solution.

As a conclusion, the importance of adequate legal framework is emphasized by all experts as appropriate regulations form the basis of the metaverse and the use of health data needs to be protected and regulated accordingly.

4.4. Social network effects

Social network effects refer to the success factors of *partnerships* and *experiences* because both are related to a network. This network is created through *partnerships* with different stakeholders and promoted through the *experiences* of various stakeholders. The conducted interviews all emphasize the high importance of having a network of experts from all fields and sectors as well as an ecosystem of stakeholders working together to build on the healthcare metaverse.

The success factor *experiences* is hereby crucial in order to promote or create awareness of the metaverse. In particular, the metaverse is hereby referred to be general and not sector-specific, because as ACw-1 mentioned: *"promoting the metaverse service across functions and sectors promotes general awareness of the metaverse."* According to the business experts from an investor and consulting background, primarily, during the initial stages of any innovation, the emphasis lies in capturing the attention and support of sponsors and investors from a financial standpoint. Nevertheless, their investment will be dependent upon the presence of solid knowledge that indicates the superiority, simplicity, or cost-effectiveness of the metaverse technology in comparison to earlier technologies. Otherwise, the metaverse will fail to establish its presence.

After securing the funding, it is crucial to develop experiences for healthcare providers, specifically doctors and clinics, as well as users, namely patients, that effectively showcase the straightforwardness of this technology through empirical evidence. It is believed that in order to raise awareness and persuade doctors and patients, it is necessary to have firsthand experiences that demonstrate the simplicity of the metaverse use. The significance of experiences is increasingly emphasized in terms of social rather than business factors. This is because people will only utilize the healthcare metaverse if the appropriate experiences are offered. Only then can widespread adoption be attained. Two other experts contended that the metaverse is a complex technological concept, and in order to incorporate it into the medical ecosystem, all stakeholders and users within the ecosystem, including patients, must be interconnected (MEm-2). This statement is corroborated by other experts, who argue that the

successful functioning of the healthcare metaverse requires the establishment of a robust ecosystem whereby all parties collaborate cooperatively, and competition is absent. The focus should be on cooperation rather than competition, especially considering the limited understanding of the metaverse. Therefore, it is imperative to enhance both awareness and collaboration (BUm-6). Also, from a medical perspective it is highlighted, that it is crucial to clearly define the role of the metaverse in healthcare. The concept of the metaverse is very complex, leading to a lack of understanding or limited exposure among the majority of individuals. Hence, it is crucial for developers and programmers of the metaverse to prioritize sharing their experiences initially. In order to attain widespread acceptability, it is vital that we exchange and communicate our experiences. Currently, our main deficiency is in the absence of both experience and effective communication of it. Finally, the addressing of the relevant experiences is emphasized.

At the same time, the success factor *partnerships* is considered as important as the success factor *experiences* because according to MEa-4 *"the whole idea of the metaverse is about a platform and that means to have partnerships."* As a medical doctor and CEO of Aimedis, he mentions the huge issue of having not a platform within the health ecosystem that connects doctors, patients, clinicians or insurance companies.

Businesses need partnerships with the right experts from the technical, business and medical field and they need to closely work together. Experts have different views on the importance of partnerships in the healthcare metaverse. Some say partnerships are crucial for the whole transformation, while others believe they are more vital at the beginning for knowledge-sharing. Overall, experts agree that partnerships are essential for developing, promoting, and implementing the metaverse in healthcare. Some emphasize their significance at the start, stating that innovation becomes more independent as technology advances. For example, BUb-2 notes that partnerships are crucial at the beginning but become less critical as technology progresses because talented individuals are needed to build the spaces or technologies.

In summary, the experts determined that, particularly in the early stages of the healthcare metaverse, it is crucial to establish partnerships among professionals with medical, business, and technological expertise. Decision-makers from these domains should collaborate closely and exchange their insights on the healthcare metaverse to enhance awareness.

4.5. Transition into current systems

There are different opinions among the experts on the question of how exactly the transition of the metaverse should take place in our existing healthcare system.

The interviewees from a business perspective, argue that insurance and payment services as payers of the technology are identified as crucial factors, with conversations focusing on the substantial upfront expenses and expenditures. The issue of financing gets repeatedly emphasized by them whereby the integration with insurance companies must include the services in the healthcare metaverse in their catalogue of services. Specifically, it is said that it would be *"a breakthrough if insurance companies recognized the added value and incorporated healthcare services into the metaverse."* BUb-2 also suggests the integration and acquisition of relevant metaverse start-ups by large healthcare players to create a shift in thinking between insurers and traditional healthcare providers. Experts argue that this strategy would ultimately result in cost-effectiveness for patients, which might be a significant achievement, especially for Europe. In addition, the significance of cryptocurrencies in boosting the metaverse is also mentioned. BUg-6 specifically explains that *"Crypto needs to rise again to push up the metaverse".* Thus, the impact of retail and institutional organizations enhances consciousness and inspire excitement. Nevertheless, obstacles arise in the domain of intellectual property (IP) preservation, as individuals and organizations prefer to protect their IP, hindering collaborative endeavors that could facilitate the smooth progression. Instead of competition, there should only be cooperation among each other.

The experts with a medical background argue that even pre-surgery consultations, mental health applications, first initial contacts with doctors or in general intake/outflow processes that do not require physical applications would already make a change. Additionally, the creation of digital twins is proposed by convincing people to use more wearables. According to the experts, the data collected is of crucial medical importance for predicting risk factors and lifestyle habits. The information collected by wearing wearables and the algorithms derived from it can be used to develop medicine into preventive medicine rather than reactive medicine, allowing risk factors of patients to be understood in advance.

The experts with a research and academic background mention the importance of organizational changes that need to be made first when integrating the metaverse into the health system since new departments and capabilities will emerge. In addition, education plays a crucial role in

involving patients, students, doctors, and the entire healthcare system. The expansion and influence of the metaverse can be enhanced through the education of stakeholders. Nevertheless, the interviewees emphasize the importance of incorporating specific stakeholders into the process.

In conclusion, the interviews show that the experts do not agree on the future and the integration of the metaverse into our existing healthcare systems which highlights the complexities of incorporating this innovative notion into our healthcare system. The professional background of the experts repeatedly plays a role, which is why the proposals vary so much.

5. Discussion

The aim of this study was to identify key success factors for conducting business in the healthcare metaverse. While there was consensus on the importance of legal requirements and social network effects, the interviews revealed the significance of additional success factors. This includes *monetization, organizational, standardization* and *scientific aspects* as further success factors. Main similarities between theoretical approaches and analyzed practical concepts can be recognized on the legal requirements and social network effects.

As reflected by the interviewed experts, the *legal requirements* are characterized by data privacy, cybersecurity and a consistent digital protected identity (*Lee et al, 2021*). According to *Wang et al*. privacy and confidentially are of critical importance for the healthcare metaverse and going further, medical data acquired in the metaverse must be protected by respective privacy legislation (*Wang et al., 2022*). Confirming these findings, the interviewed experts not only emphasize the importance of protecting personal data rights but also underscore the significance from a business perspective. They suggest that government changes in digital and health laws should occur more rapidly, aligning with a company's innovation lifecycle to effectively position digital health products in the market. This result is surprising that legal requirements as a success factor must be considered not only from the patient perspective but also from a business standpoint during healthcare metaverse development.

The social network effects involve the collaboration of stakeholders in establishing, using, and promoting the healthcare metaverse, along with the exchange of diverse experiences among all individuals involved in the healthcare metaverse (*Büchel and Klös, 2022*). Hence, there is a consensus that the adoption of the metaverse in the healthcare sector is contingent upon partnerships, a comprehensive stakeholder ecosystem, and the corresponding experiences. This is consistent with the findings of the study of *Lee et al (2021)*, which states that a metaverse is highly based on a pervasive network that relies on various human interaction networks. Furthermore, this is also in line with *Lee et al*.'s claim that the metaverse is a user-centered platform, which is why human users and stakeholders should be at the center of any metaverse. Thus, this adds further evidence to the fact that social networks effects are important for successfully doing business in the healthcare metaverse and partnerships help to further develop a business while sharing experiences help to further create awareness of the business which might lead to the ultimate goal of mass adoption (*Li et al., 2023*). The interviewees commonly mentioned that achieving mass adoption is the ultimate goal for successful business in the

healthcare metaverse. This aligns with other sectors where the metaverse is well-established. For instance, the metaverse construction industry highlights the importance of close collaboration with stakeholders and forming strategic alliances for a successful industry adoption of the metaverse (*Waqar et al., 2023*).

Regarding *technology requirements*: In the expert interviews, individuals with a technology background emphasized the significant importance of tech requirements, viewing them as the foundational elements of the metaverse. This finding is in line with *Lee et al, (2021) who* describes the hardware infrastructure and network infrastructure with different technology enablers (Network, Cloud, AI, computer vision, blockchain, robotics/IoT, user interactivity, XR) as the foundation of the metaverse. Only with these enablers, the coexistence of the physical and virtual world can be accomplished (*Lee. 2021*). This is also supported by the study of *Velayati et al. (2021*) where the technical components for telehealth are also considered contingent of the whole telehealth ecosystem and therefore a success factor. This provides further evidence to the importance of technical components as the foundation of the metaverse concept. Notably, in this study, experts with a business background perceive technical requirements - referred to as enablers by *Lee et al.* - as less crucial due to the rapid pace of technological change. Further investigation and differentiation of technical requirements, determining whether they serve as success factors or key enablers for the metaverse, is recommended.

The derived monetization and organizational aspects are in line with the theory that in order to explore how the metaverse can be used in a business context and how it will be able to engage users in healthcare, it is important to understand its business models (*Longobardi et al., 2020*). Consequently, this explains the urgency of *Longobardi et al.* to create use-cases and therefore evidence-based science to better understand the business opportunity behind the metaverse in healthcare. In order to do so, well-explained success factors can serve as base for further business models and market opportunities (*Johnson, 1971*). *Standardization* becomes a success factor by incorporating *monetization, organizational*, and *scientific* elements into the healthcare metaverse concept, facilitating mass adoption. According to *Ghose et al. (2022)* and *Accenture (2022),* using both digital (e.g., Meta, Apple, Microsoft) and non-digital (e.g., Nike, BMW, Gucci) business models is crucial for metaverse adoption. However, further research is needed to explore the development of medical use cases for additional evidence.

Coming back to the study on success factors for telehealth businesses, *van Limburg et al*. (2022) explained that the sustainability of the telehealth technology is low, primarily due to the challenges posed by the lack of technical infrastructure, inappropriate scalability and uncertainty about the effectiveness of the technology. This is also evident in the conducted interviews. Nevertheless, these challenges can be mitigated by considering success factors identified in literature and expert interviews (*Limburg et al., 2022*). Experts emphasize that thriving in the healthcare metaverse requires attention to factors like hardware, accessibility, affordability, adaptivity, regulations, partnerships, and experiences. Importantly, achieving successful business transformation in the healthcare metaverse involves addressing a broader set of success factors, necessitating the involvement of all stakeholder groups.

In summary, there is consensus on legal requirements and social network effects to be relevant success factors for business in metaverse. Experts emphasize the importance of privacy laws for patient and business perspectives, urging faster government adaptation. Social network effects, crucial for metaverse adoption, align with findings on pervasive networks and user-centric platforms. Technology requirements, deemed foundational, are contentious among experts based on their backgrounds. *Monetization, organizational, standardization* and *scientific* aspects emerge as new success factors, aligning with the need to understand business models in the metaverse. The following section explains how these findings contribute to existing theory and provide practical implications for leveraging the metaverse potential in healthcare.

5.1. Theoretical Implications

According to studies by *Lee et al. (2022) and CBInsights (2022),* the realization that the success of the metaverse can only be accomplished through the interaction of the seven success factors (hardware, accessibility, adaptivity, affordability, partnerships, experiences and regulations), has partly been confirmed. However, these factors cover generally the idea on how to conduct business in metaverse, but this study projects on the one hand these factors on a specific industry, healthcare, and on the other hand introduces certain new success factors that need to be taken into account as well. For example, the literature does not define factors such as evidence-based medicine (*scientific aspects)* or organizational frameworks (*organizational aspects)* due to the organizational changes of processes, skills and workforce.

Regarding business models, previous studies have examined new emerging business models in the metaverse with its new mechanisms of value creation and value capture (*Mancuso et al., 2023*) while other studies analyze business models, coupled with product characteristics (*Zhang and Ye, 2023*). Some other studies examine the metaverse technology and its underlying business models with strategic implications for organizations and industries (*Marabelli and Newell, 2023*). However, none of these studies address specifically the healthcare industry, only the concept of the metaverse in general, which is why this study adds value by relating the existing literature and business models to a new industry. The identification of success factors for conducting business in the healthcare metaverse, can serve hereby as a strategy for a company's success and evaluate market opportunity (*Mintzberg, 1990).*

Finally, the study brings added value in that it combines the business studies with the medical studies. While, as already described above, the business models in the metaverse focus only on the metaverse concept in general, and the medical papers primarily deal with opportunities for the healthcare system (*Petrigna and Musumeci, 2022*) challenges and future directions of the metaverse (*Chengoden et al., 2022*), current metaverse applications in healthcare (Bansal et al., 2023; *Garavand and Aslani, 2022*) or strategic scenarios for effective metaverse service planning and implementation in healthcare settings (*Lee, 2022*), this study addresses precisely this research gap. By projecting critical success factors and business implications for the metaverse onto the healthcare, an indication is created on how to conduct business in the healthcare metaverse based on success factors.

5.2. Practical Implications

This study provides a comprehensive analysis of factors that are crucial for conducting business in the healthcare metaverse. Specifically, the study assists in identifying these essential factors as well as validates them by experts with different economic, technological, academic or medical backgrounds and experiences with the metaverse in the healthcare sector.

Moreover, this study sheds light on the pivotal role of different geographies and therefore, different political, social and economic systems. Through the participation of 15 experts from 10 different countries, not only the differences in the various healthcare systems became clear, but also the political systems and the associated different regulations. According to the experts, Europe is not the most lucrative market at the moment because the regulations there are simply far too high. At the same time, the metaverse is much more advanced in Korea due to a less

regulated market. This is also the case in India. The example of America clearly shows that the lack of a public healthcare system plays a role here, as the need for digital and cheaper solutions would significantly increase access to healthcare and at the same time people who are already paying a lot of money for healthcare would also invest it in the metaverse to improve their health. This added an important contribution to the research that the geographies and its national differences need to be taken into account when conducting business in the healthcare metaverse. The study also brings added value in that experts from many different sectors were interviewed. By including several experts from business, medicine, technology and academia, all of whom have experience with the healthcare metaverse, it was possible to develop different perspectives that make it clear that it is not enough to only interview the healthcare industry here, but that all stakeholders in the healthcare ecosystem must be included and brought together in order to answer the question of what success factors are needed to conduct business in the healthcare metaverse. Thus, the different sectors from which the experts came and the different geographies, including the leaders in the metaverse area such as Korea, USA and India, increased the validity of this study.

Implications for academics

This study enhances the existing body of literature elucidating the crucial factors for conducting business within the healthcare industry through a comprehensive review. While previous studies have focused on opportunities and challenges as well as on applications of healthcare services in the metaverse, these findings suggest delving deeper in the interaction between business and the healthcare metaverse services. The identified success factors provide a guideline for theoretical development and empirical investigations, fostering a richer understanding in this emerging field of developing concrete business models.

Implications for companies operating/entering in the healthcare metaverse

For companies operating the in the healthcare metaverse, the validated success factors serve as a strategic guideline *(Mintzberg, 1990).* The insights derived from this study can inform the decision-making process, servicing as a guideline in the development of robust business models and effective management strategies. Companies entering this domain can leverage the identifies success factors to enhance their competitiveness within the health landscape, mitigate risks within this phase and align risks of the healthcare metaverse.

Implications for telecommunication companies

According to the studies of *CBInsights (2022), Gartner (2022), Lee et al. (2022), McKinsey (2022)* and *the council of the European Union (2022)*, a certain technical experience in the use and handling of the metaverse technology can be useful. These results build on the evidence that the technical requirements need to fulfill an ease of use with lower costs that all groups of society can use the metaverse concept in healthcare and have access to it in order to experience the advantages of the innovation. The validated success factors provide guidance in adapting technology solutions to the specific needs and challenges of healthcare applications. These insights help technology companies refine their offerings, drive innovation in the areas of hardware, affordability, accessibility and adaptivity to better adapt to the evolving landscape of the healthcare metaverse.

Implications for health policy makers

Health policy makers can draw valuable insights from this study to inform politicians governing the creation of health and innovation laws about the urge to develop regulations accordingly to the lifetime of innovation. This study contributes to the development and measures that enable responsible and ethical growth of healthcare services in the metaverse.

In summary, the implications of this study extend across academic, corporate, policy-making, and technological domains, fostering a holistic understanding of the key success factors and paving the way for responsible and impactful advancements in the healthcare metaverse.

5.3. Limitations and further research

Although this study has made important contributions, its potential limitations need to be outlined as well. The utilization of expert interviews as a tool for discovering a previously unexplored research domain proved to be a suitable method for data collection. Through these expert interviews, a detailed depiction of reality was able to be constructed. Nevertheless, it is imperative to consider the results of this study in light of methodological constraints. The research methodology of expert interviews in qualitative social research generally encounters the challenge that the generated empirical insights may possess a limited and, at times, subjective significance. Furthermore, due to the limited scope of the sample, the results cannot be extrapolated to a broader population. The *inherent bias* in this study is already mitigated by the wide selection of experts with different professional backgrounds by covering the relevant

areas around the healthcare metaverse, which increases the robustness and completeness of the research findings.

The interviews and scripting activities in the study have the potential for *confirmation bias*, which is the inclination to search for information that supports preexisting ideas (*Pohl, 2016*). Therefore, the list of key success factors that impact the healthcare metaverse may be inadequate, encouraging the identification of additional significant variables. Furthermore, this study may suffer from *selection bias*, which arises when non-randomly selected samples are utilized to evaluate behavioral connections (*Heckman, 1979*). Regarding this matter, the 15 interviews were performed according to the respondents' availability, which may have resulted in the unintentional omission of valuable and noteworthy contributions.

In light of the innovative nature of the subject, ongoing research should consistently monitor the evolution of the identified factors. In this context, it is foreseeable that technological advancements would not only alleviate technology-related barriers such as insufficient broadband connectivity, but also significantly reduce the investment required to create and access the metaverse. In addition to ongoing monitoring the identified factors, future research should consistently update the developed model to assess the necessity of incorporating additional variables. Another limitation of this study that is also due to the light of the innovative nature of the topic, is the scarcity of existing literature. The evolving landscape of the healthcare metaverse is still relatively unexplored, which of course represents an exciting direction for further research, it also leads to the limitations in the depth and breadth of available literature. Consequently, the lack of well-established sources may pose a challenge to fully contextualizing and benchmarking the findings within the current scientific discourse.

Therefore, future research should focus on empirically testing to provide confidence regarding the impact of the identified key factors on the degree of adoption of the metaverse in the healthcare industry. In addition, future research should include more stakeholders in the identification and validation process of the success factors for conducting business in the healthcare metaverse. More, specifically, insurance companies were mentioned several times from a cost and performance perspective with regard to their paid healthcare applications. The involvement of insurance companies or healthcare payers for further research is central to a comprehensive understanding of the entire healthcare ecosystem within the metaverse. Exploring the payer perspective provides key insights into the dynamics, challenges and potential opportunities that arise when integrating metaverse services into existing healthcare

structures. Furthermore, examining this aspect provides a more detailed view of the financial considerations and reimbursement mechanisms that influence the adoption of metaverse healthcare services. In particular, when considering the monetization aspect from a cross-functional point of view, the involvement of insurance companies in the development of a relevant pricing model for healthcare services in the metaverse becomes an interesting aspect of further research. This line of research ensures a holistic exploration of the economic dimensions that aligns with the overarching goal of creating sustainable and effective business implications in the evolving landscape of healthcare metaverse services.

6. Recommendations and conclusion

This study aims to explore business implications of metaverse services in the healthcare industry. This study is focused hereby on identifying critical success factors of metaverse services in a healthcare industry. Relevant data was obtained from various literatures and available online sources as well as from 15 conducted interviews with experts from the business, medicine, technology and academics field who all possess respective expertise and experiences of the healthcare metaverse. The analysis was performed by mitigating the findings from the literature and the results from the expert interviews followed by providing and validating success factors that are applicable to the healthcare industry.

Our current healthcare systems are failing. Physicians and nurses are leaving their profession, medical students are entering other fields. The rising demand of healthcare system cannot be meet and people wait more than ever for treatment. While the global pandemic exposed several of these limitations, increasing costs, lack of healthcare personnel and a lacking infrastructure have proven that our healthcare systems are unstainable for the future (*Ozili & Arun 2023; The Economist, 2023*). Furthermore, there is no equal access to healthcare and with the aging population, the demand of healthcare services cannot be met since the systems as well as the healthcare personnel is running at limit. As a consequence, with the advent of the COVID-19, the supply of digital healthcare services has increased dramatically as well as the demand for remote treatment (*Getachew et al., 2023*) so it is only logical that interest in various healthcare activities to be performed through the metaverse service is increasing. Various metaverse related services and platforms already appear in different sectors such as retail and education which also attract attention to the healthcare industry. Therefore, the metaverse civilization is approaching really fast and healthcare industry will not be an exception of it. Metaverse service in the healthcare industry will be an ultimate co-value creation between a provider and a user individually and collectively which is why new solutions and business opportunities need to be considered.

In order to develop potential new business models, this study identified critical success factors for conducting business in the healthcare metaverse. Previous studies examined the opportunities, challenges and application on healthcare services in the metaverse (*Lee, 2022*) while a few address potential business models on the metaverse. In this work, the market was segmented so that business implications were concretely tailored to the healthcare industry in which success factors of *technical and legal requirements* as well as *network effects* were

identified by the literature and the experts. In addition, new dimensions of the health industry were suggested like organizational aspects that need to be considered within the rise of the metaverse. Additionally, monetization aspects for both healthcare metaverse users, providers and third-party companies such as insurance companies need to be included. Scientific aspects included the use of more medical use cases in order to prove the benefits of the metaverse concept. Lastly, standardization was named as the ultimate goal for the healthcare metaverse which could lead to mass adoption. By involving a wide range of expertise from all relevant sectors (business, technology, medicine and academia), the identified success factors could serve as an indication for conducting business in the healthcare metaverse. In addition, different recommendations can be derived from four groups of *academics, companies operating/entering in the healthcare metaverse, telecommunication companies* and *healthcare policy makers*. For the academic world, it is recommended to research more on the development of new and existing business models. Companies operating or entering in the healthcare metaverse can be advised to ensure a certain level of awareness through real healthcare metaverse use cases. For telecommunication companies, who provide the respective technical infrastructure for the metaverse, price reductions and a possible simple user interface in devices that can be used and integrated in everyday life are recommended. Lastly, health policy makers should be aware of the urge to create the respective landscape of laws and regulations in order to fasten the process of legislative changes in health and technology departments.

Furthermore, the analysis showed that these success factors can only be achieved through the joint interaction and viewpoints of all stakeholders from several fields. The focus of the different stakeholders clearly shows the complexities of incorporating this innovative notion into our healthcare system.

While this study has its limitations, such as the study methodology, scope, and subjects covered, these aspects pave the way for future research opportunities. There are numerous unexplored areas that could be investigated in subsequent studies. For instance, future research could delve into developing a pricing model for the profit model of healthcare services in the metaverse. Moreover, exploring the involvement of additional stakeholders, like insurance companies, directly linked to the open question of payment, offers promising paths for further inquiry.

Appendix

Appendix I – Interview script

Focus Area:	**Questions:**
Warm up	Q1: How familiar are you with AR, VR or XR technologies?
	Q2: In which context do you use AR, VR or XR?
Metaverse knowledge	Q3: How would you define the metaverse?
	Q4: What are use areas of the metaverse?
Business in the metaverse	Q5: What kind of factors need to be fulfilled in order to enable business in the metaverse?
	Q6: What business models do you think are applicable for the metaverse?
Healthcare metaverse knowledge	Q7: How would you define the healthcare metaverse?
	Q8: What do you think are current pain points of our health systems?
	Q9: Where do you see the metaverse as a solution in there?
Success factors business the healthcare metaverse	Q10: In your opinion, what are important criteria that needs to be fulfilled in the healthcare metaverse that must be fulfilled in order to conduct business?

	Q11: How important would you consider the *hardware* as a factor to set up business on the healthcare metaverse?
	Q12: How important would you consider the *accessibility* as a factor to set up business on the healthcare metaverse?
	Q13: How important would you consider the *affordability* as a factor to set up business on the healthcare metaverse?
	Q14: How important would you consider the *adaptivity* as a factor to set up business on the healthcare metaverse?
	Q15: How important would you consider the *regulations* as a factor to set up business on the healthcare metaverse?
	Q16: How important would you consider the *partnerships* as a factor to set up business on the healthcare metaverse?
	Q17: How important would you consider the *experience* as a factor to set up business on the healthcare metaverse?
	Q17.1: Are there any other factors you would consider crucial for conducting business in the healthcare metaverse and if yes, which ones? *(optional)*
Outlook	Q18: Which out of these factors would be your biggest concern/biggest opportunity regarding business in healthcare metaverse and why?

	Q19: What will drive the future of the healthcare metaverse?
	Q20: How do you think can the metaverse and its technologies can be transitioned in our existing health systems?

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