The future(s) of digital fashion in the metaverse

An investigation into the potential future(s) of users' experiences with digital fashion products in the metaverse in the year 2032.

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ABSTRACT

The fashion industry is undergoing rapid digital transformation processes fueled by technological advancements, evolving consumer needs, and growing environmental pressures. In the face of the disruptive technological concepts as the metaverse (which can be defined as the next iteration of the current internet in the form of an interconnected network of three-dimensional virtual worlds), it is expected that the digital transformation processes will further accelerate and revolutionize many industries, the fashion industry being no exception. Therefore, the digitalization of the fashion combined with the dawn of the metaverse has the potential to provide the users with new means of experiencing clothing that could completely deviate from its conventional understanding. This study undertook to answer the research question 'How could the metaverse impact users' experiences with digital fashion products in the year 2032?' through scenario planning method, which can serve as a strategic tool for firms to plan for the uncertain future and help them operate in rapidly evolving markets. In this research, the four scenarios provided an answer to the research question through outlining four potential developments of how the future of digital fashion in the metaverse could unfold. The interviews with eleven experts in the metaverse-related and digital-fashion-related fields served as a primary source of data collection for developing the scenarios. The interviews were investigated through thematic analysis, which enabled identifying key stakeholders, trends, and uncertainties regarding the future of users' experiences with digital fashion products in the metaverse. Thematic analysis revealed level of mass adoption and interoperability as determining, yet uncertain factors on which users' experiences could be highly dependent in ten years. The identified trends revealed that in the year 2032 users' experiences could be shaped by the new contexts of uses of digital fashion products, new aesthetic possibilities, and new means of enhancing engagement with digital fashion products. The divergent character of scenarios revealed that users' experiences could differ significantly depending on how the future will unfold in terms of the level of mass adoption and interoperability in the metaverse.

KEYWORDS: *Metaverse, Digital Fashion, Digital Fashion Product, User Experience, Scenario Planning*

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1. Introduction

The fashion industry is a substantial driver of the world economy that is undergoing rapid digital transformation processes urging firms to reinvent their business models for the new digital era in which the physical boundaries cease to apply (Brydges et al., 2018). The profound digital transformation of the fashion industry is fueled by such phenomena as technological advancements, evolving consumer needs, and growing environmental pressures (Koneva, 2020). As stressed by Crewe (2017), digital technologies contribute to creating brand-new ways of engaging with fashion, and consumers' fast-paced uptake of technological developments (additionally intensified by the Covid-19 pandemic) further accelerates the urgency for adaptation among fashion businesses (Lay, 2018; Nobile et al., 2021). As emphasized by Santos et al. (2020), digitalization processes at a global scale caused the split of human existence into the real and virtual world, which resulted in new ways of perceiving, exploring, and performing fashion (Crewe, 2017). As a result, the digitalization of various facets of fashion (including the digitalization of products themselves) yields entirely new means of experiencing clothing deviating from its conventional understanding (Cabigiosu, 2020). Traditionally perceived through its physical qualities, fashion takes on a new meaning in the new digital era where physical constraints cease to apply (Särmäkari, 2021). Moreover, in the face of the emergence of the concept of the metaverse (considered to be the next iteration of the current internet in the form of an interconnected network of three-dimensional virtual worlds), it is expected that many industries will undergo even more rapid digital transformation processes – the fashion industry being no exception (Lee et al., 2021; Narin, 2021).

There are multiple phenomena attesting to the link between the expansion of the realm of digital fashion and the growing importance of the metaverse. Firstly, the rise of an array of digital-fashion-related startups such as Dress X, RTFKT, The Fabricant, Auroboros, The Dematerialised, and many more, points to the growing interest in this field (Pereira & Fernandes-Marcos, 2021). Furthermore, a growing body of globally renowned brands is ‘entering the metaverse’, which is apparent through collaborations such as Balenciaga with Fortnite, Lacoste with Minecraft, or Ralph Lauren and Gucci with Roblox (Epic Games, n.d; Lacoste, n.d.; Roblox, 2021). Other examples include brands like Nike, Adidas, Gucci, and Louis Vuitton selling virtual collectibles as Non-Fungible Tokens (NFTs) that enable users to own digital assets on a blockchain (McDowell, 2022).

In the face of the disruptive character of the metaverse, this study will investigate its potential impact on the future of experiencing digital fashion through scenario planning methodology incorporating expert interviews. The insights from experts' testimonies will serve as a basis for creating four scenarios outlining potential future(s) of users' experiences with digital fashion products in the metaverse in the year 2032.

1.1. Scientific relevance

The uniqueness of this study stems from the fact that it combines highly novel phenomena – the metaverse and digital fashion, both being ever-evolving concepts within which there is still much space for exploration (Särmäkari, 2021). As revealed in content analysis of metaverse-related articles by Narin (2021), topics related to virtual retailing and fashion in the metaverse remain highly unexplored. Whereas there have been studies on the topic of digital fashion in metaverse-related fields of 3D technologies (Park et al., 2018; Särmäkari, 2021) or the design of in-game fashion garments called 'skins' (Mjasnikova, 2021), there is little literature that would focus specifically on the experiences with digital fashion products in the 'new' metaverse (that differs from the 'previous' metaverse based on 'Second Life') (Park & Kim, 2022). In terms of users' experiences, Gursoy et al. (2022, p. 6) mentioned the notion of "metaverse consumer experience" as a topic worth investigating. Varshneya et al. (2017), in turn, stressed that very few endeavors had been made to investigate experiential value in the fashion sector and recommended investigating experiential aspects of fashion in the context of technological developments in socio-digital platforms. Lastly, as studies demonstrated that consumers give importance to experience when interacting with fashion products due to their experiential qualities of touch and feel, the metaverse with its focus on immersion through engaging users' senses renders the topic of users' experiences with digital fashion products an interesting phenomenon to investigate from its early stage (Lee et al., 2021; Mower et al., 2012).

Therefore, the purpose of this study is to fill the research gap by answering the following research question(s):

RQ1: How could the metaverse impact users' experiences with digital fashion products in the year 2032?

SQ1: How could the metaverse impact the usability of digital fashion products in 2032?

SQ2: How could the metaverse impact the aesthetics of digital fashion products in 2032?

SQ3: How could the metaverse impact the engagement with digital fashion products in 2032?

The presumptive nature of questions stems from the adopted methodology of explorative future scenarios answering the question of 'what could happen?' (Börjeson et al., 2006).

1.2. Societal relevance

According to Santos et al. (2020), the fashion industry has made the least progress in digitalizing its processes among all the creative sectors, which causes this industry to miss out on immense economic, societal, and environmental potential stemming from digital fashion products. For example, digital fashion can support the fashion industry in finding new business models that can respond to new social and cultural needs and help them efficiently operate in rapidly evolving markets (Bertola & Teunissen, 2018; Santos et al., 2020). Santos et al. (2020, p. 822) also emphasized that "the digitalization of the fashion product has the potential to widen the fashion market, allowing the emergence of small creators with niche visions" and referred to the ability of digital products to provide users with a sustainable and affordable manner of engaging with luxury brands' products. Furthermore, the co-founders of DressX pointed out that digital fashion exhibits the potential to substitute fast fashion by enabling consumers to engage with fashion sustainably – without creating any fabric waste (Joy et al., 2022). Hence, it can be stated that digital fashion can help tackle overproduction and over-consumption, which not only will benefit the society but will also enable fashion brands to improve their reputation (which has been greatly exacerbated due to the growing environmental concerns among consumers) (Brydges et al., 2018; Santos et al., 2020). Nonetheless, it is also important to emphasize that digital fashion is not entirely eco-friendly and should be leveraged responsibly. Even though digital fashion does not have a physical form, it still consumes energy – especially NFT-based digital clothing embedded on blockchain that contributes to producing unsustainable levels of emissions (Truby et al., 2022). Lastly, the investigation into the potential future(s) of digital fashion can help the businesses strategically plan to adjust their value propositions to the evolving needs of the growing demographic of 'digital natives' who regard the digital world as an inherent part of their lives (Wiederhold, 2022).

2. Theoretical Framework

This section outlines the key theoretical concepts for conducting this study. Firstly, the perspective of the evolutionary economics paradigm is discussed as a lens for carrying out this research. Next, the notion of the metaverse and its core concepts are elaborated on and followed by the theoretical discussion on the realm of digital fashion. Lastly, the notion of experiencing digital fashion is discussed along with the Digital Innovation Strategy Framework that helped in structuring this study.

2.1. Evolutionary economics and the metaverse

Evolutionary economics is "a paradigm for explaining economic change" (Cordes, 2015, p. 430) that puts emphasis on the role of innovation and examines it through the prism of technology, economy, and socio-institutional context (Perez, 2009). As the concepts of 'evolution' and 'innovation' lie at the heart of the metaverse, which has been commonly hailed as 'an evolution of the current version of the internet' (Bourlakis et al., 2009; Kim, 2021; Narin, 2021; Nath, 2022) or "a new wave of computing innovation unfolding around spatial, immersive technologies" (Mystakidis, 2022, p. 486), the evolutionary perspective constitutes a suitable lens for conducting this study. Schumpeterian paradigm – one of the central concepts within the evolutionary approach – emphasizes that technology and novel combinations of resources lie at the core of innovation and constitute a foundation for the development of new products and production methods, which leads to the transformation of whole industries, and consequently, economic development (Amit & Zott, 2001; Malerba & McKelvey, 2020). In relation to this, Kraus et al. (2022, p. 55) point to the significance of firms engaging in innovative activities through "changing the architecture or configuration of the set of activities and relationships of components in a business model" to "secure the future existence of a firm", which points to the need of (fashion) businesses to adjust their corporate models to the digital era. According to the evolutionary logic, the metaverse's underlying premise of combining various technologies to create a complex system of interconnected virtual worlds (Lee et al., 2021) renders it an innovative phenomenon that exhibits the potential for altering the modus operandi of nearly every business (Hollensen et al., 2022; Mystakidis, 2022). The notion of changing the underlying logic of whole industries is also reflected in the concept of 'creative destruction', which in the Schumpeterian paradigm refers to the process of competition between companies involving "change, transformation, disequilibrium, and development" (Robert & Yoguel, 2016, p. 9) and

causes the existing offerings to be supplanted by innovations of new products (Lee et al., 2011). Following this logic, it can be expected that (fashion) companies lured by the economic incentives of the metaverse (Goldman Sachs, 2021) will rival with each other to stay competitive through unceasing innovation and adjusting their offerings to the evolving consumer needs (Perez, 2009). Concerning the role of a consumer, Perez (2009) emphasized the role of mass adoption in innovation and stated that once market acceptance is reached, a series of incremental innovations occur (which further accelerates the pace of technological evolution). This stance can be supported by Schumpeter and Nichol (1934), who stressed that technologies are prone to interconnect and emerge around other innovations, implying that disruptive concepts as the metaverse have the potential to bring a succession of continuous innovations fueling each other. The evolutionary approach, with its focus on the role of technological developments in reshaping the economic landscape, constitutes a relevant lens, especially in the face of the metaverse being an innovative technological concept that could accelerate rapid digital transformation processes within the fashion industry and further contribute to an evolution of fashion products (Brydges et al., 2018).

2.2. The metaverse

The term ‘metaverse’ was created from a merger of the prefix “meta” (implying the notion of transcendence) with the word “universe” (Lee et al., 2021, p. 1). This term was coined by Neal Stephenson (1992) in his novel Snow Crash where it was defined as ‘a world where people interact with each other through avatars in a three-dimensional space reflecting the real world’. Although the concept of the metaverse is thirty years old at the moment of conducting this study, it still has not been fully specified due to its ever-evolving nature. Since the emergence of the idea of the metaverse, several endeavors have been undertaken to define it. Lee et al. (2021, p. 1) referred to the attempts to conceptualize the metaverse through such concepts as “lifelogging”, “collective space in virtuality”, “embodied/spatial Internet”, “a mirror world”, or “an omniverse: a venue of simulation and collaboration”. Park and Kim (2022) undertook to create a taxonomy of 48 definitions of the metaverse according to various researchers, by which they further demonstrated the lack of consensus on one standard definition of this term. The taxonomy involved such definitions as ‘a virtual world created to give users control over almost every aspect of the digital environment through creating desired objects’ (Papagiannidis & Bourlakis, 2010) or ‘a network of immersive three-dimensional spaces in which individuals can interact

with each other and the virtual environment surrounding them using real-word metaphors without being restrained by physical limitations' (Owens et al., 2011). According to Kim (2021, p.142), taking into account the multiplicity of definitions, the metaverse can be summed up as an "interoperated persistent network of shared virtual environments where people can interact synchronously through their avatars with other agents and objects". Despite the plurality of interpretations, there appear to be common characteristics that link most of the definitions of the metaverse, such as 1) the factor of interaction with other users in a three-dimensional space, 2) the idea of immersion in a 'phygital' world created in the process of convergence between physical and digital dimension (Gaggioli, 2017), in which the 3) interaction between the individuals is enabled through the virtual representations of the selves (for example, in the forms of avatars), and 4) the notion of interconnectivity between virtual environments, commonly referred to as 'interoperability' (Sparkes, 2021).

It is worth mentioning that there are also some skeptical viewpoints concerning the metaverse. As pinpointed by Kim (2021, p. 141), some critics consider metaverse to be "a vague concept", "the feel-good place of the exciting future created by tech giants without enough applications of it that are useful to users", or even doubt whether the metaverse will ever materialize. Notwithstanding the skepticism, the metaverse is not a new concept – conversely – as stressed by Stokel-Walker (2022) and Lee et al. (2022), even though the boldest visions of the metaverse still appear to be far from coming to fruition, its glimpses could have already been spotted years ago. As pinpointed by Johnson (2016), massively multiplayer online virtual universes (enabling users to simulate real life in the virtual world through real-time interaction with other individuals) such as 'Entropia Universe', 'Second Life' (both launched in 2003), or 'World of Warcraft' (launched in 2004) can be considered as the first versions of the metaverse (Johnson, 2016; Wiederhold, 2022).

When theorizing about the metaverse, it is also essential to discuss the technologies that (will) enable it. As stated by Mystakidis (2022, p. 486), the metaverse "is based on the convergence of technologies that enable multisensory interactions with virtual environments, digital objects, and people". The significance of the sense of immersion in virtual environments through immersive technologies enabling the feeling of being present through simulating visual, auditory, haptic, and motion stimuli along the reality–virtuality continuum was found in several studies and considered to be a central aspect of the idea of the metaverse (Dionisio et al., 2013;

Ning et al., 2021; Shin, 2022). Examples of such technologies are augmented reality (AR is a "real-time display of computer-generated content over a real-world scene"), virtual reality (VR can be defined as "computer-simulated, interactive virtual environments that isolate the user from the surrounding physical environment"), and mixed reality (MR refers to "the dynamic coexistence of virtual and real content in the same space"), all falling under an umbrella term of 'extended reality' or XR (Shen et al., 2021, p. 3). Access to the metaverse through these technologies can be enabled through hardware such as VR headsets or AR glasses (Lee et al., 2021). In addition, it is noteworthy that AR/VR hardware does not constitute the only means of accessing the metaverse, which is apparent through the possibility of engaging with three-dimensional virtual environments (such as Roblox or Fortnite) through devices based on 2D technologies such as laptops and smartphones. Nonetheless, as asserted by Hennig-Thurau et al. (2022), the value that the metaverse can provide for both users and firms over the two-dimensional internet remains unclear. Another technology playing an integral role in enabling the metaverse is blockchain (Kiong, 2022). Blockchain is "a ledger that stores the transactions to facilitate digital asset tracing and securing in a commercial network", considered to have the potential to make the metaverse safer, decentralized, and more transparent (Gadekallu et al., 2022, p. 2). Furthermore, within the realm of blockchain technologies, Non-Fungible Tokens (NFTs) – "digital assets that represent objects like art, collectibles, and in-game items traded online, often with cryptocurrency, that are encoded within smart contracts on a blockchain" – are another technological development that will play an essential role in the metaverse (and in the realm of digital fashion per se) (Joy et al., 2022; Nadini et al., 2021, p. 1).

To conclude, the following definition elaborated by Mystakidis (2022, p. 486) can serve as the core conceptualization of the metaverse for this study:

> "Metaverse is an interconnected web of social, networked immersive environments in persistent multiuser platforms. It enables seamless embodied user communication in real-time and dynamic interactions with digital artifacts. Its first iteration was a web of virtual worlds where avatars were able to teleport among them. The contemporary iteration of the Metaverse features social, immersive VR platforms compatible with massive multiplayer online video games, open game worlds and AR collaborative spaces".

2.3. Digitalization of fashion

Fashion is an industry exerting an immense economic and cultural impact on a global scale (Lay, 2018). As the beginning of the 21st century brought about rapid technological changes which affected an array of industries, the fashion industry was no exception. As the processes of merging the worlds of fashion and technology were progressing, fashion's physical and digital dimensions united and created a "cyber-physical system" that transformed the traditional logic that governed this fashion industry before the digital era (Bertola & Teunissen, 2018, p. 355). Likewise, Noris et al. (2021) stressed that the transfer of an increasing number of processes into the digital sphere profoundly transformed the fashion industry by altering not only the market itself but also the consumers' consumption practices (Andò et al., 2019). Pereira and Fernandes-Marcos (2021, p. 73), in terms of digital transformation emphasized the new opportunities and challenges that emerged for fashion businesses in terms of "production, communication, advertising, commerce, and creativity". Therefore, in the face of the dawn of the disruptive concept of the metaverse, it can be expected that the evolution of the practices of both consumers and businesses will be further accelerated (Hollensen et al., 2022). Furthermore, as stressed by Rocamora (2017), Schwab (2017), and Lay (2018), the digital transformation of the fashion industry caused the digital processes to be deployed throughout the whole value chain (from design through manufacturing to supply chain), allowing for the formation of a virtual replica of the entire system in real-time and virtualization of not only the fashion products but also the whole fashion-related spaces (Arribas & Alfaro, 2018). The possibility of creating such a 'virtual replica' of the fashion ecosystem will be enabled by the metaverse constituting a crossover between the virtual and the real world (Mystakidis, 2022). The notion of the duality in the existence of fashion was also stressed by Crewe (2017), who stated that in the digital age, fashion's physical and digital dimensions coexist and complement each other, which causes the digitalization of the fashion product itself.

2.3.1. Digital fashion product

According to Santos et al. (2020), as the dematerialization of the fashion product progresses, new ways of communication arise, and the real-time distribution of products digitally becomes possible, which contributes to the significant shift in the sheer essence of fashion goods that take

on new qualities (Siersema, 2015). For instance, a digital clothing item can either function in a purely virtual setting or have its physical counterpart and as a result, exist in both virtual and real worlds (Crewe, 2017; Pereira & Fernandes-Marcos, 2021). As pointed out by Särmäkari (2021), digital fashion has recently been hailed by media as the fashion industry's next important step, and it refers not only to such practices as digital prototyping and sampling, but it also relates to entirely virtual, digital-only collections that never take on a physical form. According to Park and Ko (2017), digital fashion can be defined more broadly as a field of fashion leveraging computers and software. In the existing literature from the interlinked fields that have long been incorporating the concept of digital goods (such as gaming), terms such as 'digital artifacts', 'virtual goods', or 'skins' were used to refer to the idea of digitalized objects existing in the virtual space (Johnson, 2016; Santos et al., 2020). According to Hamari and Keronen (2017, p. 60), digital goods refer to such items as "avatar clothing, weapons, virtual furniture, currencies, characters, and tokens". Given the aforementioned approaches, in this study (focusing on digital objects specifically in the context of fashion), the concept of 'digital fashion product' will refer to the digital goods that serve the purpose of visual intervention in the user's digital representation, either in the form of an avatar or the users' image of the real self captured through the camera (Lee et al., 2021).

2.4. Experiencing digital fashion

Traditionally, the value of a physical product was interpreted as a tradeoff between quality and price (Mathwick et al., 2001). Nevertheless, in the face of the dawn of "experience economy", as stressed by Pine and Gilmore (1999, p. 12), there has been a shift in the mindset of service providers from being solely a "source of goods" towards being a "source of memories" and "an experience stager". According to Alahuhta et al. (2014), experiential value is fundamental in the context of three-dimensional virtual environments. This stance was further supported by Verhagen et al. (2011), who demonstrated that users' satisfaction with virtual worlds stems directly from the experiential value derived from the interaction in them, as well as by Partala and Saari (2015), who stressed that enhancing user experience leads to increased satisfaction, and therefore, technology adoption. This point of view is also reflected in the 'value in the experience' approach, according to which the value lies not in the product of consumption itself

but rather in the experience of consuming (Sandström et al., 2008), which holds true especially in the case of purely virtual objects that do not take a tangible form, and therefore, their worth stems primarily from the experiences created in interaction with them (Jung & Stolterman, 2012). In the face the evidence pointing to the significance of the experiential aspects of virtual goods, this study assumed the perspective of 'user experience' (UX), being a domain providing a holistic outlook on the notion the experience of a user while interacting with a product/system (Partala & Saari, 2015). Furthermore, the UX perspective was selected in accordance with the stance of Kim et al. (2020), who asserted that immersive systems (metaverse being one) which actively interact with users ought to be carried out from the UX perspective. Therefore, considering the focus on users' experiences with digital products, the Digital Innovation Strategy Framework (DISF) by Nylén and Holmström (2015) was assumed for structuring this study. In the DISF, the notion of user experience with the products was operationalized through the concepts of usability, aesthetics, and engagement, which will be explained in more detail in the next section.

2.5. Digital Innovation Framework

The product-oriented DISF by Nylén and Holmström (2015), can serve as a valuable tool for structuring this study due to its focus on the users' experiences with digital products and its emphasis on innovation. In terms of product innovation, defined by Storsul and Krumsvik (2013, p. 16) as "changes in the products/services offered by an organization", Nylén and Holmström (2015) differentiate two main areas that have an impact on the product: 'user experience' and 'value proposition'. User experience (operationalized in DISF by the concepts of 'usability', 'aesthetics', and 'engagement'), in turn, has a direct bearing on the overall value proposition derived from the product. Therefore, it can be argued that user experience is an inherent element of the value proposition – not something different from it (Kohler et al., 2011). The concept of a product's value resulting from the users' experience with it is also reflected in the value as experience perspective (Mathwick et al., 2001). This perspective assumes that "value arises from the interaction between user and product within a particular socio-cultural setting" and the premise that people desire not products but rather the experiences those products provide (Boztepe, 2007, pp. 57-58). Since in the DISF each of the three user-experience-building pillars plays a crucial in building user experience, it can be stated that usability, aesthetics, and

engagement in combination produce a synergy effect and add up to the overall users' experience (Nylén & Holmström, 2015). Looking at digital fashion products through these three building blocks of the UX will serve as a framework that will allow for theorizing about the future of those digital artifacts in a methodologically viable manner.

2.5.1. Usability of digital fashion

The notion of usability constitutes one of the central concepts in the realm of interaction in three-dimensional environments (Speicher et al., 2017). According to Campos et al. (2015), 'usability' is the principal discipline in the realm of design of digital artifacts. In the UX literature, it is commonly referred to as "the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency, and satisfaction in a specified context of use" (Buono, 2008, p. 536). Consequently, the usability of digital fashion products can be understood as 'the possible interactions of users with virtual garments in particular contexts of use in the metaverse'. Concerning possible uses of virtual garments, a body of literature refers to such actions as the ability to wear entirely virtual collections on the avatars, the design of virtual garments with the prototyping tools such as CLO3D (Santos et al., 2020), virtual try-on of digital products on personal avatars and representations of the real selves on the images (Spahiu et al., 2014), or the ability to directly manipulate or influence objects, for example through customization (Shen et al., 2021). In addition, interoperability (which concerns the possibility of operating seamlessly across virtual environments without the interruption in the immersive experience) constitutes a pivotal aspect to consider in terms of the 'effectiveness' and 'efficiency', being one of the critical aspects of usability (Dionisio et al., 2013). The importance of seamless interaction has been further supported by Shin (2022, p. 1), who stated that "limited usability and ineffective user interfaces can undermine user acceptance", and consequently, have adverse impact on users' experiences and technology adoption.

2.5.2. Aesthetics of digital fashion

Aesthetics are a vital facet of fashion (whether it is traditional or digital fashion) as the manipulation of aesthetic codes through dress serves important societal functions, such as communicating one's personality to other individuals (Kaiser, 1997; Sonderegger, 2013). As

stressed by Stecker (2006), some aesthetic judgments assert the aesthetic worth of an object by describing it as ‘beautiful’ or ‘pretty’. Conversely, aesthetic admiration of an object can also be understood as the enjoyment derived from the sheer admiration of the object for its own sake (Stecker, 2006; Walton, 1993). According to Workman and Caldwell (2007, p. 591), visual aesthetics are vital aspects of the categories of products that serve as “extensions of the self”, since they act as a “coded system in identity expression”. Whether the act of expressing oneself takes place in the virtual or the real world, aesthetic aspects of (digital) garments allow individuals to situate themselves social and cultural settings, as well as non-verbally communicate their tastes in both physical and digital environments (Workman & Calwell, 2007). Materiality has traditionally been seen as a crucial element of fashion design, nevertheless, due to the dawn of rapid digitization processes, the line between physical and virtual worlds has been blurred, which brought almost infinite aesthetic possibilities (Jung & Stolterman, 2012). Technological developments not only enabled the exploration in terms of implementing physical properties of various materials in a digital context (such as realistic draping and stretching) but it also allowed for experimenting with materials unhindered by physical barriers and coining completely new aesthetic qualities of digital clothes (Jung & Stolterman, 2011). Consequently, those new aesthetic qualities result in brand-new experiential qualities (Jung & Stolterman, 2012). In addition, as stressed by Koneva (2020), digitalization processes in the fashion industry are transforming customers into co-producers of fashion products in the prosumer world. Thus, in the digital world, aesthetics are not solely produced by fashion designers who manipulate aesthetic codes and devise new styles (Workman & Caldwell, 2007) and then passively consumed by the users. Conversely, in the digital era, styles can be (co)created in the symbiotic relationship between the designer and the customer, enabled through the customization of the product by the user (Yan & Chiou, 2020), or created through data-driven design, where the creation of the aesthetics of products takes place through recommendation systems fueled by the data provided by the user (Yan & Chiou, 2020).

2.5.3. Engagement with digital fashion

The notion of engagement constitutes one of the central concepts when it comes to interaction between humans and technology (O'Brien & Toms, 2008). As stated by Jung and Stolterman (2012), digital objects do not possess meaning themselves, but rather the value of digital artifacts

is derived from the process of engaging with them. Due to the differences in the understanding of 'engagement' depending on the context (Mersey et al., 2010), in this study engagement was approached from the perspective of user interaction with digital fashion products in three-dimensional environments.

Firstly, a substantial body of experts pointed out that in the context of engagement in the platforms based on human interaction, the users' experiences and their ability to feel immersed in virtual environments is inseparably linked with social engagement (Chohan, 2022; Grinberg et al., 2014), which was also confirmed by Hennig-Thurau et al. (2022) who asserted that interaction in virtual worlds fosters a high level of the feeling of social presence. Moreover, as demonstrated by the study by AlHogail (2018), social engagement contributes to creating network effects, which enhances technology adoption. Grinberg et al. (2014), emphasized that social engagement with other individuals in virtual environments can even outweigh the photorealistic visuals in producing the sensation of presence experienced by the user. As in the real world fashion plays the role of 'social laboratory' that enables individuals to perform acts of self-expression, in virtual worlds digital fashion enables individuals to replicate this function in the digital context (Koneva, 2020). In the face of the inherently social nature of the metaverse, social engagement constitutes a vital element to consider in terms of engaging with fashion.

Secondly, as technologies such as VR significantly increase the integration of human senses with digital devices, they become increasingly advanced in enabling the users to engage most of their senses in virtual environments (Flavian et al., 2021). Traditionally, clothes have been perceived as a multi-sensory product (Workman & Caldwell, 2007), and the sensation of touch was a vital element of fashion, which is greatly hindered in the online world since touch-related cues are communicated primarily through audio-visual signals (Ornati, 2019). As people naturally experience environments through five senses, multisensory aspects are pivotal for replicating the sense of presence in the virtual worlds (Violante et al., 2019). As stressed by Jung and Stolterman (2011), engagement in the digital environments through rich sensorial feelings has not been examined to the fullest yet. Nevertheless, the developments in the realm of haptic technologies indicate that the deficit in the possibility of leveraging tactile experiences in digital worlds can be mitigated and users might be able to fully engage with digital products in the future, which renders sensory engagement in the virtual environment an important perspective to consider (Lee et al., 2021; Ornati, 2019; Violante et al., 2019).

Lastly, Riva et al. (2007) stressed that virtual environments are highly affective media that foster a sense of immersion. The authors also emphasized that many sensorial and social stimuli experienced by users in the virtual environments contribute to generating intense emotional responses (Riva et al., 2007). Therefore, the ability of virtual environments to strongly influence users' emotions renders emotional engagement an important aspect to consider (Violante et al., 2019). This stance was also reflected in the study by Han et al. (2022, p. 12), who concluded that "we need better insights into the black box of immersion and consumers' emotional engagement in the immersive experience".

3. Methodology

3.1. Rationale for the scenario planning method

This study leveraged the qualitative scenario planning method to answer the main research question and the sub-questions for several reasons. Qualitative research enables the interpretation of data that produces new or hidden meanings, understandings, and knowledge (Corbin & Strauss, 2008) and is more suitable for matters requiring a deeper understanding of highly complex phenomena than quantitative methods (Hamilton et al., 2020; Yang, 2014). Scenario planning, being a qualitative foresight methodology, has been extensively used to explore the potential future(s) in many industries (Elsawah et al., 2020). Moreover, according to Lavikka et al. (2018), this method can facilitate long-range decision-making processes and help businesses tackle uncertainty, complexity, and change in turbulent markets governed by constant shifts. As stressed by Elsawah et al. (2020), scenario planning is founded on the idea that the future, while fundamentally open and uncertain, is not entirely unpredictable and uncontrollable. Furthermore, the purpose of using scenario methodology is not to magically foretell the future but to aim to forecast potential futures as objectively as possible in a descriptive way based on current trends (Mannermaa, 1991). This stance was further supported by Oliver and Parrett (2017), who emphasized that scenario planning constitutes a valuable management tool that facilitates imagining (but not predicting) potential futures, which helps to build long-term strategies in uncertain markets (Harty et al., 2007). In addition, since people are "storytelling animals" who interpret reality in narrative forms, it was proven that research in the form of stories increases the retention of the information (Bowman et al., 2013, p. 736), which renders it a practical approach to pursue. Moreover, scenario planning can be valuable in the context of envisioning the future

of digital fashion due to the fashion industry being faced with increasing environmental pressures and rapid digital transformation processes imposing the urgent need to adjust to the changing markets (Bertola & Teunissen, 2018; Noris et al., 2021). Thus far, scenario methodology has been broadly used in various studies for the investigation of the future of technology and innovation, therefore, it can be advantageous in the face of evolving technological concepts such as digital fashion and the metaverse (De Smedt et al., 2013; LePoire, 2005; Tran & Daim, 2008;). Lastly, in the face of an array of uncertainties concerning the topic of the metaverse such as skepticism about whether it will ever fully materialize (Hazan et al., 2022), or the issues regarding the accessibility and acceptance of the metaverse technologies (Lee et al., 2022), scenario methodology constitutes a suitable methodology for investigating topics around which there is a high level of uncertainty and a scarcity of available data (Peterson et al., 2003).

3.2. Research design

Scenario planning is a method based on dialogue between the opinions of different participants that serves the purposes of sense-making through storytelling and theory-building (Burt et al., 2006). As stressed by Duckett et al. (2017), it is suitable for exploring complex and uncertain circumstances in the future. Scenarios (being the 'final product' of this method) can be interpreted as the narratives set in the future to explore how specific phenomena might be developed if certain trends were to intensify or weaken or if different events were to happen (Konno et al., 2014; De Smedt et al., 2013). As pinpointed by Van Der Heijden et al. (2009), scenarios are predictions, but rather purposive stories describing how particular phenomena could unfold in time. In this study, four divergent scenarios describing potential future(s) of users' experiences with digital fashion products in the metaverse in the year 2032 provided a conclusive answer to the RQ.

This study adopted the widely recognized scenario planning steps devised by Schoemaker (1995) that go through the consecutive stages of 1) defining the scope, 2) identifying relevant stakeholders, 3) identifying key trends and uncertainties, 4) developing preliminary scenarios, and 5) developing final scenarios. The detailed descriptions of each of those stages (see section 3.2.2), along with the method of data collection (see section 3.3) and data analysis (see section 3.4) are presented below.

3.2.1. Validity and reliability of scenario planning method

To ensure the validity and reliability, the standardized and broadly acknowledged stages of scenario planning method by Schoemaker (1995) were adopted. As the quality of scenarios is interlinked with the robustness of the source of the knowledge leveraged in building them (De Smedt et al., 2013), and expert interviews constituted the source of data for developing scenarios, it was ensured that research participants were qualified experts with diverse backgrounds who had a deep understanding of the fields relevant to this study. Moreover, as "nobody has a monopoly on knowledge of the future", recruiting relevant experts with diversified expertise constituted a critical factor in ensuring a high level of legitimacy of this study (Pérez-Soba & Maas, 2015, p. 52). The testimonies of high-ranked experts with diversified backgrounds served as a "legitimate input to forecasts" (Börjeson et al., 2006, p. 731). The interviews with experts were conducted following the semi-structured guide that was based on the theoretical framework, which ensured that the research was designed in a manner that would enable eliciting relevant data for scenario building, and therefore, assured the validity of the study. Moreover, the identification of key stakeholders, trends, and uncertainties for scenarios was based on thematic analysis that enabled capturing the repeating patterns in the testimonies of multiple experts, which ensured the reliability of this study.

Lastly, the creation of four divergent scenarios considering the interplays between different factors enabled outlining the potential futures of digital fashion without providing groundless and overly confident conclusions. As the future is inherently difficult to predict (Elsawah et al., 2020), creating disparate scenarios based on "extreme worlds" allowed for "challenging tunnel vision" and imagining different paths for the plausible future (Schoemaker, 1995, p. 38), which enhanced the credibility of this study.

3.2.2. Stage 1: Defining the scope

The first stage began by familiarizing with the extensive body of the literature on the investigated topic by the researcher and building the theoretical framework.

Subsequently, the theoretical basis served as a foundation for assuming the time frame and scope of analysis regarding products, markets, and geographic areas (Schoemaker, 1995).

The timeframe of ten years was assumed following Sivan's (2015) premise that every 10–20 years, a technology shift comparable in significance to the Internet happens and his belief that the metaverse will offer such a paradigm shift. In terms of product dimension, as this study focuses on digital fashion, all facets of digital goods that can serve fashion-related purposes were considered. Furthermore, as the metaverse is a concept of a virtual world unrestrained by physical boundaries, the geographic areas were not assumed.

As the last step in this stage, the interview guide (Appendix B) was elaborated in a way that would enable soliciting the relevant insights from experts.

3.2.3. Stage 2: Identifying key stakeholders

The knowledge who constitutes a key stakeholder in the realms of digital fashion and the metaverse was provided by experts during the interviews and then extracted from interview transcripts through thematic analysis. According to (Schoemaker, 1995, p. 28), determining key stakeholders can be facilitated by considering "who has an interest in these issues?", "who will be affected by them?", or "who could influence them?" and refer to such entities as clients, suppliers, shareholders, or regulators. The identification of 'who' constitutes a stakeholder was based on the frequent mention of particular stakeholders in interviews and the importance the experts assigned to them.

3.2.4. Stage 3: Identifying key trends and uncertainties

In Stage 3, key trends and uncertainties were determined through thematic analysis following the scenario planning steps by Schoemaker (1995). In terms of identifying trends, Schoemaker (1995) pointed to the need of considering the current phenomena in terms of technological, economic, social, political, or regulatory aspects, which was ensured through incorporating the elements of REST analysis (see section 3.3.2). When it comes to uncertainties, Schoemaker (1995, p. 28) stressed that uncertainty identification can be enacted through considering "what events, whose outcomes are uncertain, will significantly affect the issues you are concerned with?".

The trends and uncertainties were identified based on their frequent occurrence throughout the interviews, as well as the importance the experts assigned them. In the scenario

planning methodology identifying key trends and uncertainties constitutes one step, nevertheless, to ensure clarity, in the results section the findings of Stage 3 will be divided into separate sections: Stage 3a (key uncertainties), and Stage 3b (key trends).

3.2.5. Stage 4: Constructing preliminary scenarios

The two key uncertainties identified through thematic analysis in the preceding stage were paired to create a matrix for elaborating four alternative scenarios of the potential futures (Hussain et al., 2017) following the stance of Konno et al. (2014) asserting that four constitutes an ideal number of scenarios. The matrix was developed by identifying "plausible polar extremes of possible future outcomes of the uncertainties" (Burt et al., 2006, p. 66). The 'extremes' of uncertainties were determined within the "limits of possibility" to assure the credibility of the scenarios (Burt et al., 2006, p. 66) and can be found in section 4.2. The polarization of uncertainties enabled the formation of the "extreme worlds" and the creation of an appropriate level of differentiation between the scenarios (Schoemaker, 1995, p. 29). Each preliminary scenario was projected onto the matrix, given a title, and provided with a short outline of the 'circumstances' in this particular scenario.

3.2.6. Stage 5: Building final scenarios

In Stage 5, four scenarios were developed based on the preliminary scenarios and the results from the thematic analysis. Each scenario described the subjective experiences of the persona named Alex embedded in each extreme world in the year 2032 (Hussain et al., 2017). The gender-neutral name was chosen to mitigate the potential bias – the persona was referred to as 'she' in the first two scenarios and as 'he' in the two last scenarios. Building the storylines through the lens of a tangible person enabled capturing the subjective, experiential perspective, being the main focus of this study. Each narrative was elaborated in a way that would enable answering the main RQ and the sub-questions. Every scenario referred to all the experiential pillars (usability, aesthetics, engagement) and embedded them in the context of each combination of uncertainties, which facilitated the development of consistent narratives that captured dependencies between potential future advancements of the metaverse and their impact on users' experiences. Since scenario building is storytelling-related discipline, the order of describing the

experiences of a persona in each narrative was dictated by the logic that would enable the story to flow naturally for the reader – the storylines were not restrained to the same order of experiential elements (Bowman et al., 2013).

3.3. Expert interviews

3.3.1. Rationale for expert interviews

In this study, an expert-led exploratory approach was used as a source of data collection, which is an extensively used and commonly accepted method of gathering the data in future studies (Amer et al., 2013; Hamilton et al., 2020; Roubelat, 2000). An expert interview is "a qualitative semi-structured or open interview with a person holding expert knowledge" (Audenhove & Donders, 2019, p. 179). In qualitative research, interviews are the most common method of collecting data (Kallio et al., 2016). As interviewing is one of the most frequent means of understanding the complex mechanisms governing society, expert interviews can serve as an invaluable source of data for an evidence-driven process of theorizing about the potential future (Ratcliffe, 2002). Furthermore, as stressed by Bogner and Menz (2009, p. 2), experts are perceived as "crystallization points for practical insider knowledge" and serve as proxies for a wider circle of authorities in the field of interest. Lastly, expert interviews are widely acknowledged method of data collection in future studies and constitute a critical component of foresight methods (Ratcliffe, 2002).

3.3.2. Sampling criteria and technique

Since the manner in which the data is collected has a critical impact on the quality of the study, it was vital to recruit relevant experts (Kallio et al., 2016). Professional experience in the fields interlinked with immersive technologies, three-dimensional virtual worlds, or digital fashion was considered a criterion attesting to the legitimacy of chosen experts. The selected experts were professionals in digital fashion, 3D technologies, 3D fashion design, immersive technologies (such as VR, AR, XR), UX design, gaming, digital product innovation, blockchain technologies, and metaverse-related legal services. The diversified professional backgrounds of the chosen experts were a criterion that was assumed to ensure the variety of perspectives and mitigate the potential bias. It was ensured that the sample included the representatives of both genders (four

women and seven men). Due to the novel character of the metaverse itself, the years of experience were not considered a determining factor during the expert selection.

Eleven experts were recruited through a non-probability purposive sampling method in line with the methodological guidelines provided by the Erasmus School of History Culture and Communication (ESHCC). The experts were recruited through inquiries sent by LinkedIn and email. The list of eleven experts with descriptions of their professional experiences and relevance to this study can be found in Appendix A. In the results section, experts were referred to by randomly assigned numbers (e.g., Expert 1, 2, 3) to guarantee confidentiality.

3.3.3. Data collection

To assure the validity and reliability of this research, the interview guide (see Appendix B) was developed to ensure a certain level of standardization for the interviews and to keep the course of discussion towards the main topics of this study. To further enhance the validity of this research, the interview guide was based on the theoretical framework to ascertain that it was elaborated in a way that would enable obtaining relevant data for answering the RQ (Leung, 2015). The reliability of data collection, in turn, was secured in accordance with the premise that following the set of similar questions during the interviews enables gathering consistent responses and identifying patterns in experts' testimonies (Guest et al., 2012).

As this research focuses on the future, being highly uncertain at its core, the semi-structured format of interviewing was assumed (Elsawah et al., 2020). Studies have shown that this data collection format constitutes one of the most efficient techniques of acquiring expert insights (Kallio et al., 2016). Moreover, this format has been demonstrated to facilitate reciprocity between the interviewer and interviewee by asking follow-up questions, and thus, it enabled the experts to unrestrainedly articulate their expertise (Galletta & Cross, 2013). The questionnaire consisted of a set of main questions complemented by the optional probe questions, which were asked depending on the completeness and value of the answers to the main questions (Audenhove & Donders, 2019). Owing to the flexible, semi-structured format, the interviewer had room to ask multiple follow-up questions at the moments in which the conversation was going in a valuable direction (Audenhove & Donders, 2019). Due to the exploratory character of this study and its focus on the future, the questions that led the discussion were open-ended, future-oriented, and assumptive to allow the experts to theorize

about (but not predict) the potential future of digital fashion in the metaverse. The questions also incorporated REST analysis elements – a commonly used approach in future studies for identifying critical macroeconomic factors that may impact future developments in the context of Regulatory, Economic, Social, and Technological factors (Ghezzi, 2013; Hussain et al., 2017).

The interviews lasted 45-60 minutes and were conducted through the video conferencing platform Zoom. The interviews were not conducted face-to-face for a couple of reasons, such as the geographic limitations in reaching high-ranked experts (since not all experts were based in the Netherlands) and the state of the Covid-19 pandemic, which rendered the video conferencing format a new standard. The interviews were recorded with a digital recorder and transcribed verbatim with the transcription software Otter.ai. Before the interview, each expert received an informed consent form standardized by the ESHCC by email. The form clearly stated the purpose of the study, procedures, and confidentiality aspects to which the experts had to agree to participate in the study. In addition to the consent form, at the beginning of each interview every participant was asked about a permission to record the interview and use it for further analysis. Each expert expressed their consent verbally. During the interviews, the interviewer made sure to make the expert feel at ease throughout the whole meeting.

3.3.4. Operationalization

The interview guide (see Appendix B) was based on the theoretical framework. The questions incorporated the theme of the metaverse per se, the broader context of the digital fashion realm, and the three experiential pillars from the DISF – usability, aesthetics, and engagement. The questions in the guide included the elements of the REST analysis.

3.4. Data analysis

Thematic analysis is a widely approved method of scrutinizing the textual data that has been proven to be especially suitable for analyzing the interviews in numerous studies (Kuckartz, 2014). This method also facilitates structuring high volumes of textual information into organized motives and allows for identifying key patterns, which renders this method an efficient manner of organizing the insights from the expert interviews (Kuckartz, 2014; Terry et al., 2017). In this study, codes that emerged in thematic analysis were translated into key

stakeholders, trends, and uncertainties to align with the scenario planning terminology by Schoemaker (1995).

To gain the insights for scenario development from the expert interviews, three consecutive steps of thematic analysis were undertaken: open, axial, and selective coding (Braun & Clarke, 2006). The coding process was enacted through the qualitative data analysis tool Atlas.ti.

In the open coding process, the data was organized into initial codes, which enabled the structuring of complex phenomena into labeled concepts (Williams & Moser, 2019). During the open coding process, the textual data was labeled in a manner unrestrained by the theoretical framework to allow the codes to inductively emerge from the data.

Next, the codes generated in open coding were refined through axial coding, sifted, and further categorized into broader categories (Williams & Moser, 2019). As the interviews were conducted and transcribed personally by the researcher, (who was already familiar with the whole dataset), the process of categorizing open codes into broader groups was greatly facilitated.

In the third step, the axial codes were deductively assembled into final themes in accordance with the scenario planning elements of key stakeholders, key uncertainties, and key trends (Schoemaker, 1995). Key trends were organized according to the theoretical framework (around usability, aesthetics, and engagement) to facilitate developing the consistent narratives of the scenarios and answering the RQ. The coding frame can be found in the Appendix C.

4. Results

The thematic analysis of expert interviews revealed six final themes: key stakeholders, two themes of key uncertainties, and three themes consisting of key trends. The insights from thematic analysis served as a basis for further scenario development.

4.1. Stage 2: Identifying key stakeholders

The experts identified five groups of stakeholders that could play an essential role in shaping the future of digital fashion in the metaverse.

4.1.1 Tech firms

"Tech firms" were mentioned the most frequently by all the interviewees as the parties that will have a substantial impact on the metaverse due to their expertise in the development of the hardware and software (which is vital for the idea of the metaverse to materialize). Expert 2 stressed that technological companies could play a decisive role since "they are the ones investing heavily into 3D worlds and 3D creation which will cause many people and companies to become dependent on them", which was also mentioned by several other experts who commonly referred to tech firms as "gatekeepers" who will be providing the tools for the rest of the people to access the metaverse. Technological firms that were pointed out by the experts most repeatedly included Meta, Apple, Microsoft, and Google. In addition, gaming companies merit a distinction within the category of tech firms since six experts highlighted them as one of the key actors due to their head start in 3D technologies. This stance can be illustrated by the quotes of Expert 1 who said that "by looking at gaming, we can get a bit of a window into the future, because they have already been playing along for a long time" and Expert 5 who concluded that metaverse is "mainly related to gaming technology".

4.1.2 Users

The importance of the mass adoption by the users was pinpointed by most experts, which renders the user another key stakeholder that will play an important role in shaping the future of the metaverse. To illustrate, Expert 3 stressed that since we live in capitalist societies, the companies are striving to profit through catering to the needs of their audiences, and therefore, users could have a significant impact on the actions of the firms through "voting with their engagement" through which they express what they desire. Expert 6 concluded that social acceptance is the critical factor in shaping the future of digital fashion and stated that if it is not socially accepted, then there will not be mass adoption, as "it wouldn't make sense for the firms to execute it if nobody is going to buy it". This stance was supported by Experts 1 and 4, who in unison considered mass acceptance of users as the key driver that will fuel the development of the metaverse. To illustrate, Expert 4 stated: "if you think about the development of tools or technology it is because there is a driver from consumers, or from the users having to engage, or wanting to engage with different technologies".

4.1.3 Fashion brands

Five experts mentioned fashion brands as the key stakeholder that could shape the future of digital fashion. As assumed by Expert 5, “every fashion brand will at some point, like we see at Nike, for instance, or Adidas, have a department that focuses on digital items. So they will hire people who can create items specifically for Metaverse applications, and they will set the trend”. Several experts mentioned current endeavors of fashion brands to “enter the metaverse” such as Balenciaga creating a fashion collection in Fortnite, Nike buying digital fashion house RTFKT, Ralph Lauren collaborating with Roblox, or Burberry organizing a fashion show in Twitch. Experts pointed out that such projects of fashion brands, even when not conducted at a large scale, are “blazing the trails” and constitute the groundwork for the further popularization of digital fashion in the future. According to Expert 1, fashion brands entering the metaverse will play an important role in “bridging the cultural gap with gaming so that they will be able to play in those spaces without being considered completely out of place”. He also added that “digital fashion itself will become as culturally relevant as gaming is, and they will not have to hide themselves and try to play by the rules of the gaming culture, but they will be themselves the drivers of the culture”. The notion of the liberation of digital fashion from the gaming industry and becoming its own field was also mentioned by the Expert 6 who commented that he is “glad that it finally broke loose from the gaming world”.

4.1.4 New disruptive players

Several experts mentioned that the emergence of the potential new disruptors being the “Web 3.0 native companies” could have a significant impact on the future of the metaverse. Concerning this, Expert 8 posed several questions – “are there going to be new Web 3.0 native companies that are going to be so disruptive that they're gonna be the new ‘Metas’ and the new ‘Amazons’? Will the ‘Googles’ and the ‘Apples’ still be around at that time?”. Expert 8 also emphasized that there is much opportunity for disruption in the metaverse since due to the lack of the need for physical manufacturing and the ease of distribution of digital products, small creators have an almost equal chance to compete with big brands in the field of creating virtual clothing. According to experts, the lower entry threshold, and the ability of smaller companies to be more agile will open an array of possibilities for disruption in the metaverse and incentivize new

innovative entrants that will shape the future of digital fashion. This stance can be illustrated with the quote of Expert 7 stressing that “at the beginning you'll see the big companies such as Facebook, for example, paving the way, and then it's only a matter of time for smaller platforms to become more nimble, take the learnings from large companies such as Meta, and become smarter, more relevant, and nimble to evolve”. Dress X and The Fabricant were mentioned by Experts 7 and 10 as an example of such disruptors that, through being the pioneers in the highly specialized niche of digital fashion in virtual environments, are shaping the future of this realm. It can be stated that this finding supported the stance about the disruptive character of the metaverse and its potential to cause ‘creative destruction’ which was emphasized in the preceding theoretical discussion by Robert and Yoguel (2016).

4.1.5 Regulatory bodies

The majority of experts admitted that there is a need for implementing regulations in the metaverse. Expert 9 pointed out that for the metaverse to become “mainstream” it is vital “to make it safer for regular people to get into this” through “implementing proper regulation or guidance around consumer protection and accountability for the companies that are building the metaverse”. Several experts emphasized the importance of implementing regulations in the face of the increasing user traffic in the metaverse, which will cause a substantial increase in the volume of the data about the user behavior. Even though most experts agreed on the overall need to create regulatory entities in the metaverse that would impose appropriate rules, there have also been some discrepancies between the experts’ opinions. The first disparity in experts’ testimonies referred to the state of current regulations in the metaverse. Experts 1 and 8 described the current state of the metaverse as highly unregulated. Expert 1 stated that at present, the metaverse is “a world that has a green card for everything in which you can do whatever you want” and mentioned that “it should not be like that”. Expert 8, in turn, compared it to the “Wild West” and noted that such lack of regulatory restrictions is “helping the innovative spirits” and causes “there's a lot of inventions being made”. According to other experts, in turn, metaverse is not as unregulated as it appears. Expert 9 concerning the application of blockchain technology in the metaverse pointed out that “a lot of people think that the governments around the world don't have any legislation or rules around blockchain, and that's not true, maybe they may not have the best understanding of blockchain technology, but the governments globally know a lot more than

people think they do". Expert 2, in turn, pinpointed that "the way we regulate the internet is also applicable to these VR social worlds" and that he believes that "the most important things are already covered by internet's regulatory stuff already". All in all, almost all experts have agreed on the dire need for implementing regulations in the metaverse, which renders the regulatory bodies a vital stakeholder that can play a significant role in this regard.

4.2. Stage 3a: Identifying key uncertainties

The analysis of expert interviews explicitly pointed to two key uncertainties that could shape the future experiences of users with digital fashion in the metaverse. The two identified uncertainties were:

1. *Level of interoperability in the metaverse* – with the extremes of (a) 'interoperability', meaning the ability to smoothly move between different virtual spaces, and (b) 'no interoperability', meaning the lack of the possibility of seamless transfer between different virtual environments.
2. *Level of adoption of the metaverse by the users* – with the extremes of (a) 'mass adoption', meaning that the metaverse constitutes a 'mainstream' technology used by a lot of users (comparable to the current level of adoption of popular social media platforms), and (b) 'low adoption', meaning that the metaverse constitutes a niche technology that is not used by high volumes of users.

Although more uncertainties than just two characterize the future and all future-oriented data has a degree of uncertainty (Dean, 2019), experts unanimously agreed that the levels of interoperability and mass adoption constitute critical uncertainties that are composed of many less-critical (but still vital to consider) unknowns adding up to the main uncertainties. Levels of 'interoperability' and 'mass adoption' were identified as two key uncertainties due to their frequent occurrence in interviews and the importance the experts assigned to them.

4.2.1 Key uncertainty 1: interoperability

All the experts expressed in unison that the aspects related to interoperability constitute the utmost uncertainty regarding the future of digital fashion in the metaverse. As most experts

defined the metaverse as the network of interconnected virtual 3D worlds (which was also defined as such in the theoretical discussion), it can be stated that the notion of interconnectivity between different virtual environments constitutes one of the central requirements for the metaverse to fully materialize (Dionisio et al., 2013; Mystakidis, 2022). This stance was supported by Expert 11, who stated that "for the metaverse to actually be manifested, the virtual worlds have to be linked". Expert 5, when asked about the importance of interoperability, answered: "well, that's the whole idea of the metaverse, it's not sticking to one environment, but being able to jump from one to another". Expert 1 elevated the importance of seamless connectivity by stating that "if you think that metaverses are multiple, then it's not real, and it's not really the metaverse yet, I think there is one metaverse, not metaverses". The importance of the possibility of transferring virtual objects between various environments was repeatedly mentioned during most interviews. For instance, Expert 2 said that "interoperability will be very important, because just like you can bring your laptop now to different places, you also want to bring your digital assets to different places". Concerning the current state of interoperability and the metaverse, Expert 2 stressed that "the clearest form of interoperability on the internet right now is that you use your email to log in everywhere, and that's kind of an example of interoperability in the metaverse as well" and that "interoperability means that the platforms in which these worlds are built are talking the same language". Such reference can also be found in the stance of Expert 1, who referred to the World Wide Web, being built in HTML code that "makes it interoperable in the sense that you can reuse the code in the many websites". Concerning this, Expert 8 mentioned the existence of The World Wide Web Consortium that created a set of rules regulating the internet and pointed out the need for the creation of such entities in the metaverse.

Apart from emphasizing the importance and the uncertain character of interoperability in the metaverse, thematic analysis of the codes revealed that, according to experts, the future of interoperability is interlinked with three factors, namely, 1) the level of technological developments enabling interoperability, 2) the willingness of entities co-building the metaverse to collaborate and enable interoperability, and 3) the role of blockchain technology in enabling interoperability. The analysis of interviews indicated these three factors as 'sub-uncertainties', that come down to the key uncertainty regarding the state of interoperability in ten years.

4.2.1.1 Level of technological developments enabling interoperability. Almost all the experts mentioned the level of technological developments as a factor that will play a decisive role in enabling the seamless interoperability and shaping the future of the metaverse. To illustrate, Expert 2 said: “technology is basically the big enabler of the metaverse”. Expert 5, when talking about interoperability, said that “technically, we're not there yet, and a big part is dependent on the on the game engines and developers”. Expert 7 emphasized the importance of technological developments by stating: “first of all technology. I think there just needs to be much done in terms of technology development to actually make it work, and there's a lot of evolution that needs to happen on the software side”. This standpoint was also supported by Expert 8, who noted technological constraints that could inhibit enabling the interoperability by stating that “we can't have 100,000 people in the same server in a video game now because it's just way too much computing. The internet isn't fast enough. 5G is not going to be fast enough for that. So what we're doing now is cutting it up in several little slices, several little cubes, and if you move into the next cube, it loads the people that are there, and then you go to the next few, where there's another 500 different people. So that it is still limiting the progress that can be made in terms of full interoperability”.

4.2.1.2 Collaboration between entities co-building the metaverse to enable interoperability. The willingness of collaboration between the entities co-creating the metaverse was considered one of the determinants of the future of interoperability that was mentioned by nine experts. Expert 5, when asked what he considers to be the most uncertain about the future of the metaverse, answered that it is “the willingness of the big players to connect”. A similar approach was assumed by Expert 8, who expressed doubt whether “these giant corporations will work together”. The experts’ opinions on this topic were divided into two viewpoints in this regard. Expert 2, when posed with a question about whether in his opinion the companies will be willing to collaborate, he answered that “they cannot even collaborate to get one same charger on the cell phone or on the laptop, so that just won't happen” and concluded that “a miracle would have to happen for this to come true”, which was also found in the testimony of Expert 9 who admitted that in her opinion the metaverse would likely resemble “a bunch of walled-off gardens”. Expert 4, in turn, expressed that she sees more and more collaborations emerging in the metaverse and that there can be discerned “many different actors and players coming together

under the same roof". Another positive outlook was expressed by Expert 1, who said: "I'm happy to say that actually, I've seen the platforms sort of recognize that they're not working against each other, but they're actually working together" and that "it's gonna be faster than we think, even Meta probably will have to be open about this kind of standards". In relation to collaboration, six experts pointed to the need of agreeing on common standards between companies to enable interoperability. According to Expert 1, "technology needs to standardize itself to enable efficiency" and it will happen through "big organizations, getting involved in the construction of standards and interoperability". Expert 7 also said that "it has to be key players in the market that will need to collaborate and align on file formats and what their standards look like".

4.2.1.3. Role of blockchain technology in enabling interoperability. Blockchain was frequently emphasized as a technology that could play key a role in enabling interoperability, which further reflected the stance of Kiong (2022), who also emphasized the importance of this technology in the metaverse. To illustrate, Expert 3 stressed that she believes that "everything is going to run on blockchain technology", which was further confirmed by Expert 9, who also stressed that "blockchain is key" when it comes to the interoperability in the metaverse. Experts 2 and 4 emphasized that blockchain will play an essential role in supporting the possibility of exchanging virtual goods and transferring them between various environments safely and efficiently, which was also mentioned by Expert 5, who stated that the primary objective of blockchain is rendering the systems open and more transparent. Blockchain's role was also emphasized from the perspective of cryptocurrencies, which experts regarded as a universal manner of making transactions that will enable seamless transfer of digital goods. Lastly, the majority of experts asserted that blockchain could make the metaverse "more democratized" and mitigate "the influence of big tech" through enhancing the decentralization of the metaverse – meaning that it could help in avoiding the situation where the metaverse is controlled by one dominant entity (Meta was mentioned several times as an example of a company that could potentially be dominant in the future).

4.2.2 Key uncertainty 2: mass adoption

Almost all the experts regarded the aspects related to mass adoption by the users as an uncertain, yet decisive factor in terms of the future of the metaverse and digital fashion. The uncertainty of

mass adoption was found to be connected to such aspects as accessibility, lack of trust, and lack of necessity to adopt.

4.2.2.1 Accessibility issues. Eight experts pointed out the accessibility to the metaverse technologies as one of the determining factors in enabling widespread social adoption. Accessibility referred to the ease of use for an "average user" as well as the physical access to the metaverse-enabling technologies (including but not limited to AR or VR technologies). Expert 2 pointed out the importance of accessibility by stating that "if we compare metaverse to something like Facebook, which is very social, if you offer a platform that's easy to use, and that is accessible, and you have a mass of people using it, I think those are the ingredients for mass adoption". The expert also pointed to the current obstacles standing in the way of accessibility by saying that "you still need to buy new hardware, which also makes it less accessible for people, because they are already buying a laptop, a desktop, a smartphone, maybe even a tablet, and now we also expect them to be buying VR/AR goggles which makes the threshold to join very large, so I hope that there will be particular moment in time when really people start adopting it". In reference to this, Expert 5 stated that "there might be stuff out there on the market, but the average person is not going to use it. The highest possible thing people will use is their phone, and maybe access something through a selfie or a social media platform. But again, I mainly look at it as being the forefront of some technology that might evolve. But we're far from it being mainstream". Lastly, the following quote of Expert 5 can attest to the importance of accessibility in enabling mass adoption: "even if there's going to be glasses, a small minority is just going to use them. So the technology can be there. But then how is the adoption? Are people willing to use it?".

4.2.2.2 Lack of trust. Another aspect that was found to constitute a potential obstacle to mass adoption was the fact that "there's still not a lot of trust in the technology" as stated by Expert 2. He substantiated the lack of trust with an example of tech firms renewing the hardware each year, and illustrated it with an example of Oculus Quest continuously changing its terms and conditions, which exacerbates lack of trust in technology. Some experts pointed out that an initial lack of trust is inevitable in terms of new technological concepts, which can be illustrated with the quote of Expert 8 who said that "people at the beginning don't have trust, and it's

natural". He also added that "people said that with phones, computers, trains, cars, all these things. 'I've got a horse, why would I need a car?' And now it's just inevitable, right?". A similar example was found in the testimony of Expert 3, who mentioned that she saw "a video from the 90s where an interviewer is asking people on the street 'Would you carry a phone all the time with you?' and people are like, 'Are you crazy? Like why would I do that?" and that now it would be unthinkable not to have a phone. Expert 9 pointed out that for increasing the trust in technology and for the mass adoption to happen, "the narrative has to change". She stressed that legitimate entities could help alter the narrative and enhance trust. For instance, she emphasized that "if Nike is selling digital sneakers" or "if Goldman Sachs is telling its multibillionaire customers to make investments into Bitcoin" it might "give people feeling that maybe it's not a scam or a Ponzi scheme".

4.2.2.3 Lack of necessity. More than half of the experts pointed out that both the metaverse and digital fashion are not perceived as a "necessity", which could stand in the way of mass adoption. Expert 3 pointed out that currently, there is no "mainstream acknowledgement" and that "now it's seen more as something like an addition to life, we don't really need it". She also added that when not being a participant in the metaverse will entail potential social exclusion, it will be the moment when "it will attract more people" and "become a true necessity". She illustrated it with the following example – "now you don't need it in daily life to do things, but what if I have this digital dress, and this is my only way to get an entry in events?". Concerning this, Expert 2 stressed that "at the moment there is not a mass of people using it, so there's no group pressure", which was also supported by Expert 5 who said that "there needs to be an overall push for people to access this technology", and therefore, such social "push" to enter the metaverse would generate network effects that would enable the metaverse to "go mainstream". The notion of the network effect constituting the driver for the mass adoption of the metaverse further supported the stance of AlHogail (2018) who stressed the importance of mass adoption in enhancing the technology acceptance.

4.3. Stage 3b: Identifying key trends

The thematic analysis unearthed three categories of trends that were consistently mentioned by the experts – usability, aesthetic, and engagement trends.

4.3.1 Usability trends: digital fashion products and their possible uses

Thematic analysis revealed five trends that were assigned to the overarching theme of ‘usability trends’.

4.3.1.1 The digital self – a medium for interaction with virtual fashion. Nine experts mentioned the notion of the digital representation of oneself in the metaverse as a 3D avatar. Experts 2 and 5 emphasized that having a graphic representation in the virtual space is indispensable to interact with objects and other individuals, which renders the avatar a primary medium for interaction in the metaverse. Expert 5 stated, “I do think you will be able to do it just by taking a screenshot of yourself, and then you will have a basic avatar”. The notion of an avatar being a digital copy of oneself was further supported by Expert 8, who stated that “there's going to be some digital twin system where you have an avatar of yourself, which is true to size, where all your size is from your arms, to your elbows, to your hips, and waist and, and length, everything is going to be in your digital twin”. Expert 6 also said that “you would scan your face very quickly, and it will put it on an avatar in a matter of five minutes”. According to experts, an avatar will become a ledger of one’s virtual identity across many different environments and take a form of “a universal digital profile”, which can be illustrated with the quote of Expert 1, who stated: “the idea of how your profile is something that you will take across the spectrum, just as the email enables you to do things on the internet, your profile and maybe the set of NFTs that you own will enable you to enter the spaces and, and they will offer certain things based on your profile” and added that universal profile is one of the key components for enabling interoperability. Expert 11 asserted that “in 10 years, we will have so much of a stronger avatar presence” and concluded that “the avatar will be the number one market for digital fashion”.

4.3.1.2 Virtual try-ons. Almost all the experts referred to virtual try-ons as one of the most significant trends in digital fashion. Expert 2 brought up two ways of interaction with digital clothing by asserting that “it will be possible try them on their physical self using AR and wear them on their digital avatar”. The applications in which the virtual try-ons were mentioned related to their applicability in e-commerce, social media (as AR filters), or digital clothes in online video meetings. Expert 7 defined virtual try-ons as the paramount trend in the realm of

digital fashion and asserted that this technology will be available a lot sooner than ten years. Moreover, the expert said that it is the “development that in the next two or three years will already be quite robust”, which pointed to the inevitability of this trend in the metaverse.

4.3.1.3 Storing objects in digital wardrobes. Another context of use in which experts embedded digital fashion products were digital wardrobes/closets/storages/wallets/libraries – all referring to the concept of storing multiple virtual objects in one (virtual) space. As stated by Expert 7: “imagine you have your own little wardrobe, right? And you can just zoom into a product and jump out, look at your collection, see how that looks like in different spaces, fully manipulate it, browse and zoom into a specific garment of your wardrobe and see how it all matches together in terms of color consistency across multiple categories. But it's just not there yet.”. Expert 3 also referred to digital storages by stating: “when you buy an art object you have to physically store it somewhere, but if you buy a digital artwork, you can carry it always with you on your phone, because your phone is this database of all the products that you're collecting” and added that “they're now already in development”. Another common remark regarding digital libraries was the possibility of exchanging objects between users’ virtual closets, which circled back to the importance of the seamless transfer of goods enabled through the interoperability.

4.3.1.4. Product customization. Nine experts emphasized product customization as a major trend in digital fashion, which was also commonly mentioned in a body of literature (Shen et al., 2021; Yan & Chiou, 2020). Concerning this, Expert 3 stressed the importance of customization by saying that “people will want to decide and influence how they look”, and Expert 6 pinpointed that “it will be possible to customize everything”. Expert 7 stated that full customization can already be seen now for example in Fortnite, where users are provided with the tools for the “full-blown product configuration”. Expert 4 emphasized that tools like CLO3D and other digital fashion libraries “have millions of textures that can be put on top of a basic T-shirt”. Expert 5 and 8 also stated that the tools for seamless product customization with “smooth user interfaces” will be available very soon. In addition, several experts pinpointed that “the fantastic thing about going digital is that the personalization is so easy and so much less wasteful” (as quoted by Expert 4), which pointed to the significance of personalization not only in terms of expressing one’s style, but also regarding sustainability. This finding supported the

stance of Santos et al. (2020) who emphasized the potential of digital fashion to reduce fabric waste.

4.3.1.5 Using digital twins of physical products. Five experts pointed to the use of digital twins of physical clothes as one of the important trends in digital fashion. Expert 4 mentioned that digital products can go both ways on the digital-physical continuum by stating that "we give users the experience of trying it on both physically and digitally, so it's going from physical first and then moving into the digital space" but also giving an opposite example: "you can scan a QR code and then receive the try-on and the ownership, and afterwards also exchange your digital twins for the physical ones". This finding reflected the notion of the metaverse constituting the crossover between the physical and digital world, which has been referred to as "phygital" by three experts, as well as in the theoretical framework (Gaggioli, 2017). Expert 8 also referred to the duality of products by stating: "you can try that on your virtual body and see how it fits online, and then you can buy the real thing and they will ship the actual product". Expert 8 undertook to divide the notion of "phygitality" into three categories by stating that "I think fashion is going to spread into purely physical, phygital, so that could be physical connection to virtual experience, and also entirely virtual". The notion of digital twins of products that never reach the physical realm was mentioned by five experts. Moreover, Expert 4 boldly asserted that the future will bring the emergence of "fully digital brands" governed by the digital-only logic, completely detangled from physical manufacturing processes. Expert 3 also drew a vision of a world resigning from physical fashion due to ecological reasons by stating that "digital only will be the new form of fashion, physical garments will stay for the utility aspects, but in 10 years fashion and arts will exist digitally, it doesn't make sense to create them physically", which supported the stance of the founders of DressX who said that engaging with fashion trends will be enacted primarily through digital channels in the future (Joy et al., 2022).

4.3.2 Aesthetic trends: new aesthetic era.

Three aesthetic trends emerged from the experts' testimonies.

4.3.2.1 Redefinition of aesthetics. Most experts acknowledged the potential of digital fashion to break with physical constraints and the aesthetic possibilities it poses, which could

result in “some things that we haven't even seen before”, as stated by Expert 4. In relation to this, several experts emphasized that the aesthetics of digital garments are not bounded by such constraints as gravity, human shape, or temperature. Experts provided such examples as the ability to wear materials impossible to use in real life, such as lights, fire, water, or different types of fabrics and transparencies. According to Expert 3, “now everybody goes a little bit crazy on shapes and colors, and I think it will become more natural but with an extended layer of what's not possible in real life”. The notion of digital fashion imitating the real world was also found in testimonies of Experts 1, 2, and 6, who asserted that at the end of the day, fashion has a similar function of identity expression and perception management, regardless of whether it is a virtual or real-world environment. In relation to this, Expert 1 asserted that “eventually the end-user is human, so I guess we will somehow bring it back into something familiar, and even though it might not obey gravity, it will still look familiar”. Conversely, Expert 5 mentioned that virtual garments will be created for different types of avatars in different aesthetic styles and forms (not necessarily human-like). In addition, Expert 1 pointed to the complete redefinition of what can be considered as a “fashion product”. He stated that digital fashion is “limitless in the sense that it's not necessarily what you wear, or what your avatar wears. It might be the way you speak, or the way that you sort of swag while you walk, because those are also things in the metaverse through which you could express yourself”. The expert also added that fashion in the metaverse could take the form of “superpowers” and have different functions, which was illustrated with an example of a “super-dress that turns into a gun”. It can be concluded that the metaverse exhibits potential to change the traditional understanding of fashion and that anything that could be leveraged as a tool for identity expression could be considered a “fashion product”.

4.3.2.2 Co-creation of aesthetics. Co-creation was identified by several experts as one of the trends that could play an important role in shaping the future users’ experiences with digital fashion. This finding reflected the stance of Yan and Chiou (2020), who asserted that in the digital age, styles can be co-created in a symbiotic relationship between users and designers rather than passively consumed by the customers. Expert 6 even stated that co-creation constitutes a primary driving force behind digital fashion “because that never happened in fashion, that you can co-create a collection or a garment before it is put in the market”. This stance was also supported by Expert 3, who said that “there are so many more people designing

their own collections, and having a co-creation role almost, that you would think that would be the new aesthetic standard of almost like that anyone can design the look". In relation to this, Expert 1 mentioned that "fashion has gone through a similar-ish evolution back in the days where mass adoption of fashion wasn't driven by big corporations creating loads of items for everyone, but instead was more done in a made-to-order manner by households" and concluded that in the future digital fashion will be created in an "ongoing conversation" between users, designers, and data recommendations.

4.3.2.3 Data-driven design. Apart from users' role in shaping the aesthetics of digital products, several experts also pointed to the significance of data in the design of digital clothing. Concerning this, Expert 10 stated that "artificial intelligence can be a fantastic tool to help understand what the consumers want", which was also mentioned by Expert 8, who said that "there's so many systems you could make based on data where you really analyze consumer data, trends, and integrate those in your products". Experts also mentioned the use of data for adjusting fashion products to user's preferences through the history of their online behaviors, which can be illustrated by the quote of Expert 1, who said that "in the metaverse, all of these signals are very interesting. My profile has got this data signals, and based on that kind of fashion can be produced for me". Expert 3 also expressed that "in the future garments could interact based on the data they resource out of your body" through, for example, IoT devices. Lastly, Expert 1 concluded that "it's a conversation between the people, the choices of the people, and the data that that can be gathered from it".

4.3.3 Engagement trends: enhancing engagement in the metaverse.

Four trends have been identified in terms of how digital fashion could contribute to creating engaging experiences in the metaverse.

4.3.3.1 Community building through digital fashion. When asked about the primary driver of engagement in the context of fashion in the metaverse, most experts pointed to the social aspects, which confirmed the centrality of the social factor in the metaverse (Cheng et al., 2022; Falchuk et al., 2018). As stated by Expert 1, "the key driver is a sense of social and community interest". Expert 3, in turn, asserted that "if there's no community behind it, it's

valueless". Five experts referred to the role of digital fashion in expressing affiliations to social groups and establishing one's status, just like in the real world. As mentioned by Expert 11, "the ways that digital clothes are worn in games to show affiliation to clans, that's going to be exactly the same in our own virtual worlds, and in the same way that social clothes are so tied to social standings, and social interactions in the physical world". This standpoint was also found in the testimony of Expert 1 who said that digital fashion "helps you identify yourself with others and helps our community reflect your identity in a way that you feel a part of it as well". Expert 7 mentioned that in the metaverse "the users will be walking around with an exclusive piece, clicking within a certain guild community or group of people". Experts referred to such ways in which digital fashion could create social experiences as engaging in exclusive social clubs (created around ownership of exclusive collector pieces), going to social events (such as virtual fashion shows), or just "hanging out with friends" in the metaverse.

4.3.3.2. Engaging in identity-building through digital fashion. Seven experts pointed to the possibility of building one's (digital) identity through digital fashion as a trend that will play an important role in increasing emotional engagement of users in the metaverse. This finding reflected the stance of Riva et al. (2007) and Han et al. (2022) who emphasized the affective aspects of virtual environments. Expert 11 defined the ability to freely express oneself in the metaverse as "the primary reason that anyone would wear anything digitally" and "the number one most important part of the future of why clothes will look like they will". According to Expert 5, digital fashion "is all about creating your identity" and "making it look like a better version of yourself". Expert 10 stated that owing to digital fashion, "you can be whoever you want, and there's no discrimination, it's all about inclusion". This stance was further supported by Expert 6 who stated that "the metaverse and virtual worlds are going to open these possibilities that we can become another gender, we can become transgender without needing to transition like in the physical world, we could explore other bodies, other body sizes, other expressions of our identity, without so much compromise or investment" and portrayed digital fashion as a tool for enhancing users' engagement in terms of emotions.

4.3.3.3. Virtual clothes, real value: NFTs. All the experts mentioned the notion of owning digital garments in the form of blockchain-based NFTs as a trend that could play a

significant role in enhancing user engagement in the metaverse. This finding reflected the stance of Joy et al. (2022) who stressed the significance of NFTs in the metaverse.

Firstly, the economic value that comes with NFT garments was emphasized by nine experts and portrayed as a potential incentive that can significantly enhance engagement and encourage more users to "join the metaverse". As pinpointed by Expert 3 – whereas the value of physical garments mostly goes down in worth with time, virtual goods embedded on blockchain become "collector pieces" that can significantly increase in value with time. Moreover, Expert 9 compared virtual goods in the form of NFTs to investing in stocks and artworks, which can significantly increase in value over time. Moreover, NFTs were also referred to as the "receipt proving you own a virtual object".

Apart from financial value, NFTs were also found to have an application in creating the luxury value of digital products through "creating scarcity", "proving originality" and "establishing ownership". In relation to this, Expert 9 stated that "there will be a growing appetite for ownership of luxury quality". As an example, the expert mentioned the possibility of brands to enact a "scarcity model" and launch, for instance, only a thousand pairs of digital luxury sneakers. She also asserted that matching the luxury fashion market with NFTs and the notion of digital ownership could result in its own market in the upcoming years.

Lastly, NFTs were also demonstrated to play a role in enhancing social engagement, which was pointed out by Expert 3, who brought up "the social events and social interactions that you can access by having these digital goods". In reference to NFTs, the expert pinpointed that "there's a big community behind it that drives this value up", which was also mentioned by Expert 1, who said that "in the NFT side of digital fashion, there's a whole new discussion of what is valuable in terms of community expression and affiliation". In relation to this, Expert 5 emphasized the possibility of having exclusive rights to social clubs, gatherings, and events that come with the ownership of virtual goods.

4.3.3.4. Sensory engagement. The sensory engagement was a trend that was mentioned by most experts. Nevertheless, divergent opinions were expressed regarding how it could be possible to stimulate users' senses in the future. Whereas experts' opinions aligned in terms of inducing the sense of immersion in the metaverse through high-quality visuals and sounds, experts expressed doubts about the possibility of the engagement of the senses of touch, smell, or

taste. Concerning this, Expert 8 said: “I think visually, we got it perfect. We can go full immersive, mixed reality, sound seems to be pretty well done as well, we have 3D sounds, and binaural sounds can go quite deep. But a smell and touch are still lacking. And now you have these full-body suits, but I think people are not necessarily going to wear a full suit to do an experience unless they're really on the high-end, but that’s very niche”. Similarly, Expert 10 stated that “we have no haptic technology yet really for virtual fashion. There are some companies trying to develop haptic technology for feeling, but it's not there yet”. Expert 1 also expressed: “I don't imagine smell will come anytime soon”, nevertheless, he also added that “there are always ways in which you can trick the brain to think about smell, and it already happens with perfume websites, for example, by using visuals and textures to try to convey a smell”. The notion of “tricking” other senses with visuals was also found in the interview with Expert 3, who pondered: “I often hear that fashion is also about feeling, but with digital fashion, how are you going to give that same tactile experience to somebody with just a visualization?” and concluded that she believes that “the complete immersive experience how we imagined it to be is not completely there yet”. In the face of this evidence, it can be inferred that sensory engagement in the metaverse could be enacted primarily through realistic visuals and audio effects. As stressed by experts, more advanced immersive experiences that could enable engaging the sense of touch in the metaverse would require access to more sophisticated hardware (such as haptic devices), which is not expected to “go mainstream” within ten years on a massive scale according to the experts. Based on the insights from experts’ testimonies it can be inferred that the full engagement of all users’ senses in the metaverse will most likely not be possible within ten years, which substantiated the doubts of Jung and Stolterman (2011) about the possibility of rich sensorial engagement in virtual worlds. Nevertheless, since experts were frequently stating that the technology is not there “yet”, it can be implied that it is not impossible that one day the technology will advance enough to enable the full sensory engagement, as stated by Ornati (2019).

4.4. Stage 4: Constructing preliminary scenarios

The insights from the analysis served as a basis for creating a 2x2 matrix and constructing preliminary scenarios (Schoemaker, 1995) which are presented in Figure 1 below. Preliminary scenarios were used as a basis for creating final scenarios.

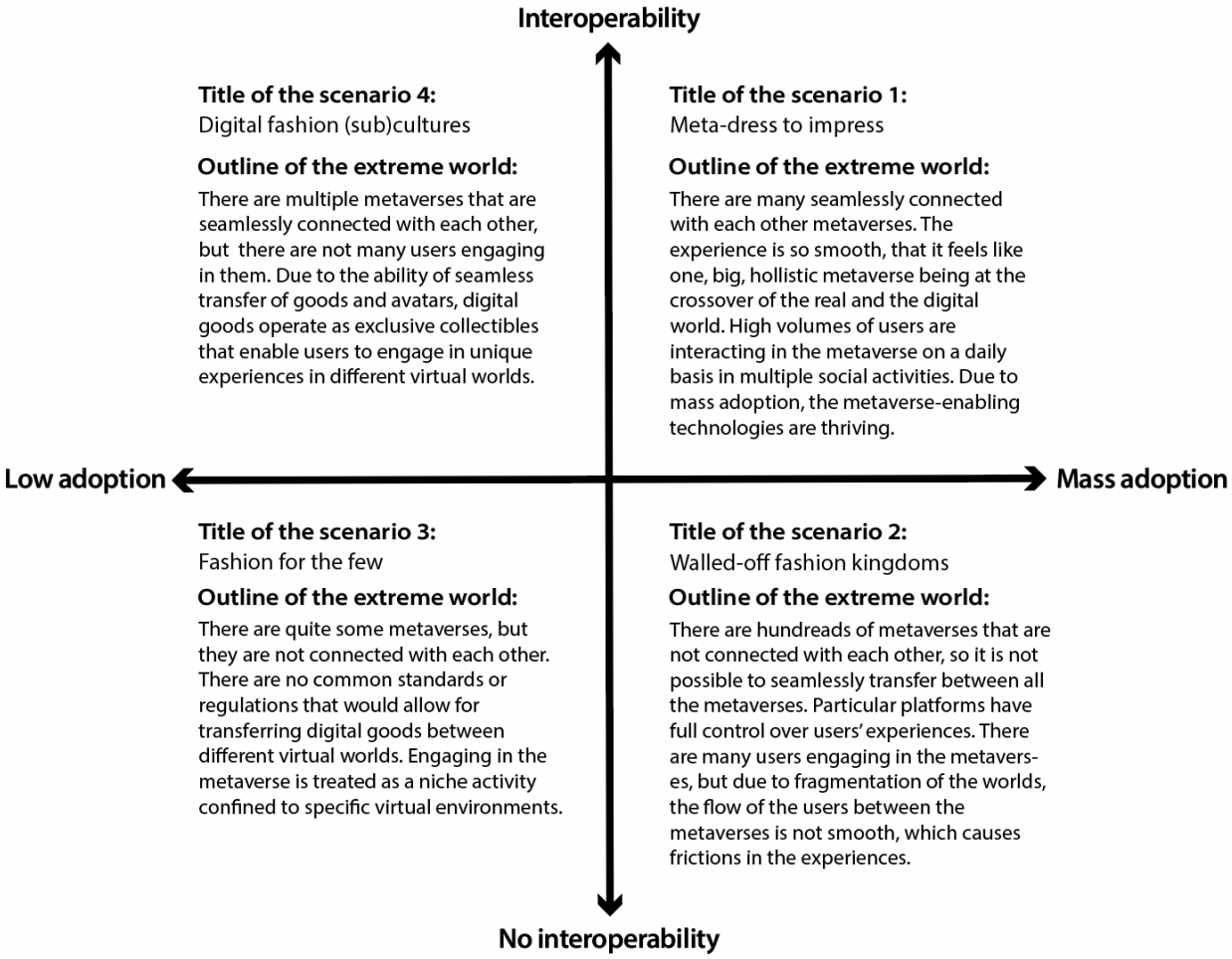

Figure 1 The 2x2 matrix showcasing the four preliminary scenarios.

4.5. Stage 5: Building final scenarios

In this stage, five final scenarios were built. The narratives of all scenarios take place in the year 2032 and describe the subjective experiences of the same persona (Alex) with digital fashion products embedded in four extreme worlds.

4.5.1. Scenario 1 (interoperability/mass adoption): Meta-dress to impress

Alex puts on a lightweight, new-generation VR headset and decides to buy a new digital dress, since today she has an important event in the metaverse. She chooses to buy it at DigitaX, a newly founded digital fashion platform everyone is talking about. She hops into DigitaX world and proceeds to try on a dress on the avatar that resembles her true-to-size real self. Since most of her friends also engage in the metaverse, she wants to be easily recognized and treats her avatar as an extension of her real identity. In the virtual changing room, Alex gets numerous recommendations of dresses based on her buying history. From all the suggestions, she chooses a long dress with a sparkling effect. Alex likes the recommendation, but she craves something more personal, so she changes its color, adjusts the length of the sleeves, and adds a pattern that she drew digitally. To see the final effect, she moves the dress around with hand gestures and zooms in. The fabric of the dress looks extremely realistic – she feels as if she could really touch it. Alex is happy with the result – she thinks the dress fully reflects her personality now. Alex feels emotionally attached to the garment and regards it as her piece of art. She pays for the dress in cryptocurrency and buys it as an NFT. She feels excited because she has a hunch that this investment can turn out very profitable in the future and significantly grow in value over time. She puts her NFT dress into the virtual closet next to the other ten garments she purchased before and compares how the dress fits with her collection of virtual sneakers. The new dress does not go well with any of digital sneakers, so she decides to buy a new pair. Within seconds, she seamlessly transfers to the SNKRS platform. She does not have to worry about the transfer of her collectibles, since all the platforms are compatible with each other. At SNKRS she chooses a pair of glowing sneakers that will go with her DigitaX dress and pays with the same universal currency she paid for the dress. At the checkout, it turns out that she can also order a physical counterpart of her SNKRS, which she does since she knows it will make an impression on her friends. After the transaction, Alex wears both digital clothing pieces on her digital-twin-avatar – now she is ready for the Metaverse Fashion Week in Decentraland, to which she directly relocates from SNKRS. At the Fashion Week, Alex meets a group of friends she usually spends time with in real life. It turns out that Alex really likes the dress of one of her friends, and they decide to swap their outfits. After exchanging clothes, Alex and her friends watch the newest trendy collections of different high-end fashion brands displayed on virtual models on the catwalk. Alex cannot resist temptation and buys a fancy digital blazer NFT for her avatar. In a

couple of clicks, the blazer appears in her virtual closet. Thanks to being embedded on the blockchain, she feels safe that nothing will happen with it, especially since she paid a fair sum of (crypto)money for this collector piece. After the fashion show, Alex wants to show off her new NFT blazer to her friends. She takes off the VR headset and records a video of her real self with a smartphone. On the captured video, there is a real-time overlay of the blazer thanks to the connection of her social media account to her virtual garderobe. The digital blazer on the video adjusts to Alex's movements and realistically imitates the draping behavior of a fabric. She is really excited about the result. Alex posts a video with a blazer on her social media account with the NFT authentication tag proving her ownership of the garment. Within a few minutes, she already has tens of likes and comments complimenting her new outfit. Alex is exhilarated about her purchase – not only was she able to flaunt her luxurious garment within seconds and at a lower price than she would pay for a fabricated piece, but she also has a clear conscience for not contributing to creating fabric waste that would come with buying a physical blazer.

4.5.2. Scenario 2 (no interoperability/mass adoption): Walled-off fashion kingdoms

Alex puts on her VR headset since she planned a meeting with her friends in the PIXL metaverse. She is a bit frustrated since it took a while before they all agreed on in which metaverse to meet as it is not possible to transfer between all the available platforms seamlessly and different friends tend to spend their time on different platforms. What is worse, one of her friends was unable to join the meeting since she bought all her digital clothes in another metaverse and could not transfer them to PIXL, so she got upset and canceled the meeting. Since Alex and her friends arranged the meeting in the metaverse that was the most suitable for the majority, her favorite digital garments stayed in the META's metaverse, where she spends most of her (virtual) time. For this reason, Alex decides to buy some new clothes before the meeting. There are not that many available fashion brands in PIXL metaverse, so she chooses any – she will not be able to take those garments to META anyway. She enters VRTL, a digital fashion brand store she heard of somewhere and gets some outfit recommendations, however, they are not too accurate (since the lack of connection between virtual worlds causes gaps in the data about her preferences). She proceeds to customize her outfit and chooses from available options of patterns and shapes. She also adds an extra effect – now her dress is floating, and the fabric is

on fire – it will surely leave her friends in awe. She wants to try the dress on her avatar, but since she is new to PIXL metaverse, her avatar is not fully compatible with her usual avatar and has some differences. Baffled by the difference in the avatar at first, Alex is still excited about the look of her new outfit, but she is a bit disappointed that it will not be possible to transfer it back to META. She decides to buy the outfit anyway in the hope that the big tech players building the metaverse will finally decide to enable the transfer of virtual goods. Recently she even heard some rumors that some firms are working on enabling the interoperability to meet the growing demand for digital fashion among consumers. Nonetheless, some firms are apparently unwilling to agree on common standards because they want to keep control over the experiences and data of their users to "lock them" in their own meta-ecosystems. To buy the dress, Alex must first transfer the cryptocurrency she usually uses in META into the PIXL cryptocurrency and pay the commission, which causes frustration. After processing the payment, the dress appears in the virtual closet, but unfortunately it is confined to PIXL metaverse. Alex wears the dress and goes to the meeting, where she will spend the rest of her day playing games available in PIXL with her friends.

4.5.3. Scenario 3 (no interoperability/low adoption): Fashion for the few

Alex's plan for today is playing games with friends in the LifeX metaverse. In LifeX, Alex usually meets with his regular group of virtual friends that he met on the platform – he does not know them in real life. Moreover, he does not know anyone from his real environment that would also hang out in LifeX, since it is not a popular pastime among his friends. Even though his group of virtual friends is not big, he feels truly connected with them since they were bonded through engaging in joint activities in the same virtual world. They hardly ever go to different metaverses since all their achievements and assets are restrained to LifeX. Alex treats LifeX as an escape, the world in which he is not restrained by the boundaries of ordinary life. Alex puts on his VR headset and enters the platform. His avatar does not resemble him at all – it looks like a hybrid of a human with animal parts, and its gender is not distinguishable. Alex looks through the garments in the virtual closet, but as he got bored of his current collection, he decides to create a new garment for his avatar. Since there are not many users in the metaverse, there are few fashion brands that would invest their resources in creating their own branded collections in

LifeX, therefore, the aesthetics of digital clothing are not shaped by any dominant brands – only imagination is the limit here. Alex wants his clothes to deviate from the aesthetics of clothes he usually wears in real life. He enters an interface where he can customize his clothes. Alex feels creative today, so he designs the most outlandish look possible. He dresses his avatar in a suit made of fire and water and adds an effect of sparkles flying around him. To boost his chances in the game tournament he planned with his virtual friends, Alex decides to pay extra to enhance his garment with an additional superpower that will enable his avatar to fly. He wears the new garment on his avatar – now he is fully ready for the playoff. Five out of six Alex's friends show up to the game. It turns out that the digital account of one of his friends was hacked, since there are no standards that would prevent such malicious activities. Everyone is startled at first, but it is not the first time that happens, so they casually proceed to play as if nothing happened.

4.5.4. Scenario 4 (interoperability/low adoption): Digital fashion (sub)cultures

Today is Alex's meeting with his exclusive community to which he received a premium access thanks to his rare collection of NFT garments. Since the transfer of digital goods between different environments is seamless, the event occurs each week in a different metaverse, where the club members come together from different virtual worlds to engage in joint social activities. Unfortunately, he does not know anyone from his real-world environment that would belong to the same community, so all his friends in the club are purely virtual. Alex puts on his VR headset, but before going to the gathering he decides to assemble his outfit. He enters his virtual closet and compares different combinations of his NFT garments to select the best fit, but he thinks he could use some new clothes to make a good impression on his friends from the club. He seamlessly hops into his favorite store with fashion NFTs. He chooses a digital suit that was displayed as a new exclusive collector's piece. The suit comes with some perks, such as discounts for in-game purchases, access to other exclusive clubs, and even some deals to use in high-end brand stores in real life. Before purchasing, he customizes the suit by changing its color and cut to fit the aesthetics of his exclusive club, since he wants to emphasize that he is really a part of this community. After incorporating adjustments, he tries the suit on his standard digital avatar that he uses in all the virtual worlds he visits. Finally, he pays for the customized NFT garment with the universal cryptocurrency and immediately wears it on the avatar. The club's

meeting is about to start soon, so he seamlessly goes from the store to the coordinates where the gathering takes place. To enter it, Alex must verify his membership by connecting his virtual closet with all his NFTs that have the proof of ownership ingrained in them. After verification, he enters the limited-access virtual space with exclusive experiences curated by luxury brands that leverage such clubs to market themselves to high-end customers and potentially redirect them to their physical products. The meeting is starting, where Alex finally engages with other club members in such activities as the exchange of virtual assets, exclusive fashion shows, and unique games.

5. Conclusion and discussion

Since the four final scenarios are regarded as a conclusive answer to the main RQ, familiarizing oneself with each of them is indispensable to gaining a comprehensive insight into the central question of this study: *How could the metaverse impact users' experiences with digital fashion products in the year 2032?*.

This study leveraged the scenario planning method to outline potential users' experiences with digital fashion products in the year 2032 in the context of the disruptive concept of the metaverse. Identifying key stakeholders, uncertainties, and trends allowed for developing scenarios describing how users' experiences could evolve depending on different courses of events. The levels of 'mass adoption' and 'interoperability' in the metaverse were identified as the main uncertainties on which users' experiences with digital fashion could be dependent in ten years and served as a groundwork for developing four divergent scenarios. Based on the disparate character of the narratives, it can be concluded that users' experiences could differ significantly depending on the context in which they would be embedded, which attests to the importance of considering the state of mass adoption and interoperability when theorizing about this topic.

As the notion of 'interconnectivity' of the metaverse was a prominent theme both in the theoretical framework and in the expert interviews, it begs the question: Is the metaverse without interoperability truly 'the metaverse'? (Mystakidis, 2022). According to this logic, it appears that the non-interoperable metaverse from the Scenarios 2 and 3 poses doubts as to whether it could be interpreted as the 'real' metaverse (Owens et al., 2011; Sparkes, 2021). Nonetheless, as

pointed out by Lee et al. (2022), even though as of the year 2022 there is still little interoperability between the platforms, it does not necessarily mean that the metaverse does not exist or that it is not on its way to materialization. Moreover, as the significance of seamless transfer between virtual worlds in enabling immersive experiences was emphasized in the theoretical framework by Dionisio et al. (2013) and a body of experts, it confirmed that the quality of users' experiences is intrinsically intertwined with interoperability, which was reflected in the scenarios. The implication of this finding is that enabling interoperability is in the interest of fashion businesses and other stakeholders co-building the metaverse since it can positively influence users' experiences in the metaverse.

The findings of this study about the importance of metaverses' mass adoption and its impact on users' experiences reflected the theoretical discussion on the centrality of social interaction in the metaverse (Chohan, 2022) and the role it plays in creating network effects and enhancing technology adoption (AlHogail, 2018; Partala & Saari, 2015; Perez, 2009; Shin, 2022), which was featured in the scenarios. Since both the findings of this study and the theoretical framework indicated the link between user experience, mass adoption, and state of interoperability, it can be concluded that some of the scenarios could be more likely to materialize than others. It can be also implied that since interoperability fosters user experience (Dionisio et al., 2013), and user experience fosters adoption (Partala & Saari, 2015), the scenarios showcasing combinations 'interoperability/mass adoption', or 'no interoperability/low adoption' could exhibit a higher likelihood of becoming reality than the scenario showcasing the combination 'no interoperability/mass adoption'.

The findings of this study also substantiated the preceding theory, where through the lens of the evolutionary paradigm, it was asserted that innovative technological concepts as the metaverse have potential to not only impact users' future experiences with digital fashion but to (re)shape them altogether (Malerba & McKelvey, 2020) and lead to 'creative destruction' of the fashion industry, where the fashion market undergoes rapid transformations, which causes the current offerings to be superseded by the innovations of new (digital) products (Robert & Yoguel, 2016). As demonstrated in this research, users' experiences with digital fashion products in the metaverse could result in new contexts of uses, redefinition of their aesthetics, and the new ways of enhancing user engagement. The insights into the potential developments in the realm of digital fashion can help fashion businesses strategize how to provide users with superior user

experiences in terms of usability, aesthetics, and engagement and tailor them to the present state of the metaverse and evolving consumer needs (Brydges et al., 2018). The findings about the evolving trends such as avatars, virtual try-ons, digital wardrobes, customization, digital twins, data-driven design, consumer as a co-creator, community building, identity expression, or NFTs can spur the fashion brands to act upon them and gradually incorporate such offerings into their value propositions to become 'ready for the metaverse'. Even if the metaverse will not fully come to fruition in ten years, as disputed by some critics (Kim, 2021), it remains beyond doubt that digital technologies will continue to play an increasingly important role in almost all industries (Matt et al., 2015). Therefore, it can be concluded that the insights into how the experiences of users could look like in the future and how to curate these experiences according to the dynamics of a digital era constitute valuable knowledge for fashion businesses irrespective of the state of the development of the metaverse.

This research filled the double-ended gap on the two novel and highly unexplored topics of digital fashion and the metaverse. It also contributed to the work of Gursoy et al. (2022, p. 6) by providing deeper insights into the realm of "metaverse consumer experience" from the perspective of the potential future of digital fashion that the authors pointed out as a direction worth pursuing, as well as to the study of Varshneya et al. (2017), who pointed to the necessity of investigating users' experiences within fashion sector from the perspective of socio-digital platforms.

5.1. Societal relevance

The next ten years will undoubtedly bring dynamic changes in the fashion industry sparked by technological developments, evolving consumer needs, and environmental pressures (Rinaldi, 2020), which will coerce fashion firms to rethink their business models. Therefore, scenarios of potential future(s) developed in this study can serve as a 'systematic method of thinking' that could help fashion firms tackle complexity and uncertainty in planning their future actions (Bouhalleb & Smida, 2018; Howlett, 2011). Moreover, as stressed by Pérez-Soba and Maas (2015, p. 52) "we cannot predict the future with certainty, but we know that it is influenced by our current actions", and actions can be deliberately planned. Hence, the developed scenarios incorporating the combinations of different courses of events can assist fashion brands in preparing for different eventualities and tailoring the experiences of their (future) users according to the state of the metaverse. In addition, as emphasized by Hollebeek et al. (2019), new

technologies can be leveraged at any stage of marketing and distribution processes. Thus, fashion brands can use the knowledge on how to use the metaverse as a new channel for enriching their customers' experiences and incorporate it into their value propositions. Moreover, in the face of the progressing processes of interpenetration between the physical and virtual worlds and the growing importance of the 'digital side of life,' digital fashion has the potential to be regarded not only as a supplement to the current firm offerings but their inherent part (Mystakidis, 2022). As the findings from this study deepen the understanding of the evolving duality of experiencing fashion in the 'phygital' world, they can provide fashion businesses with valuable insights on how to tailor their services to stay competitive in a digital era (Gaggioli, 2017; Santos et al., 2020).

5.2. Limitations

The most significant limitation of this study stems from the fact that it is future-oriented, and the future is highly uncertain and difficult to predict at its core (Elsawah et al., 2020). In addition, the four scenarios that provided the conclusion to the main RQ were developed by a single researcher (and additionally consulted with the supervisor), which could result in potential bias. Nevertheless, it is essential to emphasize that subjectivity is an inherent characteristic of all scenarios (Mannermaa, 1991). Moreover, to mitigate the potential bias, the researcher ensured to base scenarios on the data from interviews with experts from diversified fields. However, even though the sample of experts was diversified, the experts were mostly based in the Netherlands, United Kingdom, and USA, all belonging to the so-called 'western world'. Therefore, it can be inferred that the insights gathered during this research may reflect the 'western mentality' and not be globally generalizable. Moreover, due to the uncertainty and complexity of the future, prospective users' experiences will undoubtedly be shaped by thousands of factors, therefore, it is likely that the researcher was not able to capture all the complexities and all possible developments within four scenarios. Another limitation of this study is that the experts were interviewed independently, without the chance to evaluate each other's opinions on the investigated topic as it is done in a Delphi method, where the experts reach a common consensus through participating in the rounds of feedback (Barrios et al., 2021). Lastly, since metaverse is an ever-evolving phenomenon, it caused that the academic sources on this topic were frequently

limited. Throughout seven months of conducting this study, some sources available at the end of this study were not available at the beginning, which could have potentially impacted the direction of this research.

5.3. Future research

This research aimed to explore the potential future(s) of experiences with digital fashion in the metaverse considering the aspects of usability, aesthetics, and engagement. Nonetheless, it would also be advantageous to explore each of these experiential pillars separately to deepen the understanding of the process of designing users' experiences in this realm. In terms of usability, it would be interesting to investigate how the users will be able to interact with digital garments in the metaverse in terms of spatial object manipulation through motion capture technologies. Regarding aesthetics, the realm of data-driven design and fashion recommendation systems based on systems leveraging machine learning techniques constitutes an interesting yet unexplored realm to investigate. Since some experts expressed doubts about the future of haptic technologies, it would also be worthwhile to investigate to what extent the metaverse will enable its users to engage most (or maybe even all) of their senses. Lastly, since this study assumed a ten-year timeframe, it would be advantageous to revise the findings of this research in five to ten years to evaluate whether any of the scenarios were 'on the right track' and update them according to the current state of developments in the realm of digital fashion and the metaverse (Van den Berg et al., 2021). Ideally, updating scenarios could be enacted by conducting expert interviews in rounds to reach a consensus among the research participants.

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Appendix A

Name and interview date	Expert's experience and relevance to the study
Moises Nevett 13/4/2022	Moises Nevett is currently a Senior Experience Design Strategist at Media Monks (a digital production company producing websites, games, and films). Before he also worked in Wednesday (a creative agency, specializing in the fashion, luxury, retail and lifestyle sectors). Over the course of his career he worked with multiple fashion brands. Overall, he has over 13 years of experience in the field of user experience design and the development of digital products, especially from the perspective of the fashion industry. Moises's expertise brings valuable insights on the notion of the experience creation in the realm of digital fashion.
Freek Teunen 13/4/2022	Freek Teunen is a VR/AR solutions expert at VR Owl and a VRARA Chapter President (being the global industry association for Virtual and Augmented Reality). He is also the author of the book "Virtual Reality for Business". Moreover, he is a founder of PlaygroundVR, being an initiative that provides virtual playgrounds for children in the hospitals. Freek's expertise brings a valuable perspective on the realm of virtual, three-dimensional worlds and immersive technologies.
Susanne Vos 15/4/2022	Susanne Vos is a Digital Fashion Designer specialized in the 3D design of digital clothing at The Fabricant, a decentralized digital fashion house building the wardrobe of the metaverse through the co-creation platform The Fabricant Studio. Susanne's expertise constitutes an invaluable contribution in the context of digital fashion from the perspective of three-dimensional design of digital garments.
Paula Vega Tagle 21/4/2022	Paula Vega Tagle is a Founding Partner at Lablaco, the blockchain enabled circular fashion platform designed to create a next generation ecosystem for designer brands . She is also a Global Partnerships Manager at Circular Fashion Summit being "the XR global collective action community, accelerating circular fashion through Design, Technology and Sustainability". Paula's perspective provides valuable insights into such realms as fashion in immersive technologies, digitalization of fashion, and the use of blockchain technologies in fashion.
Aron Versteeg 21/4/2022	Aron Versteeg is a consultant and developer in the field of Virtual and Augmented Reality with over 18 years of experience. He is specialized in the field of real-time avatars in the areas of application such as media/broadcasting, fashion and events. He is the founder of ArtBeat, a company focusing on improving and optimizing communication processes through the application of Virtual Reality through producing 3D simulations in the form of animations and interactive environments. His expertise gives a valuable perspective on such areas as 3D avatars, three-

	dimensional virtual worlds, and immersive technologies.
Giancarlo Pazzanese 21/4/2022	Giancarlo Pazzanese is a Senior Lecturer in Fashion Business & Fashion Design at Amsterdam Fashion Academy (where he also fulfills a role of a Lead of Diversity and Inclusion) with over 20 years of experience in art direction, multimedia production and content curation. In addition, he is also a strong advocate for LGBTI inclusivity and sustainability. In addition to the broad experience in the realm of fashion, Giancarlo's expertise provides insights into the digitization processes taking place in the fashion industry, as well as the aspects of ethics, inclusion, and sustainability.
Bastiaan Geluk 21/4/2022	Bastiaan Geluk is a Head of Digital Fashion at INDG—a company which creates digital twins of products for fashion brands (ranging from luxury to sportswear). At INDG he is leading a fashion business group that delivers consumer-facing and interactive visual content based on the 3D foundation. He has over 15 years of experience in the sportswear and fashion industry during which he worked with multiple renowned brands (such as Nike and Adidas). His expertise provides invaluable insight into the topics such as the digitalization of fashion products, digital twins of physical products, and 3D technologies in fashion.
Geert Einchorn 2/5/2022	Geert Einchorn is an Innovation Director at Media Monks. In his daily work he is in charge of such fields as R&D, concept development, and art direction for: AI, VR, AR, websites, games, experiential, digital campaigns, and applications. In Media Monks he is also collaborating with a Flux Team Fashion and Luxury where he works with his team on innovations in the realms such as the future of virtual clothing. In addition, his past experience includes a position of an Artworker at Nike. Geert's expertise provides insights into such realms as digital product innovation and immersive technologies.
Shekinah Apedo 2/5/2022	Shekinah Apedo is a founder of Metaverse IP Consulting—a company that helps to manage IP addresses in virtual worlds. She is also a Senior Executive at Deadfellaz (a brand that launched a collection of ten thousand NFTs which focuses on gamification, as well as IP and NFT technology within the metaverse). In addition, in the past she was also a legal advisor for RTFKT—an organization that leverages game engines, NFTs, blockchain authentication and augmented reality, combined with manufacturing expertise to create sneakers and digital artifacts. Her broad expertise in the realm of virtual worlds from the legal perspective along with the experience with the blockchain-related brands serves as a valuable contribution in the context of regulatory aspects in the metaverse.
Leslie Holden 2/5/2022	Leslie Holden is a co-founder of Digital Fashion Group being the European-led collaboration between Fashion Academics and Industry Innovators that "equips fashion education professionals and brands with the relevant skills, mindset and strategies for tomorrow's workplace. In

	addition, Leslie worked as a lecturer at Amsterdam Fashion Institute where he initiated one of the first courses in 3D virtual fashion prototyping. Due to more than 20 years of experience in the realm of fashion, Leslie's expertise provided a holistic outlook on the topic of digitization processes that are rapidly transforming the fashion industry and the realm of 3D fashion design.
Lamia Priestley 3/5/2022	Lamia Priestley is a researcher at This Outfit Does Not Exist—a marketplace for digital fashion that is still being built at the moment of this study. Her foregoing experience lies at the border of the fields of visual arts and gaming. In the past, she used to work on projects related to wearable technologies, games, and business models around digital fashion and gaming. Therefore, Lamia's expertise provides valuable insight from the perspective of the merge between the fashion and gaming industries (being at the core of the development of the metaverse).

Appendix B

Introduction	
Introduction	● Introduce yourself. ● Thank the interviewee for taking the time to participate. ● Assure about the confidentiality of this research. ● Introduce the context of the study. ● Ask about the consent to record the interview and use the insights from the interview for further analysis.
Ice Breakers	● Could you tell me more about yourself and your expertise? ● Could you tell me a bit about the time when you first came across the concept of the metaverse?
The metaverse	
The Metaverse	● What do you think the metaverse will look like in 10 years? ● What driving forces could make this version of the metaverse come true? ● What stakeholders will play a key role in shaping the metaverse? *Probes:* - In terms of technological aspects? - In terms of economic aspects? - In terms of socio-cultural aspects? - In terms of regulatory aspects?

	● What factors do you think could potentially prevent the idea of the metaverse you described from coming true?
Experiencing digital fashion in the metaverse	
Digital Fashion	● What major trends are you currently observing in the realm of digital fashion that will be developing over the next 10 years? ● What key drivers do you think will play a key role in shaping the future of digital fashion? *Probes:* - In terms of technological aspects? - In terms of economic aspects? - In terms of socio-cultural aspects? - In terms of regulatory aspects?
Usability	● How will people be able to interact with digital fashion products in 10 years?
Aesthetics	● What aesthetic possibilities do you think the future will bring in terms of digital fashion products? ● How do you think the aesthetic value of digital fashion products will be created?
Engagement	● What engaging experiences will be enabled by digital fashion products in the future? *Probe:* - How will it be possible to engage users in terms of their senses / emotions / social experiences?
Final Question	● What are the major uncertainties that may impact the future of digital fashion in the metaverse?
Final Remarks	● Is there something that you expected me to ask me but I haven't? ● Do you have any final questions? ● Thank the expert for participating in the interview.

Appendix C

Final Themes (Selective Codes)	**Axial Codes**	**Open Codes**
Key stakeholders	Tech firms	● Tech companies providing infrastructure ● Meta as a big player ● Microsoft as a big player ● Google as a big player ● Apple as a big player ● Power of gaming tech companies ● Unity as a big player ● Epic Games as a big player
	Users	● Users playing decisive role in the future of the metaverse ● Social adoption by users necesseary for success of metaverse
	Fashion brands	● Role of fashion brands in shaping future of metaverse ● Fashion brands trying to enter metaverse
	New disruptive players	● Emergence of new metaverse companies ● Metaverse creating opportunities for small creators
	Regulatory bodies	● Need for regulations ● Current lack of regulations ● Regulations coming always late in tech
Main uncertainty 1: interoperability	Collaboration between entities co-building the metaverse to enable interoperability	● Companies unwilling to agree on common standards ● Hope for companies to collaborate ● Lack of hope for companies to collaborate
	Level of technological developments enabling interoperability	● Importance of technology in enabling interoperability ● Technology being already good enough ● Current technology being not advanced enough yet ● Doubts about future technological developments ● Current technological constraints
	Role of	● Blockchain as a key for metaverse

	blockchain in enabling interoperability	● Ensuring safety through blockchain ● Decentralization through blockchain ● Blockchain democratizing metaverse ● Blockchain enabling transparency ● Cryptocurrencies enhancing seamless transactions
Main uncertainty 2: mass adoption	Accessibility issues	● Issue with access to hardware ● Unequal access to metaverse ● Importance of giving equal access to metaverse ● Importance of ease of use ● Access to the metaverse through basic devices
	Lack of trust	● Current lack of trust in technology ● Actions of companies that cause lack of trust ● Bad reputation of tech companies ● Narrative has to change
	Lack of necessity	● Metaverse as an add-on to life, not necessity ● Need of social pressure to engage in the metaverse to go mainstream ● Current lack of pressure
Usability trends: digital fashion products and their possible uses	Digital self – a medium for interaction with virtual fashion	● 3D avatar as a medium for interaction ● Digital copy of yourself ● Avatar as a universal ledger of digital identity ● Avatar acting as an email nowadays
	Virtual try-ons	● Trying clothes on your avatar ● Trying clothes on real-self through AR ● Trying clothes on pictures ● Wearing digital clothes on social media ● Trying clothes on e-commerce sites ● Fit-and-size through AR ● Wearing digital clothes on video conferencing platforms
	Storing objects in digital wardrobes	● Digital wardrobes / closets / storages / wallets / libraries ● Manipulating objects within digital libraries ● Storing many objects in one virtual space ● Exchanging objects between libraries

	Product customization	● Customizing digital gatments ● Changing patterns ● 3D design tools ● Digital customization as a more sustainable option
	Use of digital twins of physical products	● Digital counterparts of physical products ● Physical counterparts of digital products ● Crossover between physical and digital worlds ● Digital-only products that never go physical ● Digital-only being more sustainable
Aesthetic trends: new aesthetic era.	Redefinition of aesthetics	● Fashion unrestrained by physical limitations ● Aesthetics in the metaverse still resembling real-life fashion ● Lack of limitations to human form ● Redefinition of what fashion product means
	Co-creation of aesthetics	● User as a (co)creator ● Dialogue between users and designers ● Role of designers still important in digital fashion ● Breakthrough character of incorporating users into creation process
	Data-driven design	● Role of artificial intelligence ● Integration of consumer data in design ● Recommendations based on historical data of a user ● Data derived from IoT devices ● Aesthetics created under the influence of a mix of data, designers, and users' choices
Engagement trends: Enhancing engagement in the metaverse	Community building	● Social engagement being the most important driving force of the metaverse ● Expressing affiliations to groups through fashion ● Engaging in social events in metaverse ● Meeting with friends in metaverse ● Exclusive social clubs in the metaverse
	Engaging in identity building through digital fashion	● Custom identity building through fashion ● Expressing yourself through fashion ● Possibility of expression without limits as in real life ● Being someone else in the metaverse

	NFTs: virtual clothes, real value	● Financial value luring users to engage in metaverse ● Digital objects as collectibles ● True ownership of digital assets ● Utility value of digital goods ● Monetary value of NFTs ● Luxury value of digital clothes
	Sensory engagement	● Haptic technologies ● Doubtful availability of haptic tech in the future ● High-quality visuals ● High-quality audio ● Other ways to engage users' senses