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META-QUAL:

A Holistic Framework to Evaluate

Metaverse Performance

by

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Contents

Abstract

In the dynamic landscape of technological progress, the Metaverse holds the potential to transform industries, offering a pathway to secure a competitive advantage and connect with customers. However, current academic research has not comprehensively explored how to evaluate Metaverse applications, often focusing on isolated components from either a technological or customer-centric perspective.

This thesis aims to address this gap by developing a holistic performance evaluation framework tailored for Metaverse applications. Guided by the Design Science research methodology, a scoping interview with a Metaverse expert was conducted to refine the initial understandings of this study. Subsequently, semi-structured interviews with ten expert practitioners provided valuable insights into assessing Metaverse performance. A literature review further contextualized challenges and recommendations from these interviews.

Based on insights from the interviews and literature review, the initial version of the META-QUAL framework was designed. The framework includes (i) a performance assessment scale for evaluating Metaverse applications and (ii) a checklist outlining key requirements and best practices. After the interviews, the same panel of experts was asked to complete an online survey to evaluate the proposed META-QUAL framework. The survey used a Likert-scale questionnaire, allowing participants to rate the importance of each item featured in the initial META-QUAL scale and checklist.

The experts' feedback enabled a thorough evaluation of META-QUAL's effectiveness and led to enhancements in the initial framework. As a result, META-QUAL emerges as a valuable tool for assessing the performance of Metaverse applications, encompassing three dimensions and six metrics. These dimensions are Organization (Agility), Technology (Compatibility, Functional Suitability, Usability, and Security), and Customers (Value Creation). The findings highlight the pivotal role of the Technology dimension, which is inherently interconnected with the Customer dimension. Considering all dimensions—Technology, Organization, and Customer—is crucial for understanding and enhancing the overall performance of Metaverse applications.

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1. Introduction

The COVID-19 pandemic accelerates the rise of online commerce and has stimulated businesses to adapt and innovate using technology, AI, and machine learning (Parasuraman et al., 2005; L'Oréal, 2021; Hu et al., 2022; Palmatier, 2019; Jiang, 2021). This era of disruptive innovation, exemplified by companies like Netflix and Spotify now the latest is the Metaverse and Extended Reality — a virtual environment poised to revolutionize society by offering immersive experiences across real-world and digital realms (Rayna & Striukova, 2016; Buhalis et al., 2023).

The Metaverse, as the next disruptive technology under the Meta umbrella, is predicted to transform society by offering immersive experiences in real-world and virtual contexts (Buhalis et al., 2023). Quoting Mark Zuckerberg, CEO of Meta, the Metaverse is described as "*a virtual environment where you can present yourself with people in digital spaces,*" enabling multisensory interactions (Kashif, 2022; Hatzilygeroudis, 2022). Developed within the Extended Reality (XR) umbrella, including AR, VR, and MR, the Metaverse's potential extends far beyond gaming, with applications in healthcare, education, social commerce, advertising, and smart manufacturing (Andersen, 2022; Aharon et al., 2022).

Many incumbents from many sectors are already implementing the Metaverse, including big companies like Nike, Gucci, and Mercedes-Benz. (Parker, 2022; White and White, 2023) However, despite its potential, evaluating the quality and performance of Metaverse implementations remains a challenge (Parasuraman et al., 2005; Gadalla et al., 2013; Parker, 2022). Limited research on the Metaverse's effectiveness makes tracking its performance in the corporate world challenging due to its complex and unpredictable development. (Parker, 2022).

In addition, there is a scarcity of studies guiding businesses on designing high-quality services for Metaverse applications, further complicating the evaluation and appraisal of incumbents' integration of the Metaverse. (Gadalla et al., 2013) However, recent papers have examined the evaluation of the metaverse framework, although most of them focus on just one aspect—customers or technology.

This research proposes a holistic framework for evaluating Metaverse's performance to address these challenges. Employing a structured framework provides guidance for assessing performance and offers a holistic approach to evaluating the quality of Metaverse implementations (Nilsen, 2015). By synthesizing insights from various disciplines and leveraging research methods, this framework aims to provide valuable insights into the potential opportunities and challenges of the Metaverse. Through this approach, businesses can better understand how to evaluate the performance of the Metaverse and then to enhance their performance in this evolving technological landscape.

According to L. Zhang (2022), the Metaverse technology, similar to many other technologies, must offer valuable services centered around the end user. Correspondingly, research by Parasuraman et al. (2005) explores the development of the E-service quality (E-S-QUAL) framework to ensure user satisfaction in a platform, which evaluates electronic services based on factors such as reliability, responsiveness, assurance, empathy, and tangibles. Therefore, with the similar objective to offer the service to users, the E-service quality (E-S-QUAL) framework from Parasuraman et al. (2005) will be used as a benchmark to develop the final framework. To support the final product of a framework, several identifications are needed, such as identifying success factors and best practices from the existing business case on the integration with the Metaverse, identifying the main requirements for a

business to integrate the Metaverse, and the final framework will be identified and developed to evaluate Metaverse's performance.

1.1. Research Questions

Considering the challenges faced by the incumbent to evaluate the performance of a service provided by the Metaverse integrated into their business, this thesis examines the potential framework that companies can use to help them evaluate the service of Metaverse performance. This leads to two research questions stated as follows:

- **RQ1:** What are the critical requirements and success factors that companies should consider when developing Metaverse applications?
- **RQ2:** How can companies evaluate the performance of their Metaverse applications?

Two questions have been developed to help answer the research topic and to help organize the research. These will provide the components required to complete the study and complement each other research question.

1.2. Thesis Outline

This report starts with Chapter 1, an introduction including the research problem, objective, and the research questions. Next, Chapter 2 will review the literature to assess the background and related work with the Metaverse and its implementation in the business. The research questions were formulated based on this analysis of the literature. Chapter 3 presents the methodology used for this research, including data collection and data analysis. Chapter 4 describes the research findings from scoping interview and discussed similar framework from the literature as a benchmark for the first proposal. Next in chapter 5, the result from the experiment of semi-structured interview and survey with ten expertise will be discussed and concludes a solution improvement. Chapter 6 will discuss the answer to the research questions. Then chapter 7 concludes this report with a thorough discussion of the results and principal conclusion.

2. Background and Related Work

This chapter will investigate scientific articles on the Metaverse and its landscape from the perspectives of technology, organization, and business. The structure of this chapter is divided into two main parts: the Metaverse and related work on performance evaluation framework. The first part will discuss the technology, starting with the Metaverse itself, followed by technology related to the Metaverse. The next part explains how the business inside the Metaverse relates to customer and digital marketing. The latter part then discusses the framework related to Metaverse as a service.

2.1. Metaverse Environment

Several studies have pursued an understanding of disruptive and innovative technology as a response and appraised its evolution through a framework. The hype technology is published by Gartner, which is widely adopted in high-tech management practice and presents an alternate model of innovation progression. (Linden and Fenn, 2003) The Gartner Hype Cycle model depicts the growth of technological advances as they progress through stages marked by the peak, disappointment, and recovery of expectations. With five stages, the model could help the researcher and the incumbent decide whether technology will thrive or dive. (Shi and Herniman, 2023)

According to Gartner's articles, he states that "*By 2026, 30% of the organizations in the world will have products and services ready for the Metaverse. That being said, the Metaverse is here now and is already being used by the world's largest brands*." (White & White, 2023) Metaverse is in the "Peak of Inflated Expectation" phase, especially with the launch of Apple Vision Pro, it is expected to change how humans interact with the digital world by creating more immersive experiences in real-world and virtual contexts. (Cook et al., 2020; Buhalis et al., 2023) Before reaching the "Plateau of Productivity", a significant barrier to the Metaverse's advancement lies in the technology's inadequacy required to realize its potential fully. (Value Creation in the Metaverse, 2022).

The term Metaverse has existed since 1992, when the novel "Snow Crash" by Neal Stephenson mentioned the Metaverse as a virtual environment where people can interact. (Dwivedi et al., 2022) Academic research explains the Metaverse in different ways, 3D Collaborative Virtual Environments (Gadalla et al., 2013), a shared virtual world that is fuelled by many emerging technologies (Huynh-The et al., 2023), and a new platform that integrates the physical and virtual worlds via googles, blockchain technology, and avatars. (L. Zhang, 2022)

In the Metaverse environment, Hatzilygeroudis (2022) mentions that multidimensional interactions between virtual environments, digital items, and people creates an immersive experience. Other researchers emphasize the technology that builds Metaverse is beyond XR and immersive technology, it also includes User Interaction, Artificial Intelligence, Blockchain, and Cloud Computing. (Krishnamurthy, 2022)

According to Radoff (2022) in Figure 1, there are seven layers included in the Metaverse that cover the technological aspects to the layer that deals with human-Metaverse interaction. Similarly, McKinsey published Metaverse Building Blocks in four categories: Content & Experiences, Platforms, Infrastructure & hardware, and Enablers. (Value Creation in the Metaverse, 2022) Another piece of literature has a deeper discussion on the technology part of the Metaverse architecture, called Metaverse Reference Architecture (MRA), which consists of User Interactions, Business Scenarios, Services, Infrastructure, Security and Privacy, and Quality of Services. (L. Zhang, 2022)
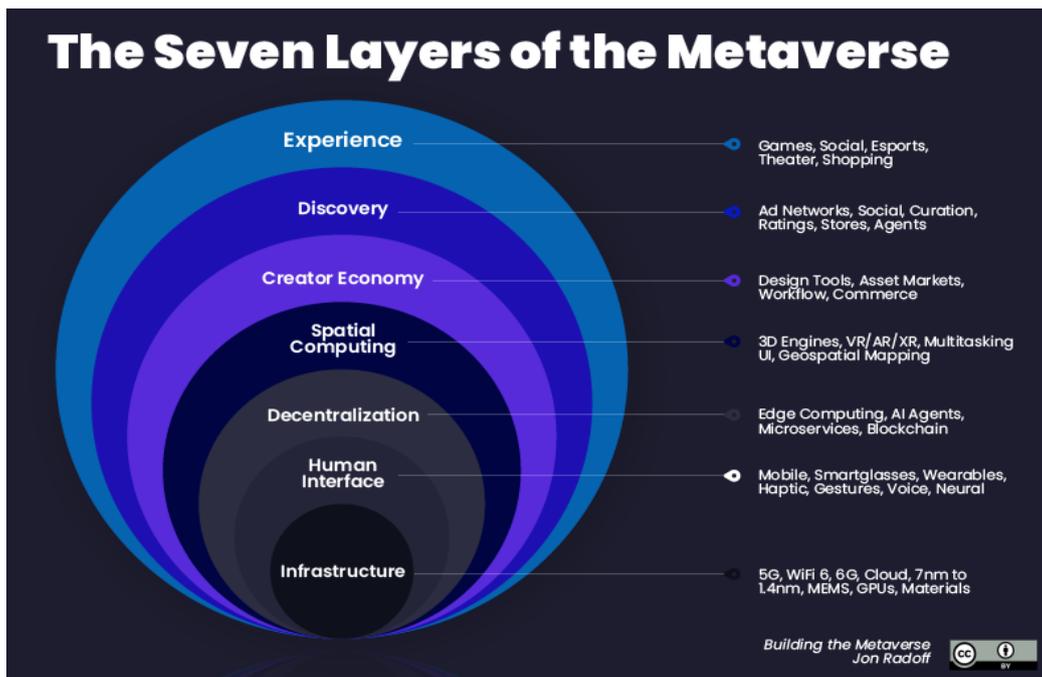
Figure 1 Seven Layers of the Metaverse (Radoff, 2022)

To summarize, understanding the structure and layer of the Metaverse provides valuable knowledge to this thesis research. The similarity between the literature discussed is ensuring that technology evolves in line with user expectations. The interaction between users is critical as their experience impacts the business and its sustainability. (Kashif, 2022) Therefore, the evaluation of the Metaverse needs to be considered to ensure the platform delivers user expectations. The following section will discuss the related framework to evaluate the Metaverse, elaborate on each aspect of technology and customer interaction to determine the most significant factor and explore any potential influences on the performance evaluation of the Metaverse.

2.1.1. Metaverse Characteristics and Enablers

To gain more understanding before the elaborate the related framework, this section will discuss on the Metaverse characteristics and enablers that later will be used for the final proposal.

Decentralization

Decentralization lies in the Metaverse layers between Human Interface and Spatial Computing, which enables the connection and interaction between the two layers. (Huynh-The et al., 2023; Ghelani & Hua, 2022) In the decentralized world, users own and are in charge of their data and assets, where they have the freedom to connect with others freely, produce unique material, and keep the value they add to the Metaverse. (Rfox, 2023)

Figure 2 illustrates the differences between centralization and decentralization, whereas, in the Metaverse, decentralization also improves privacy and security. (The Metaverse Overview, 2022) One of the technologies used to support decentralization is self-sovereign identity, an identity management that allows users to control their own data as the owner. (De Salve et al., 2023) This research aims to focus on the quality of the technology point of the decentralized Metaverse, where Blockchain and interoperability are included.
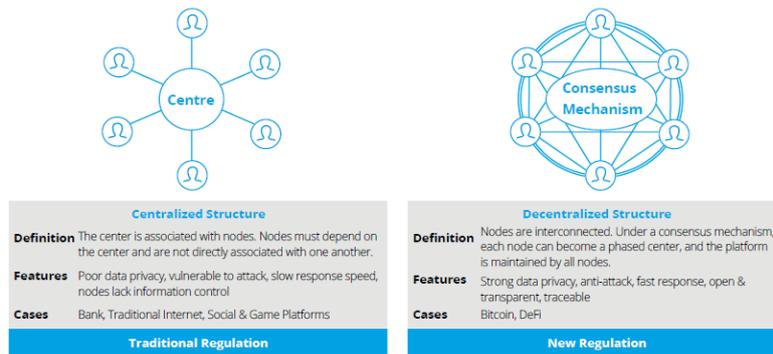
Figure 2 Centralization vs Decentralization (The Metaverse Overview, 2022)

Interoperability

Interoperability is portrayed as the extent to which two or more systems, products, or components may exchange information and utilize the information that has been shared. (ISO/IEC 25010:2011, 2011) In the Metaverse, interoperability allows users to move to one another platform or other virtual worlds without the need to re-login. In the future, there is the probability for users to move from one Metaverse to another Metaverse seamlessly. (L. Zhang, 2022)

The interoperability could be achieved by implementing the right architecture framework and a suitable protocol that allows communication and information transfer across platforms in real time and transparent. (Dionisio et al., 2013) One of the approaches is using the Blockchain to store and distribute data that must travel across the Metaverse. (L. Zhang, 2022) Based on a similar measurement of interoperability for healthcare mobile applications, interoperability results from the advancement of several technologies, compatibilities, and organizational capabilities. (Rafferty, 2023)

Blockchain

Blockchain plays a significant role in the Metaverse, as it becomes the enabler for decentralization in the platform. Blockchain is characterized as a digital ledger that uses encryption to link monitored assets and a list of recorded transactions inside the network of a business. (Maddikunta et al., 2022) Blockchain technologies enable the establishment of decentralized networks without centralized points of control, thereby reducing the concentration of power in the hands of a small number of private actors. (Ghelani & Hua, 2022)

Information on Blockchain can be instantaneous, shareable, and transparent. It is recorded in an impermeable, unchangeable ledger that only network participants with authorization can access. A standard Blockchain network is able to monitor finances, payments, purchases, and various transactions. (Maddikunta et al., 2022) Furthermore, in the Metaverse, a huge amount of data (such as videos and other digital items) is collected by VR devices, sent via networks, and kept in data centres without any security or privacy protection measures in place in the Metaverse which can easily become the target of cyberattacks. In this regard, Blockchain technology, which has a number of distinctive qualities, offers a potential solution for the Metaverse's security and privacy problems. (Huynh-The et al., 2023)

Security and Privacy

For the Metaverse, the interoperability aspect allows people to move from one platform to another, transferring data and information between platforms more seamlessly, thus increasing the concern of

security and privacy, which becomes the main factor to consider when developing this platform. (Dionisio et al., 2013)

Despite its encouraging indicators, the main obstacles to the Metaverse's continued development are security and privacy concerns. The management of enormous data streams, widespread user profiling, unfair AI algorithmic results, and the safety of physical infrastructures and human bodies are only a few examples of the many security lapses and privacy violations that could occur in the Metaverse. According to Jaber (2022), security attacks in the Metaverse have several possibilities, such as social engineering attacks, credential theft, security risks of Virtual Reality (VR), identity theft, ransomware, reduced perception of physical space, and radicalization and polarization.

From the previous section in the Metaverse layer, security become the mandatory aspect that needs to be implemented in the Metaverse layer. (L. Zhang, 2022) The scoping interview with a Metaverse expert also supports this statement. Therefore, addressing the importance of this topic, the security and privacy considered to be included into the proposal of the META-QUAL.

Immersiveness & User Experience

From the previous section of the Metaverse Layer, user interaction, human interface, and experience have been mentioned in much research. Immersiveness can be defined as the degree to which a person feels they interact more with their virtual environment than their physical surroundings. (Richter & Richter, 2023; Dwivedi et al., 2022) By providing users with a more engaging and realistic experience, the Metaverse can increase the level of immersion. (The Metaverse Overview, 2022)

In its development, immersiveness is highly correlated with interoperability and user experience, as discussed in Quality of Experience (QoE). (Zheng & Liu, 2023) The research of QoE on the Metaverse has touched many disciplines as part of Human-Computer Interaction (HCI), not only computer science inside the virtual environment but also the psychological aspect associated with humans. (Liu et al., 2023) Although much research pursues this topic and discusses the importance of the experience of the end user in the business (Parasuraman et al., 2005; Zhu & Kraemer, 2002; Gadalla et al., 2013; Peters et al., 2013), there is still debate among those researchers, on the biased that might occur due to the psychological aspects tested to the users that many factors could impact.

Generative Artificial Intelligence (GenAI)

The current trend of GenAI has been shaping modern technology; the rise of ChatGPT allows society to use smart programming to help their life. For the Metaverse, implementing GenAI could enhance many aspects, such as user experience (UX) with an innovative approach, especially in content and design production during development. (Lv, 2023)

By integrating GenAI with other technologies like Blockchain, networking, and AR/VR, the Metaverse may build secure, scalable, and realistic virtual environments on a dependable, always-online platform. (Huynh-The et al., 2023; Lv, 2023) The significance of GenAI implementation is also to ensure infrastructure stability and enhance Metaverse performance, significantly enhancing the user immersive experience that is visualized in six technical aspects as illustrated in Figure 3. (Huynh-The et al., 2023)
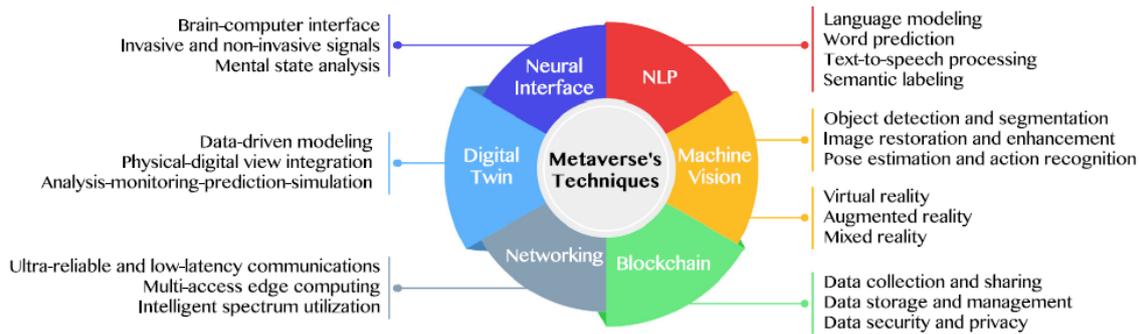
Figure 3 AI involvement in the technical aspect of Metaverse development (Huynh-The et al., 2023)

As discussed in the previous section, the user layer has been mentioned by several researchers as a crucial factor to be delivered by the Metaverse. (Kashif, 2022); Hatzilygeroudis, 2022; Krishnamurthy, 2022; Radoff, 2022; L. Zhang, 2022). The user layer is the extent to which a user interface enables the user to interact in a satisfying and fulfilling way. (ISO/IEC 25010:2011, 2011) As part of Human-Computer Interaction (HCI), one of the approaches to delivering the user experience in the Metaverse is the interface and 3D modeling in the platform. (Liu et al., 2023) According to GenAI, it can be implemented in different Metaverse components in constructing Metaverse buildings, player avatars and dialog with non-player characters, and multilingual translation.

With GenAI implementation, the design and modeling could be enhanced to be more hyper-realistic and personalized. (Lv, 2023; Huynh-The et al., 2023) For an Extended Reality world, the enhancement of this factor can significantly impact many metrics related to its performance, such as User Experience (UX) and immersiveness. (Parasuraman et al., 2005; Zhu and Kraemer, 2002; Gadalla et al. 2013; Peters et al., 2013) There are other enhancements that GenAI can deliver for the Metaverse that are discussed in the literature review. However, this thesis research will only discuss how GenAI can enhance the user interface.

2.1.2. Business in the Metaverse

With technology's significant growth and development, the Metaverse, Web 3.0, and Blockchain will create a new digital economy. (Olenski, 2015; L. Zhang, 2022) This will change how the transaction method moves to digital currency and digital assets (NFT) in an immersive way. Another opinion of the current digital economy is that "*digital economy focuses on the way digital technologies, services, products, techniques, and skills are integrated across economies in digitalization."* (Martech, 2023)

These recent technologies and their impact on the business and economy sector have reshaped how businesses provide value to their customers. This section aims to focus on customers and marketing within the Metaverse environment that will be valuable for the development of the META-QUAL.

Because of the digital economy, consumers now have higher expectations of businesses; they expect to be able to interact with brands in a seamless, contextual, omnichannel (Martech, 2023), direct, and personalized way. (What Is Digital Economy, 2020) Quoting from Irene-Marie Seelig, co-founder and CEO of AnamXR, to McKinsey in customer behaviour: "*Consumer behaviour has largely shifted toward adopting digital personas, yet many brands have yet to provide a solution. This opens up a new revenue model for brands that can supply digital assets."* (Value Creation in the Metaverse, 2022)

According to McKinsey, 60% of the current internet users are excited about moving the activity into the Metaverse. For users as customers in the Metaverse, the drivers to joining the virtual world are to connect with people, explore the digital world, meet and collaborate with remote colleagues, and purchase and trade NFT and real estate. (Value Creation in the Metaverse, 2022) This significant shift

of services from "offline" to "online" has not been enough to meet the demand for online services in the twenty-first century, despite the fact that technological advancements have altered business operations and transaction methods and increased consumer reliance on the Internet. (C. Chen, 2022) Consequently, many businesses spend a substantial amount of time and money on offering virtual reality.

In response to the need for more meaningful interactions between companies and consumers, omnichannel marketing and user-friendly app development have grown in popularity. (Martech, 2023) Thus, providing every consumer with a personalized and unique experience has become essential, starting from the moment they visit a business website and continuing through the process of making a purchase. (What Is Digital Economy, 2020)

Marketing in the Metaverse

According to Reibstein and Iyengar (2023), marketing in the Metaverse is the subsequent development that expands upon earlier marketing domains, including omnichannel marketing, the 4 Ps (promotion, product, place, and price), and the 5 Cs (customers, company, competitors, collaborators, and context). For example, in the Metaverse, with no limitation in physical activities, marketers are able to create a product that answers customers' needs and is personalized to consumer preferences in the interconnected and interoperable virtual world. (Lu and Mintz, 2023)

In the user targeting topics, which are still considered a niche market, the importance of reaching more audiences to the Metaverse is through omnichannel marketing, where customers or users can feel the same brand identity across channels and platforms, offline and online. (Abraham & Laughlin, 2023; Value Creation in the Metaverse, 2022; Martech, 2023) Kantar set an example of the ads of Meta's Quest 2 VR headset through a sports competition, where a customer could participate as a sports player through the headset. In their hypothesis, a sports competition is widely known by the mass market; thus, it can help raise awareness of the Metaverse among those outside the specialized gaming community that currently uses it. (Abraham & Laughlin, 2023)

While it is crucial to bridge the gaps between online and offline channels with omnichannel (Lu & Mintz, 2023), omnipresence is also essential where brand presence is at the same level of bridging the gaps. Omnipresent offers personalized advertisements, content suggestions, and search results; with the integration of GenAI, omnipresent can enhance user experience, recognize trends, and predict future events. (Dwivedi et al., 2021; De Libero, 2023)

As the last point, Abraham and Laughlin (2023) stated that the organizations' attitude towards innovative technology also plays a significant role. Because the Metaverse is a new technology still in its exploration phase where risk and significant uncertainty are most likely to happen. (The Metaverse Overview, 2022) Therefore, a risk-averse and customer-centric company will more likely excel in joining the hype of the Metaverse and excel in its marketing strategy. (Dwivedi, Hughes, Wang, et al., 2022; Abraham & Laughlin, 2023) This statement also aligns with academic research as it is crucial from a marketing standpoint to be flexible in adapting to the innovative technology (Barnes & Mattsson, 2011; Donthu et al., 2021)

Marketing techniques will play a crucial role in the success of brands when they explore the Metaverse, as they have more opportunities to engage with current and potential clients and give them an immersive experience. Retailers who know how to use the Metaverse to improve their stores and engage customers, create experiences, and cultivate their brand community will likely have a significant competitive advantage going forward. (Value Creation in the Metaverse, 2022).

2.2. Related Work on Performance Evaluation Framework

Many approaches exist to evaluate software and online services performance, such as theories, models, and frameworks. (Nilsen, 2015). In addition, according to Kivunja (2018), there are two approaches to frameworks: conceptual and theoretical. The theoretical framework is constructed of others' points of view that are related and important to the research. In comparison, the conceptual framework incorporates all the information and data gathered from the research, including recommendations and outcomes. (Kivunja, 2018) Therefore, , a conceptual framework will be developed in this thesis research to provide a more actionable framework to evaluate the Metaverse for the firm.

Like many other technologies, Metaverse needs to be capable of offering end users meaningful services. (L. Zhang, 2022) A combination of services aiming to satisfy customer scenarios' demands and provide solutions will comprise the future world. Thus, the final framework will be developed using the E-service quality (E-S-QUAL) framework from Parasuraman et al. (2005) as a benchmark because this framework has been used in much research for years. Their research focuses on how to measure an E-service quality, summarized as "*the outcome of an evaluation process, where the customers compare their expectations with the service they have received*." (Parasuraman et al., 2005)

Research by Parasuraman et al. (2005) on E-service quality (E-S-QUAL) is the development of their previous research with nine dimensions to evaluate the quality of an E-service. The nine dimensions are Tangibles (site aesthetics), Efficiency (ease of use/navigation, functionality, accessibility), Responsiveness (respond to complaints, serviceability), Reliability fulfilment, delivery, Information content, Assurance (security/privacy, trust), Empathy (customer service/support, interaction, contact, tailored communication), Personalization and Hedonic (entertainment). (Zeithaml et al., 2000)

In their study development, they discuss the simplified nine dimensions of E-S-QUAL into seven dimensions: Efficiency, Responsiveness, Fulfilment, System Availability, Privacy, Compensation, and Contact, which can be seen in Table 1. Parasuraman et al. (2005) keep several dimensions that are still relatable with current technology, such as Efficiency, Responsiveness, Fulfilment, and Privacy, in the simplification E-S-QUAL framework. While other dimensions have been merged or generalized to be more adaptable with future technology development, such as Tangibles (site aesthetics), Information Content, Personalization, and Hedonic are merged as System Availability, which refers to the correctness of technical functioning of the Metaverse.

Table 1 Comparison on the new development of E-S-QUAL Dimension

Zeithaml et al. (2000)	Parasuraman et al. (2005)
Tangibles (site aesthetics)	-
Efficiency (ease of use/navigation, functionality, accessibility)	Efficiency
Responsiveness (respond to complaints, serviceability)	Responsiveness
Reliability fulfilment, delivery	Fulfilment
Information content	System Availability
Assurance (security/privacy, trust)	Privacy
Empathy (customer service/support, interaction, contact, tailored communication)	Compensation, Contact
Personalization	-
Hedonic (entertainment)	-

In addition, we use the second benchmark, ISO/IEC 25010 from the Institute of Electrical and Electronics Engineers (IEEE), the standard that has been used as a reference for many technology developments. This standard became the second reference as it is more related to recent technology, especially the Metaverse. Based on IEEE, software quality needs to be maintained to modify a software system to correct faults, improve performance, and adapt to a changed environment. (ISO/IEC 25010:2011, 2011) From the ISO/IEC 25010 standard, the quality of software products is characterized based on eight framework elements, as shown in Figure 4: functional suitability, performance efficiency, compatibility, usability, reliability, security, maintainability, and portability. (ISO/IEC 25010:2011, 2011)

Figure 4 Product quality model defined in ISO/IEC 25010 standard (ISO/IEC 25010:2011, 2011)

Although many kinds of literature publish similar frameworks on online service quality, those publications written about E-service and other related technology from decades ago are likely outdated. Because Blockchain, decentralization, interoperability, artificial intelligence, and Meta are relatively recent technologies, they are not covered in the older publications. Therefore, for this thesis research, similar frameworks that discuss the recent technology relevant to the Metaverse will be compared, such as the framework for social media, E-commerce, and Metaverse, which will be discussed in the following section.

2.2.1. Social Media for Business Evaluation Framework

In its development, research regarding social media strategy is a rapidly growing field of interest, and several frameworks have been developed to evaluate social media performance based on the objective of each measurement and the specific needs of brands. Table 2 provides an overview of prior studies on social media performance framework.

Table 2 Literature Review on Social Media Performance Framework

Dimension	Metrics	Study Field	Source
CBE (Consumer Brand Engagement)	Consumer Involvement, Self-brand Connection, Brand Usage Intent	Psychology, Marketing	(Hollebeek et al., 2014)
Customer Engagement	Connection, Interaction, Loyalty, Advocacy	Psychology, Marketing	(Shawky et al., 2020)
Social Media Strategy	Target Audience, Channel Choice, Goals, Resources, Policies, Monitoring and Content Activities.	Sociology, Marketing, and Psychology	(Effing and Spil, 2016)
Organizational Guidelines for Managing social media	Motives, Content, Network Structure, Social Roles, and Interactions	Marketing, Organization	(Peters et al., 2013)

	Type of Media and Brand		
Maximize Social Media Engagement	Type of Media and Brand Content, Brand Involvement of the Company, Social Media Channel Used, and Cross-channel Management Strategies	Marketing, Organization, Technology	(Reimer, 2023)

The social media framework in Table 2 measures the connection between a platform and a customer in psychological and marketing research. As mentioned by Reimer (2023), social media is a platform that can create brand awareness as an additional touch point that can influence customers and can be optimized with an understanding of customer-brand relationships in the engagement process. Therefore, with the similarities in the dimension that has more correlation with the interaction between customers and platform, several checklists and surveys from the academic literature will be adapted for the outcomes in the final framework for this thesis.

2.2.2. Web-based E-commerce Evaluation Framework

With the velocity of online shopping expansion, several studies have pursued research on determining which points are essential for E-commerce performance that will benefit future changes in customer behavior. The similar logic behind this framework will also be beneficial for this research to determine which metrics are best used to evaluate the performance of Metaverse integrated into the Business. The overview from prior studies on the E-commerce performance framework is provided in Table 3.

According to Parasuraman et al. (2005), their E-service Quality (E-S-QUAL) framework is based on previous web commerce or E-commerce developments. Therefore, the similarity of the framework is higher than that of the social media framework. While the Social Media framework focuses on the interaction between the user and the platform, the E-commerce framework has a broader measurement from a technology and business perspective that will be valuable in META-QUAL framework development.

Table 3 Literature Review on E-commerce Performance Framework

Dimension	Metrics	Study Field	Source
E-commerce Performance Metrics	Revenue per Employee, Profit Margin, COGS, Inventory Turnover	Marketing, Finance	(Zhu and Kraemer, 2002)
IT Infrastructure Metrics for E-commerce	PC, Local Area Network (LAN), MIPS (Millions of Instructions Per Second), IT Stock, IT Intensity	Technology, Finance	(Zhu and Kraemer, 2002)
E-commerce Capability Indicators	Information, Transaction, Interaction and Customization, Supplier Connection	Technology, Marketing, Supply Chain	(Zhu and Kraemer, 2002)
Quality Framework of m-Commerce	Functionality, Usability, Efficiency, Reliability	Technology, Marketing	(Garofalakis et al., 2007)
E-commerce System Quality Assessment	Functionality, Usability, Efficiency, Reliability	Technology, Marketing	(Stefani and Xenos, 2007)

2.2.3. Metaverse Evaluation Framework

In this section, related frameworks for Metaverse from other scientific literature will be discussed in order to make a holistic review that is beneficial for the final objective.
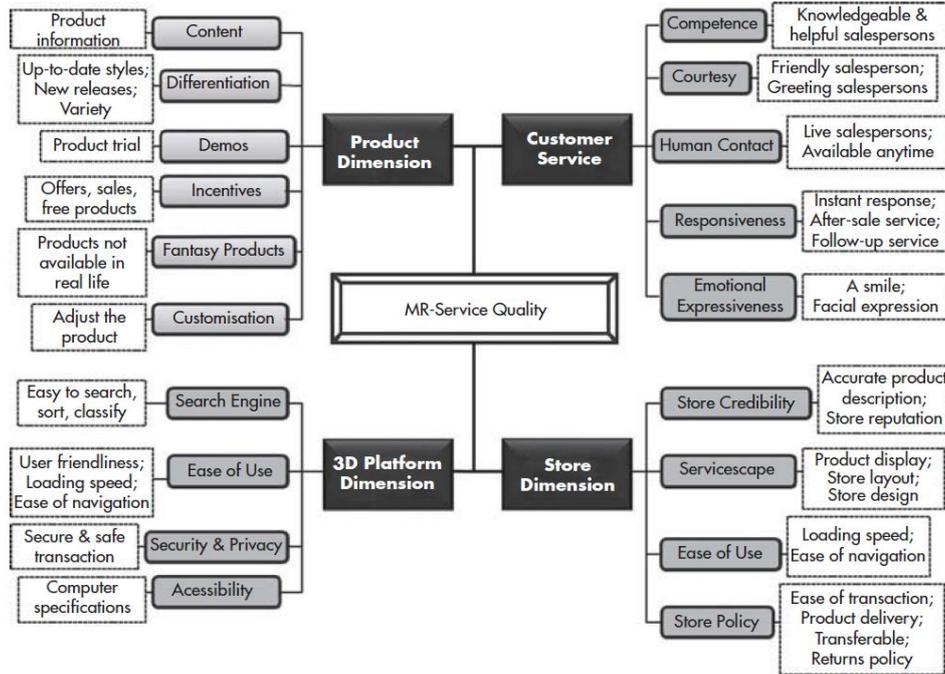
Figure 5 A conceptual model of the determinants of MR-service quality (Gadalla et al., 2013)

According to Gadalla et al. (2013) in Figure 5, the MR-Service Quality (Metaverse-Retail Service Quality) to evaluate the performance of a Metaverse retail is divided into four dimensions: product dimension, customer service, 3D platform dimension, and store dimension.

In another study, F. Shi et al. (2023) have another explanation of the key component in the technical framework of the Metaverse; they propose a framework to fulfill the Maslow Hierarchy of Needs. In a recent publication, a scientific study from Rauschnabel et al. (2023) published framework 4C (Consumer, Content, Context, and Computing Device) illustrated in Figure 6.
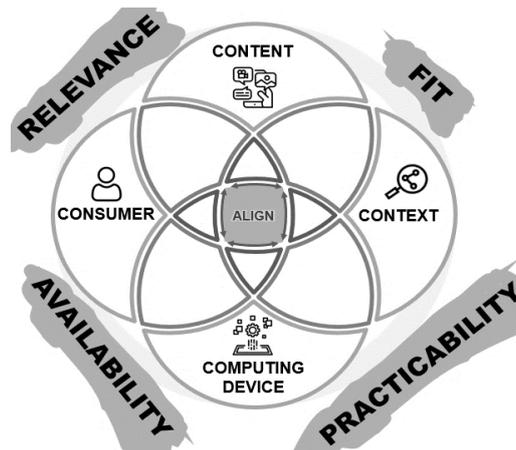

Figure 6 The 4C Framework (Rauschnabel et al., 2023)

There have been many Metaverse frameworks published by other academic literature, and Table 4 is used to compare the dimensions and metrics used from the existing study.

Table 4 Similar Framework in Metaverse Technical Part

Dimension	Metrics	Study Field	Source
Human-Computer Interaction	Ubiquitous Connection, Space Convergence, Virtuality & Reality Connection, Human-centered Communication	IT, Human Behaviour	(F. Shi et al., 2023)
Technology	BIGANT (Blockchain, Interactive Technology, Video Game Related Technology, Artificial Intelligence, Network & Computing Technology, Internet of Things – IoT)	Technology, Virtual Reality	(F. Shi et al., 2023)
Technology Hardware and Related Skills	XR, User Interactivity, AI, Block Chain, Computing Vision, Internet of Things, Robotics, Edge and Cloud Computing and Future Mobile networks	Technology	(Krishnamurthy, 2022)
Technological Building Block	Networks, Computing, 3D Modelling, IoT, AI, Blockchain, XR, Interface Devices	Technology	(Barrera & Shah, 2023)
Consumer Experience	Immersiveness, Sociability, Environmental Fidelity	Technology, Business, Human Behaviour	(Barrera & Shah, 2023)
Technology	Environment, Interface, Security & Privacy, Interaction	Technology	(Dwivedi et al., 2022)
Extended Reality	Immersiveness, Social Networking, Persistence, Interoperability	Technology,	(Richter & Richter, 2023)
Metaverse Retail Service Quality	Product Dimension, Customer Service, Store Dimension, 3D Platform Dimension	Technology, User Perspective	(Gadalla et al., 2013)

With the velocity of technology development, many terms have been advanced. In the dimension of Privacy, many updated terms have been classified, such as Blockchain (Krishnamurthy, 2022; Barrera & Shah, 2023; F. Shi et al., 2023) and Ubiquitous Connection (F. Shi et al., 2023). Blockchain, as discussed in the previous section, provides an intriguing solution to the security and privacy issues in the Metaverse by allowing only network participants with authorization to access by recording the information in an impermeable, unchangeable. (Maddikunta et al., 2022; Huynh-The et al., 2023)

Recall the statement from Gadalla et al. (2013) that research to help businesses understand how to design high-quality services in Metaverse is still in the development process; after many years, the research and framework that are listed in Table 4 are still mainly focused only on one point of view, either users or technology. This thesis will contribute to combining a related factor and providing a holistic performance evaluation framework from the users, company, and technology dimensions.

2.3. Summary and Contribution

From the previous section, the academic literature has examined the evaluation of the metaverse framework, although most of them focus on just one aspect—customers or technology. Therefore, this thesis research contributes to combining all the aspects of consumer, technology, and organization to give a holistic view of Metaverse evaluation. The similarity of a dimension in a framework for assessing online service performance is displayed in Table 5.

The various perceptual characteristics under each dimension make matching the dimensions across studies challenging. For simplification purposes, several elements on the list have been modified to be more appropriate and fit with the benchmark while considering the sense similarities because there are variations that could be advantageous for the Metaverse in different terms but similar meanings. For example, interface and 3D modeling mentioned by Dwivedi et al. (2022) and Barrera & Shah (2023) are grouped in the tangibles (site aesthetics) dimension by Parasuraman et al. (2005).

However, the "other" list items are too dissimilar and unfocused for the final objective. For example, literature from Zhu and Kraemer (2002) on E-commerce Capability Indicators mentioned PC, LAN, IT Stock, Revenue per Employee, COGS, and Inventory Turnover. While hardware attributes are essential for developing the Metaverse, this thesis focuses more on the software improvement companies should make to enhance the quality of their Metaverse services.

Target audience and channel choice from Effing and Spil (2016) and Cross Channel Management Strategies and Type of Media by Reimer (2023) are grouped as the Responsiveness dimension from Parasuraman et al. (2005). The reason is that targeting the audience and the channel and media choice is part of a company's response to the customer needs, as described by Parasuraman et al. (2005) in the Responsiveness dimension.

Interestingly, while the Compensation and Contact dimensions from Parasuraman et al. (2005) are challenging to match with the ISO/IEC 25010 standard (ISO/IEC 25010:2011, 2011), the Social Media Framework has more similarities in order to evaluate the interaction between the platform provided by business and customer as users. Dimensions Compensate and Contact from Parasuraman et al. (2005) fits with Social Roles and Interactions (Peters et al., 2013), Consumer Involvement (Hollebeek et al., 2014), Monitoring Content Activities (Effing and Spil, 2016), Connection and Interaction (Shawky et al., 2020) and Brand Involvement of the Company. (Reimer, 2023)

The dimension of the E-commerce framework has more direct and general terms rooted in the ISO/IEC 25010 standard. For example, Garofalakis et al. (2007) and Stefani and Xenos (2007) have the exact measurement dimensions of Functionality and Usability that are similar to the dimensions from ISO/IEC 25010 standard that are grouped as System Availability from Parasuraman et al. (2005) According to the literature, System Availability is described as the degree of technical functioning correctness of the site that is similar to what IEEE (2011) described as Functional Suitability, where the software meets the standard of completeness, correctness, and appropriateness. The decision to group Usability from ISO/IEC 25010 standard into the System Availability dimension is that IEEE (2011) explained the terms as the extent to which specific users may utilize a system or product to fulfill specific objectives in a specific context of usage with efficacy, efficiency, to satisfy the users.

From the comparison, many dimensions from the current literature have more similarities to the dimension of System Availability, Compensation, and Contact from Parasuraman et al. (2005). For example, there are Content and Accessibility by Gadalla et al. (2013) and Environment and Interface by Dwivedi et al. (2022). The latest technology, such as Artificial Intelligence (AI), Internet of Things (IoT), Networks, Computing Technology, XR, and Immersiveness (Krishnamurthy, 2022; Barrera & Shah, 2023; F. Shi et al., 2023; Richter & Richter, 2023) also grouped in System Availability.

Table 5 Comparison of the Dimension for E-S Qual with Similar Framework (Elaborated by the Author)

Parasuraman et al. 2005	Zhu and Kraemer, 2002	Garofalakis et al., 2007	Stefani and Xenos, 2007	IEEE, 2011	Gadalla et al. 2013	Peters et al., 2013	Hollebeek et al., 2014	Effing and Spil, 2016	Shawky et al., 2020	Dwivedi et al., 2022	Krishnamurthy, 2022	Barrera & Shah, 2023	Richter & Richter, 2023	F. Shi et al., 2023	Reimer, 2023
Efficiency		*	*	*	*							*			
Responsiveness	*			*	*			*	*						*
Fulfilment		*	*	*	*								*		
System Availability	*	*	*	*	*	*	*	*		*	*	*	*	*	*
Privacy				*	*		*	*		*	*	*		*	
Compensation, Contact	*				*	*	*	*	*	*	*	*	*	*	*
Others	*					*		*							

3. Methodology

This chapter presents the methodology used to gain information, data, and results during this study. The research methodology, the selection of the literature review, and the interview analysis are explained in the following chapters.

3.1. Research Approach

The structure of this research will be discussed in this part. As part of the information system and technology topics, this study will use a design science research methodology (DSRM) for information system research. (Peffers et al., 2007) Figure 7 describes the process model of design science research methodology for information system research. With the iteration process implemented, the methodology will help this study for continuous improvement at every stage.
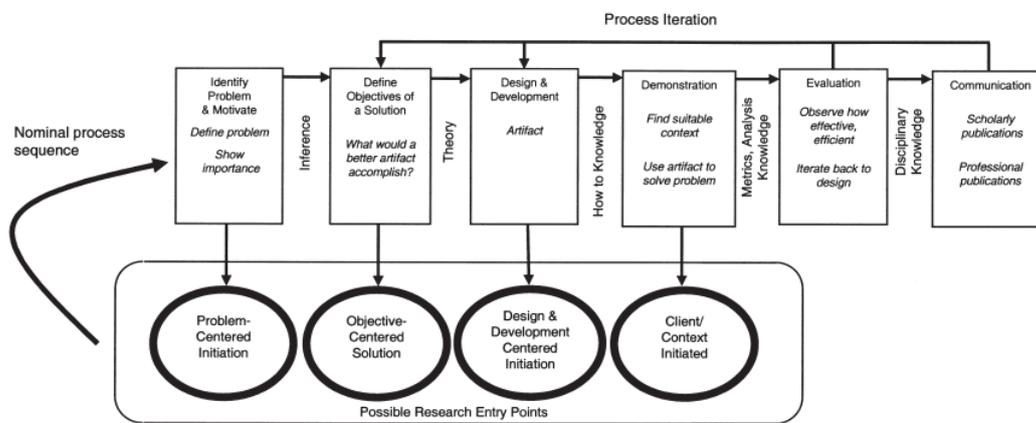

Figure 7 DSRM Process Model (Peffers et al., 2007)

Referring to the DSRM framework, the process model is simplified and adapted to the needs of this research that can be seen in Figure 8 for the actual process that will be conducted in this research.
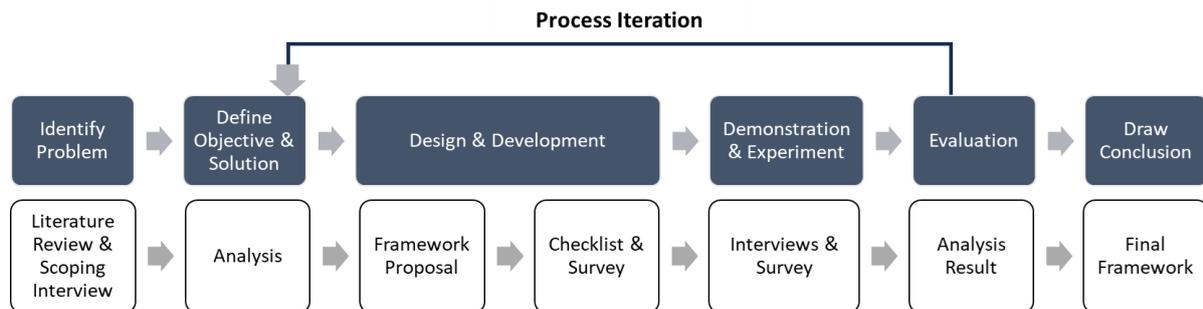

Figure 8 Research Approach Adaptation from DSRM for this Thesis Research

As the first step, this study reviews the existing literature and conducts scoping interviews with semi-structured interviews with a practitioner about the experiences with the Metaverse. The objective is to propose a comprehensive framework that can meet the needs of corporations in understanding themselves and their customers by identifying the challenges and critical success elements to evaluate Metaverse's performance. The in-depth literature review will be done to find existing research on the Metaverse, and the technology related to the Metaverse and to pinpoint the specific difficulties and critical requirements for incorporating the Metaverse into the business.

The scoping interview with an industry expert will be performed to acquire further information, identify best practices for incorporating the Metaverse into businesses, and get input on the challenges and opportunities that will be beneficial for the development of framework and business models.

Based on the results of the scoping interview and the literature study, the next step is developing a framework proposal, checklist, and survey. The framework proposal will be assessed in a semi-structured interview with Metaverse experts from various sectors. Following the interview, an online survey through Qualtrics will be given as a complementary to the semi-structured interview result to gather more information about their responses on the details of the final product. In the end, the final framework will be presented as a conclusion with expert insight and feedback.

3.2. Research Process

3.2.1. Identify Problem – Scoping Interview

To identify the problem, we design a scoping with semi-structured interviews. Scoping interview aimed at assessing, defining, and sharpening preliminary perspectives, presumptions, and ideas from the literature review about the metaverse, its trends, and evaluation methods. (M. D. J. Peters et al., 2020) The semi-structured interview approach enabled us to modify the questions while retaining the general format, ensuring comparable data gathering from the participants. Participants were encouraged to share their experiences and give thorough details during the interviews using open-ended questions. In this manner, we can compile the data and elaborate on the fascinating subject that will be valuable for the framework's development.

The problem identification is obtained from a semi-structured interview with an expert from a Metaverse consultancy from Spain, which later will be identified with a code S-1. The interviewee has been asked 17 questions from 7 sections about the Metaverse and the possibility of metrics that will be used to evaluate a Metaverse performance. The 7 sections are background, challenges, and requirements of the Metaverse, best practices from existing business cases, evaluation of the past business case, evaluation metrics, potential risks and solutions, and wrap-up. The questions and interview protocol details are presented in Appendix section 9.1.1 about Semi-Structured Interview Protocol - Scoping Interview.

The objective of the scoping interview is to generate specific items for the proposed metrics of the framework to evaluate Metaverse integrated into the business and select the items that correlate more with the existing studies.

4. Solution Proposal: META-QUAL

This section will cover the findings from the initial round of scoping interviews and the literature review leading to the META-QUAL solution proposal. The purpose is to identify the key components to evaluate the Metaverse's performance from the scoping interview and connect it with the literature review to support the analysis. Then, in the last part, combining both data collections led to the META-QUAL proposal.

4.1. Interpretation from First Result

This section will discuss the results of the first data collection, starting with scoping interview results and then a literature review. The table will be used to visualize the result to give an easy understanding of the analysis.

4.1.1. Interpretation from Scoping Interview

The problem identification is obtained from a semi-structured interview with an expert from a Metaverse Consultancy from Spain (S-1). The results for this section are divided into four parts: Metaverse in General, shown in Table 6; Metaverse Integration in a Business in Table 7; Risk, Challenges, and Mitigation in Table 8; and Performance Evaluation in Table 9.

Table 6 Metaverse in General

Topics	Question	Answer
Metaverse in General	Could you briefly define the Metaverse from your perspective?	Metaverse is a natural evolution of the internet, a platform that allows millions of users to connect and interact anytime. The Metaverse means more for the business and is a place to create, entertain, and collaborate.
Metaverse Trends	Looking at the latest news and articles which suggest that the Metaverse will not thrive. What is your opinion about this?	Society is still sceptical and do not believe in what is about to happen, but this has always happened in the innovation phase, especially disruptive innovation.
		Because it still has a real niche market and insufficient communication through its cross-platform strategy, it made the target even smaller.

From Table 6 above, we focus on the Metaverse description from a consultancy perspective and ask their opinion on the current trends in Metaverse. From the answer, we gain an understanding of what the experts think of Metaverse and how they feel hopeful about the trends for the future. Moreover, we asked multiple questions that our interviewee could describe more about the future of Metaverse.

Table 7 Metaverse Integration in Business

Topics	Question	Answer
Metaverse Consultancy Project	Could you briefly describe the most significant Metaverse implementation projects you have worked on?	Developing a new virtual world for a business that allows other brands to collaborate and can be accessed through the website and mobile targeting the new generation.
Company's motivation	What do you think motivates businesses to	To build a seamless bridge between the digital and physical worlds and to show products/services in

Integrating Metaverse	join the hype of Metaverse?	diverse ways, immersive, fun, and creative, to increase brand awareness and grow revenue by selling the product in a virtual world.

From Table 7 above, the interviewee has been asked to describe their project related to Metaverse development. From the answer, we are convinced of what the experts experience with the development of Metaverse. In this part, we gain knowledge to dive more into the story behind the development discussed in the next part.

Table 8 Risk, Challenges and Mitigation

Topics	Question	Answer
Risk and Challenges	What are the main risks/challenges that companies face when integrating the Metaverse into their business model?	**General:** - Recent technology with few historical success stories, what works and what does not. - Many success stories might not be adaptable for other companies from different industry sectors. - Metaverse is a decentralization platform that could lead to dark business because it has anonymous stuff. - Metaverse is a decentralization platform that allows users to own their own data, making it difficult for businesses to track their users. **Capital:** - Much money and time is needed to do trial and error. - Silos situation in the company's organization during the project. **Audience:** - The market is still niche. - Sudden changes and movement to the Metaverse could frustrate the target audience, the customer. - Attract traffic by engaging new audiences and maintaining current customers. - Create a constant creative content.
Mitigation	Do you have any suggestions for mitigating these risks/ challenges?	**Capital:** - Organizational: Create a workforce involving people from different departments to reduce the silos - Planning: strategic plan, continuous and iterative, starts with small, then increasing it progressively **Audience:** - Attract a new audience with cross-platform marketing strategies. - Use the Web 2.0 platform, involving social media, to attract a new audience. - Attract new audiences by creating content every day. - Strong and synergy marketing and communication plan.
Failures and Learning	In the past, there were failures from the	**Failure:** A technological malfunction during the launch

	companies that integrated Metaverse into their business. What do you think are the reasons?	**Reasons:** - Lack of testing before the launch day - Unclear agreement between client and provider on the objective and product result - Last-minute updates and changes **Solution and Mitigation:** - Clear agreement on the timeline, objective, and process between client and provider. - Implement iterative process and agile methodology. - Spare enough time, budget, and planning for trial and error. - Clear communication between client and provider. - Modern company culture and vision towards future technology.

From Table 8 above, we discussed the challenges and risks they and their client company face when integrating Metaverse into the business. We collect the data from the answers to benefit our recommendations for companies integrating Metaverse into their business.

Table 9 Performance Evaluation

Topics	Question	Answer
Success Factor	What are the **key metrics/ success factors for measuring the success** of the Metaverse integration into the business?	**- Organizational:** Company culture and vision to the future technology, mindset **- Business Models:** With Metaverse decentralized, the company will not get much user data. The changes in business models to sell services to allow and attract people to come to an ecosystem where these people can also benefit and create value in that ecosystem. By doing business inside, such as creating, selling, and buying. **- Capital:** Budget, Technology, and Manpower (People) **- Planning:** Start small, strategic plan, knowing the objective, clear target, understand the problem, and continuous strategy. - **Marketing:** **Audience:** Number of visitors, Number of purchases **Brand Awareness:** Noise in social media **Capital:** Conversion rate, Revenue

In Table 9, we focus more on the success factor and metric that would be useful for the final product of the framework we will develop. From the response, we derived the information that success factors can be divided into two parts: Qualitative and Quantitative. From the Quality section, we categorized it as Organizational, Business Models, Capital, and Planning. For the Quantitative section, we categorize it as Audience, Brand Awareness, and Capital.

The result from this interview section shows similarities with the Digital Transformation enablers and inhibitors, such as organization and managerial inside the company. (Gilbert, 2005) Obtained from other literature, the role of Organizational, Cultural, and Management characteristics in innovation plays a vital role in the innovation progress of the company. (Raffaelli et al., 2019; Dwivedi, Hughes, Wang, et al., 2022) Supported by interviewee S-1 as one of the critical points to achieve the best performance of the Metaverse, the organizational and managerial need to reduce the silos mentality that can reduce the flexibility and adaptability to the innovative technology.

4.1.2. Interpretation from Literature Review

From the summary of literature review in Section 2, the similarities of metrics and dimension used to evaluate the performance of E-service Quality, Social Media, E-commerce and Metaverse has been discussed. Although various works of literature publish similar frameworks on the quality of online services, publications written about E-service and other related technology decades ago are likely out of current terms. Because Blockchain, decentralization, interoperability, artificial intelligence, and meta-data are newer technologies that are not discussed in previous books. In order to provide a more present technological table 10 compares Parasuraman et al. (2005) to the ISO/IEC 25010 standard from IEEE (2011).

Table 10 Comparison between two foundations benchmark

Parasuraman et al. (2005)	IEEE (2011)
Efficiency	Functional Suitability, Performance Efficiency, Usability
Responsiveness	Maintainability, Portability
Fulfilment	Compatibility, Usability, Reliability
System Availability	Functional Suitability, Usability
Privacy	Security
Compensation, Contact	

According to ISO/IEC 25010 standard from IEEE, the dimensions are explained as follows:

1. **Functional Suitability** measures how well a system or product fulfills stated and unstated needs when used in specific circumstances.
2. **Performance Efficiency** indicates performance concerning the quantity of resources used under specified conditions.
3. **Compatibility** is the extent to which a system may share a software environment with other systems to exchange information and conduct essential operations, such as interoperability.
4. **Usability** is the extent to which specific users may utilize a system or product to fulfill specific objectives in a specific usage context with efficacy, efficiency, and satisfaction.
5. **Reliability** measures the system, product, or component's degree of ability to conduct specific tasks for a given amount of time in a given set of circumstances.
6. **Security** is the extent to which a system or product controls data and information to allow users or other products or systems to access it to the right extent according to the types and degrees of authorization.
7. **Maintainability** refers to how easily and effectively it may be adjusted to make corrections, enhance functionality, or adjust to shifting demands and environmental conditions.
8. **Portability** is the degree to which a product, system, or component can be effectively and efficiently moved from one operating or usage environment or piece of hardware to another using software or other tools.

The decision in the matchmaking dimension from Table 10 is based on the similarity in their definition. For example, the Efficiency from Parasuraman et al. (2005) measures the accessibility of a platform according to its easiness and speed. This dimension later matched with three dimensions from IEEE (2011), which are Functional Suitability (a platform that is well performed can be accessed), Performance Efficiency (mention the time and efficiency), and Usability (how accessible the platform is).

Most of the dimensions from Parasuraman et al. (2005) are covered by the IEEE (2011) framework. While five of six dimensions are covered in both literature, one dimension not listed in IEEE (2011) is Compensation and Contact. While looking at the description, Compensation, and Contact by Parasuraman et al. (2005), it refers to the interaction and Responsiveness of a company to their customer as users during their activity in the platform, including assisting with problem-solving. This description is similar to the Responsiveness from the same literature articulated as the Maintainability and Portability dimension from IEEE (2011).

From the comparison, dimensions from IEEE have been repeated at least twice to cover the similarity. The dimension of Functional Suitability from IEEE has been mentioned twice in the Efficiency and System Availability dimension by Parasuraman et al. (2005). Also, Usability is mentioned in Fulfilment and System Availability. Therefore, Table 11 will be used as a secondary consideration to minimize duplication in the framework development.

Table 11 Comparison of the framework dimension mentioned in existing literature.

(ISO/IEC 25010:2011, 2011)	Functional suitability	Performance Efficiency	Compatibility	Usability	Reliability	Security	Maintainability	Portability	Others
(Zhu and Kraemer, 2002)	*			*		*	*	*	*
(Garofalakis et al., 2007)	*	*		*	*				
(Stefani and Xenos, 2007)	*	*		*	*				
(Parasuraman et al., 2005)	*	*	*	*	*	*	*	*	
(Gadalla et al. 2013)	*	*	*	*		*	*	*	*
(Peters et al., 2013)				*					*
(Hollebeek et al., 2014)				*					*
(Effing and Spil, 2016)			*	*		*	*		*
(Shawky et al., 2020)				*					*
(Dwivedi et al., 2022)	*		*	*		*			
(Krishnamurthy, 2022)			*	*		*			
(Barrera & Shah, 2023b)	*		*	*		*			
(Richter & Richter, 2023)	*		*	*					*
(F. Shi et al., 2023)			*			*			*
	53%	27%	60%	93%	20%	53%	27%	20%	60%

From Table 11, we conclude that four out of eight dimensions with a minimum of 50% usability from other literature to evaluate the performance of the online platform will be used to develop the META-QUAL framework proposal. While half of the dimensions are used, the "Other" dimensions with 60% usability are also worth considering. This can be seen in Table 12 below:

Table 12 Other Dimensions from Literature Review

Literature	"Other" Dimensions
(Gadalla et al. 2013)	Customer Service Competence & Courtesy
(Peters et al., 2013)	Motives, Network Structure
(Hollebeek et al., 2014)	Consumer Involvement, Brand Usage Intent
(Effing and Spil, 2016)	Target audience, Resource, Goals
(Shawky et al., 2020)	Loyalty, Advocacy
(Richter & Richter, 2023)	Social Networking
(F. Shi et al., 2023)	Human-centered Communication

While the ISO/IEC 25010 standard focuses on the technology part that correlates with infrastructure, internet, and software development, the "Other" dimensions mainly discuss how the online platform interacts with the customer and users in the marketing area. Thus, the other data collection from the literature review and scoping interview will accommodate this dimension.

4.1.3. Contribution

As a result of the first step of the research methodology, the objective solution was defined through data collection from the scoping interviews and a literature review.

Gadalla et al. (2013) found that little study has been conducted to help businesses identify the design of services, including what constitutes high-quality services in Metaverses. Thus, it is still unclear how the several incumbents that have incorporated the Metaverse into their businesses will be assessed and evaluated for its performance.

Furthermore, the result from the scoping interview has also stated that organizations and customers are key elements to consider when evaluating the Metaverse's performance. Nevertheless, a lot of the frameworks that have been proposed have only given attention to one side—the user perspective or the technical-technology side. As a result, this thesis research contributes to the combination of the most discussed dimensions that must be considered while developing a comprehensive framework that meets everyone's needs. It is also necessary to make modifications to accommodate the Metaverse's rapid evolution.

4.2. META-QUAL Frameworks' Proposal

This section will discuss and illustrate a proposal framework in Figure 9. META-QUAL is the proposal framework to measure and evaluate the performance of the Metaverse. The META-QUAL captures both the users' and the company's aspects of the quality in the Metaverses. The dimensions illustrated integrate several similar metrics of offline and online retail service quality explained in the literature; nevertheless, some fundamentals remain unaltered. The proposed META-QUAL framework is divided into three big dimensions: Technology, Organizational, and Business Impact. The additional table as part of the framework is added to show two points of view from the company and users in perceived value in the Metaverse as a service.

As mentioned in the previous section, the framework from E-S-QUAL from Parasuraman et al. (2005) and the ISO/IEC 25010 standard from IEEE (2011) are used for this framework proposal on the Technology dimension. The metrics inside this dimension are to address the terms that are used in the Metaverse. In conclusion, the Technology dimensions are divided into four sub-dimensions: Compatibility, Functional Suitability, Usability, Security, and Privacy.

From the four sub-dimensions, the four other metrics are used to measure the performance except for security and privacy; the four metrics are as follows: interoperability as part of Compatibility, decentralization in Functional Suitability, immersiveness & user experience, and generative AI implementation on the interface in Usability. Although all the metrics are crucial for both the user and the company, interoperability, which is part of Compatibility in the Technology dimension, is the only dimension measured from the company's perspective. Interoperability is the ability of the system to integrate and exchange information between the same platform and with different platforms. (IEEE, 2011; Dionisio et al., 2013) Furthermore, the company must focus on providing interoperability Metaverse for users by developing a cross-Metaverse language using Blockchain that allows users to communicate and work together. (L. Zhang, 2022)

The second dimension is Organizational, which refers to the interview result from the previous section of the case study with our interviewee on the question of the key metrics/ success factors for measuring the success of Metaverse integration into the business. Interviewee S-1 stated that company culture, mindset, and vision for future technology are some success factors. This statement is also supported by academic literature discussed in the previous section on the Metaverse marketing framework that specified one of the critical roles in the community and organization inside "hybrid stakeholders" (Dwivedi, Hughes, Wang, et al., 2022). The organizational and managerial characteristics are needed to reduce the silos mentality that can reduce the flexibility and adaptability to the recent technology (Cook et al., 2020), the Metaverse, in this research specifically.

The last part of the framework measures Business Impact as an outcome of the services provided by the company in the Metaverse to the user who perceives value from the platforms. As mentioned by McKinsey, the goal of a business in developing a Metaverse is to make an impact and create value for their business. (Value Creation in the Metaverse, 2022) In the Metaverse, creating value through services is the only way to prove their value to loyal and new customers. (Parasuraman et al., 2005; L. Zhang, 2022)

The framework used for years to evaluate a business's performance is Business Model Canvas, which includes four categories and nine criteria: Infrastructure (Key Activities, Key Resources. Partner Network, Offering (Value Proposition), Customers (Customer Segments, Channels, Customer Relationships), Finances (Cost Structure, Revenue Streams). (Osterwalder, 2004) From the previous section in the literature, value creation is the crucial thing companies should achieve and provide to

their customers. (Parasuraman et al., 2005; Value Creation in the Metaverse, 2022; L. Zhang, 2022) As a result, by tying the literature research and the framework covered in the previous section, "Value Proposition" as an "Offering" category from Business Model Canvas is adapted and constructed into "Value Creation" as a component of the "Business Impact" dimension.
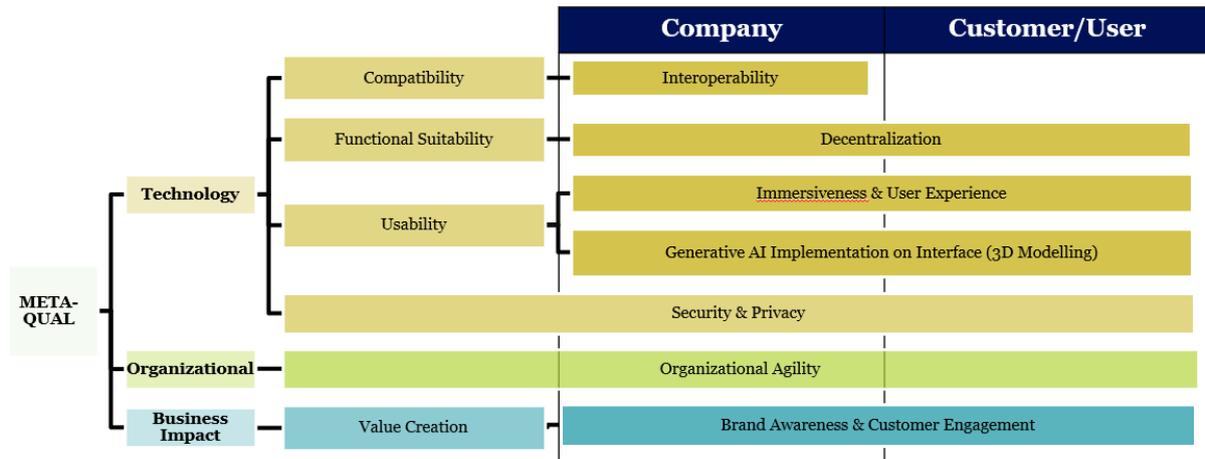

Figure 9 META-QUAL Framework Proposal

Each dimension and metric from Figure 9 will be explained in this section through Table 13, which focuses on the definition mentioned in the previous section.

Table 13 Description of the Framework Proposal

Dimension	Metrics	Attribute	Definition
1. Technology	1.1. Compatibility	1.1.1. Interoperability	The virtual environment's accessibility and usability across many platforms and immersive worlds. (Richter & Richter, 2023)
	1.2. Functional Suitability	1.2.1. Decentralization	The users have full ownership and control over data, assets, and identities. (Frey, 2008)
	1.3. Usability	1.3.1. Immersiveness & User Experience	The degree of experience of physically being in a non-physical reality (Richter & Richter, 2023)
		1.3.2. Generative Artificial Intelligence (AI) Implementation in Interface (3D Modelling)	A form of AI that can generate new content autonomously, such as text, photos, audio, and video, offering distinctive approaches for creating content and addressing deficiencies in the Metaverse's development. (Lv, 2023) that enhance enjoyment across several virtual worlds and platforms. (Richter & Richter, 2023)

			Data protection from users in the digital world: Cybersecurity is implemented in Metaverse due to its development in the cyber environment. (Dwivedi et al., 2022)
	1.4. Security & Privacy		
2. Organization	2.1. Organisational Agility		A company's ability to adapt to external and internal changes. (Carless et al., 2000)
3.Business Impact	3.1. Value Creation	3.1.1. Brand Awareness & Customer Engagement	A brand's ability to have a significant presence in cultural or societal consciousness. While developing relationships in order to promote brand awareness & loyalty.

4.2.1. Metrics and Attributes Discussion

In this section, metrics and attributes from the framework proposal will be discussed, including the potential questionnaire to measure each parameter.

1. Technology

The first dimension is the technology that refers to the E-S-QUAL from Parasuraman et al. (2005) and SQuaRE ISO/IEC 25010 standard for Quality Model from IEEE (2011) that has been discussed in a related work. Metaverse as a platform consists of both software and hardware. Focusing on the software, a Metaverse should fulfill the quality check based on the ISO/IEC 25010 standard that will be used as metrics in this framework proposal that has been adapted to the needs. There are four metrics that will be discussed more in this section: compatibility, functional suitability, usability, and security.

1.1. Compatibility

From the ISO/IEC 25010 standard official published document, compatibility in software quality is interpreted as the ability of a product, system, or component to share information with other products, systems, or components and/or perform its necessary functions while utilizing the same hardware or software environment. (ISO/IEC 25010:2011, 2011) To dive more the highest relation between the compatibility in software quality and the Metaverse is interoperability, which will be discussed in the next section.

1.1.1. Interoperability

As part of the compatibility metrics in software quality, interoperability is portrayed as the extent to which two or more systems, products, or components may exchange information and utilize the information that has been shared. (ISO/IEC 25010:2011, 2011) In the software quality field, interoperability is a common standard that is used in the current technology. This metrics will be used to evaluate how the Metaverse allows users to move to one another platform or other virtual worlds without the need to re-login, in the future, there is the probability to move from one Metaverse to another Metaverse. (L. Zhang, 2022)

1.2. Functional Suitability

Functional suitability is the extent to which a product or system, when used in accordance with predetermined guidelines, fulfils both explicit and implausible demands. (ISO/IEC 25010:2011, 2011) The difference between functional suitability and compatibility is the plan's fulfilment at the beginning of the development process.

1.2.1. Decentralization

Users own and are in charge of their data, assets, and identities in a decentralized Metaverse. They have the freedom to connect with others freely, produce material that is unique to them, and keep the value they add to the Metaverse. (Rfox, 2023) For users of the Metaverse, decentralization also improves privacy and security. This metrics will be used to evaluate how the Metaverse delivered the decentralization by allowing user to own and control their data.

1.3. Usability

The usability metrics in this section have more association with humans as the user. According to the IEEE on the ISO/IEC 25010 standard of Software Quality, usability is defined as the extent to which a product or system may be utilized by a specific user group to achieve a specific goal in a specific usage environment with effectiveness, efficiency, and satisfaction. (ISO/IEC 25010:2011, 2011) For the Metaverse, usability has a lot more relation and interconnection with Human-Computer Interaction (HCI), therefore, to get a holistic result, the metrics should be measured from both sides, the developer, and the users.

1.3.1. Immersiveness & User Experience

In its development, immersiveness is highly correlated with interoperability and user experience discussed on the subject of Quality of Experience (QoE). The research of QoE on the Metaverse has touched many disciplines as part of Human-Computer Interaction (HCI), not only computer science as part of the developer who will provide the platform and virtual environment but also the psychological aspect that is associated with humans. This metrics will be used to determine to evaluate how the Metaverse deliver the immersiveness that enhance the user experience.

1.3.2. Generative Artificial Intelligence (GenAI) Implementation on Interface (3D Modelling)

From the literature review, for the Metaverse, the implementation of generative AI could enhance user experience (UX) with an innovative approach, especially in content and design production during development. (Lv, 2023) According to Lv (2023), the application of GenAI to the implementation of different Metaverse components are construction of Metaverse buildings, player avatars and dialog with non-player characters, and multilingual translation. This metrics will be used to evaluate how the GenAI implemented to create and deliver attractive user interface.

1.4. Security

In this metric, the security will be measured on how well a system or product safeguards information and data so that users or other products or systems can access it to the right extent for their types and degrees of permission. (ISO/IEC 25010:2011, 2011) Therefore, security is one of the essential metrics that need to be addressed and considered by the companies that integrate Metaverse. The main obstacles

to the Metaverse's continued development, despite its encouraging indicators, are security and privacy concerns. The management of enormous data streams, widespread user profiling, unfair AI algorithmic results, and the safety of physical infrastructures and human bodies are only a few examples of the many security lapses and privacy violations that could occur in the Metaverse.

According to Jaber (2022), there are several possibilities of security attacks in the Metaverse, such as social engineering attacks, credential theft, security risks of Virtual Reality (VR), identity theft, ransomware, reduced perception of physical space, and radicalization and polarization. Therefore, the security layer needs to be considered and implemented in the Metaverse for a significant preventive checklist when developing a Metaverse.

2. Organizational Agility

As mentioned in the literature review, to win the Metaverse performance, a collaboration between technology, marketing, and organization is crucial. Therefore, the agility of the organization in adaptation and flexibility towards the innovative technology with uncertainty is crucial. (Cook et al., 2020; Dwivedi, Hughes, Wang, et al., 2022).

3. Business Impact

There are several frameworks and metrics to evaluate the business impact in a company. Business Model Canvas is a standard tool for seeing business strategies. In order to evaluate performance, as a consultancy and business owner, understanding and knowing their clear business model canvas is necessary to understand their business. For consultancy, understanding the start-up's business model canvas can help them decide on their project and check on the business opportunity, but also able to evaluate the readiness of the business owner to understand their business and challenge. (Rayna & Striukova, 2016b) In conclusion, a detailed explanation of the business model will help the company reach its goals and allow stakeholders to understand the key elements to achieve them.

The business owner's main objective in integrating the newest technology is to gain revenue, engage their customers, and win the competition with their competitive advantage. In this paper, to evaluate the performance of the Metaverse integrated into a business, use the metrics in the business model canvas, and value creation that mainly focus on the customer.

3.1. Value Creation

Creating value for users is the only way these innovative technologies can prove their worth and value, and through services, they can add value for the final user. (Parasuraman et al., 2005) For businesses in this customer-centric era, Metaverse is helping reach their value of engaging new customer and maintaining their loyal customer. Metaverse can provide the ability to monitor engagement and comprehend the data and analytics underlying client behaviour, enabling businesses to continuously evaluate, measure, and enhance their marketing efforts. (L. Zhang, 2022)

3.1.1. Brand Awareness and Customer Engagement

According to Donthu et al. (2021), there are eight clusters in marketing that are related to the psychology of the customer: marketing environment; consumer engagement, online consumer behaviour and marketing, luxury consumption and marketing; sustainable consumption and marketing; influencer and international marketing; customer relationship; satisfaction, and loyalty; and marketing futures (for

example, aesthetics and consumer impressions). In addition, the framework of E-S-QUAL from Parasuraman et al. (2005) and many other frameworks from social media, E-commerce and Metaverse mentioned that the interaction between company and users are crucial to create brand value in the Metaverse. This value in the Metaverse is determined by factors such as value, type of medium offered, and range of offerings (Barnes and Mattsson, 2011).

4.2.2. Practicality for Company

Different approaches will be implemented for the Company and the customer, as Metaverse needs a holistic view from both sides to evaluate the performance. The checklist and survey items questionnaire details are listed in the Appendix in the Survey Items section.

For the Company, the strategy in checklist forms for Technology, Organizational, and Business Impact provides an understanding of the dimensions and metrics to enhance evaluation of the Metaverse's performance. Checklists are commonly used to evaluate the quality of research. Academic research has mentioned that a checklist is developed to improve understanding, aid memorization, and delve deeper into the covered subjects. (Protogerou and Hagger, 2020; Makram et al., 2022) This checklist aims to be used by the new business or existing incumbent to evaluate their performance and improve their value creation for the end users. Before the questionnaire distribution, we defined some acronyms and defined them as code in the following table:

Table 14 Proposal of Checklist for Company

Code	Checklist Item	Source
Technology - Compatibility		
F-TC-1	● The Metaverse developed should be compatible with different devices and platforms.	Adapted from Ndlovu et al. (2023)
F-TC-2	● Implementation of communication layer should be developed on the framework to support communication and transfer between platforms and system.	Adapted from L. Zhang (2022)
Technology - Functional Suitability		
F-TFS-1	● The Blockchain technology should be implemented to store and distribute data and allow the information exchange to travel across the Metaverse.	Adapted from Kaur (2021)
F-TFS-2	● Company should provide the possibility to test the Metaverse platform before launch it.	Adopted from Gadalla et al. (2013)
Technology-Usability		
F-TU-1	● Generative AI should be implemented in the Metaverse development to support 3D content creation (avatars, audio, graphics) into more realistic virtual worlds.	Adapted from Qin and Hui (2023); Adapted from Tang & Hou (2022)
F-TU-2	● Company should provide fantasy products in the Metaverse that are not available in real life	Adopted from Gadalla et al. (2013)
F-TU-3	● Company should provide the ability to customize the products or brand to properly fit any users' avatar in the Metaverse	
F-TU-4	● Metaverse architecture provides hybrid artifacts which leverage the advantages of physical and digital properties for users to manipulate.	Adapted from Tang & Hou (2022)

Code	Survey Items	Source
F-TU-5	● The Metaverse interface should be visually appealing and attractive	Adopted from Gadalla et al. (2013)
Technology – Security & Privacy		
F-TSP-1	● The platform aligns with key national policy documents (e.g., the GDPR).	Adapted from Ndlovu et al. (2023)
F-TSP-2	● The platform development upholds the security, privacy, and confidentiality of users and company's data.	
F-TSP-3	● The Metaverse platform should provide a safe purchase and payment process.	Adapted from Maddikunta et al. (2022)
Organizational Agility		
F-OA-1	● Our organization quickly adopts the new technology related to the Metaverse (e.g., Blockchain, generative AI) to our current platform	Adapted from Lee et al. (2015)
Business Impact – Value Creation		
F-BV-1	● COMPANY's offerings have the best quality and implement cross channel marketing vs competition	Adapted from Kuppelwieser & Klaus (2021)
F-BV-2	● Information about the brand and or product should be available to users and regularly updated.	Adopted from Gadalla et al. (2013)
F-BV-3	● Metaverse able to engage customer in the economic activity inside the platform	Adopted from Mittal and Bansal (2023)
F-BV-4	● Company should be able to track and monitor customer in the Metaverse platform to collect customer data and interaction between customer and object	Adapted from Dwivedi, Hughes, Wang, et al., (2022)
F-BV-5	● Branding in the Metaverse must be aligned with the platform and the brand philosophy.	
F-BV-6	● Company should understand the target customer that suitable for the Metaverse environment.	

The user will rate the Metaverse performance on each scale item using a 5-point scale (1 = strongly disagree, 5 = strongly agree). Likert scale is selected for this final framework for the customer as a user because, in the Likert Scale, the respondents select the choice that most accurately expresses their feelings regarding the message or question. (Joshi et al., 2015) This way, the goal is to understand the value creation in the Metaverse with the Likert scale that captures users' level of agreement or their thoughts about the quality of Metaverse service more nuancedly. The details of each survey can be seen in Table 15.

Table 15 Proposal of Survey Items for Customer

Code	Survey Items	Source
Technology-Functional Suitability		
C-TFS-1	● I feel that I have proper control over the content of the Metaverse application.	Adapted from Zhang et al. (2022)
C-TFS-2	● I think that I would need the support of a technical person to be able to use this technology	Adapted from Jacobs et al. (2023)

C-TFS-3	● I found the various functions of the technology were well integrated	
Technology-Usability (Immersiveness & User Experience)		
C-TU-1	● I enjoyed the visuals of the activity in the Metaverse platform	Adapted from Jacobs et al. (2023)
C-TU-2	● It was as if I could interact with the simulated environment as if I were in the real world	
C-TU-3	● The Metaverse experience can replace the experience of physically visiting the site in person.	Adapted from Yeh et al. (2020)
Technology-Security & Privacy		
C-TSP-1	● I can do a transaction inside Metaverse platform safely under my control.	Adapted from Maddikunta et al. (2022)
C-TSP-2	● I feel that I am able to trust the Metaverse platform completely.	Adapted from Barnes and Mattsson (2011)
Business Impact-Value Creation		
C-BV-1	● It feels like the Metaverse platform is talking personally to me as a customer.	Adapted from McLean et al. (2018)
C-BV-2	● The experience in the Metaverse platform is exactly what I needed.	
C-BV-3	● This experience has worked out as well as I thought it would.	
C-BV-4	● The products/services in the Metaverse are similar to brand's real-life product/services	Adapted from Barnes and Mattsson (2011)
C-BV-5	● I feel the sense of human contact on the Metaverse platform	Adapted from Baker et al. (2019)

The checklist and survey questions will later be used as complementary data collection that will be distributed to the expert and later discussed in the next section for the result. The link and questionnaire from Table 14 and Table 15 are in the Appendix.

5. Experiment Result

The outcomes of the surveys, interviews, and secondary data collection with the resource persons are presented in this chapter. Graphics or textual representations are used to present the results. The personnel participating in the data collection are briefly described in the first section of the chapter, and the analysis of the survey and interview data takes place in the second half.

5.1. Interpretation of Interview Result

The results from semi-structured interviews will be given in this section in two parts: perspective of the Metaverse and framework discussion. Details of the interview protocol and interview questions can be seen in section 9.1.2 from the Appendix. The participants in this study are interviewees who work for various industries and organizations. Nevertheless, all respondents were engaged in Metaverse's development and implementation. Their names were kept confidential. While some were contacted via emails and LinkedIn messaging, most responders were contacted through the author's network. The characteristics of the interviewee can be seen in Table 16.

Table 16 Interviewee Profile

Interviewee	Industry	Role	Experience	Country
I-1	Metaverse Consultancy	Co-Founder	5 years	Indonesia
I-2	Metaverse Consultancy	VP	3 years	The Netherlands
I-3	Metaverse Consultancy	VP	8 years	Belgium
I-4	Business Services	Manager	3 years	USA
I-5	Business Services	Director	3 years	USA
I-6	Academic Research	Research Lead	2 years	Switzerland
I-7	Academic Research	Researcher	3 years	The Netherlands
I-8	Metaverse Consultancy	Developer	3 years	Indonesia
I-9	Business Services	Manager	5 years	Germany
I-10	Metaverse Consultancy	Co-Founder	8 years	The Netherlands

From Table 16, the average experience of the interviewees is three to five years. Obtaining respondents with ten years of expertise is challenging. This is due to the fact that the Metaverse is a relatively new hype technology that has grown significantly over the past ten years.

5.1.1. Perspective of the Metaverse

This section will discuss the first topic about perspective of the Metaverse. We will examine three questions that were posed to the ten persons throughout their interviews in order to help form the response to this research topic. The following is a statement of these queries:

1. Could you briefly **define the Metaverse** from your perspective?
2. What do you think motivates **businesses** to join the hype of Metaverse?
3. What are the **main challenges** that companies face when integrating the Metaverse into their business?

Additionally, we will use a few applicable details from the secondary data from the literature review that is related to the topic.

Metaverse Description from Expert's Point of View

Following the introductory questions, all participants were questioned regarding the Metaverse from their perspective. The following table 17 presents the findings.

Table 17 Metaverse Perspective from Expert

Interviewee	Could you briefly define the Metaverse from your perspective?
I-1	The Metaverse extends beyond virtual reality, XR, and AR. The Metaverse is a virtual environment that facilitates safe and secure interactions and transactions between users.
I-2	Metaverse is a more intimate communication medium that can transform the digital world into a physical one. It is a platform for communication that enhances existing ones rather than replaces them.
I-3	Metaverse is a place for simulation that enable the company to reduce their cost to do expensive and dangerous things in real world.
I-4	It is an interconnected digital 3D space where users have a sense of self through customizable avatars and can chat and interact; it is not a single entity and does not require a virtual or augmented reality component (but it can be enhanced by it).
I-5	Metaverse is so broad that it has multiple definitions or perceptions. With Blockchain, Metaverse has its own economy where users can create/buy/sell goods & services.
I-6	It is a collective term for how we in an immersive way, can interact with each other and with virtual data and assets really to put it as simply as possible
I-7	We see Metaverses as an ever-changing and decentralized and creating a driven ecosystem, where the humanities and the technological exist.
I-8	Simply a parallel world of our existence right now, but in a digital version. We define Metaverse also as a virtual space that can gather people together, a space where people can interact with each other to have social and economic activity.
I-9	There are 2 version of explanation, the first one all existing virtual worlds experiences gaming experiences. Second, I do think it is an open virtual ecosystem, decentralized, and consists of multiple virtual worlds. That is interoperable and persistent in a 3D interactive experience with unlimited user capacity with ultimate goal a hyper realistic and real time rendering ecosystem that converges with the physical world.
I-10	Metaverse is the next thing of the internet development, the new step of a Web 3.0, and this is a new reality with immersive experience that will changing the world. It will change the technology, and other sector such as marketing and sales.

We are able to understand the opinions regarding the explanation of the Metaverse from expertise perspective. Although from our participants the concept of Metaverse conceptualization is enigmatic, we conclude that the explanation of the Metaverse is a virtual world that imitates the real world and allows people to communicate, socialize, and conduct business.

Motivation

After the introduction questions about their perspective on the Metaverse, each participant was asked about their perspectives on the motivation of businesses to integrate the Metaverse. The results are shown in Table 18 below.

Table 18 Motivation for the Companies to Integrate the Metaverse

Interviewee	What do you think motivates businesses to join the hype of Metaverse?
I-1	The trends, businesses do not want to be late to implement the newest technology.
I-2	A way to give the user a greater experience and bring more loyalty and excitement to the user and employee.
I-3	Cost reduction on building something expensive in real life, enables to develop projects that is unfeasible to do in real life.

I-4	Companies do not want to miss tech trends in general for fear of missing out and being left behind and capturing customer attention.
I-5	To provide the best experiences for consumers that are exciting, give a reason to engage and return (i.e., rewards, collectibles).
I-6	The firm wants to be the early adopter of the newest technology because then it will have the biggest return on investment when it is a success.
I-7	Companies are FOMO (Fear of Missing Out) to the latest trends and want to be the number one to try the recent technology.
I-8	They want to follow the trends and compete to give the best experience to their customers.
I-9	I do think there are multiple points. The first one is all about new business and new revenue stream opportunities, the second one is attracting new target audiences that are younger and technology savvy, and the third one is creating a new brand experience for the company as well as the user.
I-10	They mostly want to be the first adapter before it is too late to join the trends. But also, when the firm knows its objective, it can be to develop something that is not feasible to do in real life.

The range of expert responses leads to further limitations on this research and ideas for further research. For example, I-1, I-2, and I-3 have distinct viewpoints as Metaverse developers and consultants, and their conclusions on the different responses from this interviewee are based on their experiences collaborating with several clients in various businesses. In conclusion, based on the interviewees' diverse responses and secondary data from the literature review, many incumbents incorporate Metaverse in an effort to gain a competitive advantage in providing value to their customers.

Challenges

Following the discussion of the company's motivation and an understanding of the Metaverse, each participant was questioned regarding the challenges they encountered when integrating the Metaverse. Table 19 below displays the findings.

Table 19 The Challenges of the Metaverse Integration from Experts' Perspective

Interviewee	What are the main challenges that companies face when integrating the Metaverse into their business?
I-1	Company culture, organization adaptability, Metaverse understanding and knowledge of the human resources
I-2	Infrastructure and tools (such as the headphone and glasses), clear objectives on join the Metaverse
I-3	Understand of the objectives, and capital funding (Metaverse can reduce cost, just if it already developed and become part of the investment)
I-4	Decide on the objective of the benefit for all stakeholder (employee and customers), another challenge is that Metaverse integrations are not cheap and require consistent updates to maintain their engagement value.
I-5	Alignment of the relevancy between the target and platform with brand objective.
I-6	The infrastructure and technology capability are the most challenging point, and the reason behind their Metaverse development remains unclear.
I-7	The "WHY" they develop it, why they want to put a big investment in this. And the "WHY" people as customer and users should use their Metaverse platform. The

	humanity in this recent technology also is a challenge, an innovative technology such as Metaverse should consider the humanity aspect, how to make it more humanized for the users and customer.
I-8	Human capability in developing the Metaverse, and the organization understand this recent technology. Some of the company only follow the crowd and being impulsive, so they just riding on the trends without really define their objective in developing it.
I-9	The experience for user is still not satisfy the customer needs, company's lack of concern in developing many cases to "testing" which one is meeting their expectations. And then another challenge is of course the access to device is also in terms of diversity and inclusion.
I-10	I think the expensive and not accessible tools to experience the Metaverse become really challenging, especially for a company as a new adapter, they need to invest a lot of money for a platform with many uncertainties. The marketing part also is a challenge, since it will be the first way to get the customer and made them stay loyal, especially with the new target of Gen-Z customer that is unpredictable.

Table 19 shows, from the practitioner's perspective, the unclear goals and objectives in integrating a Metaverse become the main challenges. The organization's management is crucial in setting the objectives and goals; this can lead to their main focus: customers. With unclear goals and direction, the organization faces difficulties using technology to engage its customers.

5.1.2. Framework Discussion

Prior to introducing the proposed framework, all participants were questioned about the most important indicators that they would use to assess the Metaverse's performance. This question also helped minimize the participants' confirmation bias on the framework proposal. Responds from the participants to this question also provide an answer for **RQ-2: "What are the critical requirements and success factors that companies should consider when developing Metaverse applications?"** The results are shown in the table 20 below.

Table 20 The Key Success Indicators to Measure Metaverse Performance from the Expert

Interviewee	What are the key metrics/ success factors for measuring the success of the Metaverse integration into the business? (that are not in the framework presented)
I-1	The knowledge from the organization, infrastructure, and technology capability. How the leaders in the organization understand the objective and are flexible to the recent technology through the modification of business model innovation. Also, security and ethics according to the latest standard.
I-2	The most important is the human resource inside the organization that understands the technology and its flexibility in development. Also, to be able to give the best experience, the infrastructure needs to be available, such as the tools for enabling Mixed Reality from Meta or Apple.
I-3	The Metaverse is a multi-user platform; it needs to address this main focus. The other technology that enables this goal is implementing GenAI to enhance its service.

Interviewee	
I-4	I would add budget capabilities and priorities for the organization. And product/market fit to make sure our organization is delivering true value or solving a problem.
I-5	From the perspective of brands, it is important that the Metaverse is safe, easy to access and use, as well as controllable and a high-quality smooth experience.
I-6	How the company provides the benefits for the user absolutely. From a psychological point of view, the crucial elements are usability, ease of access, accessibility in terms of costs, and how difficult it is to learn how to use it.
I-7	I always go back to the "WHY," which is the goal of integrating the Metaverse. This "WHY" can lead to the element that impacts the performance. I also say as a connection of humanity in the Metaverse, the UGC (User Generated Content) could be important because currently, we live in a UGC world, where the creator, customer, and the firm work together as a co-creator, so it is important to evaluate how the company enables this co-creation.
I-8	I think human resources are important, not only for the developer but also for the technology- the Metaverse knowledge of people in the organization. Clear goals and objectives in developing is also important to understand in order to develop the right solution in the Metaverse.
I-9	It basically depends on each use case and the industry sector, but the infrastructure, the device, the technology, and the people who are capable of doing it are absolutely the basic important things to be there during the development to be able to make the platform perform. The other one is how the company provides the experience to the users.
I-10	Infrastructure is absolutely important; the Metaverse without the technology tools is difficult, then the experience that the customer feels, also the cost and investment from the company. It is important when measuring performance, the data collected before and after implementation to see the effectiveness of a platform. But it depends on the industry; they usually have their own KPI (Key Performance Index). They want to achieve that by the end of the project, it will be measured, but it will be really customized.

As a response from the experts, Table 20 shows that organization management, technology, and how the firm provides a solution to their customers through the Metaverse are crucial when evaluating performance. In addition, most of them also mentioned that infrastructure, tools and devices, and human resources are essential checklists a company should have to evaluate the Metaverse implementation.

Although several points still need to be added to the current version, most of the answers to the earlier questions fit inside the suggested framework. Therefore, the framework proposal was shown to each participant as the last step before the company's checklist and the customer survey were distributed, and they were questioned regarding their opinions of the framework. Table 21 below displays the findings.

Table 21 Expert Feedback and Evaluation on Framework Proposal

Interviewee	Looking at this framework, what do you recognize, and what does make more sense? Or does it not make sense? What are your thoughts on the suggested framework?
I-1	This is excellent and sensible, but it would be helpful to incorporate the business model and ethical considerations.

I-2	It captures the goal that a company should consider when integrating the Metaverse from a commercial perspective and business effect standpoint.
I-3	The checklist contains many more dimensions to be considered in order to adequately serve the needs of Metaverse Developers, but it is appropriate for businesses that integrate Metaverse to understand their performance. The wording of "fantasy product" also not necessary and create ambiguity, since it is not always a fantasy but might be mean a different product that is not feasible to build in real life.
I-4	Overall, it is useful and practical, however it can be modified based on the specific definition of "Metaverse" in each case.
I-5	It is incredibly important to understand both side of brand and customer, this framework already one way to give a "helicopter view" for both sides. Agree on the engagement as a key but adding gamification and communication is a way to keep users staying longer inside the space and coming back to the platform.
I-6	I mostly agree with a lot of things here, such as security and privacy and generative AI. But in the value creation dimension, it is more than just brand awareness and customer engagement, how we can improve society with the Metaverse.
I-7	I think this framework definitely has reflects some evolution of iteration. I think that is remarkably interesting, but at this moment, prosumer, omnichannel, and transmedia strategy is important, but here, the stakeholder mapping you have still separated customer and company. As I mentioned before, UGC that enables co-creation will also be beneficial for the company to consider on the performance evaluation.
I-8	I think all of these dimensions and metrics are important, and for me as a practitioner, it will help to check whether we already checked the lists or not. But it will give a much more complete framework, a holistic one, if Business Impact also includes the performance on revenue impact because we also struggling to define on what is the best revenue management that we can get from developing the Metaverse.
I-9	This is interesting; it covers most of the essential elements that I mentioned before. I would like to highlight the organization part since most of the Metaverse is developed by the top-down direction from the leaders, so leadership and agility are really important. The other one is the good point on value creation to the customer, since this is the main goal of a business to satisfy their customer.
I-10	This is a solid holistic framework, and you address all the critical things. I love how you visualize the connection between the dimensions. But if I may add, you need to add cost and capital to build this; how big an investment does the company put in this innovative technology, customer activity in the customer dimension, and infrastructure? This implication is also a practical idea, but it might also be beneficial for the company that has just started to check its readiness.

Table 21 shows the answers from participants I-7, I-8, and I-10, with psychology backgrounds, mentioned that to engage with the customer, the Metaverses need to be humanized. One example is enabling co-creation, such as UGC (User-Generated Content).

The META-QUAL framework proposal received positive feedback from the participants. They all agreed that the three dimensions—technology, organization, and business impact—affect performance and are essential to the assessment. However, some parameters must be added in order to provide a more thorough review. The majority of them also emphasized the necessity of having a different framework for developers and companies who incorporate the Metaverse. In conclusion, all the participants appreciate the holistic approach the META-QUAL gives that covers the company's and customer's perspectives.

5.2. Interpretation of Survey Result

As mentioned in the methodology and research approach, after the development of the META-QUAL framework proposal, two questionnaires have been created for company practicality to evaluate the Metaverse's performance: the Company Checklist Questionnaire and the Customer Survey Questionnaire. The Likert scale used in the questionnaire's design ranges from 1 to 5, where 1 represents Very Unimportant and 5 represents Very Important. Before the analyses, we used the code acronyms from the previous section for the testing variables for more accessible analyses; the data was exported and cleaned in Excel and further analyzed.

The survey aims to obtain participant input on the importance of each checklist for company practices and each statement for the customer survey. The Customer Survey Questionnaire is distributed to participants to rate the importance and relevance of the survey for their performance evaluation. Both questionnaires were only presented to interviewees who had briefly explained the framework to obtain participants' assurance and confidence in their responses. The results are divided into two sections for each questionnaire, Company Checklist, and Customer Survey Questionnaire, and then explained in three sub-sections based on the three dimensions used: Technology, Organization, and Business Impact, which will be discussed in the following sub-section.

The survey respondents were the same as the interview participants and were categorized into Metaverse Consultant/Provider/Developer, Academic/Researcher, and Consumer Goods Company/Business. The majority of the respondents come from Metaverse Consultancies (50%), Consumer Goods Company/Business (33%), and Academic Research (17%). Six out of ten interviewees responded to the survey questionnaire on time, which is used for this analysis. The respondents have between three and five years of experience on average. This is because, during the last ten years, the Metaverse—a relatively new and hyped technology—has expanded tremendously. Time constraints and connectivity issues make finding individuals with ten years of experience challenging.

5.2.1. Survey Data Analysis

This section will discuss the process of analysis in results from the survey. The code acronyms from the previous section are used for the testing variables for easier analyses. In addition, the Likert scale used in the questionnaire's design ranges from 1 to 5, where the representation is as follows:
- 1 = Very Unimportant
- 2 = Unimportant
- 3 = Neutral
- 4 = Important, and
- 5 = Very Important.

Based on the Likert Scale from 1 to 5, to assess the reliability of the results and to reduce bias and ambiguity, the point above Neutral represented 4 will be ranked as reliable. The analysis process is explained as follow:

1. The data was exported from Qualtrics cleaned in Excel and further analysed.
2. The weighted average was calculated for each question with multiply the quantity of response (n=6) and the point of each rank (1 to 5).
3. The question with weighted average score 4.0 and above then decided as a reliable question that will be kept for the final solution.
4. The question with weighted average score below 4.0 then decided as a question that will be deleted for the final solution.

5. The data then converted into graph to give more visualization for the reader.

5.2.2. Company Checklist

The results of a questionnaire on the Company Checklist will be covered in this section. The Company Checklist questionnaire is made up of 19 checklist items that are grouped into three dimensions. Respondents were asked to rank the importance of each checklist item based on its relevance to evaluate the Metaverse performance.
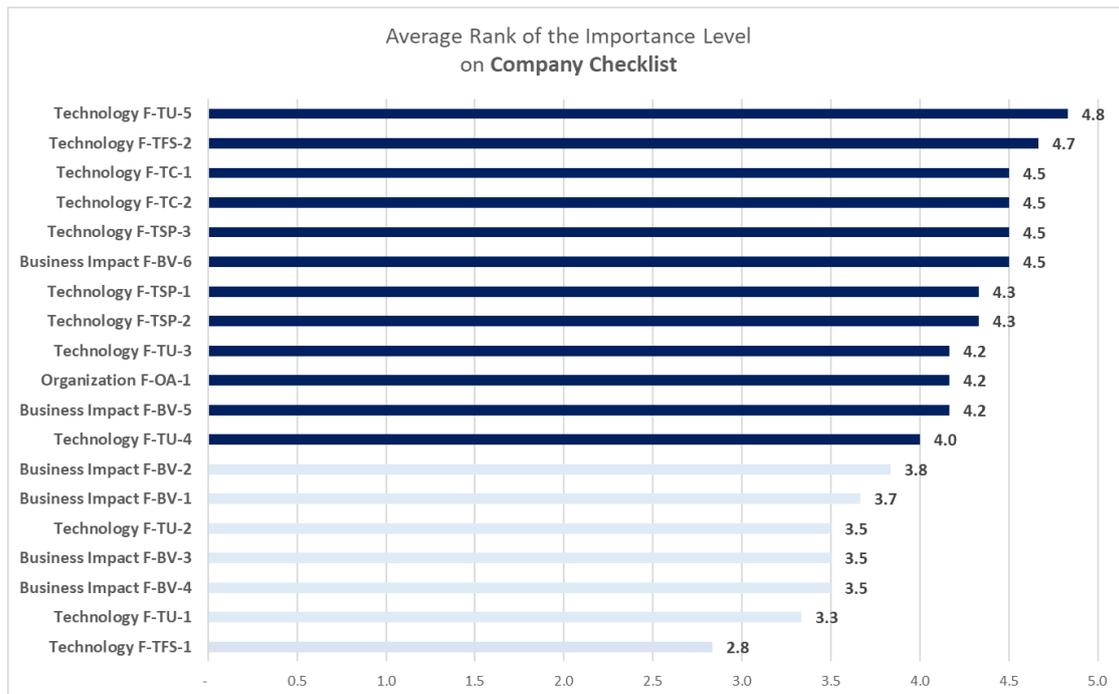

Figure 10 Average Rank of the Importance Level on Company Checklist Result

The summary of the checklist survey result is presented in Figure 10. From the previous section, the weighted average score of 4.0 is the threshold for deciding whether the checklists will be deleted or kept. From the graph above, the checklists with a score below 4.0 are F-TFS-1, a checklist from the Technology Dimension in Functional Suitability metrics, F-BV-1, F-BV-2, F-BV-3 and F-BV-4 from the Business Impact Dimension in Value Creation metrics, and F-TU-1 and F-TU-2 from Technology Dimension in Usability metrics. Therefore, these lists will be removed from the checklist for the final solution to keep the reliable and relatable checklist for the company's practicality.

The results show that from the expert perspective, the key factor in evaluating the Metaverse's performance comes from the Technology dimensions in the Usability metrics; the checklist F-TU-5, with a score of 4.8, discusses the importance of an attractive and appealing interface. This result is also supported by the previous publication that provides an interactive and realistic experience that can increase customer engagement and the level of immersion. (Dwivedi et al., 2022; Richter & Richter, 2023; Zheng & Liu, 2023) And F-TFS-2, where there is enough testing before launch.

The following section will discuss each dimension thoroughly to see how the comparison between the participant responds to each checklist. It will be divided into three-part dimensions: Technology, Organization, and Business Impact.

5.2.2.1. Technology

The first dimensions of Technology will be discussed in this segment with thorough analysis on four sub-dimensions: Compatibility, Functional Suitability, Usability and Security & Privacy.
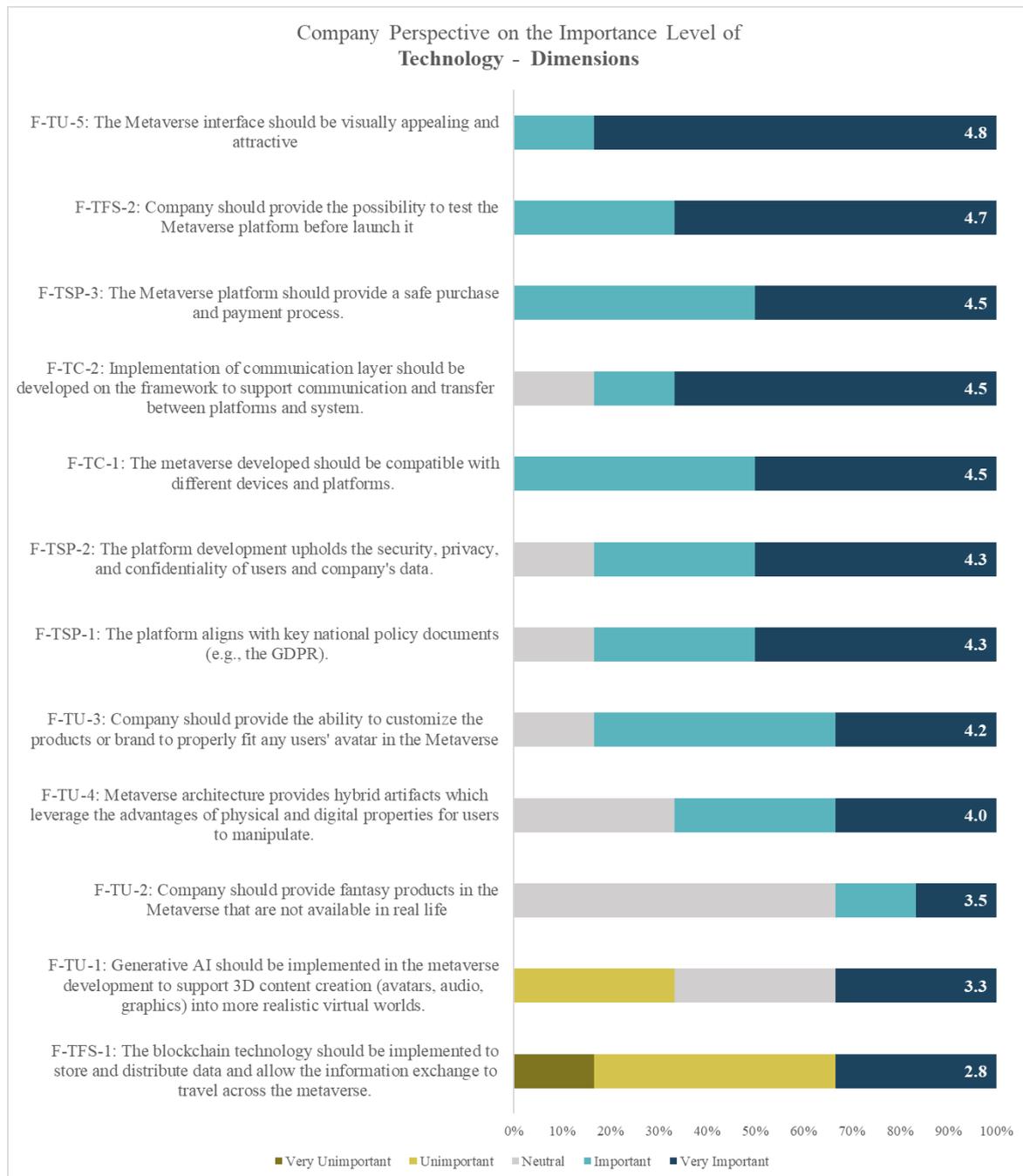

Figure 11 Result on Company Checklist on Technology Dimension

From the twelve checklists shown in Figure 11, F-TFS-1, F-TU-1, and F-TU-2 with scores below 4.0 will be deleted. The results show that F-TFS-1 has the lowest score with 2.8, which explains the implementation of Blockchain as a less relevant element in evaluating Metaverse performance. Although the previous research mentions that Blockchain has played a significant role in the Metaverse for decentralization enabler and enhance security (Ghelani & Hua, 2022; Maddikunta et al., 2022; Huynh-The et al., 2023) the result from the expert and practitioner interview and survey shows that

Blockchain is less significant when evaluating a Metaverse compare to other factors, such as interoperability from the exact dimension of Technology – Functional Suitability.

The highest score comes from F-TU-5, with a score of 4.8, receiving a strong positive response; this checklist describes the user interface as a key factor when evaluating a Metaverse. F-TU-2, with a score of 3.5, will be deleted; this "fantasy products" checklist has mostly neutral responses from 70% of respondents. The only checklist with 33% Unimportant response is F-TU-1, which discusses the importance of Generative AI implementation in the Metaverse development. With a score below the threshold, F-TU-1, although it still obtained 66% positive results from the respondents, the checklist will be deleted. In comparison, all the checklists from the sub-dimension of Technology-Security & Privacy, listed as F-TSP-1, F-TSP-2, and F-TSP-3, received a strong positive response. The most substantial response appeared in F-TSP-3, which states that the company enables safe transactions on the Metaverse Platform.

5.2.2.2. Organization Dimension

This section will discuss on the second dimensions, Organization, where the respondents were asked on the agility of the organization in adapting the velocity of technology development.
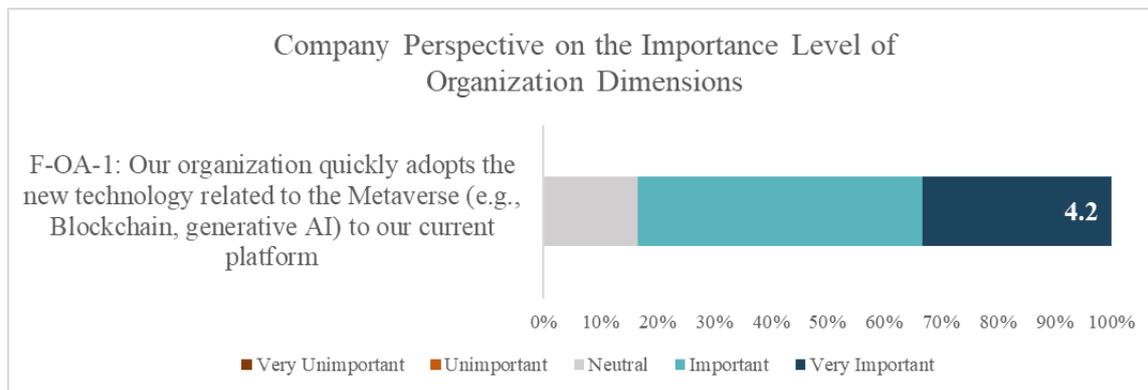
Figure 12 Result on Company Checklist on Organization Dimension

The result in Figure 12 shows a strong positive response, with a score of 4.2, where 83% of the participants rate the organization's agility as an essential element to evaluate the Metaverse performance. This result is supported by the literature discussed in the previous section on how the organizations' ability plays a significant role in innovative technology implementation with big uncertainty and risk; the risk-averse attitude combined with agility can lead to better implementation and performance of the Metaverse. (The Metaverse Overview, 2022; Abraham & Laughlin, 2023)

5.2.1.3. Business Impact Dimension

This last section of the Company Checklist will discuss the result of Business Impact on Value Creation and Customer Engagement to the Customer. From Figure 13, two checklists will be deleted, F-BV-3 and F-BV-4, with scores below the threshold. Checklist F-BV-6 received strong positive feedback, with 4.5 as the highest score in this dimension; all the respondents agree that the strategy to understand the

right customer target is essential. In contrast, F-BV-4, with the lowest point at 3.5, shows that 67% of the participants responded Neutral about the ability of the company to track and monitor customer data.


Company Perspective on the Importance Level of
Business Impact - Dimensions

F-BV-6: Company should understand the target customer that suitable for the metaverse environment.		4.5
F-BV-5: Branding in the metaverse must be aligned with the platform and the brand philosophy.		4.2
F-BV-2: Information about the brand and or product should be available to users and regularly updated.		3.8
F-BV-1: COMPANY's offerings have the best quality and implement cross channel marketing vs competition		3.7
F-BV-4: Company should be able to track and monitor customer in the Metaverse platform to collect customer data and interaction between customer and object		3.5
F-BV-3: Metaverse able to engage customer in the economic activity inside the platform		3.5

■ Very Unimportant ■ Unimportant ■ Neutral ■ Important ■ Very Important

Figure 13 Result on Company Checklist on Business Impact-Value Creation Dimension

Although regular update of content (F-BV-2) and best offer versus competition (F-BV-1) receive 83% of positive feedback, the final score shows that it is still below the threshold 4.0, which is according to the previous statement, these two lists will be removed.

The checklist about the right customer target in F-BV-6 becomes the highest score among Business Impact dimensions. From the interview participants, I-4, I-5, I7- and I-10 highlighted the importance of understanding the customer, especially in this fast-moving technology era. The academic literature also mentions that the customer is the main goal of the business when implementing innovative technology

(Donthu et al., 2021; Dwivedi, Hughes, Wang, et al., 2022; Rauschnabel et al., 2023), specifically with the changes of the customer behavior shifting from offline to online. (C. Chen, 2022)

5.2.3. Customer Survey

This section will address the findings from the Customer Survey questionnaire. The Customer Survey questionnaire comprises thirteen statements divided into two dimensions: Technology and Business Impact - Value Creation. The survey statement in this section describes customers' feelings towards the Metaverse Platform. However, due to the time limit and the fact that no specific platform was being discussed, this survey was distributed to the same correspondent as the Company Checklist and Interviews. Respondents were asked to rank the importance of each checklist based on its relevance to Metaverse performance and how this survey helped them to evaluate their performance, especially in creating value for the customer.
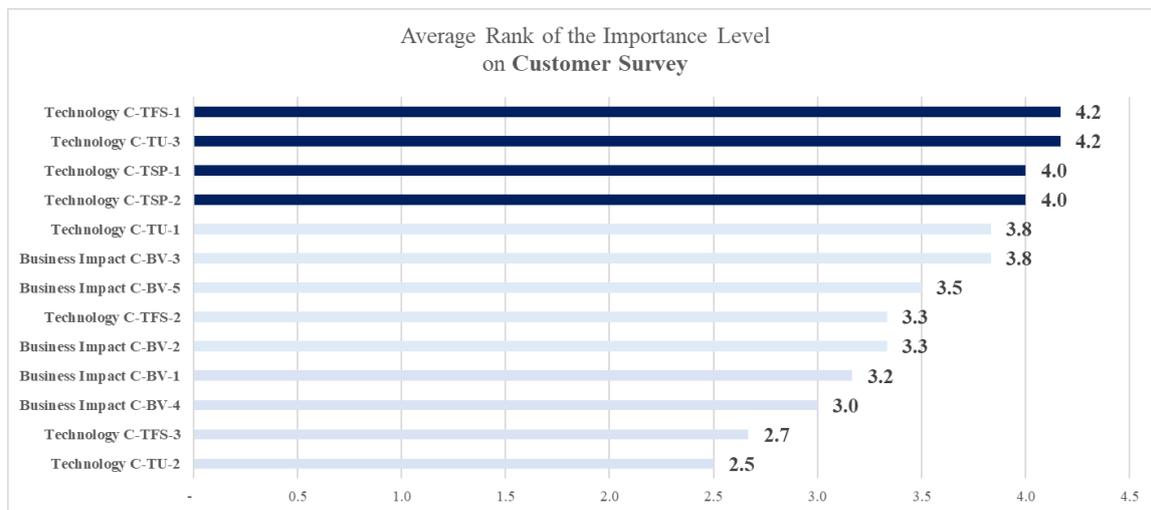
Figure 14 Average Rank of the Importance Level on Customer Survey Result

The summary of Customer Survey results is presented in Figure 14. The highest score comes from the Technology dimension in Functional Suitability metrics, where the survey discusses how the user controls the content in the Metaverse. The survey participants agree that this factor is relevant to be checked by the customer as a user to evaluate the Metaverse's performance because this control over the data and content is part of the decentralization, one of the characteristics of the Metaverse. (Radoff, 2022; De Salve et al., 2023; Rfox, 2023)

From the previous section, the weighted average score of 4.0 is the threshold for deciding whether the checklists will be deleted or kept. From the graph above, nine checklists scored below 4.0, which are C-TU-1, C-TU-2, C-TFS-3, C-BV-4, and C-BV-1. C-BV-2, C-TFS-2, C-BV-3, and C-BV-5. Therefore, these lists will be removed from the checklist for the final solution to keep the reliable and relatable survey questions for the company's practicality.

The following section will discuss each dimension thoroughly to compare the participant's responses to each survey list. It will be divided into two parts: technology and business impact.

5.2.3.1. Technology

The first dimensions of technology will be discussed in this segment, which is visualized in Figure 15; the result is divided into three sub-dimensions: Functional suitability, usability, and security and privacy. From the first dimension, two survey questions will be removed, C-TU-2 from the Usability

sub-dimension and C-TFS-2 and C-TFS-3 from the Functional Suitability sub-dimension, with a score below the threshold of 4.0.

The survey question C-TU-2 describes how the users can feel the simulated environment in real life, while C-TU-3 describes how users can have the same experience as in real life. Both lists have similarities in terms of "replace the real life," but there is a significant result in the score. The difference between the two survey lists is that C-TU-2 focuses on the "simulated environment replaces real life," while C-TU-3 "experiences as in real life." From the interview, I-1, I-3, I-6, I-7, and I-10 mentioned that the Metaverse is an environment that mimics the real world as a digital twin, but it does not mean replacing the real world. The Metaverse realm is developed in order to enhance the real world, such as creating a simulation for non-feasible activity in real life, for example, showing a client from a different country the detailed architecture of a building. For C-TFS-2, the survey list focuses on how the "ease of use" achieved in the Metaverse, which refers to some of the literature that points out this element (Zeithaml et al., 2000; Parasuraman et al., 2005; Gadalla et al., 2013; Krishnamurthy, 2022; F. Shi et al., 2023) Although 67% of the response said this survey list is essential, it does not fulfill the threshold that later will be removed.

From the last sub-dimension of Security & Privacy, all statements of C-TSP-1 and C-TSP-2 received high positive results. Most respondents agree that security and privacy are crucial elements in evaluating the Metaverse from customers' perspective when interacting with the platform.
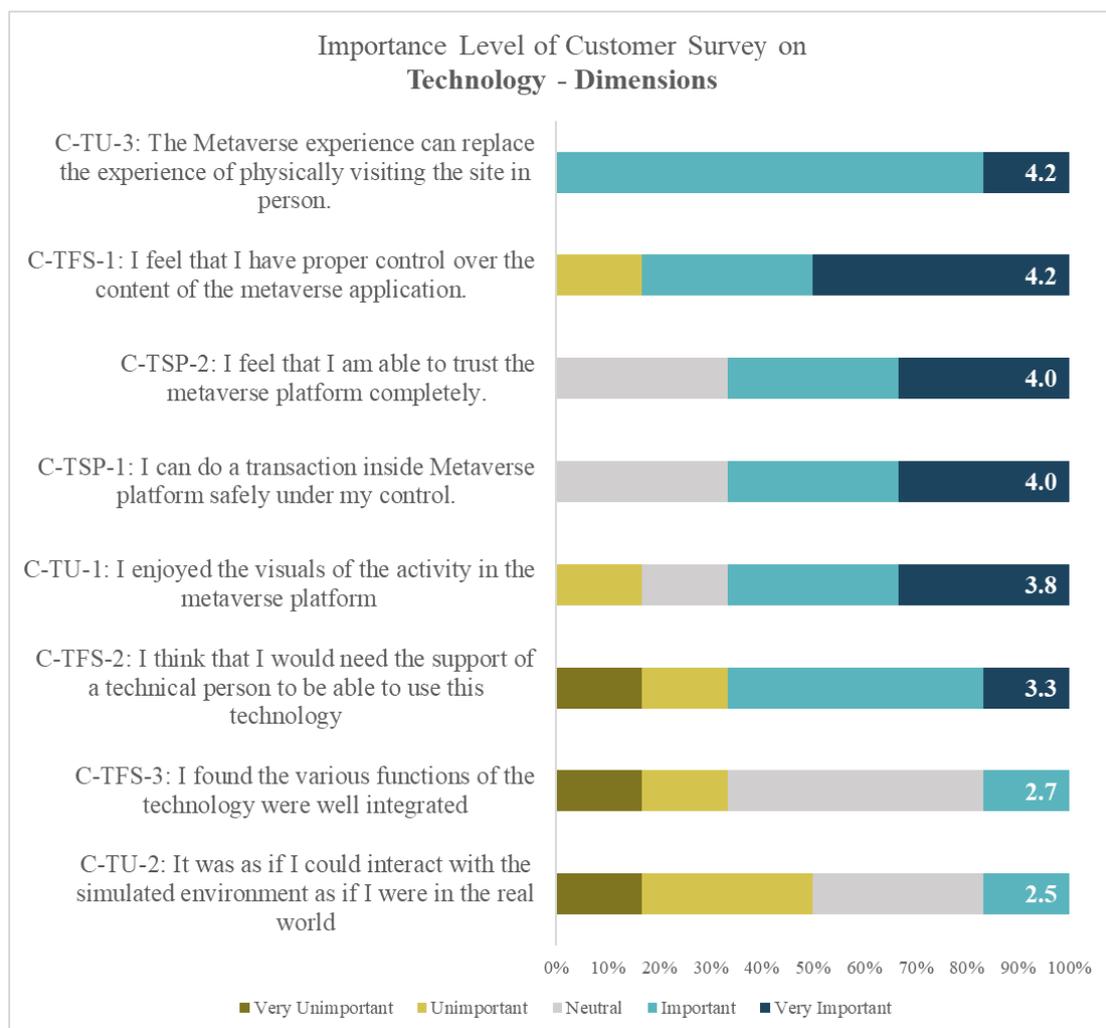
Figure 15 Result on Customer Survey on Technology-Functional Suitability Dimension

5.2.3.2. Business Impact – Value Creation

This last section of the Customer Survey will discuss the result of the Business Impact on Value Creation to the Customer in Figure 16. From the second dimension, all of the checklists from this dimension are scored below the threshold of 4.0 and, thus, will be removed.

The survey questions C-BV-4 describe how the users perceive a similarity between products in real life and the Metaverse. The participant disagrees that this point is essential. The interview also mentioned that although the Metaverse is developed to mimic the real world, it should be an "upgraded version" of the real world and not change it. To show a holistic correlation and cohesiveness between the survey questions, this C-BV-4 is similar to C-TU-2 from the Technology dimension, also removed from the list focusing on the Metaverse that is replacing the real world.

Although from the result, C-BV-3 is the only statement without negative feedback, the respondents rate the customers' expectations for experience in the Metaverse platform as important to measure their performance, this list still be removed due to insufficient to meet the threshold. However, according to a recent publication, the critical factor of the Metaverse is how it reaches the customer as a user and delivers the experiences that the customer needs. (Gadalla et al., 2013; F. Shi et al., 2023; Rauschnabel et al., 2023; Abraham & Laughlin, 2023) Therefore, looking at the importance and close to passing the threshold, for future research this is an opportunity to refine the question to be more precise to deliver the objective of this survey.
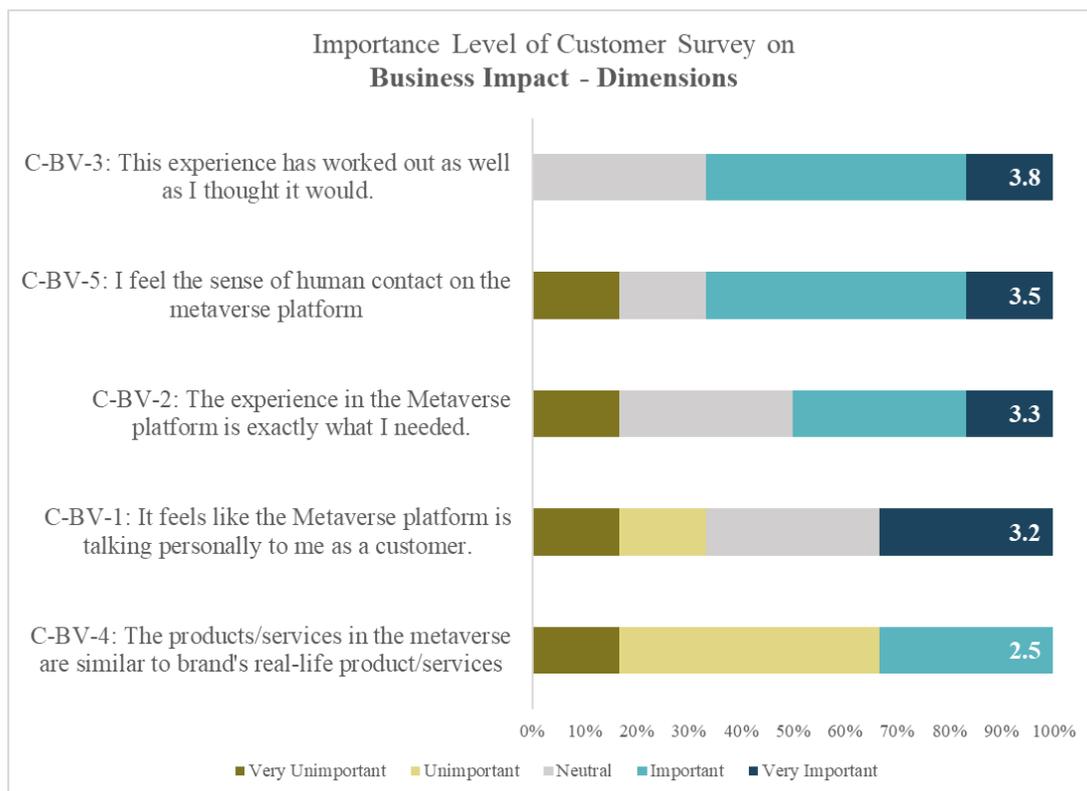
Figure 16 Result on Customer Survey on Business Impact-Value Creation Dimension

5.3. Solution Improvement

The scoping interviews and literature reviews provide insights upon which the basic solution was constructed. After that, in the interviews, interviewees were given the proposed strategy in an effort to collect more thorough ideas and insights. Their advice was helpful in helping us optimize the framework evaluation as well as adjust its practices.

Most of the evaluation results and data-gathering feedback were optimistic about the META-QUAL framework and its implications. Nevertheless, after reviewing the initial framework proposal and considering the evaluation and feedback received, changes will be made to the final product to provide a coherent framework for a holistic viewpoint.

5.3.1. META-QUAL Final Solution

After gathering information and data collection through surveys, literature, and interviews, the framework is modified and used to provide greater insight for the client, consultant, and company. The alteration is minor, consisting of changing the words but maintaining the connection between them and the structure. A specific modification is made to the "Business Impact" dimension found in the framework's initial proposal to the "Customer" dimension, as seen in Figure 17. The adjustments aim to create a coherent phrasing for the other two aspects of Technology and Organization as an object of evaluation. The modification also clearly describes the dimension of evaluating the value creation of the Customer side and not value creation to the firm.
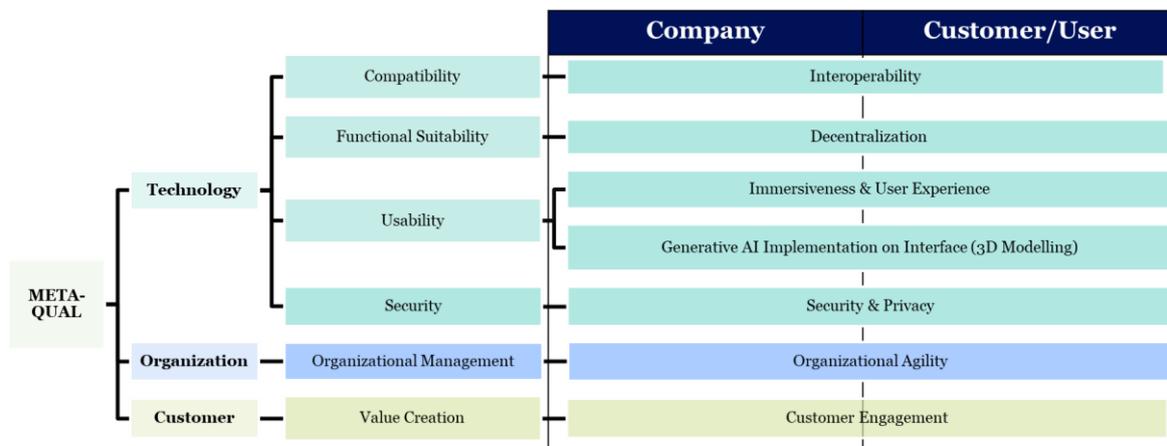
Figure 17 Final META-QUAL Framework Solution

The alteration was also made for the Technology dimensions, in Compatibility metrics where initially, Interoperability was only measured on the Company's side. From the data collection, I-5 and I-6 suggest Interoperability was also measured from the customer side.

5.3.2. META-QUAL Checklist

Improvements are also to be made based on the results of the surveys. For the Company Checklist in Table 22, the final implications will use 12 instead of 19 checklists. The deletion of checklist F-TFS-1, F-TU-1, F-TU-2, F-BV-1, F-BV-2, F-BV-3, and F-BV-4 based on the semi-structured interviews with experts and data collection from surveys with the same participants.

Table 22 Solution of Checklist for Company

Code	Checklist Item	Source
Technology - Compatibility		
F-TC-1	● The Metaverse developed is compatible with different devices and platforms.	Adapted from Ndlovu et al. (2023)
F-TC-2	● Implementation of communication layer is developed on the framework to support communication and transfer between platforms and system.	Adapted from L. Zhang (2022)

Technology - Functional Suitability		
F-TFS-2	● Company provides the possibility to test the Metaverse platform before launch it.	Adopted from Gadalla et al. (2013)
Technology-Usability		
F-TU-3	● Company provides the ability to customize the products or brand to properly fit any users' avatar in the Metaverse.	Adopted from Gadalla et al. (2013)
F-TU-4	● Metaverse architecture provides hybrid artifacts which leverage the advantages of physical and digital properties for users to manipulate.	Adapted from Tang & Hou (2022)
F-TU-5	● The Metaverse interface is visually appealing and attractive	Adopted from Gadalla et al. (2013)
Technology – Security & Privacy		
F-TSP-1	● The platform aligns with key national policy documents (e.g., the GDPR).	Adapted from Ndlovu et al. (2023)
F-TSP-2	● The platform development upholds the security, privacy, and confidentiality of users and company's data.	
F-TSP-3	● The Metaverse platform provides a safe purchase and payment process.	Adapted from Maddikunta et al. (2022)
Organizational Agility		
F-OA-1	● Our organization quickly adopts the new technology related to the Metaverse (e.g., Blockchain, generative AI) to our current platform	Adapted from Lee et al. (2015)
Business Impact – Value Creation		
F-BV-5	● Branding in the Metaverse aligned with the platform and the brand philosophy.	Adapted from Dwivedi, Hughes, Wang, et al., (2022)
F-BV-6	● Company understands the target customer that suitable for the Metaverse environment.	

As discussed in the previous section, 67% of the respondent's rate F-TFS-1 as less relevant. Despite Blockchain enabling decentralization, data collected from the scoping interview and semi-structured interview, S-1, and I-4, mentioned that the decentralization of the Metaverse is still in its development process. Therefore, for relevance to the current development, the decision to delete F-TFS-1 from the framework has been made.

In addition, F-TU-2: "Company should provide fantasy products in the Metaverse that are not available in real life" also revealed some confusion in the result, with 67% of the respondents voting this checklist as Neutral. In the semi-structured interview, I-3 mentioned that the word "fantasy" in the checklist creates ambiguity since most of the products and services in the Metaverse are not necessarily fantasy but mimic real life. Thus, this checklist also deleted from the lists.

5.3.3. META-QUAL Customer Survey

For the Customer Survey, 9 out of 13 points are deleted, C-TFS-2, C-TFS-3, C-TU-1 and C-TU-2 from the Technology dimension and C-BV-1, C-BV-2, C-BV-3, C-BV-4, and C-BV-5 from the Business

Impact dimension. From the Technology dimension, the survey list C-TFS-3 with the description "I found the various functions of the technology were well integrated," with a score of 2.7, only rated critical by 17% of correspondents. The survey list C-TU-2 describes, "It was as if I could interact with the simulated environment as if I were in the real world." it also has a similar result with a score of 2.5. Almost half of the participants rate this point as unimportant. During the interview, I-1 and I-2 statements support the decision to delete C-TU-2, as they mentioned that Metaverse should not replace the current real world but instead enhance the real-world environment.

From the Business Impact dimension, C-BV-1 describes, "It feels like the Metaverse platform is talking personally to me as a customer," scoring 3.2. And C-BV-4: "The products/services in the Metaverse are similar to the brand's real-life product/services." Survey results show a score of 3.0, with 67% of the correspondents rating this as unimportant. This statement indirectly contradicts the F-TU-2, where the checklist for the company suggests providing fantasy products. Therefore, upon the deletion of F-TU-2 from the Company Checklist, the C-BV-4 was also deleted to reduce confusion and ambiguity.

Table 23 Solution of Survey Items for Customer

Code	Survey Items	Source
Technology-Functional Suitability		
C-TFS-1	● I feel that I have proper control over the content of the Metaverse application.	Adapted from Zhang et al. (2022)
Technology-Usability		
C-TU-3	● The Metaverse experience can replace the experience of physically visiting the site in person.	Adapted from Yeh et al. (2020)
Technology-Security & Privacy		
C-TSP-1	● I can do a transaction inside Metaverse platform safely under my control.	Adapted from Maddikunta et al. (2022)
C-TSP-2	● I feel that I am able to trust the Metaverse platform completely.	Adapted from Barnes and Mattsson (2011)

6. Discussion

The proposed research question is revisited and addressed in the section on discussion. The following paragraphs will emphasize and mention the significant findings from this study with respect to the research questions. Furthermore, we will explore possible areas for future research after discussing the limitations identified in this study.

RQ1: What are the critical requirements and success factors that companies should consider when developing Metaverse applications?

The previous analysis sections indicate that organization management, technology, and how the firm provides a solution to their customer through the Metaverse are crucial factors when evaluating performance. While hardware attributes are essential for the performance evaluation of Metaverse, this thesis focuses more on the software improvements companies should check to evaluate the quality of their Metaverse services. From the discussion in Section 5, all the dimensions in the META-QUAL received positive feedback. The result shows that the appealing, attractive, and realistic user interface and user experience become the most relevant items to evaluate the Metaverse's performance based on an expert's perspective. According to expert interviews and surveys, security and privacy are also considered the key factors in developing the Metaverse and delivering user experience.

A thorough analysis is explained into three distinct subsections, each dedicated to a specific dimension: Organizational, Technology, and Customer.

Organization Agility towards the Velocity of Technology Development in the Metaverse

The performance evaluation begins from the internal aspect, which is about the Organization. The interview results from both scoping and semi-structured interviews have supported this statement, especially from participants with industry backgrounds from consultant, developer, and business. Participants S-1, I-1, I-3, I-4, I-6, I-7, and I-8 state that developing and integrating the Metaverse is a significant investment, in which sometimes the direction comes from top-down decisions. The practitioner's feedback in section 5.1.1 adds that organizational agility in setting goals becomes the biggest challenge in integrating a Metaverse. Thus, the effectiveness and agility of organizational management play a pivotal role in establishing clear objectives and goals, directing the Organization's primary attention toward customer satisfaction.

The result is supported by the academic literature in section 2, which discusses agile organization management as necessary and holds a vital role when implementing such an innovative technology with significant uncertainty. (Dwivedi, Hughes, Wang, et al., 2022) Organizational and managerial agility need to be implemented to reduce the silos mentality that can reduce the flexibility and adaptability to the recent technology. (Gilbert, 2005; Raffaelli et al., 2019)

In conclusion, to support the final product, the Organizational dimension offered in the META-QUAL framework, along with practicality in Company Checklist F-OA-1, received a positive result from the experts with a score of 5.0 with 83% response to the checklist as important. This checklist will help the firm check its organization and management agility towards the new development of the Metaverse, leading to a holistic evaluation.

Technology that Evolves in line with User Experience

The second crucial part is Technology, an essential foundation for building the Metaverse. A thorough review of the literature review in section 2 mentions many technology enablers in the Metaverse, such as decentralization, interoperability, blockchain, security privacy, immersiveness user experience, and

GenAI. (Dionisio et al., 2013; Dwivedi et al., 2022; Zheng & Liu, 2023; Huynh-The et al., 2023; Lv, 2023) Supported by interview results, participants S-1, I-5, I-6, and I-10 emphasize that the Metaverse is a virtual environment developed by many technology enablers that can enhance the user experience. According to the practitioners in section 5.1.1, the Technology inside the Metaverse is infrastructure and hardware, decentralization, interoperability, blockchain, and GenAI. While hardware characteristics are crucial for evaluating the performance of Metaverse, this thesis primarily emphasizes the software enhancements that enterprises should examine to evaluate the quality of their Metaverse services.

The survey results from the Company Checklist show that according to experts, almost all technical dimensions offered in the META-QUAL framework are relevant to evaluating Metaverse's performance. Based on the result, the rank of the most relevant elements in order is: in interface attractiveness (F-TU-5 with a score of 4.8), Metaverse testing before launch (F-TFS-2 with a score of 4.7), safe transactions (F-TSP-3 with a score of 4.5), implementation of communication layer (F-TC-2), compatibility in different devices (F-TC-1), data privacy and GDPR alignment (F-TSP-1 and F-TSP-2). In contrast, although previous research and interviews show the importance of Blockchain, the survey result of checklist F-TFS-1 on Blockchain was deleted from the list due to insufficient meeting of the threshold. These results indicate that Blockchain is less significant than other factors, such as interoperability, in evaluating a Metaverse's performance.

The survey results also show that providing fantasy products (F-TU-2) and GenAI implementation (F-TU-1) are less relevant compared to other lists when evaluating Metaverse performance. From the interview, I-1, I-3, I-6, I-7, and I-10 support the deletion of F-TU-2, with their statement that the Metaverse is an environment that mimics the real world as a digital twin, but it does not mean replacing the real world. The Metaverse realm is developed in order to enhance the real world, such as creating a simulation for non-feasible activity in real life, for example, showing a client from a different country the detailed architecture of a building. For F-TU-1 on GenAI implementation, participants I-6 and I-7, as researchers, said that GenAI implementation is still in the development process and is not necessary to be part of the development process despite the focus on the infrastructure and how to create value for customers will be more relevant to evaluate the Metaverse performance.

For the Customer Survey, according to the experts, the highest rank of importance factors is the realistic user experience (C-TU-3 with a score of 4.2), user ability to control their data (C-TFS-1 with a score of 4.2), and safety (C-TSP-1 and C-TSP-2 with score of 4.0). While Metaverse replaces the real world (C-TU-2), integration between functions (C-TFS-3) and ease of use (C-TFS-2) are deleted due to insufficient scores in meeting the threshold. From the interview, I-1, I-3, I-6, I-7, and I-10 mentioned that the Metaverse realm is developed in order to enhance the real world, not replace it, such as creating a simulation for non-feasible activity in real life, for example, showing a client from a different country the detailed architecture of a building.

Although much literature mentions the "ease of use" as an essential element (Zeithaml et al., 2000; Parasuraman et al., 2005; Gadalla et al., 2013; Krishnamurthy, 2022; F. Shi et al., 2023) based on the survey with the expert, this C-TFS-2 is less relevant when evaluating the Metaverse performance. This "ease of use" matter might be an opportunity for future research to understand this element better. The C-TU-1, with the statement "I enjoyed the visuals of the activity in the metaverse platform," scored just 0.2 points below the threshold with 67% positive responses from the participants. The importance of this list is supported by participants I-7 and I-10, who mentioned how the Metaverse needs to be more humanized and more understanding towards the customer through an appealing activity. This enjoyable visual is also supported by much literature on how the user experience when interacting with the Metaverse is essential when evaluating its performance. Therefore, for future research, this could be an opportunity to explore how to deliver the objective of this point to a more precise list that can lead to the same understanding and be more beneficial for the firm practicality.

In conclusion, from the Technology dimension, based on the literature review and experiment with the experts, it is crucial for technology to evolve in line with user expectations that can be reflected in an attractive user interface and user experience, decentralization, and security in the platform. The META-QUAL Company Checklist can help the company check Metaverse's usability, functional suitability, compatibility, and security to deliver the user expectations in the META-QUAL Customer Survey, leading to a holistic review.

Win the Customers by Delivering the Right User Experience to the Right Customers

The Customer is an essential element that becomes the objective of an organization when integrating the Metaverse. As mentioned by Parasuraman et al. (2005), creating value for users is the only way these innovative technologies can prove their worth. Through services, they can add value for the final user. The recent publication in Metaverse also mentioned the importance of the Customer element in developing and evaluating the platform. (Donthu et al., 2021; L. Zhang, 2022; C. Chen, 2022; Lu & Mintz, 2023; Abraham & Laughlin, 2023; Rauschnabel et al., 2023)

The results of interviews with the experts established the literature analysis. Interviewee I-4, I-5, and I-9, with Business Service backgrounds, state that how the firm provides a solution to their customer through the Metaverse is crucial when evaluating performance. Therefore, with the importance and relevance of the objective, the modification applied to the Business Impact dimensions to the Customer dimension. This adjustment also gives the reader a more straightforward objective in this dimension. Using the Business Impact – Value Creation dimension can raise questions on the other value created to the firm while we are not elaborate. This modification is also more suitable with the other dimension naming focusing on the object, Technology, and Organization.

To support the statement, the survey result from the Company Checklist shows that almost all lists received positive feedback. According to the experts, the most relevant element in performance evaluation from the Customer Dimensions is the right customer target (F-BV-6 with a score of 4.5) and alignment between online and offline branding (F-BV-5 with a score of 4.2). In comparison, the economic activity engagement (F-BV-3) and tracking and monitoring the customer (F-BV-4) are deleted because does not meet the threshold. Although the list F-BV-3 received 67% positive feedback and was supported by I-1 from the interview with his statement, "There is no Metaverse if there is no transaction happened," the final score of 3.5 is not enough to pass the threshold. Therefore, it is an opportunity for future research to have a deeper understanding of the financial matters in the Metaverse platform.

From the Customer Survey list, all the checklists scored below the threshold of 4.0. The most relevant list that almost meets the threshold is where the user experience meets user expectations (C-BV-3 with a score of 3.8). In contrast, the two lists considered less relevant and removed from the survey are personalized platform (C-BV-1) and product similarity between the Metaverse and real life (C-BV-4). The result significantly reflects the development of a suitable questionnaire and survey list because, for example, C-BV-2 stated that the Metaverse meets the user expectations and scores lower. However, during the interview, many participants, I-3, I-4, I-5, I-8, and I-9, stated that it is crucial to understand the user target and their needs before developing the Metaverse. Therefore, for future research, it can be an opportunity to have a more precise and direct list for the survey or questionnaire list to achieve the objective of the survey. Although we delete all lists from the Customer Survey, the expert supports the Company Checklist offered.

To conclude, the customer dimension in the META-QUAL, refined based on the experiment result and thorough analysis, offers relevant elements to evaluate Metaverse's performance. The META-QUAL framework offers a Company Checklist to help the firm ensure that the developed platform answers the users' needs and delivers the user expectations listed in the META-QUAL Customer Survey. The firm that understands how to use the Metaverse to improve its business and engage customers, create

experiences, and cultivate its brand community will likely have a significant competitive advantage. (Value Creation in the Metaverse, 2022)

RQ2:   How can companies evaluate the performance of their Metaverse applications?

According to the previous analytical sections, this study develops a framework by merging diverse perspectives through the lens of theory and data collection from the experts using qualitative data complemented by the survey to quantify the study. As a solution and answer to the main research questions, this research provides the META-QUAL framework, in which three dimensions drive the Metaverse performance quality: Technology, Organization, and Customer. The META-QUAL framework consists of three dimensions and six metrics, which will be used to evaluate the performance of the Metaverse.

As part of the contribution to company practicality, this research also develops a META-QUAL Company Checklist that the firm can use to evaluate Metaverse's performance. Checklists are commonly used to evaluate the quality of research. Academic research has mentioned that a checklist is developed to improve understanding, aid memorization, and delve deeper into the covered subjects. (Protogerou and Hagger, 2020; Makram et al., 2022) This META-QUAL Company Checklist aims to be used by the new business or existing incumbent as a tool to evaluate their performance.

To give a holistic evaluation, this study also contributes a META-QUAL Customer Survey that firms can use to check their performance through customers' lenses. Users will rate the Metaverse performance on each scale item using a 5-point scale (1 = strongly disagree, 5 = strongly agree). Likert scale is selected for this final framework for the customer as a user because, in the Likert Scale, the respondents select the choice that most accurately expresses their feelings regarding the message or question. (Joshi et al., 2015) This way, the goal is to understand the value creation in the Metaverse with the Likert scale that captures users' level of agreement or their thoughts about the quality of Metaverse service in a more nuanced manner.

From the experiment results, 14 META-QUAL Company Checklists and six lists of META-QUAL Customer Survey have been considered the most relevant elements of evaluating Metaverse performance. By combining many aspects of Technology, Organizational, and Customer, this thesis research offers a holistic view of a framework to evaluate the Metaverse's performance.

Following an analysis of the data collection results, the relationship and impact between the META-QUAL dimensions must be demonstrated. Defining a relationship between the dimensions aims to provide the developer and the firm using the META-QUAL framework with greater insight into how the three dimensions are interconnected, and when the simultaneous action is done, it will bring a higher performance expectation. The graph below illustrates the relations between the three dimensions and their metrics and demonstrates how maintaining all three dimensions is crucial for evaluating Metaverse's performance. The organization element will enable the adaptability of the second element of technology, which will create an enhanced experience for the third element of the customer.
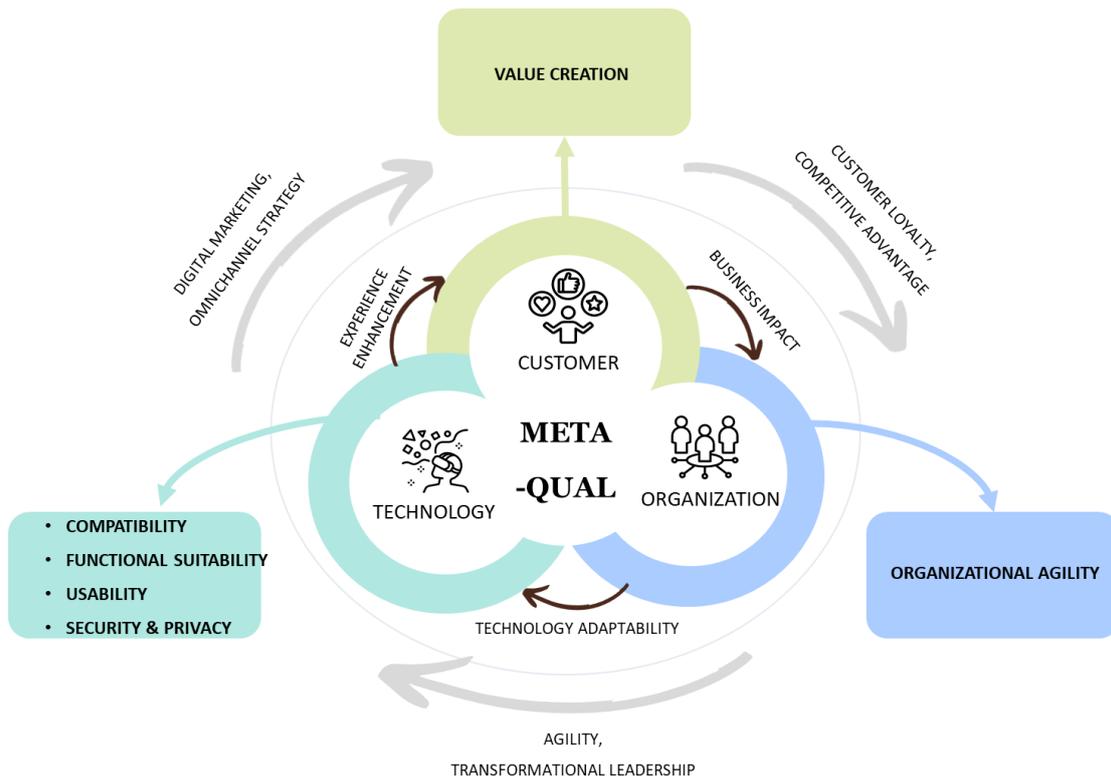
Figure 18 Connection between Dimension of META-QUAL

6.1. Limitations

While the META-QUAL exhibits potential in assessing Metaverse performance, it is fundamental to acknowledge its limitations. The limitations we encountered in doing this research, which may arise in DSRM, were assessed in this chapter. These limitations may impact the results' reliability and adaptability.

1. **Velocity of Research in Metaverse:** Recent Metaverse papers state that most new research is survey-based, and the scientific work conducted decades ago is outdated. The previously published works do not address Blockchain, decentralization, interoperability, artificial intelligence, or meta technology because they are new. The more recent articles touch on some of those themes, though not in excessive detail.

2. **Broad Scope of the Metaverse Enabler:** As complementary to the Metaverse, GenAI is suggested as a crucial element by much research from the literature review. GenAI, summarized from the literature review, could enhance the development of the Metaverse in many aspects of user interface, aesthetics, customer data management, and security and create more humanized platforms. However, this thesis research only focuses on the user interface aesthetics of GenAI. Nevertheless, later, supported by the data collection from practitioners, we can leave aside the GenAI as it is also still in the development process.

3. **Challenges to Incorporate the Investment and Infrastructure Element:** From the literature review and semi-structured interview, many more tangible elements need to be considered in evaluating the Metaverse, such as hardware, tools, and infrastructure from the technical aspects and the return on investment, market share, and business models from the business aspects. Due to limited time and research scope, this thesis research only focuses on the software quality to deliver

the user experience. Furthermore, future research can help to incorporate more elements to make a more comprehensive and holistic framework.

4. **Challenges in Research Implementation:** Due to limited time, there is a delay in the development and assessment of the framework. On the scoping interview, only one participant was involved, while on the semi-structured interview, we were able to gather data from more experts. Although much academic literature was used to develop the framework proposal, the result from more than one practitioner will increase the validity of the first proposal. The same respondents for all data collection on the scoping interview, semi-structured interview, and survey could also enhance the final solution, as it will give a coherent understanding of this research. In addition, interviews with I-4 and I-5 were conducted through Microsoft Teams and email due to time availability; the questions were asked and documented through email. Moreover, because of the respondents who submitted the survey on time, only 6 out of 10 were used for this research.

5. **External Validity:** It is impossible to measure the survey's effectiveness for the customer due to practical and time constraints that prevented this methodology from being implemented in real-world business cases. Furthermore, whether the methodology's efficacy would change depending on the size, complexity, domain knowledge, and availability of resources of the project was not explored. It might need more verification and modification to guarantee application in diverse scenarios. Its flexibility and effectiveness could be improved by conducting further studies with a real business case with various organizations and project sizes.

6. **Practicality for the Firm:** Although many respondents agree with the checklist and survey for the company and customer, there still needs to be more clarity on the performance expectations. For example, a scoreboard from the current checklist can help the firm illustrate its Metaverse performance phase and recommend the following action for the company. However, future studies can help define a valid and reliable scoring board that can help more for the firm practicality.

7. **Reliability of Survey Testing:** A survey has been conducted to complement the interview as our primary data collection. The assumption has been used to quantify the result from the survey due to time limitations and the small amount of data gathered. For future research, more extensive data can be used to quantify the questionnaire's effectiveness. Then, a reliability test such as Cronbach's Alpha can be used to ensure the reliability of the result.

8. **Suitability Questionnaire List:** Many lists with scores below the threshold are mentioned in the literature review as an essential element in evaluating the Metaverse. However, the result could not be revised and assessed for iterative process with the participants due to time limitations. Thus, the opportunity for future research is to refine the checklist to find the best way to communicate the objective of the lists.

The primary focus of this study's evaluation outcomes is participant feedback and opinions regarding the META-QUAL to evaluate the Metaverse performance. Nevertheless, the study only examined the literature to compare its conclusions with those of other frameworks or project management techniques. To get an in-depth understanding of this methodology's advantages and limitations, comparing it with alternative approaches would be helpful.

6.2. Future Work

The next stage ought to be to increase the sample size and get input from actual project scenarios to boost this study's validity. The problem definition could be improved, and the research's conclusions could be reinforced.

In future studies, it would be beneficial to investigate how well the META-QUAL framework scales and applies to other business scenarios. Examining how this practice affects stakeholder satisfaction, teamwork, and project success could yield insightful information.

During the study, there were opportunities to refine the sentences in the Company Checklist and Customer Survey questionnaire list to be more precise with the firm needs. The opportunity for future research is to refine and revise the sentences in order to meet the suitability between the objective of the survey and the needs of the firm.

In addition, there is also an opportunity to measure the checklists through a scoring board. Further research might concentrate on how the scoring system might assist the business in comprehending where it stands within the performance phases. This understanding could then be used to help the business identify potential solutions and improve performance.

Because of time constraints, the breadth of the experiments was limited. Increasing the scope of the experiment could yield more accurate and comprehensive results. This addition might clarify some of the limitations that have been brought to light, offer suggestions for mitigating their impact, and improve the reliability and validity of the findings.

Lastly, this study assumed that the Metaverse's performance could be assessed using the META-QUAL framework. Although this was done by a qualitative study and complemented by a quantitative study from literature, interviews, and surveys, there is a chance to perform a more open study that adds several approaches, such as a business case with a particular company.

7. Conclusion

Our research aims to discover the key components that can be used to evaluate Metaverse's performance using a framework. The thorough literature review shows a scarcity of studies guiding businesses in designing high-quality services for Metaverse. Although there is research on the Metaverse evaluation framework, it mainly focuses only on one aspect—consumers or technology.

The validity of these components in the developed META-QUAL framework was investigated through a qualitative study with ten experts through semi-structured interviews and surveys based on a Likert-scale questionnaire. Participants from practitioners and experts in the Metaverse sector rated each item's importance in the META-QUAL framework through interviews and surveys. With one scoping interview and ten solid participants from semi-structured interviews, we were able to get significant insights into the main research questions.

Our research leads us to conclude that the META-QUAL framework gives a holistic evaluation, with the most relevant variables to evaluate the Metaverse's performance according to the experts and are concluded in the META-QUAL framework, which has three dimensions and six metrics: Organization (Agility), Technology (Compatibility, Functional Suitability, Usability, and Security), and Customers (Value Creation). Nonetheless, we also demonstrate how the three aspects are related and how keeping all three dimensions intact is essential.

For company practicality, we offer the META-QUAL Company Checklist and META-QUAL Customer Survey, which cover all three dimensions of the META-QUAL framework. Based on our experiment and analysis, we have reached the conclusion that twelve lists of Company Checklists and four lists of Customer Surveys were rated as the most relevant to evaluate the Metaverse performance based on our ten expert respondents. The result shows that assessing the platform's appealing and attractive user interface and how the user experience in the Metaverse delivers the user expectations safely and securely is crucial in evaluating the Metaverse's performance.

In conclusion, the META-QUAL framework offers a holistic view and practicality for the business through the Company Checklist to help the firm evaluate the Metaverse by assessing their organization's agility and technology development in delivering the user experience to meet the user expectations listed in the META-QUAL Customer Survey.

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9. Appendix

9.1. Interview Protocol

9.1.1. Semi-Structured Interview Protocol - Scoping Interview

Table 24 Scoping Interview Protocol

Section	Topic	Detail
Introduction	Greetings	- Greet the participant and introduce yourself. - Explain the purpose of the interview, which is to discuss and gain feedback on the framework development to evaluate Metaverse performance.
Practicalities	Consent	- Consent - Recording - Provide an overview of the interview process, including estimated duration and any confidentiality measures.
Disclaimers	Confidentiality	- Explain the confidentiality measures in place and assure the participants that their responses will be anonymized, and no names of participants or organizations will be shared and strictly used for research purposes only. - The interviewee has the right to withdraw their participation without any consequences.
Background	Metaverse in general	1. Could you briefly **define the Metaverse** from your perspective?
	Metaverse trends	2. Looking at the latest news and articles which suggest that the Metaverse will not thrive. What is your opinion about this?
	Metaverse consultancy project	3. Could you **briefly describe the most significant Metaverse implementation projects** you have worked on?
	Company's motivation integrating Metaverse	4. What do you think motivates **businesses** to join the hype of Metaverse?
Core Questions	Readiness	5. Readiness: What are the **key metrics to determine if a company can** integrate the Metaverse into its business model?
	Risk and challenges	6. Challenges and opportunities: What are the **main risks/challenges and opportunities** that companies face when integrating the Metaverse into their business model?
	Mitigation	7. Do you have any suggestions for **mitigating these risks/ challenges**?
	Success factor	8. Performance evaluation: What are the **key metrics/ success factors for measuring the success** of the Metaverse integration into the business?

Self-Challenges	Risk and challenges	9. What **challenges do you face when working on Metaverse-implementation projects** for your clients? 10. How did you overcome them?
Evaluation	Failures and learning	11. In the past, there were failures from the companies that integrated Metaverse into their business. What do you think are the reasons?

Trends	Metaverse trends	12. Optional questions on the trends:
		  - [I have seen several examples like from Nike and Gucci in the Metaverse, but why did it not boom like their other campaigns, which are always booming and become the hype around the world]
		  - [What do you think about Apple's new product incorporating MR into their devices? Since Apple is a well-known company where almost all their campaigns work well, do you think it will be the new hope for the Metaverse trend?]

Wrap-up	Closing and additional	13. What future developments or trends do you foresee in immersive and creative technology? 14. Do you want to share anything that you might think was important to me but did not cover in the questions? 15. Is it possible to connect us with someone from the companies that you have already worked on the Metaverse? 16. Is it possible to contact you through email or conduct another interview if any interesting topics could be discussed?

9.1.2. Semi-Structured Interview Protocol – Evaluation and Feedback

1. Introduction
    a. Greet the participant and introduce yourself.
    b. Explain the purpose of the interview, which is to discuss and gain feedback on the framework development to evaluate Metaverse performance.
2. Practicalities
    a. Consent - Video On
    b. Consent - Recording
    c. Provide an overview of the interview process, including estimated duration and any confidentiality measures.
3. Disclaimers
    a. Explain the confidentiality measures in place and assure the participants that their responses will be anonymized, and no names of participants or organizations will be shared and strictly used for research purposes only.
    b. The interviewee has the right to withdraw their participation without any consequences.

Introduction
Greet the participant and introduce yourself.
   - Hi ___, thank you for your time. As an opening, I would like to introduce myself and my supervisors and brief information on our research.
     My name is Maria Goretti, a master's student of ICT in Business from Leiden University. I am currently working on my thesis research under the supervision of Natalia Amat & Niels van Weren. Our main topic is exploring what happened around Metaverse related to

businesses. We have 3 points that we would like to discuss: Challenges, Opportunities, and Performance Evaluation.

- Given your experience with Metaverse applications across different clients, we are very interested in your knowledge about these areas. Before moving forward, **I would like to ask your permission to record this interview**. Would that be okay for you?
- Okay, perfect. Let us start. Could you introduce yourself and briefly explain your experience?

Background

1. Could you briefly **define the Metaverse** from your perspective?
2. What do you think motivates **businesses** to join the hype of Metaverse?
3. What are the **main challenges** that companies face when integrating the Metaverse into their business?

Core questions

4. Performance evaluation: what are the **key metrics/ success factors for measuring the success** of the Metaverse integration into the business?

Present the suggested framework.

5. I have 7 metrics to propose as key metrics for measuring the performance of Metaverse integration, would you mind rating how important it is on a scale 1 – 5, 1 is the least important, and 5 is the most important:
   a. Compatibility: Interoperability
   b. Functional Suitability: Decentralization
   c. Usability:
      i. Immersiveness & User Experience
      ii. Generative AI implementation on Interface & 3D Modelling.
   d. Security & Privacy
   e. Organizational Agility
   f. Value Creation to Customer: Brand Awareness & Customer Engagement

Evaluation and Feedback Question

6. Looking at this framework, what do you recognize, and what does make more sense? Or does it not make sense?
7. What are your thoughts on the suggested framework?
8. What potential risks or drawbacks do you foresee in implementing this approach? Are there any specific areas that might need further refinement or consideration?
9. How feasible and effective do you believe this approach would be in your context or organization?
10. What training or support might be necessary to ensure team members can effectively use the Performance Evaluation of the Metaverse?

Wrap -up

11. What future developments or trends do you foresee in immersive and creative technology?
12. Do you want to share anything that you might think was important to me but did not cover in the questions?
13. Is it possible to contact you through email or conduct another interview if any interesting topics could be discussed?

Follow up.

14. Send the Survey link to the participants to get feedback on each question and checklist.

9.2. Questionnaire for Company Checklist and Customer Survey Items

9.2.1. For Company

An understanding of the dimensions and metrics to enhance the Metaverse performance is provided by the strategy/checklists for Technology, Organizational and Business Impact. This can be used by the new business or existing incumbent as tools to evaluate their performance and improve their value creation for end user.

*Technology - Compatibility

Compatibility is interpreted as the ability of **the Metaverse** to share information with other systems and perform its necessary functions while utilizing the same hardware or software environment.

	Very Unimportant	Unimportant	Neutral	Important	Very Important
The metaverse developed should be **compatible with different devices** and platforms.	○	○	○	○	○
Implementation of a **communication layer** should be developed on the framework to **support communication and transfer** between platforms and systems.	○	○	○	○	○

< Previous page   Next page >

*Technology - Functional Suitability

Functional suitability is the extent to which **the Metaverse**, when used in accordance with predetermined guidelines, fulfills both explicit and implausible demands.

	Very Unimportant	Unimportant	Neutral	Important	Very Important
The **blockchain technology should be implemented** to store and distribute data and allow the information exchange to travel across the metaverse.	○	○	○	○	○
The company should provide the possibility to **test the Metaverse platform before launching** it.	○	○	○	○	○

< Previous page   Next page >

*Technology-Usability

Usability is defined as the extent to which **the Metaverse may be utilized** by a specific user group to achieve a specific goal in a specific usage environment with effectiveness, efficiency, and satisfaction.

	Very Unimportant	Unimportant	Neutral	Important	Very Important
Generative AI should be implemented in the metaverse development to **support 3D content creation** into more realistic virtual worlds.	○	○	○	○	○
Company should **provide fantasy products** in the Metaverse that are not available in real life.	○	○	○	○	○
Company should provide the **ability to customize the products** or brand to properly fit any users' avatar in the Metaverse.	○	○	○	○	○
Metaverse architecture **provides hybrid artifacts** which **leverage the advantages of physical and digital properties** for users to manipulate.	○	○	○	○	○
The Metaverse interface should be **visually appealing and attractive.**	○	○	○	○	○

< Previous page   Next page >

*Technology – Security & Privacy

The security will be measured on how well **the Metaverse** safeguards information and data so that users can access it to the right extent for their types and degrees of permission.

	Very Unimportant	Unimportant	Neutral	Important	Very Important
The platform **aligns with key policy documents** (e.g., the GDPR).	○	○	○	○	○
The platform development **upholds the security, privacy, and confidentiality of users** and company's data.	○	○	○	○	○
The Metaverse platform should provide a **safe purchase and payment process**.	○	○	○	○	○

< Previous page   Next page >

Universiteit
Leiden
The Netherlands

*Organizational Agility

The agility of the organization in **adaptation and flexibility** towards the new technology with uncertainty.

	Very Unimportant	Unimportant	Neutral	Important	Very Important
Our organization **quickly adopts the new technology related to the Metaverse** (e.g., Blockchain, generative AI) to our current platform.	○	○	○	○	○

‹ Previous page   Next page ›

Universiteit
Leiden
The Netherlands

*Value Creation - Brand Awareness & Customer Engagement

Creating value for users is the only way **the Metaverse can prove its worth and value**, and through services, it can add value for the final user.

	Very Unimportant	Unimportant	Neutral	Important	Very Important
The company's offerings have the **best quality** and implement **cross-channel marketing vs competition**.	○	○	○	○	○
Information about the brand and or product should be **available** to users and **regularly updated.**	○	○	○	○	○
Metaverse able to **engage customer** in the **economic activity** inside the platform.	○	○	○	○	○
Company should be able to **track and monitor customer** in the Metaverse platform to collect customer data and interaction between customer and object.	○	○	○	○	○
Branding and **communication** in the metaverse **must be aligned with the platform** and the **brand philosophy.**	○	○	○	○	○
Company should understand the **target customer that is suitable** for the metaverse environment.	○	○	○	○	○

‹ Previous page   Next page ›

Do you have additional comments on the survey/checklist?

*This is the end of the question. Are you sure you want to submit your response?

○ Submit

‹ Previous page   Next page ›

We thank you for your time spent taking this survey.
Your response has been recorded.

9.2.2. For Users

Respondents are users of the Metaverse, they will rate the Metaverse performance on each scale item using a 5-point scale (1 = strongly disagree, 5 = strongly agree). The items below are grouped by dimension.

Welcome to our research! We are interested in understanding how the company evaluates the performance of the Metaverse.

This survey is divided into two parts:

(1) **General information:** you will be asked several general questions, such as your occupation link to the metaverse group that you identify yourself with.

(2) **Rank the importance:** you will be presented with a series of surveys that customers will use to evaluate the performance of your Metaverse. You will be asked to rate the importance and related of these questions for your side as a Business/Company or Consultancy/Provider who develops the Metaverse platform. You will be asked to rank with ratings 1-5, from 1 for very unimportant to 5 for very important.

The rank is divided into two parts: **(2.1) Technology, (2.2) Business Impact - Value Creation**

This research takes around **3-5 minutes to complete**. All your answers will be treated confidentially and stored anonymously, and your data will only be used for research purposes. Your participation in this research is completely voluntary. You have the right to withdraw at any point without any consequences. Should any of the tasks or the question cause discomfort, you may withdraw from this research at any point. If you have questions about this research, you may contact the project owner, Maria Goretti R Murwani, via email at s2676389@vuw.leidenuniv.nl .

Next page ›

*Which of the following groups most describe your relation with the Metaverse environment:

○ Metaverse Consultant/Provider/Developer

○ Consumer Goods Company/Business

○ Academic/Researcher

○ Other _____

*How many years of Metaverse development/implementation experience do you have?

_____

< Previous page   Next page >

*Technology-Usability (Immersiveness & User Experience)

Usability is defined as the extent to which **the Metaverse may be utilized by a specific user group to achieve a specific goal** in a specific usage environment with effectiveness, efficiency, and satisfaction.

	Very Unimportant	Unimportant	Neutral	Important	Very Important
I **enjoyed the visuals of the activity** in the metaverse platform.	○	○	○	○	○
It was as if I could interact with the simulated environment **as if I were in the real world.**	○	○	○	○	○
The Metaverse experience **can replace the experience** of physically visiting the site in person.	○	○	○	○	○

< Previous page   Next page >

*Technology-Usability (Generative AI Implementation on Interface 3D Modelling)

Usability is defined as the extent to which the Metaverse may be **utilized by a specific user group to achieve a specific goal** in a specific usage environment with effectiveness, efficiency, and satisfaction.

	Very Unimportant	Unimportant	Neutral	Important	Very Important
I feel that **I have proper control over the content** of the metaverse application.	○	○	○	○	○
I think that **I would need the support of a technical person** to be able to use this technology.	○	○	○	○	○
I found the **various functions** of the technology were **well integrated.**	○	○	○	○	○

< Previous page   Next page >

*Technology - Security & Privacy

The security will be measured on **how well the Metaverse safeguards information and data** so that users can access it to the right extent for their types and degrees of permission.

	Very Unimportant	Unimportant	Neutral	Important	Very Important
I feel that **I am able to trust** the metaverse platform completely.	○	○	○	○	○
I can **do a transaction** inside the Metaverse platform **safely** under my control.	○	○	○	○	○

[< Previous page] [Next page >]

*Value Creation - Brand Awareness & Customer Engagement

Creating value for users is the only **way the Metaverse can prove its worth and value**, and through services, it can add value for the final user.

	Very Unimportant	Unimportant	Neutral	Important	Very Important
It feels like the **Metaverse platform is talking personally** to me as a customer.	○	○	○	○	○
The **experience in the Metaverse** platform is **exactly what I needed.**	○	○	○	○	○
This **experience has worked out** as well as I thought it would.	○	○	○	○	○
The **products/services in the metaverse are similar to brand's real-life** product/services.	○	○	○	○	○
I feel the sense of **human contact** on the metaverse platform.	○	○	○	○	○

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Do you have additional comments on the survey/checklist?

[   ]

*This is the end of the question. Are you sure you want to submit your response?

○ Submit

[< Previous page] [Next page >]

We thank you for your time spent taking this survey.
Your response has been recorded.

9.2.3. Final Checklist Presentation

METAVERSE
PERFORMANCE EVALUATION CHECKLIST

| **Technology Compatibility** | ☐ The metaverse developed is **compatible with different devices** and platforms. |
| | ☐ Implementation of the **communication layer** is developed on the framework to support communication and transfer between platforms and systems. |

| **Technology Suitability** | ☐ The company provide the possibility to **test the Metaverse** platform before launching it. |

Technology Usability	☐ Company provides the **ability to customize the products** or brand to fit any user's avatar in the Metaverse properly.
	☐ Metaverse architecture provides hybrid artifacts that leverage the advantages of physical and digital properties for users to manipulate.
	☐ The Metaverse interface is visually **appealing and attractive**.

Technology Security & Privacy	☐ The platform **aligns with policy documents** (e.g., the GDPR).
	☐ The platform's development **upholds the security, privacy, and confidentiality** of users and the company's data.
	☐ The Metaverse platform provides a **safe purchase and payment process**.

Figure 30 META-QUAL Checklist Page 1

METAVERSE

PERFORMANCE EVALUATION CHECKLIST

Organization Agility

☐ Our **organization quickly adopts** the new technology related to the Metaverse (e.g., Blockchain, generative AI) to our current platform.

Business Impact And Value Creation

☐ **Branding and communication** in the metaverse **aligned** with the platform and the brand philosophy.

☐ Company **understand the target customer** that is suitable for the metaverse environment.

Figure 31 META-QUAL Checklist Page 2

METAVERSE

PERFORMANCE EVALUATION SCORECARD

Technology   ___ / 9

- **Compatibility**   (__/2)
- **Functional Suitability**(__/1)
- **Usability**   (__/3)
- **Security & Privacy**   (__/3)

Organization Agility   ___ / 1

**Business Impact
And Value
Creation**   ___ / 4

TOTAL   ___ / 14
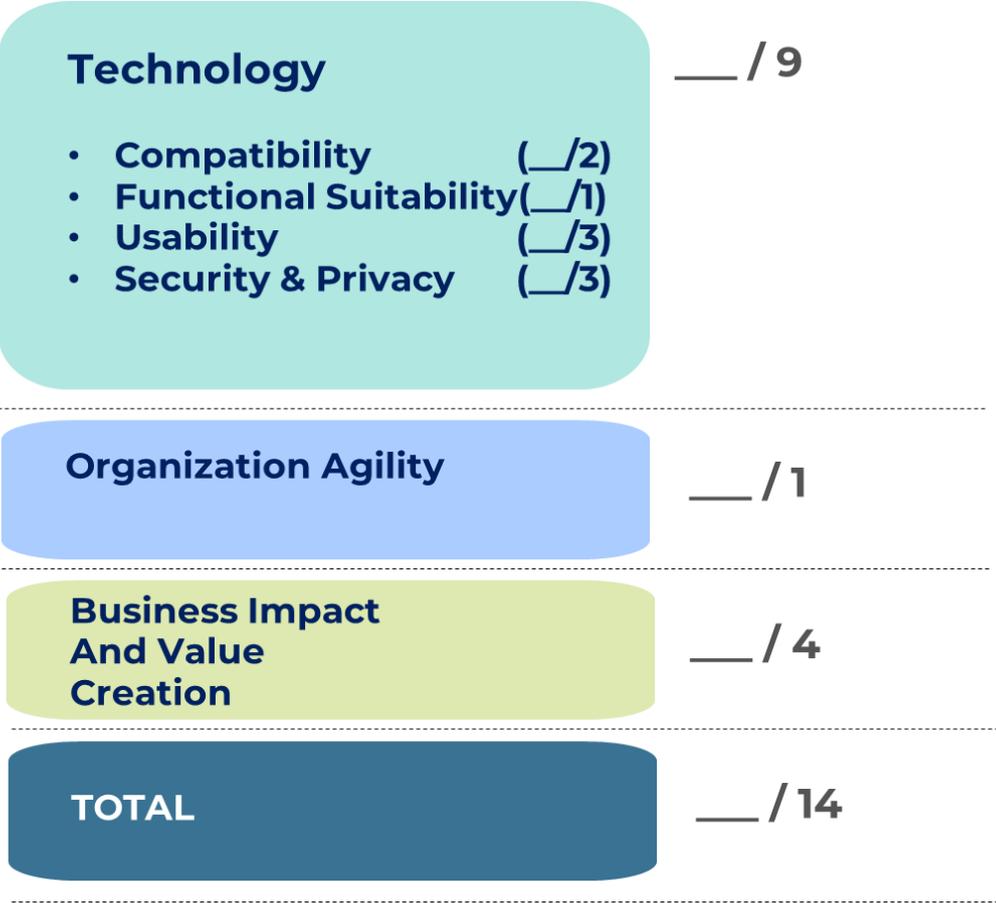
Figure 32 META-QUAL Checklist – Scoring