ARCADA

Digital transformation.

How can it provide the most value to fashion brands while enabling sustainable change?

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Abstract:

This research project aims to assess how the digitalization of fashion can contribute to the sustainable development of the fashion industry, in line with the UN Agenda 2030. It seeks to determine how digital fashion can provide the most value to fashion brands focused on efficiency and growth, while enabling genuine sustainable change. Web3 technologies, enabling real-time community connectedness, provide an ideal environment for collaborative fashion creation, which can help brands optimize problematic large-scale physical production volumes. However, the uniqueness of these technologies poses challenges for the full understanding and adoption of them by non-technology professionals. In the prevailing managerial climate, this can lead to a centralized profit-driven approach, emphasizing the monetary value of digital fashion over its other material values. Qualitative research methods were used to gather the data for this study, including a literature review and a netnographic observation during Metaverse Fashion Week 2023, as well as a post-event social media analysis. The research confirms that due to the underdeveloped interoperability of Web3 worlds, the NFT route is currently a precarious solution. Nevertheless, when integrated into fashion brands' design, production, marketing, and sales processes, digital 3D fashion shows the potential to drive long-term growth while contributing to sustainable transformation. This necessitates the interactive involvement of all stakeholders in the open internet. For equal participation in the co-creation of a decentralised internet, technology companies must provide comprehensive Web3 education to less technology-savvy users, including media, organisations, and individuals. This emphasizes the role of DAOs in promoting equity among individuals and simultaneously fostering economic development during Web3's ongoing development stages.

Keywords: Digital 3D fashion, Web3, sustanable development, UN Agenda 2030

Lärdomsprov

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Digital transformation. Hur kan det ge mest värde för modevarumärken och samtidigt möjliggöra hållbar förändring?

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Detta forskningsprojekt syftar till att undersöka på vilka sätt digitaliseringen av mode kan bidra till en hållbar utveckling av modebranschen, i linje med FN:s Agenda 2030. Syftet är att fastställa hur digitalt mode kan ge mest värde till modevarumärken som fokuserar på effektivitet och tillväxt, samtidigt som det möjliggör verklig hållbar förändring. Web3-teknik, som möjliggör uppkoppling och samarbeten i realtid, utgör en idealisk plattform för kollaborativt modeskapande, vilket kan hjälpa varumärken att optimera problematiska storskaliga fysiska produktionsvolymer. Men eftersom dessa tekniker är så unika är det svårt för icke-tekniker att förstå och använda dem fullt ut. I det rådande chefsklimatet kan detta leda till en centraliserad vinstdriven strategi, som betonar det monetära värdet av digitalt mode framför dess andra materiella värden. Kvalitativa forskningsmetoder användes för att samla in data till denna studie, inklusive en litteraturgenomgång och en netnografisk observation under Metaverse Fashion Week 2023, samt en analys av sociala medier efter evenemanget. Forskningen bekräftar att NFT-vägen för närvarande är en osäker lösning på grund av den underutvecklade interoperabiliteten mellan Web3-världar. När digitalt 3D-mode integreras i modevarumärkenas design-, produktions-, marknadsförings- och försäljningsprocesser har det dock potential att driva långsiktig tillväxt och samtidigt bidra till en hållbar omvandling. Detta kräver ett interaktivt engagemang från alla intressenter på det öppna internet. För att alla ska kunna delta i skapandet av ett decentraliserat internet måste teknikföretagen tillhandahålla omfattande Web3-utbildning för mindre tekniskt kunniga användare, inklusive media, organisationer och privatpersoner. Detta understryker DAO:ernas roll när det gäller att främja rättvisa mellan individer och samtidigt ekonomisk utveckling under Web3:s pågående utvecklingsfaser.

Nyckelord: Digital 3D-mode, Web3, hållbar utveckling, FN:s Agenda 2030

Opinnäyte

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Digitaalinen muoti. Miten se voi tuottaa eniten arvoa muotibrändeille ja mahdollistaa samalla kestävän muutoksen?

Arcada Ammattikorkeakoulu: Media Management, 2023.

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Tämän projektin tavoitteena on selvittää, miten muodin digitalisoiminen voi edistää muotiteollisuuden kestävää kehitystä YK:n Agenda 2030:n mukaisesti. Se pyrkii selvittämään, miten digitaalinen 3D-muoti voi tuottaa eniten arvoa tehokkuuteen ja kasvuun keskittyville muotibrändeille, samalla mahdollistaen kestävää muutosta. Hajautetut Web3-teknologiat tarjoavat reaaliaikaisine yhteisöllisine yhteyksineen ihanteellisen alustan muodin yhdessä luomiselle, mikä voi auttaa brändien ongelmallisen suurien fyysisten tuotantomäärien optimoinnissa. Kyseisten teknologioiden ainutlaatuisuus voi olla haaste vähemmän teknologiataitoisille, jotka saattavat kohdata vaikeuksia niiden ymmärtämisessä ja omaksumisessa. Tämän päivän johtamiskeskeisessä ilmastossa se voi johtaa keskitettyä hyötyä tavoittelevaan lähestymistapaan, painopisteenä digitaalisen muodin rahallinen arvo, sen muiden materiaalisten arvojen sijaan. Tutkimusaineiston keräämiseen käytettiin laadullisia tutkimusmenetelmiä, sisältäen kirjallisuuskatsauksen ja netnograafisen tutkimuksen Metaverse Fashion Week 2023 -tapahtumassa, sekä tapahtuman jälkeisen sosiaalisen median analyysin. Tutkimus vahvistaa, että Web3-maailmoiden keskeneräisen yhteentoimivuuden vuoksi keskittyminen muoti-NFT:eiden tuottamiseen on tällä hetkellä epävarma ratkaisu. Sen sijaan muotibrändien suunnittelu-, tuotanto-, markkinointi- ja myyntiprosessien täysi digitalisoiminen voi edistää pitkän aikavälin kasvua ja samalla kestävää muutosta. Menestys edellyttää brändeiltä interaktiivista työskentelyä avoimessa internetissä, yhdessä kaikkien sidosryhmien kanssa. Jotta hajautetun Web3:n edelleen kehittäminen toteutuisi tarkoituksellisesti, teknologiayritysten on tarjottava kattavaa ja tasavertaista Web3-koulutusta vähemmän teknologiataitoisille käyttäjille, mediat, organisaatiot ja yksilöt mukaan lukien. Tässä korostuu myös hajautettujen autonomisten organisaatioiden (DAO) rooli yksilöiden välisen tasa-arvon ja maailmantaloudellisen kehityksen yhteisöllisenä edistäjänä.

Avainsanat: Digitaalinen 3D-muoti, Web3, kestävä kehitys, YK:n Agenda 2030

Figures

Glossary of Terms

AI (Artificial intelligence) is intelligence demonstrated by machines. It is a tool for amplifying the human ability to learn and to reason, to generalize, and to infer meaning.

AR (Augmented reality) is an integration of computer-generated content with the user's real-life environment in real time. It is achieved through sensory stimuli via holographic technology and experienced with mobile phones.

Assets are blockchain-based non-fungible tokens, e.g., digital art, music, videos, and other forms of media, virtual real estate, in-game items, and collectables.

Avatar is a figure representing a person in a video game, virtual world, or social media.

Bitcoin is the very first cryptocurrency and blockchain.

Blockchain is a shared, unchanging digital database that facilitates the safe recording of transactions and tracking of tangible and intangible assets in a business network. Based on mutual trust it has no central authority, I.e., middleman. Blockchains are the core technology for building cryptocurrency protocols.

B2B means business to business.

B2C means business to consumer.

Centralized authority and control are in the hands of selected decision-makers, e.g., banks and governments.

Cryptocurrency is a borderless and secure digital currency maintained by blockchains that the **native coins** (Bitcoin, Ethereum, Polygon, etc.) are built on.

DAO (Decentralized Autonomous Organization) is a self-managed, blockchain-based institution that retains no central authority and is fully transparent. It is based on an open code structure. Its members have tokens that allow it to subsidize various operations and initiatives throughout the DApp.

DApp (Decentralized Application) is an open-source application that resides on the blockchain, e.g., Decentraland.

Data is internet user's personal information such as name, age, location, interests, browsing history, device usage, purchasing habits, etc.

Decentraland Mana is Decentaland's own, fully decentralized cryptocurrency for buying and renting plots of land.

Decentralized means a distributed peer-to-peer network that has no control of centralized authority.

DeFi (Decentralized Finance) is a model for organizing and enabling cryptocurrency-based transactions, exchanges, and financial services without the authority or control of middlemen.

Digital fashion is digital fashion made of code, not fabric.

Digital 2D fashion is a digital fashion illustration either drawn manually and scanned to a computer or created with illustration and image editing software. It can be added and edited on anyone's photo which can be shared, for example, on social media.

Digital 3D fashion is 3D rendered clothing and accessories made with 3D modelling software. It is viewed in 360 degrees in which the volume of clothes is revealed, and they move and bend. Digital 3D fashion as AR filters can be integrated with the user's body in real-life environment videos and worn by avatars in virtual worlds.

Digital twin is a virtual model of a physical object.

Eco-fashion is clothing and accessories produced by methods that are not environmentally harmful. It involves materials from renewable sources and sustainable resources, efficient waste management, recycling, use of renewable energy, carbon-neutral shipping, transparency, and fair working conditions.

Emote portrays an avatar's emotion theatrically. Among other things, it can be a little dance, hands clapping, or a wave.

Ethereum is a public blockchain that serves as a foundation for Dapps.

Fast fashion is inexpensive, trendy clothing and accessories mass-produced at a rapid pace for high demand that catwalk and celebrity culture influence.

Functional wear includes clothing pre-defined for particular performance or functionality. Such are workwear, uniforms, and smart wear.

Gas is a transaction fee or a smart contract execution fee on the Ethereum blockchain. It depends on the transaction's complexity and how busy the network is.

Haute Couture is the creation of exclusive custom-fitted fashion, originally produced primarily in Paris.

IRL (in real life)

Legacy designer/ brand is an ageing designer/ brand staying relevant by continually modernizing his/ her/ its manufacturing and building new around its original signature item. For example: Chanel's little black dress or Burberry's trench coat.

Metaverse I.e., real-time 3D social media is a networked online space with digitally continuing environments that people explore as avatars for synchronous interactions and experiences. The shared virtual space is accessed through virtual reality, augmented reality, game consoles, mobile devices, or traditional physical computers.

Mining is the process of verifying transactions, organizing them into blocks, and at last saving blocks to the blockchain by **miners**, people who carry out the process.

Minting is creating a fungible or non-fungible token on a blockchain through a Proof-of-Stake protocol.

NFT (Non-fungible token) is a digital certificate of authenticity used to assign and verify ownership of a unique digital or physical asset. Unlike fungible tokens, NFTs are not interchangeable with one another.

Open-source means open and public. It is accessible to all to view, audit, and alter.

Phygital is physical + digital.

POAP (Proof of Attendance Protocol) is an Ethereum-based app that helps event organizers give out attendance badges in the form of minted NFTs. Recipients can use POAP badges to

show proof of attendance at a physical or virtual event and to unlock a variety of benefits and experiences post-mint, including access to group chats, discounts, and tickets for future events.

Polygon Mana coins are used in Decentraland for publishing and buying wearables, skins, emotes, and names.

PoS (Proof-of-Stake) protocol is a validation protocol for newer **Altcoins (any other coins than Bitcoin).** Equipment and energy wise it is faster and lower cost than the **PoW (Proof-of-Work)** protocol that, for example, Bitcoin uses.

Protocol is the foundational software layer of a program. Protocol has become a general term used to refer to both layer 1 blockchain networks and the layer 2 applications built on top of them.

ReFi (Regenerative Finance) is a concept that combines financial practices, social responsibility, sustainability, and regeneration to support the growth of an economic system by emphasizing social well-being, economic prosperity, resource sustainability, restoration, and renewal.

Salesman samples (SMS) are made for selling physical fashion collections to retailers and other B2B customers.

Skin is a one-piece aesthetic look of an avatar in a virtual context.

Slow fashion is a movement that encourages the production and consumption of eco-fashion e.g., clothing and accessories that are environmentally friendly and support the livelihoods of artisans and makers.

Smart contract is a self-executing code deployed on a blockchain. It allows transactions to be made without middlemen expecting the parties involved to trust one another. In the fashion industry, they are used, among others, in supply chain management and stocktaking.

Token is a digital asset created on an existing blockchain, transferred from one party to another, following certain rules defined by their creators. They are used to power DApps.

Transaction is data written to a blockchain. It to be considered valid and be added to a block a certain number of nodes must verify it.

Venture Capital (VC) is financial backing provided to entrepreneurs and companies through capital financing, technological expertise, and/ or managerial experience to spur high-growth innovation.

VR (Virtual reality) is the use of computer technology to create a simulated environment that can be explored in 360 degrees. It is used for example in remote co-creation of fashion show sets.

VR headset is worn in virtual worlds for immersive experiences in VR video games and other applications including simulators, trainers, and co-creation apps.

Wallet is a software application or hardware device that stores the private key that proves ownership of a digital asset.

Wallet Address I.e., public key is the address for a blockchain wallet, like a bank account number, knowing which the other users can send digital assets to one's wallet.

Wearable is a piece of clothing and accessories worn by an avatar.

Web1 is the first version of the web I.e., the *read-only web* with no user interaction or user-generated content.

Web2 I.e., **the** *read-write web* made possible the user-generated content and improved user experience and interoperability between different applications and websites (blogs, Wikipedia, YouTube, social media).

Web3 I.e., emerging *read-write-own web* pushes forward blockchain technology, open-source applications, and the decentralization of data and information. Its main objective is to return ownership of user data from big technology companies to its users.

Contents

1. INTRODUCTION

The fashion industry wrestles with multifaceted issues related to the sustainability of environmental, social, and governance aspects. According to a report by the Ellen MacArthur Foundation (2023), fashion sales units doubled between the turn of the Millennium and 2015. However, their utility decreased by 36%. The rapid growth of e-commerce and online retailers offering free returns within timeframes extending up to 100 days have brought the fashion return rates up to an astonishing 50% (Butler, 2022). Coupled with brands' practices of destroying returned and unsold stock in efforts to protect their brand image it results in annual losses of approximately USD 500 billion, impacting both the environment and businesses (Mulhern, 2022).

Van Heugten (2023) and Rosso (2023) contend that it is nearly impossible for a fashion business to be 100% sustainable. The difficulty arises from the fact that the available resources, both human and natural, are often exploited in the service of growth. Moreover, the attractive appearance disguising sustainability is often maintained through governmental initiatives aimed at environmental protection, which, upon closer examination, reveal themselves to be less environmentally conscious than they appear. It is rooted in the values of regulatory bodies aligning with the industry interests rather than the objectives of organizations striving for transformative change (Jermier & Forbes, 2003, 164-165). As an example, Van Heugten (2023) draws attention to the American outdoor fashion brand Patagonia. While the brand is widely recognized for its commitment to sustainable development it is worth paying attention to the fact that their production happens in the same factories utilized by some of the most notorious fast fashion brands. Additionally, the relocation of Patagonia's offices can be interpreted as a strategic move to countries with lower taxation. Both raise questions about the company's true sustainability intentions.

Side by side with the circular economy business model Ellen MacArthur Foundation (2021) proposes a concept of digital 3D fashion production and consumption in virtual environments as a solution to the problems caused by unsustainable fashion. It posits that by purchasing, renting, and circulating digital fashion pieces as non-fungible tokens (NFTs) within the context of social media content creation, a significant reduction in the volume of textile waste can be achieved. Under this model brands can rent out or gift digital fashion items to social media

influencers, who frequently wear clothing once for their online presence, subsequently rendering the physical items unwanted.

In addition, the Ellen MacArthur Foundation advocates for brands to create and showcase their expensive sales samples in digital formats, which would reduce or fully remove the need for them. In recent years, many fashion brands have responded to this call and started integrating digital technologies into their operations. However, the digital fashion movement gained momentum not until the advent of the first-ever Metaverse Fashion Week, held in March 2022, and many brands joined it primarily to make an impression as early adopters, lacking a comprehensive strategic approach (Hirschmiller, 2023). Today their metaverse presence is stagnant.

Those, who had a strategy may have taken the opportunity to capitalize on the early hype for additional revenue streams (Ginsburg, 2022). A notable example is Nike, who made USD 185,000,000 in just a few minutes by selling their 20,000-pair collection of virtual sneaker NFTs. The average price for a pair was USD 5 000-130 000 and it can be worn in Nike's own, closed metaverse world or used as a social media Snapchat AR filter (Jimenez, 2022). Additionally, a demand for physical copies arose, and Crypto Kicks iRL was introduced. (RTFKT, 2023)

Another example is American art collective MSCHF's pair of Big Red Boots inspired by a famous cartoon character and crafted from TPU rubber and EVA foam. Initially designed for digital screens only, these playful boots gained huge popularity thanks to social media influencers. The unexpected demand inspired MSCHF to produce a physical batch, which sold out within minutes at a price point of USD 350 a pair. Over the following few days, the boots were reselling at USD 1000 (Jana, 2023). Five months later, MSCHF collaborated with Crocs, a popular high-street brand, releasing a new physical version of their cartoonish boots. This collaboration gathered significant attention, with celebrities endorsing the product across social media platforms. However, despite the initial hype, recent reviews of the MSCHF x Crocs collaboration have not been particularly favourable (Bramley, 2023).

The original physical batch may have generated substantial profits for both MSCHF and resellers, giving the boots a statement piece status. Nevertheless, the inherent incompatibility of their design with everyday physical wear and the transformation into fast fashion through

collaboration with a major high-street brand raises sustainability concerns. Even though the Nike Krypto Kicks iRL, with a more traditional shoe style, may offer a potentially more sustainable option it is essential to critically assess Nike's strategy, considering the sneakers' high price.

1.1 Purpose, Objectives, and Methodology of the Study

Both Nike's and MSCHF's operations suggest that they may be driven by a pursuit of extra profits rather than a genuine commitment to sustainability. It gives rise to the question that warrants further investigation: Can digital fashion truly help the sustainable development of the fashion industry?

This thesis work intends to find solutions, so a simple *yes* or *no* response falls short. For businesses, profit growth is of paramount importance. To offer a meaningful digital 3D fashion value proposition for fashion brands grappling with their sustainable development strategies, it answers the question:

1. How can digital 3D fashion provide the most value to fashion brands while enabling genuine sustainable change?

This thesis focuses on two main topics: sustainable fashion and digital 3D fashion. To address the research question, it is imperative to first gain familiarity with the fundamental concepts, encompassing both physical and digital 3D fashion, sustainable fashion development, and Web3. Given that digital 3D fashion is a relatively emerging field of study, this thesis aims to conduct an in-depth exploration of its material aspects and environment. This journey will be guided by the supporting research questions:

1.1. Which materialities of digital 3D fashion support sustainable development?

1.2. Which features of Web3 affect sustainable development?

Qualitative research methods were applied in this thesis. Fashion industry and Web3 knowledge were drawn from the author's own experience, earlier research, webinars, conferences, course materials, social media, and fashion and industry articles. Furthermore, the author immersed herself into the digital 3D fashion creator and consumer communities within two Web3-enabled metaverse worlds, decentralized Decentraland and centralized Spatial,

aiming to provide a more realistic picture of them beyond the realm of marketing hype. The immersive study took the form of netnographic observation that was conducted throughout the Metaverse Fashion Week 2023. Data collection was complemented by a selection of digital fashion reviews from creators, consumers, and media outlets. Lastly, reflexive thematic analysis of the collected data was conducted to find new insights and patterns within the phenomenon.

Stevenson (2023) has conducted an extensive study of digital fashion and its sustainability, albeit from a Web2 social media consumption viewpoint. Kirjavainen's (2022) study focuses on the benefits of fashion NFTs for luxury fashion brands and how to successfully implement NFTs in the brand's business model. Similarly, this thesis emphasizes the advantages of digital 3D fashion for fashion brands but is motivated by the research gap: its efficiency as a process tool within the industry and collective activities towards the United Nations 2030 Agenda for Sustainable Development goals.

Accessibility is promoted as a highly empowering element concerning the social sustainability of fashion. To test it the netnographic observation was conducted by using basic devices, an 8-year-old MacBook Pro connected to 4G wi-fi, a regular mouse, and a mobile phone. The deliberate choice to personalize one's avatar using freely available wearables, and hair and beauty styles provided the author with an opportunity to examine the effect of low-budget participation on consumers.

Rather than producing lots of new knowledge this thesis work primarily gathers scattered insights from the World Wide Web into a cohesive resource. Its objective is to provide less technology-savvy individuals and organizations with a solution-centred comprehension of the material value aspects of digital 3D fashion within the framework of sustainable development. This understanding can shape people's attitudes and behaviours in a manner that bolsters both sustainability and economic growth for both current and future generations. Armed with this knowledge, they can collectively play a role in steering the fashion industry toward sustainable transformation.

Considering the fast pace of fashion and technology development knowledge is drawn from industry sources no older than five years. For the same reason, there are lots of opportunities for further research in the digital 3D fashion field. They're discussed in the concluding chapter.

1.2 Structure of the Study

This thesis is structured in 5 main chapters. The first is the Introduction which presents the background of the study and defines its purpose, objectives, research questions, and limitations. The second chapter makes the reader familiar with the main concepts of the work: physical fashion, sustainable development, Web3, and digital 3D fashion. The third chapter introduces the theoretical framework and research methods used in this work. Chapter 4 analyzes and discusses the research findings from the perspective of sustainable development reflexively. The last chapter concludes the thesis with key findings and the non-numeric value proposition of digital 3D fashion for fashion brands.

2. CONCEPTUAL FRAMEWORK

2.1. Physical Fashion

Physical fashion encompasses garments and accessory pieces made from textiles and related goods. The materials include natural fibres derived from plants and animal hairs, synthetic fibres made from petroleum products, as well as animal hides, plant-based or synthetic leathers, rubber, and metals. It is worn in real life and showcased through runway shows and visual content in digital 2D and print media (Blaazer, 2022).

The fashion industry produces collections comprising different types of garments, allowing for a diverse range of fashion looks. Typically, brands produce 2-4 seasonal collections each year, with the spring-summer and fall-winter collections being the most common. If four annual collections are produced the additional ones are referred to as *pre-spring* or *high summer* and *pre-fall* collections. Seasons shape the pace and rhythm of the global fashion year. The spring-summer collection is delivered to shops within the first quarter of the year. It goes on sale in July, making way for the arrival of the autumn-winter collection. The sale for the autumn-winter collection starts typically after Christmas and continues for one month. This implies that fashion collections have a limited shelf life (Blaazer, 2022).

Fashion brands produce unique collections, distinguished by variations in quality, fit, colours, and materials. Each collection is guided by a comprehensive plan informed by the former year's performance data and feedback from retailers. The plan outlines garment styles, colour variations, prints, the number of stock-keeping units (SKUs), and the delivery schedule to retail

stores. The new collection is a mix of commercial easy-to-sell basics, signature styles that represent brand classics, and trendy items. Many brands have adopted a strategy of delivering monthly drops aligned with meteorological seasons. It enables retailers to frequently present new things to consumers (Blaazer, 2022).

The intense competition within the fashion industry leads brands to operate behind closed doors until the collections are ready for public release. The forthcoming sub-chapters provide an in-depth exploration of the creative process unveiling the journey from design inspiration to the presentation of garments on the rails of retail stores.

2.1.1. Design Process

Fashion collections draw inspiration from runway shows, renowned brands, vibrant streets of fashion capitals, trend forecasts, insights from colour institutions, and the introduction of new fabrics. This creative process often involves some travel, including visits to fabric trade shows and agencies to source materials. Twice a year, designers view the latest collections from fabric and trimmings suppliers and order small sample pieces with colour cards for evaluation. Afterwards, mood boards are crafted, inspired by a distinctive theme or storyline that guides the creative process. During this stage, many brands send the ordered fabric samples to the brand's laboratory for comprehensive testing. These tests typically include evaluations for durability, shrinkage, and pilling.

In the design phase detailed designs emerge, including fabrics, colors, and shapes for each item. The sketching process unfolds both on paper and using 2D design software. Following the design phase, technical drawings are crafted for each style. Additionally, initial patterns with manufacturing instructions are generated to facilitate prototyping. The latter stages are primarily digital processes (Blaazer, 2022).

The physical prototypes are cut and assembled by an in-house sample maker or at a ready-to-wear factory. They serve as tools for brands to assess, improve, and adjust their designs. Human fitting models are engaged in the assessment phase to see how the garments fit, sit, fall, move, and feel when worn. If there's a need for alterations, samples are sent back to the maker or factory for improvements. The fitting process is iterated until the patterns are perfected for production. In cases where the selected fabrics for salesman samples are not yet in production,

similar fabrics with matching fibre composition, weight, and weave are used in the prototypes and salesman samples.

Expertise in fabric and garment structures knowledge is essential for designers and pattern drafters. It often eliminates the need for the second sample and the prototype serves as the salesman sample. However, when dealing with novel materials, material mixes, and weaves it is important to use the exact material for the salesman sample to accurately represent the final product (Blaazer, 2022).

2.1.2. Fashion Weeks

Trade shows and fashion weeks launch the new seasons for brands and retailers. These events provide a platform for presenting the new collection to professional buyers. To align the marketing with the start of the trade shows the collection must be ready one month before they start. A comprehensive marketing program, including a lookbook complete with editorial-style photos and detailed product and design information for each item, is executed alongside the collection launch. For the high-quality photos, a professional photoshoot featuring commercial fashion models is arranged. Also, the recommended retail price and wholesale price are determined before these events (Blaazer, 2022).

Fashion weeks are biannual events, lasting 4-9 days, where fashion houses present their latest collections to retailers and media through runway shows. Those getting the most media coverage are held in the world's fashion capitals: New York, Paris, London, and Milan, of which New York is the most popular. All fashion weeks encompass both women's and men's fashion shows. Notably, Paris hosts a significant portion of the Haute Couture whereas New York is known for business and sales-oriented shows (Wikipedia, 2023a).

Fashion weeks exclusively cater to industry professionals and individuals with significant media influence. This group includes retailers and e-commerce buyers, editors, stylists, PR managers, Very Important Clients (VICs), celebrities and influencers. Being strictly business-focused events consumers are not granted passes to fashion weeks. While public shows have been introduced in recent years they do not feature the biggest names in fashion, and the availability of highly-priced tickets is limited (Glamobserver, 2023a).

2.1.2.1. Fashion Shows

Runway shows serve as platforms for presenting new looks and trends for the next season. Substantial resources are invested by fashion houses in their shows to stand out and gain the recognition and attention of potential customers. According to Glamobserver (2023b), the expenses associated with a 10-15-minute fashion show can range from USD 200,000 to USD 1 million. The high costs encompass venue rental, production expenses, fees for stylists and models, PR efforts, and media coverage.

The show venue is booked a year in advance due to the fierce competition for the most original locations sought after by brands. Producer companies assist brands in selecting them and designing the show sets. The expertise of production teams guarantees the smooth execution of every detail on the show days, including model timings, choreography, music, and lighting (Glamobserver, 2023b).

Stylists are responsible for sourcing garments and collaborating closely with designers to define the style and direction of the show event. Additionally, they supervise dressers who are tasked with preparing the styles for the show. The role of a stylist coordinating a single show typically spans 10-14 days. Dressers' responsibilities include ironing, steaming, and altering the garments to fit the models perfectly. They also take care of accessorizing the outfits and dressing the models (Glamobserver, 2023b).

The selection of models for runway shows involves casting sessions. For major Fashion Weeks, internationally renowned high fashion models are hired. In contrast, for tradeshows and showroom presentations, local models are usually recruited, helping to manage costs. The expense associated with models varies based on the model agency's rates, the number of models hired, and the level of fame they have achieved. Additional costs such as castings, fittings, and transportation are added on top of it. While hair and makeup for the models are typically provided by the beauty companies that sponsor the fashion shows (Glamobserver, 2023b).

When it comes to attracting, informing, and retaining buying visitors PR and media play an important role. The PR professionals take charge of organizing not only the fashion shows but all sub-events such as press days, store openings, dinners, cocktails, and various social

gatherings. They excel in sending out invitations that make a statement (Glamobserver, 2023b) – pushing creative boundaries with unconventional choices such as Louis Vuitton's wall clock or Balenciaga's iPhone invitations (NSS, 2022), typically reserved for individuals holding substantial value for brands. These individuals are journalists, influential customers, celebrities, VIPs, and influencers who are seated in the front row and offered various perks (Glamobserver, 2023b).

Fashion Week participation is primarily reserved for the top brands of the fashion industry. It is driven by the pursuit of brand recognition and customer acknowledgement. For the participating brands, the most important metric for measuring success in the event is the media impact value (MIV) which assesses the impact of relevant media placements across various channels including paid, owned, and earned media (Glamobserver, 2023b).

2.1.3. Production

The selling season that starts after the fashion shows can lead to alterations in garment designs, based on buyer feedback. The alterations are incorporated into the patterns before pre-production samples are created, serving as guides for the final production process. Once a brand submits a production order to a clothing manufacturer or a workshop that carries out production on its behalf, the production phase begins. The order size is subject to the production country and the manufacturer's capacity. While larger brands may place orders for 500-1000 pieces per item, smaller, emerging brands' orders typically range from 50 to 150 pieces. Fashionable styles are often made in smaller volumes compared to basics or classics, which renders them more expensive to produce. Price agreements are negotiated between brands and suppliers when the production order is placed. The prices are influenced by the order size, the cost of materials, and labour operations. Many manufacturers also enforce minimum order quantities (MOQs) which can add pressure for brands to place larger orders (Blaazer, 2022).

Order quantities are determined after the pre-order phase I.e., trade show sales, and increased by a small percentage to accommodate extra stock for retailers in case an item sells well. The delivery time for production orders typically ranges from 1 to 3 months, the duration being influenced by the order size and the manufacturing location. Brands may have several different manufacturing locations depending on their product range. Initial selection of them along with sustainability assessment involves travel to those locations. Production is often carried out in

China due to the country's reputation for fast manufacturing processes and industry expertise (Blaazer, 2022).

In a ready-to-wear factory, the production process involves dividing garments into various distinct operations. Cutting is performed using patterns that are graded into a range of standard sizes. Before cutting, the fabric is carefully machine-layered on a lengthy cutting table in multiple layers. The patterns are then strategically placed atop the layers, following an economical cutting method to minimize fabric waste. Lastly, all layers are simultaneously cut by using a textile cutter.

Cutting, assembling, and post-processing tasks such as washing the garment, involve manual labor. In a factory, various types of machines are employed for different operations, which makes a garment the result of a large team's collaborative efforts. The amount of labour required for production impacts the final price of the garment. An extra button or a zip, or opting for a slightly higher-priced fabric, can substantially influence the recommended retail price of the product.

Completed production orders are transported to the brand's distribution centres and warehouses all over the world. Orders that are manufactured in Asia for European or American markets involve extensive transportation. The route choices depend on cost considerations, the specific routes to be covered, and the nature of the products being transported - whether the garments can be packed in boxes or if they require specialized handling, such as moving on rails. In the fashion industry timing is important. Therefore, despite its higher cost, air freight is frequently chosen over sea freight due to its faster transit times (Blaazer, 2022).

From the start of the creative process to the garments' arrival in brand outlets and retail stores, approximately a year has passed. Depending on the number of annual collections and collection drops brands may be concurrently working on two to four collections when considering retail sales (Blaazer, 2022). The workload places significant pressure on employees, making additional help highly welcomed when available. In addition to concerns related to the unfair treatment of production labour, the fashion industry has faced criticism for offering unpaid and exploitative designer internships (Do Prado Lima, 2021).

2.1.4. Marketing and Sales

Fashion marketing is a strategic process aimed at advertising clothing and accessories to specific target audiences. Its objectives are sales and profitability boosting and brand awareness building, which are done by consistently delivering a cohesive brand message across different mediums. Marketing relies heavily on research and consumer insights to understand the preferences and behaviours of the target audience, enabling the creation of appealing marketing material. Fashion marketers actively manage the brand image and align it with the desired market positioning. They predict and track trends and establish cost-effective marketing budgets, continuously assessing the success of the campaigns (Jackson & Shaw, 2009).

While fashion brands are heavy users of social media platforms' marketing tools, their engagement with communities remains limited. Rather than fostering a true two-way dialogue aimed at exchanging views and achieving mutual understanding between the brand and consumers, product communication tends to be primarily informative. This means that communication flows in one direction, from the organization to its stakeholders. Alternatively, it involves persuasive two-way communication to gather feedback. In both cases, the organization typically does not change as a result (Cornelissen, 2020, 74-75). This communication often concludes after the point of sale unless issues with product quality and customer satisfaction arise.

Retail plays a key role in minimizing such issues and preventing returns. In physical stores, garments are treated with special care. They are stored and displayed neatly, and inspected to detect even the smallest flaws before they are added to the shelves and rails. Care of displayed items is taken by maintaining the store's cleanliness, dust-free conditions, and protection from direct sunlight. To ensure the displayed garments' optimal appearance they are steamed when wrinkles appear, and refreshing is needed. Frequent routine checks are done for missing buttons, ripped seams, or broken zips and any necessary repairs are promptly carried out. However, the most critical aspect is the provision of expert service to generate sales. Trained sales professionals assist customers in finding styles and fit that suit them best and deliver guidance on garment care. Conversely, in e-commerce stores, customer service is typically limited, and customers often face challenges related to issues such as size, fit, and garment care knowledge. Additionally, customers may encounter unexpected flaws in their items upon unpacking their orders, leading to requests for returns.

The influence of social media and celebrity culture has contributed to a phenomenon where clothing is worn once for online visibility and subsequently returned. This practice is facilitated by the availability of free returns within generous timeframes. An unfortunate consequence of extended return policies is that, given the short shelf life of fashion items, if they are not discarded, returned garments typically find their way into sales, resulting in a significant decline in revenue (Pyy, 2023).

Moreover, the revenue generated by a product typically concludes at the point of sale, despite the potential for significant circular value. Huhtamäki (2023b), the CEO of Emmy Second-hand Clothing Company highlights that GDP (gross domestic product) measures the value of newly sold goods as national wealth while overlooking the value of resold goods. Consequently, despite increasing fashion consumption, GDP decreases with the rise of the circular economy because purchases of second-hand goods are not accounted for in the statistics. GDP regarded as a powerful indicator places greater emphasis on new product sales which receive more media attention overshadowing positive developments in the circular economy.

2.1.5. Waste and Carbon Footprint

The textile industry drives industrialization, trade, development, and societal impact. For instance, New York Fashion Week, a bi-annual event lasting 7-9 days, draws in over 200,000 attendees and contributes USD 900 million annually to the city's economy. The event also creates international job opportunities in buying, design, manufacturing, marketing, and research, resulting in USD 10 million in wages and approximately USD 2 billion in tax revenue (Galo, 2023). However, in contrast, it is responsible for emitting 2-8% of the world's greenhouse gases, consuming around 215 trillion litres of natural water resources and contributing to 9% of microplastics in the oceans. Moreover, as a USD 2.4 trillion global business, it employs 300 million individuals, with 68% being women, who often find themselves in vulnerable positions and subject to exploitation, underpayment, or other forms of abuse (UNEP, 2023c).

The fashion industry's complex supply chains make emissions tracking difficult, complicating sustainability efforts (Ro, 2020). A report by Business of Fashion & McKinsey (2022)

highlights that the production of materials (as depicted in Figure 1), has the most significant climate impact throughout the fashion lifecycle. Following closely behind are fashion retail and consumption.

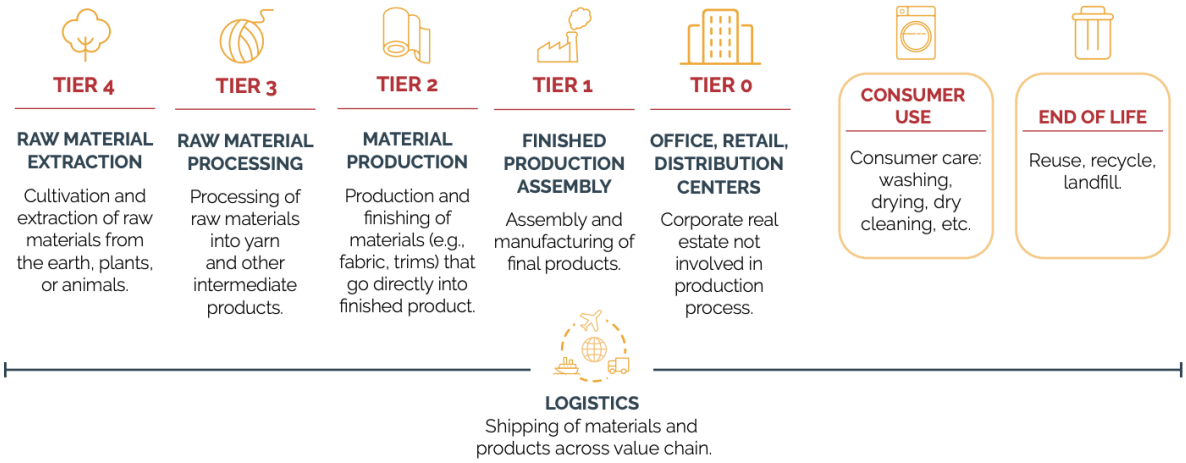


Figure 1. Apparel and footwear value chain. (Sadowski et al., 2023, 13)

For instance, a single pair of jeans demands 1 kg of cotton, equivalent to a decade of one person's drinking water. Processes like bleaching, sandblasting, and pre-washing harm water and aquatic life. Stretchy fibres added for a skinny fit hinder recyclability and worsen environmental effects. Nearly one-third of jeans' emissions arise from fibre and fabric production, with another 24% from jeans production. The remaining 40% results from consumers' washing and eventual landfill disposal (Ro, 2020). Additionally, it is crucial not to overlook the emissions resulting from the transportation of garments (Blaazer, 2022).

Fashion's waste, from design and manufacturing, poses a significant challenge. Recycling and disposal, especially for fast fashion, are costly. French luxury fashion resale pioneer Vestiare, among others, has taken a stand by prohibiting fast fashion items on its platform after witnessing the burden these garments place on African markets and landfills. The burden underscores the wider problems associated with fast fashion, including its effects on the developed world's consumption patterns (Halliday, 2022). Additionally, the intricate and inadequately communicated material compositions of these garments render recycling nearly impossible (Pyy, 2018).

Online shopping can reduce emissions related to shopping travel. However, it is vital to consider the carbon footprint associated with returns (Ro, 2020). Especially, frequent purchases

of single items with free shipping, a practice promoted by some e-commerce giants, can negate the benefits of reduced travel emissions (Niedt, 2023). Furthermore, physical fashion rental and library services, while extending the lifespan of garments, can raise the carbon footprint of circulating fashion due to increased travel for pick-up and drop-offs, along with the need for frequent washing after short-term rentals (Zamani et al., 2017).

Also, the fashion industry's expenditure of approximately USD 1,4 billion on travel for the four main fashion weeks raises concerns about carbon emissions. The data, starting from 2020, reveals that the buyers' and designers' business travel to New York is the top emitter, accounting for 37% of all emissions, followed by Paris (28%), London (18%) and Milan (17%). In total, their travel generates 241,000 tonnes of greenhouse gases (tCO2e), equivalent to the electricity consumption of 42,000 homes in a year. Notably, an individual fashion buyer's annual business travel carbon footprint is 12.1 tCO2e, which is more than twice the average citizen's carbon footprint (Casati, 2020).

2.2. Sustainable Development

The United Nations has mandated the fashion industry to address sustainability in response to fashion's harmful impacts. The 2030 Agenda for Sustainable Development, unanimously adopted by all member states in 2015, aims to achieve global peace and prosperity for both people and the planet, both today and in the future (The United Nations Department of Economic and Social Affairs, 2023). Simply put it is

> ”*development that meets the needs of the present, without compromising the ability of future generations to meet their own needs.* ” *(Sustainable Development Commission, 2023)*

The newly released Sustainability and Circularity Roadmap by the UN Environment Programme addresses the environmental and social impacts of fashion by prioritizing meaningful actions involving all stakeholders while fostering collective participation. Simultaneously, the roadmap promotes the well-being of individuals, economic prosperity, and fairness (UNEP, 2023b).

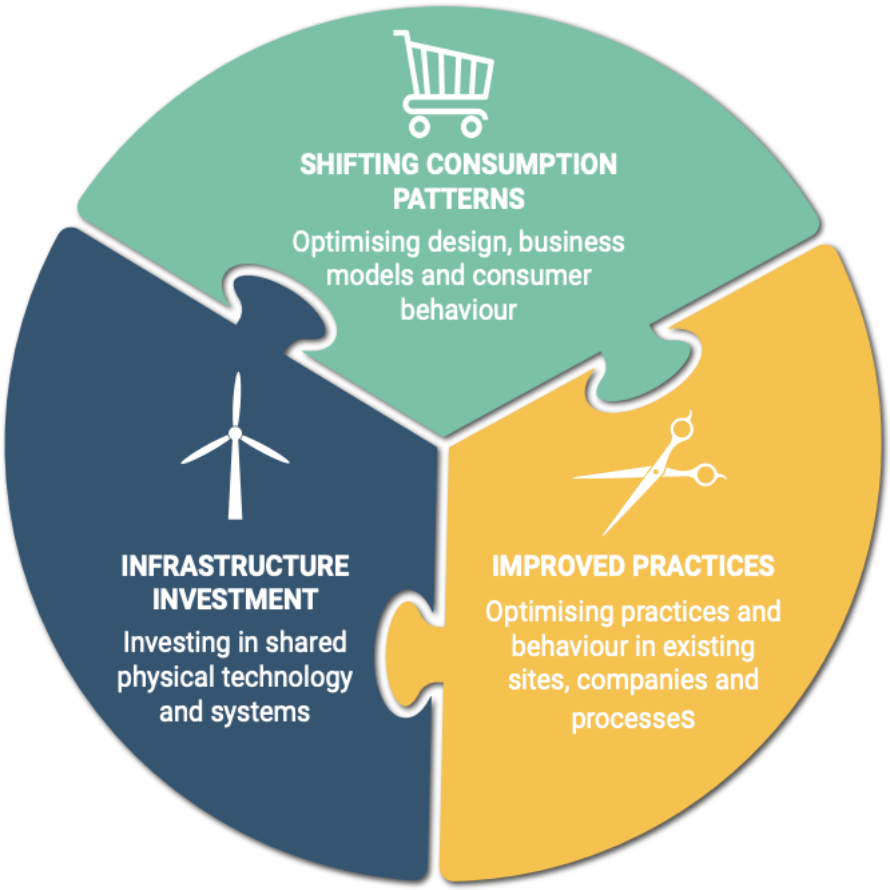


Figure 2. Three priorities to deliver system change in the textile value chain (UNEP, 2023b).

Figure 2 introduces the three key priorities of the transformation agenda toward sustainability and circularity: altering consumption patterns, enhancing practices, and investing in infrastructure. These priorities are closely intertwined and actions in one area can significantly influence actions in another. Consequently, a coordinated, collaborative approach involving all participants along the value chain is essential. The overall goals for the industry encompass achieving net zero emissions of the textile value chain, minimizing freshwater consumption while eliminating water pollution, creating a net positive impact on biodiversity, and committing to an annual investment of USD 30 billion in circular and sustainable textiles (UNEP, 2023b).

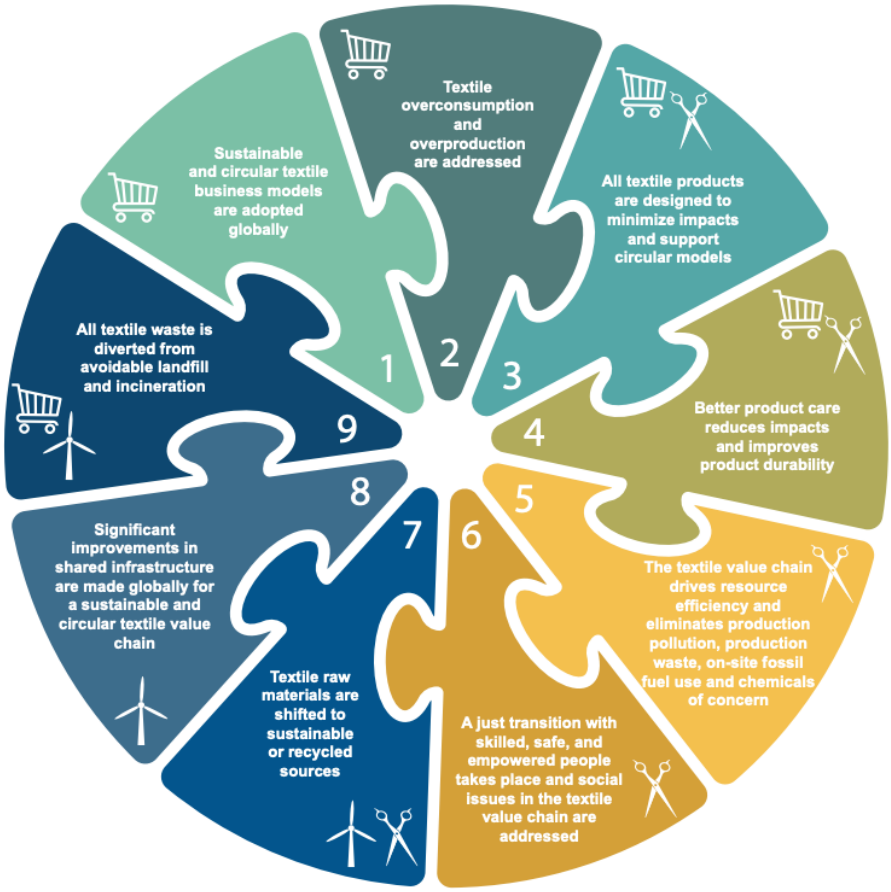


Figure 3. Nine building blocks are needed to deliver the three priorities (UNEP, 2023b).

The nine key factors influencing environmental and socio-economic impacts across the value chain, as depicted in Figure 3, align with the industry's goals. To achieve these goals and optimize results, all stakeholders are urged to engage in collective discussions and initiatives, while also acting within their spheres of influence (UNEP, 2023b).

2.3. Web3

Decentralized Web3, often referred to as Web 3.0, is built on top of centralized and crowded Web2. It is characterized by trustless and permissionless operation structure which replaces reliance on trusted third parties with incentives and economic mechanisms (Ethereum, 2023a). A fundamental goal of Web3 is to grant users sovereignty and ownership over their data, entitling them to rights and credits when sharing their data. It fosters co-creation and collaboration and provides tools for creator equity recognition. Moreover, Web3 is designed to be accessible to everyone, offering opportunities for collective wealth creation, but it also

demands shared responsibility (Hoppenbrouwer-Pereira, 2023). To give a better understanding of Web3's significance, the next chapter explores its evolution.

2.3.1. Evolution

According to Cassat (2022, 4-6), for three decades following its inception in the 1960s, the Internet primarily served the purposes of government and university researchers. It was in the 1990s that Tim Berners-Lee, the inventor of the World Wide Web, introduced it to the public. The initial iteration, known as Web1, provided a set of tools for creating and accessing web pages with text, images, and clickable links to other documents and resources on the global network. Its engineers held the belief that open, decentralized networked systems could give life to vital social and scientific knowledge while fostering a more equitable distribution of power. Web1 had a profound impact by substantially increasing both the quantity and quality of accessible information, thereby democratizing its availability to a wider audience.

However, Web1 was not designed for decentralization in the eyes of entities like governments who sought to maintain control. It also lacked the capability for decentralized file storage across multiple servers. As the internet became more widely accessible and the number of websites grew rapidly, discovering relevant content became a daunting task. To address the challenge, young engineers started creating closed spaces to enhance internet usability for everyday users. Notably, they established directory websites, like Yahoo and Google offering lists of links for easy navigation. Additionally, social networking platforms such as Facebook emerged to fulfil the human desire for self-expression and connection, and e-commerce giants also joined the fray (Cassat, 2022, 5-9).

The year 2004 marked an important moment when Web2 came into existence, characterized by interactivity, centralization, support of user-generated content, and mobile-friendliness (Ethereum, 2023a). Subsequently, the same young engineers who had contributed to the open internet's growth faced commercial pressures as their companies expanded and attracted investments from venture capitalists. Instead of relying on user subscription fees, these companies turned to user data as a more efficient means of generating shareholder value; products that could be marketed to third parties. In the race for profit, social consequences were overlooked (Cassat, 2022, 9-11).

Blockchain technology which forms the foundation of the decentralized Web3, seeks to address the shortcomings of Web2 by repositioning the users within the value ecosystem. Its origins trace back to Bitcoin, the first-ever blockchain and digital currency powered by a distributed ledger. This ledger constantly updates with records of addresses, each associated with a wallet protected by public-key cryptography. In this system, when Bitcoins are sent between publicly visible addresses, the wallet's owner validates access using a private key, akin to a password. The essence of Bitcoin's security lies in its immutable and transparent nature. Every time a new transaction occurs, I.e., Bitcoin blockchain processes a new block, Bitcoin adds it to the ledger, and the nodes on the network collectively verify the transaction. Building on top of the existing blocks, and modifying data within a block is extremely challenging, as it would require changing all the blocks that come after it in the chain (Cassat, 2022, 12-19).

The security of Bitcoin transactions is safeguarded through a mechanism known as an incentivized, common goal-oriented transaction processing mechanism, referred to as block mining. The process involves computers running nodes of the network utilizing their computational power to solve complex mathematical problems with each new block. Coupled with the need for numerous computational iterations, the complexity of these mathematical problems makes each block exceedingly challenging to replicate. Consequently, the falsification is extremely low. Any attempt to tamper with a block would be quickly overruled by the consensus of the other nodes in the network motivated by the miner incentive, new bitcoins as a reward (Cassat, 2022, 19).

To enhance the capabilities of the Bitcoin network capabilities innovators began exploring ways to build upon and alongside it. Notably, Canadian scientist Vitalik Buterin envisioned a decentralized blockchain that could do more than just facilitate Bitcoin transactions. He took the initiative to create an entirely new blockchain called Ethereum, complete with its native currency called ether. Ethereum, launched in 2015, extended beyond Bitcoin's functionalities, enabling developers to upload and execute programs on the network for a wide range of applications – build anything that involves value in a digital context. Ether is used to pay gas (transaction) fees which prevent the network from becoming overloaded and sluggish due to the sheer volume of transactions. Ethereum's flexibility and capabilities have led to the emergence of various innovations, including tokenization (digital artefact functionality programming), decentralized applications (dApps), decentralized finance (DeFi), decentralized

autonomous organizations (DAOs), non-fungible tokens (NFTs), and Web3-enabled metaverse worlds. These features make it a powerful tool for constructing a transparent, efficient, fair, and inclusive virtual economy, harnessing the vast online communities that Web2 has brought to the internet (Cassat, 2022, 23-26).

2.4. Digital 3D Fashion

Digital 3D fashion represents the fusion of fashion and technology. Its unparalleled freedom of self-expression and liberation from real-life utilities and traditional creative constraints sets it apart from physical fashion. It promotes inclusivity by accommodating individuals regardless of their abilities, body types, sizes, ages, genders, classes, nationalities, and races (Ginsburg, 2022).

2.4.1. Design, Production, Marketing and Sales

The creation and visualization of digital 3D fashion involve the use of 3D modelling software. A notable option is the freely available open-source Blender among a wide selection of easy-to-use, subscription-based solutions accessible to creators and users with regular computers (Ginsburg, 2022).

Before starting the virtual creation process, physical materials, including patterns and fabrics, are digitized. These materials are transformed into 3D versions using a fabric material scanner and subsequently imported into the software. The creative process itself resembles the traditional physical fashion design process, where patterns are crafted by draping the fabric on a fitting model. To facilitate this, a 3D avatar is required. Many software options provide default avatar models to choose from, but custom avatars can also be imported. The imported patterns are then positioned around the avatar, stitched together, and simulated to form the clothing. Finally, the 3D fabrics are applied to the clothing. (TG3D Studio, 2021).

Digital fabric libraries continue to expand, and with the integration of VR and tactile rendering, the visual and haptic assessment of textiles is more immersive. This obviates the necessity for physical fabric samples, further streamlining the digital fashion experience (Periyaswamy & Islam, 2022; Paldanius, 2022).

The integration of digital 3D modelling in the fashion industry enhances efficiency. Handbag designer Rebecca Minkoff reveals a 27% increase in conversions only after testing the 3D technology (Browzwear, 2023). Digital 3D modelling allows designers to view products from any angle and experiment endlessly with colours, textures, prints, and sizes within computer software. Furthermore, designers can cater to B2B customers by providing them with a broader range of choices and the opportunity to propose digital alterations before physical production commences. Premium lifestyle brand Tommy Hilfiger announced cutting two weeks off its design review process since they integrated digital 3D modelling into their operations (McDowell, 2021). It minimizes waste throughout processes by reducing, or at its best, eliminating the need for physical garment samples (SgT the Textile Quality Experts, 2022). Pepco, a European chain of discount shops, outlines a 40% reduction in children's wear samples two years after moving to digital processes (Browzwear, 2023). Transmitting 3D presentations and garment patterns with complete technical drawings and precise size details digitally to manufacturers greatly reduces production waiting times (SgT the Textile Quality Experts, 2022). Li & Fung, a pioneer for the consumer goods supply chain, reports a 50% lead time reduction between design intent to sample production (Browzwear, 2023).

The 3D designs are rendered into images and animated videos, with or without the avatar and different backgrounds. Photorealistic 3D modelling opens up plenty of opportunities for fashion marketing, rendering physical photoshoots and tradeshows largely unnecessary (SgT the Textile Quality Experts, 2022). Organizing a digital Fashion Week parallels the process of hosting a physical fashion showcase but eliminates the logistical challenges of moving physical garments and people. The process comprises onboarding the brands, digital creative ideation, and several rounds of virtual execution testing (Allsup, 2023).

Digital 3D fashion can be worn by one's digital identity, which is transferable across various virtual worlds, including video games. It can also be worn as augmented reality (AR) overlays on Web2 platforms. Additionally, both in retail stores and online shops, virtual fitting room technology superimposes digital 3D clothing items onto live images of customers, allowing them to virtually try on items to assess size, style, and fit without physical contact (Dopson, 2023). Brands that have adopted this AR technology report that around two-thirds of their online store visitors convert into buying customers when they can virtually try on garments. Additionally, the technology has led to a significant decrease in return rates, reducing them by

over one-third compared to the pre-technology era (Dopson, 2023). Digital 3D fashion is bought, sold, swapped, and resold in the form of NFTs in digital marketplaces (Fung, 2023).

2.4.1.1. Tokenization

Tokens representing units of value on a blockchain network offer advantages like frictionless peer-to-peer transactions, cost savings without intermediaries, secure storage, and transparency through decentralized ledgers. The ERC-20 token standard is an innovation within Ethereum technology, providing a method for creating various fungible tokens on the Ethereum blockchain, each with programmable functions. Programming can be done to serve multiple purposes, such as granting access to products or services, enabling governance through voting (in DAOs), providing memberships to social groups, incentivizing desired behaviours as reward tokens, and more. By structuring valuable assets within an economic system, ERC-20 tokens enhance their tradability and value. However, value is not solely financial, and the dynamics of supply and demand play a crucial role in converting various forms of value into tradable assets. While bitcoin and ether are money in digital form, NFTs intentionally lack fungibility. Their creation is enabled by the open ERC-721 standard, another innovation within Ethereum technology, that allows anyone to create these distinct digital assets (Cassat, 2022, 27-41; Ethereum, 2023c).

Notably, NFTs can serve as proof of ownership and authenticity for physical items, impacting the value of physical garments, especially when combined with brand recognition and limited production. An NFT can be tied to the physical item through a digital twin or by storing relevant details in a QR code attached to the garment (Kirjavainen, 2022). However, according to Kaikkonen (2023), an IP (intellectual property) attorney at Bird & Bird, NFTs as digital certificates do not 100% eliminate illegal counterfeit industry and copyright issues, reminding us of the importance of trademark registration. However collaborative efforts, like utilizing blockchain platforms, such as Aura Consortium, can help protect copyrights while providing transparency on sourcing and sustainability metrics (Kirjavainen, 2022; Aura Blockchain Consortium, 2023).

Additionally, NFTs can be programmed to provide ongoing royalties to creators and brands upon resale of both digital and physical items (Kirjavainen, 2022; Pagotto, 2022). The promise of perpetual royalties serves as an incentive for brands to craft enduring and timeless, digital,

and physical products, encouraging sustained community engagement and growth in resale value. Furthermore, these royalties, categorized as corporate income, have the potential to foster economic growth by generating tax revenue for the governments (Vero, 2015).

The term *phygital fashion* aptly describes this convergence of physical and digital fashion where digital fashion enhances the value and experience of physical fashion (Barrera, 2023).

2.4.2. Waste and Carbon Footprint

Digital fashion is powered by the information and communications technology (ICT) sector which is a significant source of greenhouse gas emissions. While being relatively low in emissions during creation and viewing, NFT minting, purchases, resales, swaps, and deletion contribute significantly to negative environmental impact. However, Ethereum, the home blockchain of NFTs claims to be environmentally conscious. In May 2023, its energy consumption was 0,002% of Bitcoin's and 1% of PayPal's, largely due to transitioning away from the energy-intensive Proof-of-Work mechanism in September 2022 (Benson, 2021). This reduced Ethereum's annual energy consumption by 99% and substantially decreased its carbon footprint from 11 016 000 to 870 tCO2e. Ethereum also fosters an active regenerative finance (ReFi) community, leveraging decentralized finance (DeFi) components to build financially beneficial applications with positive environmental impacts (Ethereum, 2023b).

Digital fashion retailer DressX has measured the environmental impact of digital garment creation, including design and file transmission to customers. Their findings indicate that digital garments generate a remarkable 97% fewer CO2 emissions and conserve an average of 3300 litres of water compared to traditional physical garment production. Similarly, Helsinki Fashion Week's analysis of their 2020 shows revealed a substantial reduction in carbon emissions, with the footprint per visitor decreasing from 137kg to just 0.66 kg CO2e when the event went fully digital. However, it is important to note that the increased online attendance of digital events may potentially offset these savings, resulting in emissions that surpass those of physical events (Benson, 2021).

Disposing of digital 3D fashion is a straightforward process, typically accomplished with the click of a delete button, causing the pixels to vanish permanently. In contrast, NFTs, once minted, remain on the blockchain indefinitely unless removed by their creators. If an NFT is

owned by someone other than the creator and the current owner wishes to burn (delete) it, a transfer back to the creator is required. Similar to minting, burning NFTs involves gas fees, ensuring that transactions on the blockchain are processed efficiently and securely (Foundation, 2023).

3. METHODOLOGY

This chapter outlines the research methodology used in this study. It includes the theoretical framework that guides the data collection and analysis, research methods, and details on data collection and analysis procedures.

3.1. Digital Materiality

Human interactions with technology, architecture, and narratives shape our daily experiences and enable us to envision and shape the future. Digital materiality serves as a tool for change agents like designers, activists, and leaders disrupting established norms in environments where digital materials are integral to everyday life. While *digital* and *material* may appear distinct, they are interconnected, and grasping digital materiality requires an understanding of materiality itself (Pink et al., 2016, 2-3).

Leonardi (2010) defines digital materiality through matter, practical instantiation, and significance. In this context, *matter* refers to any substance with mass and occupying space (Helmenstine, 2020). *Instantiation* relates to the property of having existed in the past or currently, essentially representing a version of an object (Wikipedia, 2023b). *Practical* pertains to utility, while *significance* denotes the quality of being noteworthy or important, as defined by the Oxford University Press (2023).

The central idea of Leonardi's (2010) argument is that if materiality is solely defined as matter, digital artefacts would not be considered to possess materiality. When materiality encompasses practical instantiation and the significance of an artefact, it becomes evident that digital artefacts possess materiality. In essence, whether it exists in digital or physical form, what an artefact is made from is less relevant than what it allows one to do – a difference in the current situation. To gain a deeper understanding of the practical and meaningful aspects of digital materiality within the context of user experiences and activities Leonardi suggests that

researchers should explore how this feature gains importance within the specific context of the user's work, their interactions with others, and their ability to maintain control over their activities.

The production of digital material involves a multi-disciplinary process that intricately weaves together data, material, programming, and construction. Those involved in this process encompass ordinary individuals navigating their lives at home, work, and school, as well as purposeful designers aiming to disrupt established practices. Crucially, digital materiality is an ongoing process rather than a final product or a completed entity (Pink et al., 2016, 10).

3.1.1. Mess

The continually evolving and adapting digital materiality is influenced by a countless number of factors, including complexity, messiness, contingency, conflict, idiocy, and confusion (Pink et al., 2016, 13) triggered by, among other things, marketing.

Marketing orientation evolved from advertising during the 1950s and 1960s. It was not intended to replace the back-then product-oriented mentality of firms but rather to overlay it with a customer-centric facade while still operating within the broader framework of profit-driven business practices. The framework prioritizes efficient production over customer needs. According to this perspective, marketing operates as a hidden persuader, manipulating individuals into desiring items they may not genuinely need. The informative and educative marketing communication draws from extensive research and customer behaviour data collected by organizations, both large and small, public, and private, at every interaction and transaction. This practice has persisted for well over half a century, with companies asserting that it benefits those outside the organizations (Morgan, 2003, 113-116).

Cialdini (2009, 198-226) outlines a technique called material configuration that can heighten the pleasures associated with desiring and acquiring both physical and digital consumption items. The technique is rooted in the economic theory of the scarcity principle which explains the price relationship between supply and demand. When demand for a good is expected to be high, its price increases, and when demand decreases, the price drops. The artificial scarcity technique capitalizes on psychological reactance, exploiting human tendencies for shortcuts, fear of losing freedom, interest in prohibited items, and tendency to compete. Those all trigger

a rush of arousal, leading to increased blood pressure, emotions, and narrowed focus. This, in turn, reduces our defences against scarcity tactics, even when we are aware of their use. The most commonly employed tactics include limited-number (quantity scarcity) and deadline (time scarcity) approaches.

Cassat (2022, 46) highlights that artificial scarcity plays a key role in creating economic value for digital artefacts through tokenization. While it may raise ethical questions, its transparency in blockchain technology can provide both opportunities and challenges, depending on how it is applied and managed.

3.1.2. Engaged Practice

To understand the ongoing and intricate dynamics of digital materiality and create meaningful changes in the lives of others, designers and activists must immerse themselves deeply in the digital material world, encompassing infrastructure, technology, content, and context. It is done through collaborative, creative processes involving participants. As the outcome, research and interventions become integrated into the ongoing flow of life, with people often appropriating them in unexpected ways, transforming them into something different from their original intent (Pink et al., 2016, 16).

Ferreira & Scaraboto's (2015) study examines the physical fashion design phase where designers envision and create future scenarios and align them with consumer needs to shape and craft products. After the design phase marketing steps in to infuse the products with the cultural ideals and intended meanings desired by producers. As consumers engage with these products, brands, and with each other, often through social media platforms, a community and consumer culture organically form. This interaction can be a self-transformative journey for consumers, influencing their identity and preferences. In a reciprocal process, the collective consumer culture reshapes the product and the brand, illustrating the dynamic relationship between consumer engagement and the evolution of products and brands within the fashion industry.

3.2. Data Collection

Data collection was performed in three ways of which the first was an extensive literature review. It was conducted to construct a theoretical framework around the main concepts:

physical and digital 3D fashion, sustainable development, and Web3. The four concepts mentioned also served as the primary keywords to initiate the literature research. The literature review helped refine the problem statement and research questions, confirming the issue the author aims to address, and outlining potential ways to proceed with the research work (Figure 4).

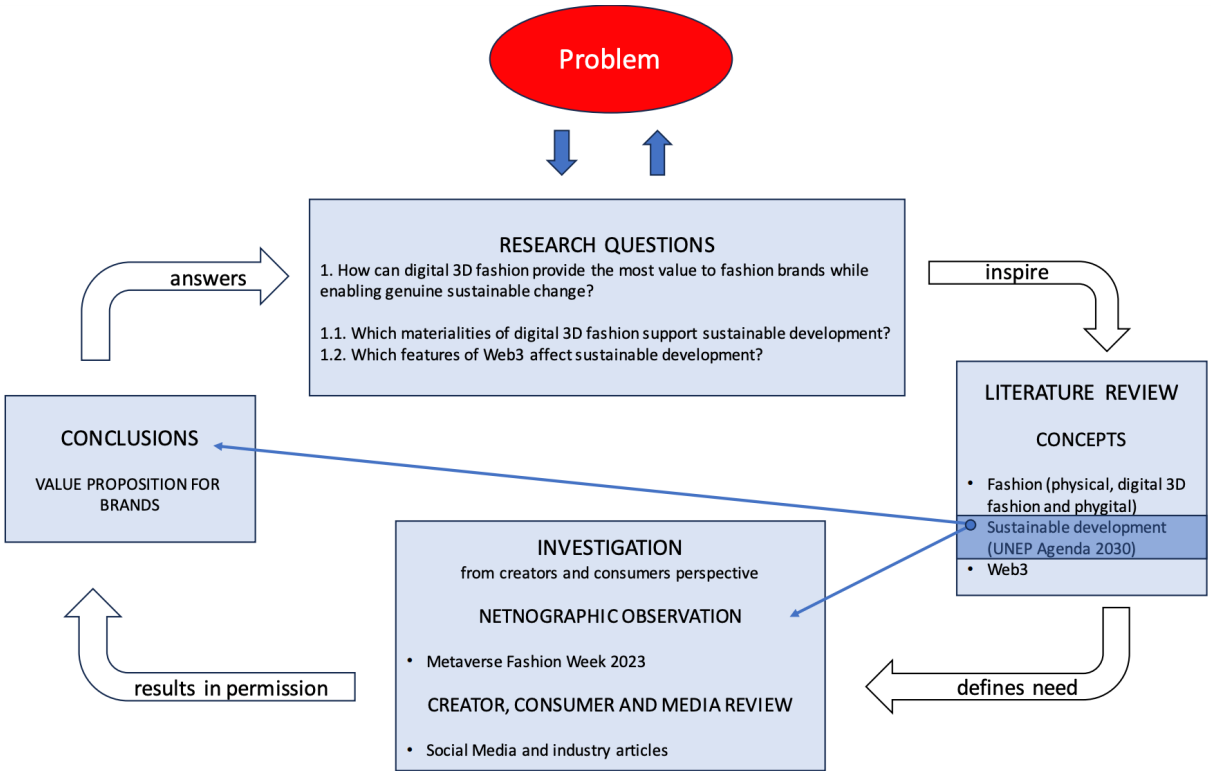


Figure 4. Conceptual map of research.

The literature review in this thesis involved several stages: searching and locating information resources, evaluating them, making notes, developing a conceptual framework, structuring the literature review, writing the literature review, and building a bibliography. It is a compilation of the author's intrinsic knowledge including her own experience and expertise in sustainable fashion design, production, marketing and sales, and extrinsic information including recently published keynote speeches and panel talks in a Web3 conference and courses, research journals, degree projects, fashion and technology industry articles, NGO reports, YouTube video talks and social media posts. The theoretical part of this thesis consists of printed and digital literature, covering professional books and journal articles.

According to Webster & Watson (2002), a literature review evaluates and justifies propositions of knowledge by presenting theoretical explanations, citing past empirical findings, and providing practical examples to support the reviewed concepts. Well-executed, it clearly defines the research boundaries, outlining its scope and limitations. Moreover, beyond summarizing existing knowledge, a strong literature view develops a model to guide future research by identifying the knowledge gaps.

Considering the saving of resources and reduction of waste achieved by the integration of digital 3D modelling into the brands' design, production, marketing, and sales processes the literature review advocated for a *yes* response to *Can digital fashion truly help the sustainable development of fashion industry?* However, it did not result in solutions for the research problem arising from Nike's and MSCHF's confusing activities, further investigation was necessary.

Due to the dynamic and evolving nature of digital materiality and it being a relatively new research area, instead of constructing interpretations based on just one predefined theory and attempting to prove it, a grounded theory arose from this study. Grounded theory adheres to scientific methods and their rigorous procedures drawing conclusions from the study's data (Strauss & Corbin, 1990, 23-26).

The data collection process of this thesis extended to include a netnographic observation during the four-day Metaverse Fashion Week 2023 event hosted in the Web3-enabled world Decentraland. The event was selected because of its ability to provide multi-disciplinary first-hand information on digital 3D materialities in a Web3 environment. Moreover, the timing of the event was a perfect match with the research work of this thesis.

The observation was supplemented by an examination of digital fashion reviews from creators, consumers, and media outlets that were published after both Metaverse Fashion Week 2022 and 2023 events. A more comprehensive discussion regarding the nethnographic observation and the selection of relevant documents is provided in the following chapters.

3.2.1. Netnography

Netnography is a qualitative research approach aimed at understanding the cultural experiences surrounding and being reflected within the online activities, practices, networks, and systems of social media. These experiences are actively engaged with, communicated through, and reflected upon forming the fundamental elements of netnography: investigation, interaction, and immersion. Netnography's procedural guidelines prioritize adaptability and continuous evolution. It serves as a method for uncovering social truths and gaining deeper insights into cultural understandings (Kozinets, 2019, "What is Netnography?" section).

Qualitative research is a method of gathering and analyzing descriptive data to understand individuals' social realities including attitudes, beliefs, and motivations. It is a non-quantitative analytical procedure that generates findings from data collected through various means (Strauss & Corbin, 1990, 18-19). Research data are considered trustworthy pieces of information, either known or assumed to be factual and reliable. They are raw materials, that are selectively co-created while being experienced, observed, or collected as samples (Kozinets, 2019, "What Exactly are Data?" section, para 2). Qualitative data capture the essence of people, objects, and situations, and this essence is expressed through words. These words are derived from observation, interviews, or documents. The research process involves deep engagement with a life situation, fostering empathetic understanding, and typically spans a sustained period of time (Miles & Huberman, 1994, 6).

In this thesis netnographic data collection followed an investigative approach, emphasizing immersion while refraining from direct interaction. It is important to note that data only come into existence when a scientific observer, in this case, the netnographer, initiates a research project by classifying specific information (Kozinets, 2019, "Netnographic Observer Effecting" section, para 1). The investigative operations are selective. The data, however, do not necessarily provide direct answers to the research question. Instead, the selection of traces to become investigative data is influenced by the netnographer's decisions, interests, perspectives, and the observer effect. The selectivity in the data collection process is driven by ethical considerations related to ownership, sharing, and the utilization of digital data (Kozinets, 2019, "Investigative Data Operations: An Introduction" section, para 1). In grounded theory, data collection and analysis are connected processes, and analysis of data

starts at the very first bit of collected data. Early analysis is necessary because it directs the next observations (Corbin & Strauss, 1990, 419).

Similar to the analytical phase, data collection is conducted with reflexive (Ho et al., 2022) and ethical considerations as integral components of the process.

3.2.1.1. Ethics

In both netnographic observation and the process of writing a research paper there is the potential to expose, outrage, ridicule, and offend the subjects under investigation. Therefore, it is of utmost importance to carefully consider how cultures, communities, and individuals are portrayed throughout the entire research process, including observation, data-gathering, and interpretative analysis procedures (Kozinets, 2019, "Orienting to Ethics in Netnography" section). While it is commonly assumed that individuals posting on social media and engaging in virtual spaces understand they are making public entries, this does not inherently imply that they are granting consent for academics to use their data without restrictions (Kozinets, 2019, "Platform Users Think in Contingent, Consequentialist Ways as Well" section).

Consequently, consent is imperative when research qualifies as *human subject research*. As per the United States Department of Health and Human Services, human subjects research encompasses

> *"studies in which there is either direct intervention or interaction with another individual to collect information, or it involves the recording of information by a researcher in a way that allows the direct or indirect identification of a real person through the data" (Kozinets, 2019, "Is Netnography Human Subjects Research?" section).*

Although netnography may not initially be human subjects research it often turns into it over the data collection process if the researcher publishes a post or starts to engage with participants through comments that involve asking questions. As depicted in Figure 5 this entails not only seeking consent from participants but also rigorously reviewing research ethics and securing the platform moderator's approval for studying profiles and utilizing data. It also involves preparing to anonymize names and identifiers throughout the archival, analysis, interpretation, and research presentation stages (Kozinets, 2019, "An Ethics Process for Netnography" section).

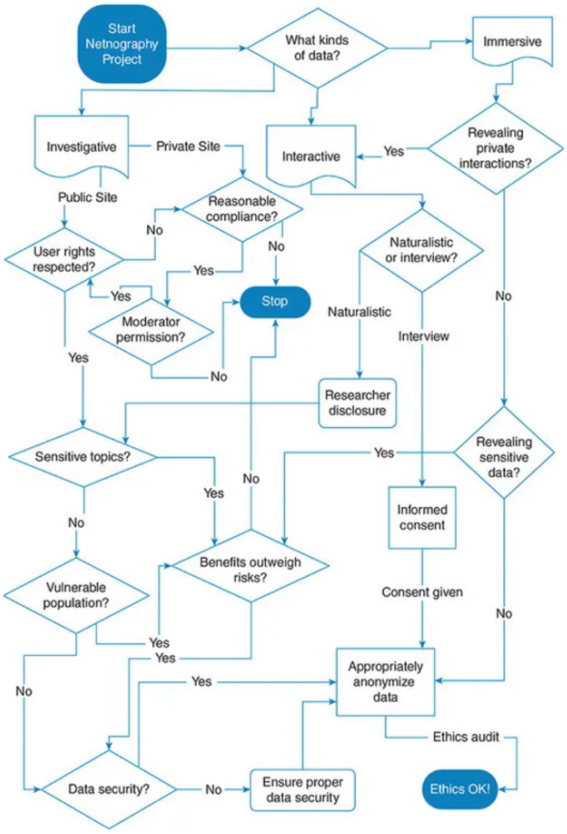


Figure 5. Research ethics process flowchart for netnography (Kozinets, 2019, "Applying the Ethics Process Flowchart" section).

3.2.1.2. Research Preparations

As a newcomer to Web3, the author prepared for the research by enrolling in a Web3 course offered by The Good Cartel and Tampere University, five days before the Metaverse Fashion Week 2023. The aim was to gain a basic understanding of Web3 concepts, including blockchain, cryptocurrencies, NFTs, and metaverse worlds. The author also dedicated time to an in-depth study of Decentraland, as well as the event partners, Spatial and Over platforms. Practical preparations involved testing creator tools, customizing avatars and training avatar operations, setting up a crypto wallet, and familiarizing oneself with the crypto-buying process. These preparatory measures allowed for a more focused and informed approach to observation during the actual event.

The deliberate decision to conduct netnographic observations using basic office equipment was made to evaluate the event's accessibility. Initially, the author's laptop encountered

compatibility challenges, as it was unable to install the Decentraland desktop client software due to the source not being the Apple Store. Furthermore, Apple's web browser Safari was not compatible with the Metamask crypto wallet. In the end, successful access was attained by utilizing the Google Chrome web browser.

Although the 8-year-old MacBook Pro laptop's graphic card was asserted to be insufficient for running Decentraland, the observation with a 4G Wi-Fi connection proceeded relatively smoothly, albeit with occasional sluggishness in avatar movement. To enhance the avatar camera view and control avatar movements more effectively, a wireless mouse was employed. Additionally, a large monitor proved helpful, especially for simultaneous gaming activities and note-taking. The author relied on a mobile phone for real-time event updates conveyed through X (former Twitter) and Discord (Figure 6).

Figure 6. Set up for the netnographic observation in MVFW 2023.

3.2.1.2.1. Metaverse Fashion Week

Metaverse Fashion Week (MVFW) is a multidisciplinary and cross-metaverse fashion event. Occurring in March, shortly after physical fashion weeks, MVFW acts as a central hub for prominent fashion brands, legacy designers, emerging creator communities, independent creators, and Web3 experts. The event encompasses fashion shows, immersive experiences within brand stores, after-parties, educational talks, and workshops focused on the creation of

wearables and virtual spaces (MVFW, 2023). Its central objective is to promote inclusivity by uniting diverse communities and broadening global perspectives on fashion. It serves as a platform for worldwide dialogues encompassing both digital and physical fashion, and grants access to a diverse array of fashion experiences ranging from high-end showcases to community-driven activities (Dahle, 2023).

The four-day event is hosted by Decentraland which is one of the most popular Web3-enabled metaverses. In contrast to Web2 games, metaverse worlds offer open and liberated environments where players' avatar identities can engage in real-time activities, enjoying fun, shopping, and learning without the constraints of intermediaries or gatekeepers. This environment creates numerous opportunities for various stakeholders, including 3D designers, game designers, gaming companies, digital and conventional fashion labels transitioning to 3D, virtual real estate developers, and pioneers in 3D shopping experiences (Cassat, 2022, 60-63).

3.2.1.2.2. Decentraland

Decentraland, depicted in its peculiar cartoonish style in Figure 7, was founded in 2017 as the pioneering decentralized virtual world. It is owned by its users and governed by a decentralized autonomous organization (DAO). This DAO comprises a changing group of developers whose decision-making processes are guided by the votes of token-holding users. Decentraland's foundation is built upon open-source protocol, which means that anyone can participate in expanding its functionalities, conduct audits, make contributions, and develop projects on the platform (Decentraland, 2023c).

Decentraland's mission is centred around its development as a public good, aiming to create a social visual world that is accessible to all individuals. This accessibility extends to users with basic laptops, and Decentraland can be freely explored without the need to set up a crypto wallet. Just before Metaverse Fashion Week 2023, shopping for wearables in Decentraland Marketplace was made more convenient by introducing the option for regular card payments. However, for those who wish to preserve their customized avatars, the use of a crypto wallet is necessary. It does not need to contain cryptocurrency unless the user also intends to trade and create assets within Decentraland. For these purposes, either Decentraland Polygon Mana or Ethereum Mana is required, with Mana being Decentraland's native currency (Decentraland, 2023a).

Figure 7. Screenshot of cartoonish Decentraland during one of the Metaverse Fashion Week 2023 runway shows.

Leveraging her design background, the author expressed curiosity about crafting her wearables in anticipation of the event. To embark on this creative journey, she initiated the process by setting up a Metamask crypto wallet claimed to be one of the most widely used Ethereum wallets (Rodriguez Cruz, 2023), and then delved into the Decentraland Builder tools.

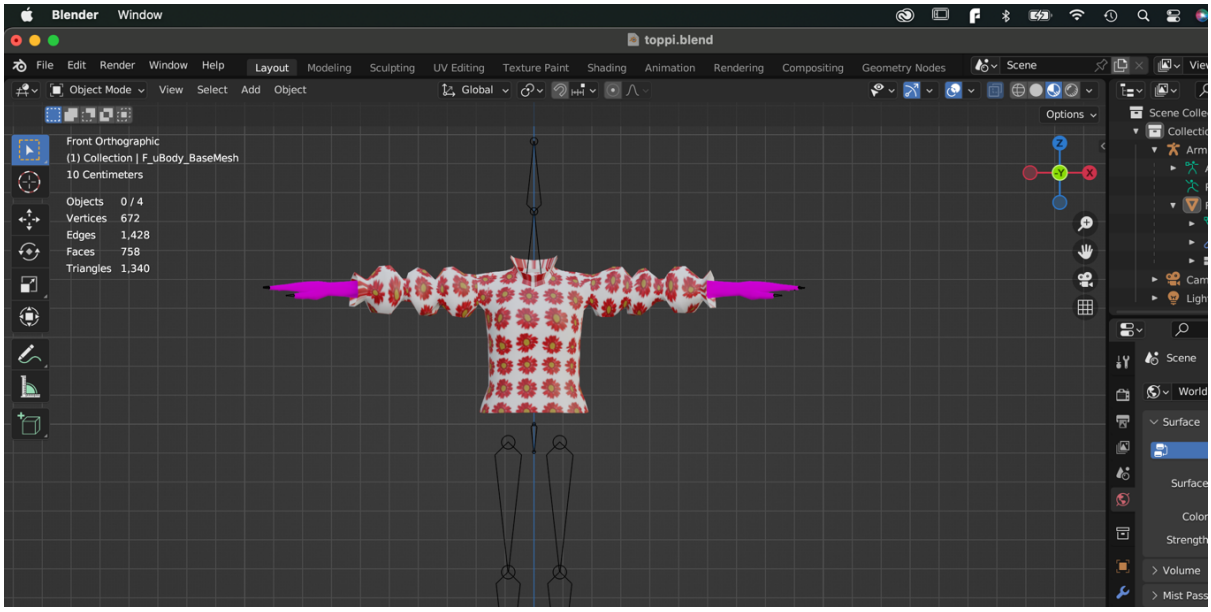


Figure 8. Completed top in Blender software.

For creators, Decentraland offers comprehensive resources, including detailed instructions and base mesh files for crafting wearables for both female and male avatars. The animated base mesh can be conveniently downloaded from the platform and then imported into 3D modelling software. Subsequently, the wearables are designed (Figure 8) following Decentraland's guidelines (Decentraland, 2023b).

Finished items are exported to a file and subsequently imported into Decentraland Builder (Figure 9). The creator should diligently review them before attempting to publish, ensuring that all wearables are technically impeccable. This process is curated, and a predetermined publishing fee per item in Polygon Mana must be paid in advance. However, the payment does not guarantee publication, and in the event of a design failure, the fee is non-refundable. This protocol is established to safeguard against fraudulent activities on the platform (Decentraland, 2023).

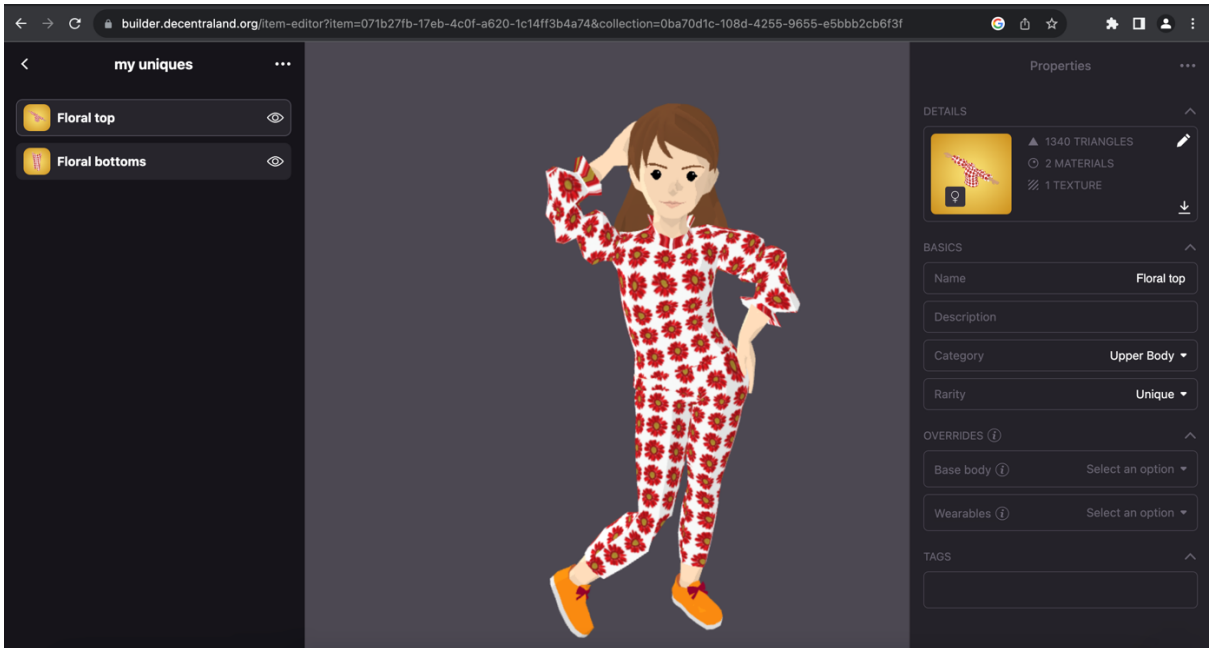


Figure 9. Completed top and pants in Decentraland's Wearables Builder previewer.

The author's decision to forgo publishing her wearables was prompted by a high publishing fee per item. Instead, she opted to customize her avatar using the basic wearables and hairstyles that were readily available within Decentraland (Figure 10). This decision turned out to be a wise one, as it allowed her to explore and review another feature that was accessible to all participants during the event.

Figure 10. The author's Decentraland avatar customized with basic wearables.

Decentraland faces certain limitations that impact its accessibility and functionality. Notably, it does not support cross-platform transferability of avatars and wearables, and access to mobile phones is not currently available. Furthermore, the development team has encountered challenges in creating VR client software to enhance the immersive exploration of the metaverse (Huigsloot, 2023). Considering these limitations, Metaverse Fashion Week 2023 opted for a collaborative approach by partnering with two other metaverse worlds, Spatial and Over.

3.2.1.2.3. Spatial

Centralized, VR, desktop, and mobile phone-friendly Spatial (Figure 11) is a more advanced metaverse world in various aspects, including avatar movements, aesthetics, interoperability, and accessibility. Teamed up with the game engine Unity this company is at the forefront of developing user-friendly tools and open-world solutions for the Web3-enabled metaverses. It offers a range of features, including one-click NFT galleries and spaces that foster collaboration among creators, collectors, and brands (Spatial, 2023).

Spatial views the metaverse as a thriving community and is dedicated to empowering creators by providing them with both free and paid service plans. These plans include a space to alter to one's liking, within which the company supports hosting exhibitions, meet-ups, live events, and more. Like Decentraland, Spatial places a strong emphasis on user support and offers free tutorials to help users get started and navigate the challenges of the creative process (Spatial, 2023).

Through a collaboration with Ready Player Me, a cross-game avatar platform tailored for metaverse creators and residents, Spatial enables users to explore Web3-enabled worlds while maintaining a consistent identity across synchronized platforms (Ready Player Me, 2023).

Figure 11. The author's real-life mimicking Ready Player Me! avatar in real life mimicking Spatial world customized with a classic Boss suit won in a game.

3.2.1.2.4. Over

Over specializes in augmented reality (AR) technology, which involves adding various forms of digital content to real-world video, audio, and 3D environments. AR technology, accessible from any device equipped with a camera, creates the illusion that physical and digital elements coexist in the same space in real time (Over, 2023a).

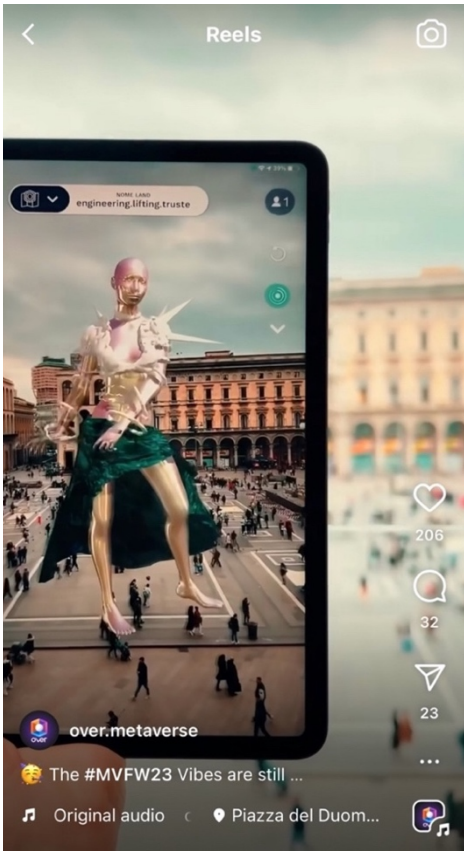


Figure 12. Phygital fashion show in Milan enabled by Over. (Over.metaverse, 2023)

The company encourages users to become Over-platform token owners and enhance their physical world with interactive content and experiences. The platform is structured around three fundamental layers. First is the Ownership Layer (OVRLands) revolving around hexagon-shaped land NFTs that owners can populate with content. When individuals access the geographic location associated with this land, whether in person or remotely via a mobile device, they can see, hear, and interact with the content. The second layer is the Mapping Layer with OVRmap NFTs that allows users to map iconic real-world locations with high localization accuracy, down to 20cm. Third is the Builder Layer which provides user-friendly tools for creators and professional developers to craft immersive environments, create photorealistic avatars, and design digital 3D fashion experiences as depicted in Figure 12 (Over, 2023b).

3.2.2. Investigative Observation at Metaverse Fashion Week 2023

The investigative data collection in Metaverse Fashion Week 2023 took place from March 28th to March 31st, 2023. The diverse range of activities, that the author had carefully selected from the schedule before the event, including brand store events, fashion exhibitions, games, runway

shows, panel talks, and creator community parties, fell in between 9:00 am and 9:00 pm +3 UTC. The 12-hour timeframe provided flexibility between the selected events to freely experience Fashion Week, make notes, and transcribe recordings.

Notetaking was done partially by hand, after which the notes were digitized. The majority of the informative panel talks were recorded with a mobile phone voice recording application after which they were transcribed in Microsoft Word without identifiers and saved on the author's personal computer. The participants were founding members of the event: professionals from the fashion industry, Web3 technology, marketing, sales, and software development, and digital 3D fashion creators. Additionally, an interview with an avatar production specialist is part of the collected data.

Over four days, the author not only attended events but also actively engaged in various activities. This included moving across different platforms, collecting free items, and observing the behaviour and interaction of other avatars while embodying a neutral virtual identity. Between events, she followed the crowd to brand stores offering games and brand promotions. In addition to notetaking, the author captured screenshots and screen recordings of significant moments in crowded after-parties, fashion shows, panel talks, and bustling Decentraland chat.

In total, the author spent approximately 35 hours actively participating in Metaverse Fashion Week. This excludes the time spent on preparations, which included 1 ECT worth of Web3 studies and wearables creation took up around 40 hours.

3.2.3. Creators' and Consumers' Views

During the literature review and the investigative netnographic process, an observation was made that the materialities of digital 3D fashion are primarily shaped by the perspectives of digital creators and 3D technologies experts. Additionally, the Decentraland chat and real-time event updates conveyed through X (former Twitter) and Discord predominantly featured casual small talk rather than informative discussions. Therefore, a compelling need to investigate the non-technology consumer perspective existed, the study's conclusion to offer a more holistic response to the research question and serve as a gateway to achieving the research goal, as illustrated in Figure 4.

This data consists of four digital fashion YouTube reviews with the viewers' comments, a moderated discussion involving three Finnish Web3 specialists sharing their digital 3D fashion experiences, and nine Metaverse Fashion Week 2022–2023 media reviews, two of them with readers' comments. The four video reviews were conducted by two digital creators, a fashion critic, and a gamer, all of whom have substantial followings ranging from 50,000 to 200,000 international followers. Their content primarily engaged creator and consumer followers in interactive discussions about the value of physical and digital fashion, as well as the opportunities that digital fashion offers for both creators and users. The reviews from nine well-known technology and fashion media outlets compared the first and second Metaverse Fashion Weeks.

At the start of supplementary data sourcing, it seemed that the internet was flooded with digital fashion reviews. However, upon further investigation, it became apparent that most of these reviews focused solely on AR fashion, making them less relevant to the research. Given that significant innovations in the digital 3D fashion field have not emerged since the mainstream adoption of AR filters and no significant differences were detected between Metaverse Fashion Week 2022 and 2023, the author decided to utilize the whole small lot of digital 3D fashion reviews available from 2022 and 2023 as sufficient creator and consumer data.

The YouTube reviews were voice-recorded using a mobile phone and subsequently transcribed in Microsoft Word for easier analysis. Viewer comments without identifiers were included in the transcription files. Similarly, media articles were copied and pasted into separate Microsoft Word files, including any relevant viewer comments. All files were saved on the author's personal computer.

Since the supplementary data included Metaverse Fashion Week 2023 reviews the data collection extended over one month after the event.

Before analysis, field notes require correcting, and recordings must be transcribed and edited. However, during this process, it is crucial to minimize corrections to avoid introducing researcher bias into the data. Good quality qualitative data have the potential to uncover unexpected findings, foster new insights, and enable researchers to construct meaningful narratives (Miles & Huberman, 1994, 9).

The data were divided into three focus groups according to the sources: *MVFW2023 people*, *creators and consumers*, and *media,* and three separate Microsoft Excel tables were set up. In addition to the four digital fashion YouTube reviewers with the viewer's comments, the three Finnish Web3 specialists, and the media readers' comments along with the author's observations were included in the creators and consumers group. While the other identifiers in the data were eliminated this grouping intended to find out whether there are differences between the views of the three focus groups and why is that.

3.3. Data Analysis

3.3.1. Thematic Analysis

The qualitative thematic analysis method was employed to process the collected data set. This approach entails a comprehensive review of the data to identify recurring patterns in meaning, ultimately leading to the identification of themes (Delve, 2023).

In the grounded theory approach the pieces of collected data including incidents, events, and happenings as potential indicators of a phenomenon are given conceptual labels. In open coding, the data are first broken up and then labelled as concepts (Corbin & Strauss, 1990, 423).

Considering the large amount of data collected in this research, instead of fully using the inductive coding method I.e., breaking up the texts sentence by sentence, which is characteristic of qualitative research, the coding started with the deductive method: the author made a list of words that stood out in the data. (Delve, 2023).

As depicted in Figure 13, these concepts were listed in the very left column of the tables. In MVFW2023 people's talks *legacy, story(telling), identity (y), sustainab(le)/(ility), heritage, web3/(three), gam(e)/(er)/(ing)/(ifying), social, community, experience, empower, collaboration, technology, virtual, bridg(e)/(ing), physical, interoperab(le)/(ility), value, AI, 3D, nft, interaction* and *change* repeated. Conversations between creators and consumers were slightly differently focused. In them *access, quality, identity, sustainab(le)/(ility), culture, metaverse, gam(e)/(er)/(ing)/(ifying), soci/(ety)/(al), community, educate, power, collaboration, technology, digital fashion, clothing, cheap/free, value, nft, 3D, waste,*

consumption, change, heritage, physical, experience, interoperability and *wearable* stood out. Media reviews emphasized *access, quality, sustainab(le)/(ility), metaverse, gam(e)/(er)/(ing)/(ifying), soci/(ety)/(al), community, educate, collaboration, technology, digital fashion, clothing, interoperab(le)/(ility), value, nft, consumption,* and *experience*.

	A	B	C
4	Concept	Quote	Category
5	legacy	highlight the meaning of preserving fashion and history for new generations rather than just consuming aimlessly (because blockchain technology enables limitless reselling and royalties to original artist and when art is minted it's on blockchain forever) t	Slow fashion
6		Storytelling plays a key part.	corporate communication
7		It's really beautiful that it's not just cross meta versus but cross generation, right, which is also something you have to be mindful about that the fashion industry has many incredible legacy names and we can't just let them out.	Creator identity
8		The legacy we're building today for the next generations. To come, but also that we are the legacy of the future and looking back into the ones who came before us.	Slow fashion
9	story(telling)	fashion leans on storytelling, fashion brands tell stories that extend the life of product. That's why brands participate in technology.	Slow fashion
10		how to make outfits for the masses? People enjoy storytelling in games, we don't have to be gamers to enjoy this world.	corporate communication
11		I believe that digital fashion stories are just big.	corporate communication
12		So I think like one of the main ones for brands either to create in-house or collaborate with the virtual influencer is basically that they gain creative control of the narrative and also they don't need to worry about any scandals. They are kind of like in contr	corporate communication
13		On decentral land. Being able to build a story wherever your mind is, it's it's very fulfilling and and then well that that's that's what bringing also on the where in the aspect of the wearable in the physical one great example that has brought to life.	corporate communication
14		It's not just giving away fashion. It's empowering people who may not have been able to have access. To a brand to now love that brand and become an ambassador for that brand and champion that brand for their values, for their story, for their heritage,	corporate communication
15		As I was growing in my career, so it was like our direction we just like. Sketching the storyboards and then adapting it with Exploration of like how do I implement something? And just take it to the next level. Really explore the full length and grow of this s	corporate communication
16	identity(y)	fashion is identity, how we use it, its utility and social identity more today > today's technology allows one express oneself.	Web3
17		everyone is customer, all identities.	Cross realities social identity
18		we're not limited to utility only, we can just express our identity.	Cross realities social identity
19		In more magnified identity, stronger belonging to class/ group in virtual world, you can be anybody, anything. And it can be a creative force.	Cross realities social identity
20		Re-engaging with person who has item in their wallet, no end at point of sale,	Slow fashion
21		sustainability lense, a new way to sell experiences that give value to brand identity and Business to Customer relationships.	Corporate communication
22		New metaverse identities, Now it's about pushing the technology so you know load and I have worked on some interesting things recently where it's not just about the outfit, right, it's everything.	Cross realities social identity
23		I mean, for me, yeah, the very exciting part is the fact that it's bridging different communities and the fact that again, because at the end of the day, fashion is really about identity. And so that you can carry your identity and and the way you express yourse	Cross realities social identity
24		But in these immersive worlds, people identify with those avatars because it's a further reflection of their identity. And so when we have the opportunity, as designers and brands to help empower people's identities with these wearables, it's something m	Corporate communication
25		With visuals, fashion items with things that we like to wear into virtual spaces and it will be very soon that our identity in virtual lands will drive also who we are and how we look into the real life.	Cross realities social identity
26		in virtual spaces you can be whatever you want. You can have you know your code can be on fire. Our identity will drive our identity and looks in real life too	Cross realities social identity
27		And I mean how, how, how those brands can somehow ensure you know that the does the Italian identities for example reflects the their values, right and the and the mission.	Stakeholder management
28		I think it's really about, you know, talking to the client and sitting together, what their objectives for their metaverse. Or or yeah Digital identity strategy is going to be	Stakeholder management
29		What is the barrier for brands to get into this digital identity, action or strategy? Because I know that there is a lot of pain behind.	Corporate communication
30		Put some new life into. It that's like, that's one of the main ones, but also to target like a new audience, like younger audience like Genesis or even Gen.	Stakeholder management
31		I believe many brands are going to take a step back and fully focus on evaluating what a digital identity is for them and building it from like from scratch from the.	Corporate communication
32		But in my opinion at least, digital identity is like it's many things. Once it's a, it's a sum of how a brand is presenting itself online and. Does not only include a virtual identity as like a character of some sort or an embodiment like of a brand of a mask, but it's	Corporate communication
33		And I think that's an extension of who you are and in this immersive Internet metaverse that we're building, I think it's also an extension of our identities. When you think about custom avatars and.	Cross realities social identity

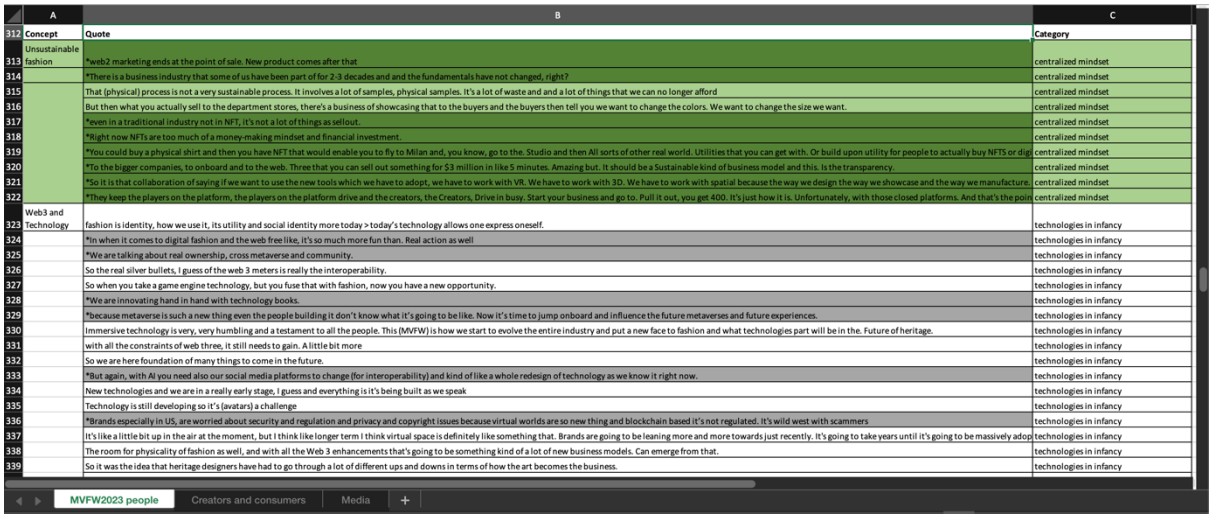
MVFW2023 people | Creators and consumers | Media | +

Figure 13. Open and axial data coding in Microsoft Excel.

In the next phase, axial coding, the author went through all the data in Microsoft Word by doing as many word searches as there were concepts. She copied the found sentences and pasted them into the Excel tables, next to the concepts. Then she read them through and compared the sentences to highlight similarities and differences to produce lower-level concepts. Those with the same kind of meanings were grouped to form categories. Clear duplicates were deleted. Through this, categories given explanatory power and being related to one another can form a theory (Corbin & Strauss, 1990, 420). These categories were color-coded.

The Metaverse Fashion Week panel talk categories were *unsustainable fashion, Web3 and technology, identity, hybrid, interoperability and accessibility, slow fashion, strategy, communities, stakeholder management, corporate communication, collaboration,* and *tools*. Likewise, creators and consumers' talks involved *unsustainable fashion, identity, hybrid, accessibility, slow fashion, strategy, communities, stakeholder management, corporate communication, collaboration,* and *tools*, but also new categories came out: *technology challenges, creator opportunities/ creator recognition, creator challenges, decentralized platform challenges, nonsense,* and *free collectables/ wearables.* Media review categories were *unsustainable fashion, technology challenges, identity, accessibility/ interoperability, slow*

fashion, strategy, communities, stakeholder management, corporate communication, content creator opportunities, creator challenges, collaboration, tools, and *crypto.* These categories were grouped and color-coded (Figure 14).



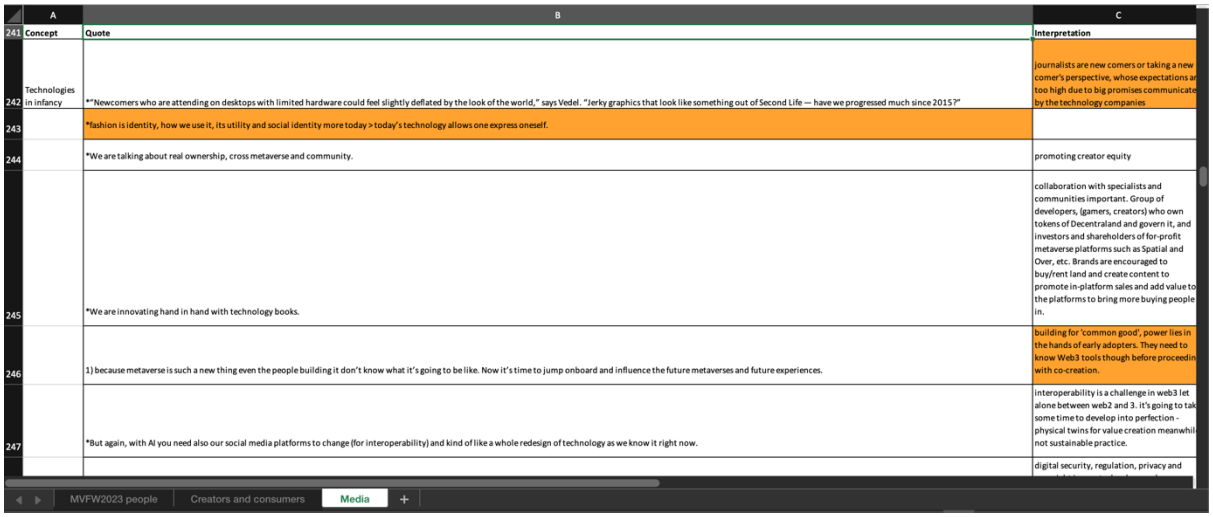
	A	B	C
312	Concept	Quote	Category
313	Unsustainable fashion	*web2 marketing ends at the point of sale. New product comes after that	centralized mindset
314		*There is a business industry that some of us have been part of for 2-3 decades and and the fundamentals have not changed, right?	centralized mindset
315		That (physical) process is not a very sustainable process. It involves a lot of samples, physical samples. It's a lot of waste and and a lot of things that we can no longer afford	centralized mindset
316		But then what you actually sell to the department stores, there's a business of showcasing that to the buyers and the buyers then tell you we want to change the colors. We want to change the size we want.	centralized mindset
317		*even in a traditional industry not in NFT, it's not a lot of things as sellout.	centralized mindset
318		*Right now NFTs are too much of a money-making mindset and financial investment.	centralized mindset
319		*You could buy a physical shirt and then you have NFT that would enable you to fly to Milan and, you know, go to the. Studio and then All sorts of other real world. Utilities that you can get with. Or build upon utility for people to actually buy NFTS or digi	centralized mindset
320		*To the bigger companies, to onboard and to the web. Three that you can sell out something for $3 million in like 5 minutes. Amazing but. It should be a Sustainable kind of business model and this. Is the transparency.	centralized mindset
321		*So it is that collaboration of saying if we want to use the new tools which we have to adopt, we have to work with VR. We have to work with 3D. We have to work with spatial because the way we design the way we showcase and the way we manufacture.	centralized mindset
322		*They keep the players on the platform, the players on the platform drive and the creators, the Creators, Drive in busy. Start your business and go to. Pull it out, you get 400. It's just how it is. Unfortunately, with those closed platforms. And that's the poin	centralized mindset
323	Web3 and Technology	fashion is identity, how we use it, its utility and social identity more today > today's technology allows one express oneself.	technologies in infancy
324		*in when it comes to digital fashion and the web free like, it's so much more fun than. Real action as well	technologies in infancy
325		*We are talking about real ownership, cross metaverse and community.	technologies in infancy
326		So the real silver bullets, I guess of the web 3 meters is really the interoperability.	technologies in infancy
327		So when you take a game engine technology, but you fuse that with fashion, now you have a new opportunity.	technologies in infancy
328		*We are innovating hand in hand with technology books.	technologies in infancy
329		*because metaverse is such a new thing even the people building it don't know what it's going to be like. Now it's time to jump onboard and influence the future metaverses and future experiences.	technologies in infancy
330		Immersive technology is very, very humbling and a testament to all the people. This (MVFW) is how we start to evolve the entire industry and put a new face to fashion and what technologies part will be in the. Future of heritage.	technologies in infancy
331		with all the constraints of web three, it still needs to gain. A little bit more	technologies in infancy
332		So we are here foundation of many things to come in the future.	technologies in infancy
333		*But again, with AI you need also our social media platforms to change (for interoperability) and kind of like a whole redesign of technology as we know it right now.	technologies in infancy
334		New technologies and we are in a really early stage, I guess and everything is it's being built as we speak	technologies in infancy
335		Technology is still developing so it's (avatars) a challenge	technologies in infancy
336		*Brands especially in US, are worried about security and regulation and privacy and copyright issues because virtual worlds are so new thing and blockchain based it's not regulated. It's wild west with scammers	technologies in infancy
337		It's like a little bit up in the air at the moment, but I think like longer term I think virtual space is definitely like something that. Brands are going to be leaning more and more towards just recently. It's going to take years until it's going to be massively adop	technologies in infancy
338		The room for physicality of fashion as well, and with all the Web 3 enhancements that's going to be something kind of a lot of new business models. Can emerge from that.	technologies in infancy
339		So it was the idea that heritage designers have had to go through a lot of different ups and downs in terms of how the art becomes the business.	technologies in infancy

MVFW2023 people | Creators and consumers | Media | +

Figure 14. Selective data coding round 1 in Microsoft Excel.

The last phase of grounded theory is selective coding where all categories are connected around one core category to define a coherent theory around the research (Corbin & Strauss, 1990, 424). By now, the sought difference between the three focus groups was detected. Highlighted was the lack of Web3 technology knowledge among consumers and media, which may influence negative perceptions of digital 3D fashion. The author could continue the coding phase by combining all the remaining categories in one table.

She read through the sentences again and organized them into new categories: *Web3 and technology*, *technology challenges*, *tools*, *crypto*, *creator challenges*, *nonsense*, *free collectables/ wearables,* and *content creator opportunities/ recognition* were placed into *technologies in infancy* category and *unsustainable fashion*, *decentralized platform challenges* and *interoperability* into sub-category *centralized mindset. Accessibility* was the third category. *Identity* and *slow fashion* were placed under *identity* and *community* and *collaborations* under *community collaborations.* Hybrid represents *long-term relationships*. *Corporate communication, stakeholder management* and *strategy* were combined under the *storytelling* sub-category. These categories are under the core category of *successful development of decentralized Web3* which influences the sustainable development of the fashion industry and the material value of digital 3D fashion (Figure 15).



	A	B	C
241	Concept	Quote	Interpretation
242	Technologies in infancy	*"Newcomers who are attending on desktops with limited hardware could feel slightly deflated by the look of the world," says Vedel. "Jerky graphics that look like something out of Second Life — have we progressed much since 2015?"	journalists are new comers or taking a new comer's perspective, whose expectations ar too high due to big promises communicate by the technology companies
243		*fashion is identity, how we use it, its utility and social identity more today > today's technology allows one express oneself.	
244		*We are talking about real ownership, cross metaverse and community.	promoting creator equity
245		*We are innovating hand in hand with technology books.	collaboration with specialists and communities important. Group of developers, (gamers, creators) who own tokens of Decentraland and govern it, and investors and shareholders of for-profit metaverse platforms such as Spatial and Over, etc. Brands are encouraged to buy/rent land and create content to promote in-platform sales and add value to the platforms to bring more buying people in.
246		1) because metaverse is such a new thing even the people building it don't know what it's going to be like. Now it's time to jump onboard and influence the future metaverses and future experiences.	building for 'common good', power lies in the hands of early adopters. They need to know Web3 tools though before proceedin with co-creation.
247		*But again, with AI you need also our social media platforms to change (for interoperability) and kind of like a whole redesign of technology as we know it right now.	interoperability is a challenge in web3 let alone between web2 and 3. it's going to tak some time to develop into perfection - physical twins for value creation meanwhil not sustainable practice.
			digital security, regulation, privacy and

MVFW2023 people | Creators and consumers | Media | +

Figure 15. Selective data coding round 2 in Microsoft Excel.

Personal experiences and perspectives, along with the disciplines and research practices to which the research practitioners belong (Pink et al., 2016, 13-18), can influence the research process and outcomes. Questions arise about the representativeness and generalizability of results due to sampling concerns. Moreover, the credibility of conclusions drawn from qualitative data can impact their utility in informing real-world policies and actions (Miles & Huberman, 1994, 9-10).

By critically examining personal judgments, practices, and beliefs throughout data collection and analysis, researchers can better understand and address potential biases and ensure the research is conducted with transparency and integrity (Ho et al., 2022). For an open-minded coding and interpretation process, the author made an effort to step away from preconceived notions and biases to allow new perspectives and insights to emerge (Strauss & Corbin, 1990, 29).

Technical and non-technical literature were used to stimulate theoretical sensitivity and questions. For validity and applicability of findings, they were critically reviewed and validated throughout the theory definition phase with the help of extrinsic information including keynote speeches and panel talks in a Web3 conference and courses, webinars, research journals, degree projects, multi-disciplinary industry articles, and NGO reports (Strauss & Corbin, 1990, 48-53)

3.4. Ethics Audit

The research did not fall under the category of human subjects research because the author neither interacted with individuals during the observation nor engaged in posting or commenting on data. Therefore, consent was not requested (Kozinets, 2019, "Is Netnography Human Subjects Research?" section). Furthermore, the real names and usernames of individuals and organizations encompassing the data set were not connected to the research paper. Additionally, the transcriptions, screenshots of crowded Decentraland and the Excel tables were anonymized. All data files were stored in an organized folder on the author's personal computer during and after the study.

4. RESULTS AND DISCUSSION

This part discusses the themes found in the data. Notable through all of them is the battle between decentralized and centralized mindsets, which affects the overall perception of Web3 and digital 3D fashion.

The border between physical and digital is blurred in many areas of contemporary life (Cassat, 2022, 44), as well as in fashion. Benini (2012, "Approccio alla coscienza" section) argues that our experience of reality is defined by our consciousness, not rationality, based on how we perceive moments of life with our senses. Trevisan (2021) concludes that

> "*as our exposure to the digital world increases, we will absorb more and more its communicative rules and visual codes, to the point that it will be natural for us to seek the same rules and codes also in the physical world.*"

Thus, material aspects of digital 3D fashion as a sustainable development agent necessitate exploration within the framework of physical, digital, and phygital domains through which transformations can happen.

4.1. Technologies in Infancy

This chapter focuses on the nascent state of Web3 technologies and their effect on digital 3D fashion perception.

1) ”***Because metaverse is such a new thing even the people building it do not know what It is going to be like. Now It is time to jump onboard and influence the future metaverses and future experiences***.” *(MVFW2023 people)*

MVFW2023 people praise the advantages of open platforms, which are claimed to serve as inclusive, accessible and interoperable spaces for both organizations and individuals. They encourage creators and brands to invest in land and create content to boost in-platform sales, and this way enhance the overall platform value, which attracts more users (Cassat, 2022, 65).

2) ”***Decentraland drops people in multiple different realms to keep from overloading a space, not all participants are visible***. *“When I logged into my own party it was empty,* ” *Plein says.* ”*But, the other one was packed.* ***You can have a date in the same world, but not in the same realm.*** ”*...* ”***At times, Decentraland can feel lonely,” Vedel says. “It is not a naturally sociable place and there have been limitations on how many people can attend events.*** ” *(media)*

3) ”***I visited Hugo Boss space where one can collect water droplets and having collected all 4, one can claim a unisex classic Boss suit. It is redeemed in ReadyPlayerMe! Avatar provider where one can edit the avatar further and connect it with Spatial platform***. *I visited Vogue Singapore space in Spatial from where one could travel to Decentraland space BUT the avatar won’t travel with you; in Decentraland only the Decentraland avatar works.* ” *(creators and consumers)*

4) ”*To purchase wearables or access the Decentraland marketplace****, users must leave the metaverse and visit Decentraland’s website****. While the marketplace now boasts new categories like accessories, skins, emotes, and rarity tags,* ***constantly shifting between distinct sites destracts from the MVFW experience****.* ” *(media)*

5) ”***I experienced disappointment because I couldn’t wear the items I created***. ”*...* ” ***Self-expression being so highly promoted and implemented by majority of other participants I also felt quite strongly like an outsider. I was for example shy to use emotes to express myself in fear to stand out.*** ” *(creators and consumers)*

6) ”*People have not yet been given a reason to want to spend time in these spaces, to understand how the Metaverse is meant to fit into their lives. It seems like every involved party has so far over indexed on the retail part to make a quick buck while every other potential use case remains underdeveloped****. I’m not buying new clothes if I never have a reason to go out****.* ” *(creators and consumers)*

7) ”***The 3D design capabilities of Decentraland are currently restrictive, the end result can be underwhelming, and thus those who aren’t evangelists of digital fashion might find it off-putting and could be turned off from other events in the future***.” *(media)*

8) ”***First, I created a fake fur coat to match my real life identity and favourite piece of clothing but the design had too many triangles (over allowed 1500) so it looked in the previewer like a simple chunky knitted jumper***.” *(creators and consumers)*

The technology people envision the success of Web3 coming from seamless interoperability between Web2 and Web3 platforms, enabling one's visual identity, avatar, and wearables to traverse the entire internet. While this concept is partially realized through the use of a crypto wallet, which serves as one's identity and asset repository across Web3 platforms, avatar, and asset transferability currently function only on a few synchronized centralized platforms, as seen in the study of them.

The above quotes show that despite big promises to investors, organizations, and members of public decentralized Decentraland is still hosting rather a small number of events and appearing with other limitations, which results in frustration, that mounts, as technological glitches persist year after year. This frustration has led to declining attendance at events, with the second Metaverse Fashion Week drawing only half the number of visitors compared to the first event (Kostina, 2023).

> 9) "*While Plein* ***acknowledges that we are in a crypto winter, he still believes in cryptocurrency and Web3 in the longterm. "Our metaverse events have brought us a new audience many of which have become customers and this is why we continue doing them and continue to develop our Web3 investment which we believe in the future will be a big asset****...*" *(media)*

> 10) "*I noticed* ***the same avatars were everywhere*** *so they must have followed the same timetable as I did.* ***It was quite a small group*** *and having the avatar name tag set on I could see the names of the avatars and* ***them chatting with each other*** *(using* ***gamer/tech/teen) community language that I did not necessarily understand.*** " ***(****creators and consumers)*

Apart from the technology giants, who have helped build Web3 with their notable investments (Mileva, 2023), the fashion lovers remaining active are predominantly young Web3 natives and experts in the digital 3D fashion field. This community actively participates in the development of metaverses and metaverse events, has made financial investments, and perceives promising prospects within the Web3 ecosystem.

> 11) "*...****to the bad connotations that people have with NFT's that the word NFT is not mentioned at all...digital collectibles or assets instead.*** " *(creators and consumers)*

> 12) "*... because* ***digital fashion events are still so nascent and vulnerable to criticism****, and because the* ***crypto community is so powerful****, multiple* ***experts*** *that Vogue Business spoke to* ***declined to go on-record with criticism for fear that it would jeopardise future projects****.* " *(media)*

13) ”*The thing that frustrates me most about this is that...if Decentraland wasn’t a Crypto based scam it might actually be kind of fun to check out. Build. Like the sims or something.* ***But it IS Crypto based and just...just no****.* ” *(creators and consumers)*

14) ”***Brands especially in US, are worried about security and regulation and privacy and copyright issues because virtual worlds are so new thing and blockchain based It is not regulated. It is wild west with scammers****.* ” *(MVFW2023 people)*

15) ”*This journalist witnessed a broken feature.* ***They experienced a bug rather than reporting critically on the failure of a key feature of the event, the article pulls its punch in the last line through the language of puff journalism***”*...* ”*This isn’t some grand conspiracy, It is just dozens of individuals independently reaching the same conclusion.* ***The product sucks, and it’d be a bad idea to show it.*** *This is true for both DCL users, but also the journalists covering it. Decentraland looks so unprofessional that coverage of Decentraland looks unprofessional by extension.* ” *(media)*

16) ”*The space is evolving and the bear market (declining market) is an opportunity because we’re cleaning it up and* ***the only people that really believe on what the metaverse and this new virtual lands can bring to our future life are still here and are still experimenting.*** ” *(MVFW2023 people)*

17) ”***Opening (explaining) pie to all of brands and their managers – be emphatetic and answer questions about change and manage biases****.* ” *(MVFW2023 people)*

With new technologies there often also comes a cohort with extensive knowledge and intentions to exploit the system for personal gain, taking advantage of those who are less informed (Cassat, 2022, 5-6). It can be seen happening in the context of cryptocurrencies and NFTs, for example. According to the Finnish Police, approximately half of today’s registered crimes occur online, with young individuals, who spend a significant portion of their hours awake on social media and gaming platforms, being the most common victims (Mattila, 2023).

The research data shows that media and consumers often perceive digital 3D fashion negatively. Human psychology tends to prioritize negative events, information, or emotions over positive ones, which is why negativity often dominates the news, and media outlets may emphasize technology flaws to serve their own interests (Perlmutter, 2019). This kind of backlash can occur when a well-known brand or celebrity introduces a poorly conceived product or an obvious money-making intention Cassat (2022, 189), or when crime is involved, which subsequently garners negative attention in the news. Today’s media landscape is shaped by private equity firms, national or transnational business magnates with political influence, and states. In the digital realm, giants like Google, Facebook, and Apple also play a significant

role in determining communication norms (Craufurd Smith et al., 2021). The dynamics within the media environment can significantly impact the success of emerging technologies.

The development of technologies greatly benefits from rapid testing (Ideo.org, 2015, 19-21). This solution-oriented approach enhances efficiency by uncovering unforeseen issues and enabling swift responses to them (DeBara, 2020). Immersing oneself in technologies is also the most effective way to learn to adopt them. However, because Web3 differs significantly from the internet we are accustomed to, many people are hesitant to embrace it, potentially missing out on its benefits. The biased approach may influence the perception of less informed (Cherry, 2022) and in the worst case lead to backlashes. Therefore, comprehensive and inclusive education must be provided throughout the preview stage to create a positive perception. To foster sustainable development in the realm of fashion NFTs, media, brands, and consumers must pick up a solid understanding of both the positive and negative aspects of the technology. This knowledge will enable all to create and enjoy value safely while fostering mutual trust. The developer communities, guided by the original vision of Web3, play a critical role in providing this education (Cassat, 2022, 138-140).

4.1.1. Centralized Mindset

18) ”***"Don’t shop less, shop digitally" is the perfect summary of the nightmare fuel the metaverse is***.” *(creators and consumers)*

19) ”***You know what my boss loved? Efficiency. If you think companies care about the quality of the work more than the sheer amount of it, you’re being naive.*** ”... ”***The over-consumption of art has been a problem for a long time.*** ” *(creators and consumers)*

20) ”***We’re obsessed with new and we can’t never get enough of it, as consumers***. ” *(creators and consumers)*

Shifting towards digital solutions does not automatically ensure sustainability. The dominant business mindset shaped by a centralized business model, often places greater emphasis on growth and efficiency at the expense of quality. This perspective has been engrained in the consciousness of individuals over generations and is widely perceived as the norm in everyday life (Klikauer, 2015, 1114). Thus, a shift to a fully decentralized mindset can be a complex task, especially given that large corporations have played a significant role in the development of Web3 technologies (Cassat, 2022, 181-182; Mileva, 2023). The required education by

technology companies being incomplete or completely missing, can present challenges when attempting to implement sustainable practices and effectively manage change.

21) "***Right now, NFTs are too much of a money-making mindset and financial investment.***" *(MVFV2023 people)*

22) "*To the bigger companies, to onboard and do the web three, that you can* ***sell out something for USD 3 million in like 5 minutes. Amazing but it should be a sustainable kind of business model*** *and this is the transparency. "… "****even in a traditional industry not in NFT, It is not a lot of things as sellout.*** *" (MVFV2023 people)*

23) "***Tommy Hillfiger store: too easy games, freebies and €0 AI-generated TH puffer jackets, discounts on physical online store items****. " (creators and consumers)*

The pressure for rapid growth driven by investors and shareholders often compels brands to adopt promising technologies hastily. Moreover, fragmented information can create an enticing image of easy-to-use tools for quick gains.

Nike's sale of 20,000 Crypto Kicks NFTs at USD 5,000 – 130,000 each has drawn criticism from the Web3 community, as the promotional tactic is incompatible with the ethos of Web3. According to Cassat (2022, 184), the Web3 natives are very sceptical of newcomers to try and sell anything to the community unless they appear authentically interested in Web3 and are willing to build and maintain long-term relationships, which make their NFTs grow in value over time. Furthermore, it appears impractical given the nascent state of interoperability that limits their utility value – even though the buyers were investors knowing that the interoperability would be fully developed in a few years. Jessica Berger (2023), the Senior Vice President of Innovation at Publicis Media, among others, states that digital assets lose their value sitting unused in the crypto-wallets.

The high price of Nike's NFTs hints that the buyers of Crypto Kicks were investors. Naturally, they are expecting the value of their purchases to appreciate (Williams, 2022). To address this, the brand may have been compelled to introduce real-world counterparts of Crypto Kicks (iRL) to offer the community more engagement opportunities across various channels and thereby maintain and grow the NFTs' resale value. Creating physical twins to make up for failed NFT projects is not a sustainable practice though.

24) ”***Web2 marketing ends at the point of sale**. **New (physical) product comes after that.*** ” *(MVFV2023 people)*

Kirjavainen (2022) argues that the primary motivation for purchasing physical luxury fashion items among Gen Z and Millennials is not necessarily wearing them but rather sharing their possessions on social media. Afterwards, the item typically returns to the closet with no further engagement with the brand. This behaviour leads to the accumulation of numerous forgotten unused items in people’s homes. As just stated by Berger (2023), while digital 3D fashion pieces do not occupy physical wardrobe space, they lose their value remaining unused. Similarly, physical material possessions lose their value if they remain stagnant. According to Huhtamäki (2023a), the potential of a circular economy could be ten times greater in many product categories if people actively utilized and released unused items that are often "sleeping" in their closets. This approach would not only contribute to a more sustainable economy but also boost purchasing power within the national economy and reduce the environmental impact of consumption and production. If physical fashion items were connected to a royalty system like NFTs’, perhaps it could serve as an incentive for a more rapid turnover of these items.

25) ”***You could buy a physical shirt and then you have NFT (digital twin) that would enable you to fly to Milan and, you know, go to the (brand) Studio and then all sorts of other real world utilities that you can get with**. Or build upon utility for people to actually buy NFTS or digital products from your brand.” (MVFV2023 people)*

While linking an NFT to a physical item can provide value to the owner and brand (Kirjavainen, 2022) it is crucial to consider the environmental impacts associated with this approach. Transporting individuals over to the other side of the world as VIP perks, poses significant environmental consequences, considering the high carbon footprint of air travel (IEA, 2023). Furthermore, minting a large number of NFTs to serve as customer benefits can be costly. While blockchain technology can store endless amounts of data and Ethereum is considered a more environmentally friendly network (Ethereum, 2023b) the overall environmental impact of the growing Web3 ecosystem cannot be ignored. Compensating the potential benefits of NFTs with their environmental footprint is a critical consideration in the sustainable development of digital 3D fashion.

26) ”*...**just because something was not going to cost USD 5000, it didn’t mean that it didn’t need the same love and attention that you do do for a product that costs that much.***

And the real work went into it working with his stylist. But in reality it does mean as much and it will mean as much because that's your community you're talking about. " *(MVFW2023 people)*

27) "***If you launch your your own project like, yeah, we're launching 10,000 NFTS and then you have to pay for it****.* " *(MVFW2023 people)*

In the context of Web3, the traditional approach relying on users exchanging their data for goods or services, becomes irrelevant (Cassat, 2022, 114) Additionally, NFTs possess resale value only if the brand actively cultivates them to maintain community engagement Berger, 2023). Consequently, giving away a large number of free items, or AI-generated designs which may not even grant copyrights to the brand (Fagan et al., 2023), is a wasteful expenditure. The processes of minting and burning NFTs incur high gas fees and exert a strain on the environment. In light of these considerations, it is more prudent to approach NFT creation focusing on long-term value creation (Benson, 2021).

28) "***People buy crazy expensive skins for CS:GO cause the game is good and they enjoy it, they wouldn't put that money for a shitty metaverse they would play twice****…*" *(creators and consumers)*

29) "***Game engine called Unity (that Spatial works with) creates beautiful high fidelity and experiences, but it also can take your wearables and help them flow and really show the fabric****…*" *(MVFW2023 people)*

Many gamers place immense value on unique in-game items and are willing to spend substantial sums on skins and outfits created by talented design teams of popular games because appropriate looks enhance their gaming experience (Karjalainen, 2023) which is highly social. The data shows that gamers prioritize the centralized gaming experiences over non-gaming fashion collaborations on decentralized platforms because the fidelity of the latter does not meet their high expectations.

Their expectations can be influenced by the phenomenon of FoMO (the fear of missing out), initially triggered by marketing and continuously fostered by social media. It is closely tied to community membership and involves two key processes: first, the perception of missing out, followed by compulsive behaviour to maintain one's social connections (Gupta & Sharma, 2021). Ware (2022) argues that such artificial scarcity runs counter to the concept of a free and open Internet. Instead, it contributes to its privatization, negatively affecting most individuals,

because the game collectables hold little to no intrinsic value unless their owners possess the necessary resources and sharp business acumen to keep them in circulation.

30) ”***I’m not buying anything of his desire. I’m getting everything for free***. ” *(creators and consumers)*

31) ”*Alright,* ***let’s see what’s up with DKNY****, bro? Yo, who’s here? And your free wearable area? So we already did this.* ***We got the free wearable***. ” *(creators and consumers)*

32) ”***Alright, there better be a free Tommy Hilfiger. Where it because last time there wasn’t an oh ****. OK, except collect all pieces, assemble the puzzle eye so. Ohh POAP, please tell me we have a POAP***. ” *(creators and consumers)*

33) ”*These are official Tommy Hilfiger NFT emails. Bro, I don’t want anybody tell me ** about this tonight or after tomorrow or anything.* ***We’re in Tommy Hilfiger land, bro. This is insane***. ” *(creators and consumers)*

34) ”*Oh my God, this is amazing. Where’s my Adidas jacket? There we go.* ***Yo, not official Adidas NFT wearable bro, what do you not understand? We not comprehend Adidas, bro, come on***. ” *(creators and consumers)*

The author spotted a large group of free item hunters at the Metaverse Fashion Week. They often represent the Web3-native community who abstain from spending money on collectables that primarily serve to generate extra profits for centralized gaming companies. While they may appreciate the attractive designs, high quality, and sense of belonging associated with exclusive high-end or luxury brands, many of them have acquired practical knowledge about how marketing techniques exploit scarcity when introducing new collectables (Torres, 2022; Ware, 2022).

35) ”***Asset creation pipeline is different from gaming***. ” *(MVFW2023 people)*

Access to high-quality game asset creation tools, distinct from those used for fashion assets, is typically controlled by centralized gaming companies. For decentralized organizations that are hesitant to invest in such tools and be open to external control, their developers must re-invent the wheel, which can hinder platform user experience quality and development speed (Georgiev, 2023), as seen in Decentraland. This is a sample of digital 3D fashion’s inaccessibility, which along with its accessibility is opened in the next chapter in a more detailed way.

4.2. Accessibility

36) ”***Digital design tools have been around since video games were made, and have been adopted by designers (independent and institutional) shortly after***. ” *(creators and consumers)*

37) ”***Technology is much more accessible today – especially for industry***. ” *(MVFV2023 people)*

The launch of virtual gaming dates to the late 1980s (Point in Time, 2021), and since then, centralized gaming platforms have evolved significantly. This leads to the conclusion, that for quite some time now digital 3D modelling has matured and become widely accessible, making it affordable and user-friendly. As demonstrated by the author's test run of Blender 3D modelling software, today's technology-savvy individuals can quickly learn to create impressive and lifelike animated content with open tools and tutorials.

38) ”***It is empowering people who may not have been able to have access to a brand to now love that brand and become an ambassador for that brand and champion that brand for their values, for their story, for their heritage, for what they bring to the space, for their creativity.*** ” *(MVFV2023 people)*

39) ”*Runway shows were just as amazing as physical ones, and* ***anyone could get a front row seat!*** ” *(creators and consumers)*

40) ”***Metaverse Fashion Week 2023 brought high fashion to an average consumer, linking a highly exclusive event with online users. In many ways, it offered both brand followers and retailers something a physical world cannot: connection, virtual out-of-this-world experiences and a community.*** ” *(media)*

Digital 3D fashion offers consumers a unique opportunity to access global brands and events that may be financially out of reach or unavailable in their geographic location.

41) ”*I view 3d fashion in a more art way and im not certain whether it can be more than that. For me personally,* ***i started learning 3d to make clothes cuz its hard af to make it in real life.*** ” *(creators and consumers)*

42) ”***Fashion-lovers aren't well off economically and how much digital fashion helps in overcoming it.*** ” *(creators and consumers)*

43) ”*(Physical) clothes are an effing hard thing to make. Problem is quality is 95% of the time compromised because of overarching demand. We're obsessed with new and we can't never get enough of it, as consumers.* ***But at the bottom of the barrel, digital fashion helps monetize a segment of the creative design process that remains uncapitalized or unseen to the wider audience and markets***. ” *(creators and consumers)*

44) ”***This means that some creators from all around the world will get the opportunity and exposure that they never would have had access to before****. So imagine no matter where you are in the world, you’re a digital creator, you’re digital fashion designer. You now have the opportunity to step into the same room as one of the biggest companies in the world.* ” *(creators and consumers)*

45) ”***I like the idea of digital fashion introducing a new skill set to the designer’s arsenal, and hopefully a career in fashion can come to encompass all those people who create clothing/outfits for non-tactile spaces.*** ” *(creators and consumers)*

Additionally, digital 3D modelling provides an accessible avenue for aspiring designers who may lack the financial resources, machinery, or skills required for traditional physical fashion construction. Särmäkari (2021) posits that digital fashion offers designers unparalleled creative freedom, allowing them to break free from the constraints imposed by brands and market demands. This newfound creative space encourages traditional designers to adapt, learn new skills, and collaborate with the emerging generation of digital designers. It democratizes the design field, welcoming newcomers while also providing experienced designers with opportunities for self-development and enhanced professional recognition. The coexistence of both traditional and digital fashion design enriches the industry, fostering innovation and diversity.

46) ”***My brain auto-translated it into “spend money on something that costs nothing to produce”.*** ” *(creators and consumers)*

47) ”***I’m a journalist, and I understand the value and labour of creating intangible assets****. While I agree with you on pretty much everything,* ***it is still hard for me to accept the prices at which NFTs are going on around the internet because we’re in a bubble****.* ” *(creators and consumers)*

48) ”***3D modelling is no joke, I tried learning Z Brush once and compared to 2D digital art, just the various shortcuts you need to learn to use the program efficiently was too much for me to deal with****.* ” *(creators and consumers)*

49) ”***And clearly we cannot consider either one or the other a cheap way to make fashion, because in real you have machinery, places and so on, but in digital we also have programs and more programs to be signed/purchased, textures and many other things that will against a final value, apart from the lack of access to it and the elitization****…*” *(creators and consumers)*

However, according to the author’s findings, while digital fashion does not rely on physical materials, machinery, or expensive education, it is not a low-cost endeavour. There may be plenty of free tools available to use online, but some of the most efficient plugins and texture

libraries often come with monthly subscription fees. Additionally, the devices used for digital fashion creation can be expensive and require frequent replacement due to incompatibility with the newest operation system updates. Whereas the machinery used in physical fashion production is often less hi-tech, easier to repair, and requires only routine servicing instead of complete replacement. Several online presentations show that the design process often requires just as much time as the assembly of a detailed physical garment. In sum, digital fashion is a sophisticated and innovative process that encompasses designer expertise, creative input, technological resources, energy consumption, and financial investment.

While fast fashion is often lauded for democratizing fashion through affordability and widespread availability (Haapanen, 2021), it also comes under scrutiny for its resource wastage and tendency to replicate high-end and individual designer collections (Pruitt-Young, 2021). Thus, designers in the fast fashion industry often play a role more akin to administrators than creators. This approach can lead to the erosion of the creative joy in designing meaningful fashion and may contribute to unfair labour practices at various production levels (Huoviala, 2015).

> 50) ”***We are talking about real ownership, cross metaverse and community***. ” *(MVFW2023 people)*
>
> 51) ”***There is no like default clothing for any of the digital characters in all of the digital movies and video games and everything else***. *There’s no default for them to wear. A decision has to be made at some point about what is going to clothe their bodies, even for people who wear uniforms.* ***That uniform was designed by somebody and selected for a specific purpose for people to wear***. ” *(creators and consumers)*
>
> 52) ”*They keep the players on the platform, the players on the platform drive and the creators, the Creators drive in busy. Start your business and go to pull it out, you get 400. It is just how it is. Unfortunately, with those closed platforms. And that’s the point that we have to that’s where will onboard them by giving them their 70-80% cuts and stuff like that. You know, because that’s what the game industry does.* ***I mean as fair as everybody thinks the game industry is, It is not. These game developers make industry on the planet right now for a reason. Also the most lucrative. It even beats Hollywood and the music industry combined.*** ” *(creators and consumers)*

All products around us are designed by someone, they do not come as default. In the current fashion industry landscape, brands receive exclusive credit for all product design, except in cases where they collaborate with celebrity designers. A regular designer’s success is frequently gauged by their association with prestigious brands.

Like in the fashion industry, investor-driven game platforms can swiftly respond to user demands with their constantly developing, superior gaming experiences. This tendency keeps users engaged with centralized platforms and can lead to burnout among developers trying to keep up with the rapid pace of business (Lombardo, 2020).

53) ”*...**here in Brazil I still believe that I am one of the first to have this access (to digital software) and to be able to live directly from it having come from a disadvantaged place**.* ” *(creators and consumers)*

54) ”***I can’t always pull out my computer or put on my VR headset if I wanna hop into an event it needs to be accessible from my phone. That’s a personal experience**.* ” *(MVFW2023 people)*

In many regions where reliable electricity and internet connections are scarce, mobile phones with chargeable batteries serve as the primary means of internet access. Additionally, numerous individuals cannot afford to own devices or subscribe to software services beyond their mobile phones. On the other hand, people seek to minimize the number of items they carry when going out during their daily lives while maintaining access to social environments worldwide. (Camara, 2023). Therefore, to enhance the inclusivity of digital fashion, it is essential to develop mobile phone-friendly user experiences. To maximize the environmental and social sustainability of the technology, people should have effortless access to services using the minimum number of devices and as little energy as possible (UNEP, 2023b).

55) ”***All this energy spent for superficial needs in a virtual world... At the same time, the real world suffers severely from the mining of metals used to build these virtual worlds. Species are disappearing, rainforests are burning... Sick. Shame on you Vogue and the other ones**.* ” *(creators and consumers)*

56) ”***Imagine walking hours to gather clean drinking water for your family in a third world country and seeing people in the west spending hundreds of thousands to build virtual businesses that no one uses.*** ” *(creators and consumers)*

57) ”*One thing which I do worry about is digital fashion as a financial product which will become more and more inevitable and is already true, to an extent, for physical high fashion.* ***Until now digital fashion has represented a kind of fashion autonomy and even a democratization of fashion because one person can do it with limited resources and can even teach themself (all of that to an extent). I hope if it becomes financialized and more commodified that there will still be corners where it is collaborative and something "normal people" can do.*** ” *(creators and consumers)*

The above statements prompted the author to dive deeper into the power dynamics surrounding the co-creation of digital 3D fashion. These technologies are recognized for offering accessibility to anyone aspiring to become a digital fashion designer and potentially earn a livelihood from it (Pagotto, 2022). Nonetheless, an examination of both decentralized and centralized platforms highlights the absence of digital 3D fashion creator tools that are accessible via mobile phones. Therefore, digital 3D fashion should not be communicated fully inclusive.

Additionally, as discovered during the netnographic observation, wearables publishing fees are low on centralized platforms but high on decentralized platforms. While high fees may help the maintenance of high-quality content on decentralized platforms (Decentraland, 2023b) they direct creators to centralized low-fee platforms that provide access to creativity to those with limited resources. This grants control over the content to these centralized companies and also individuals who can afford to use a wide range of devices and software. Which allows the companies and wealthy individuals to potentially shape the digital 3D fashion and Web3 according to their preferences.

While the author encountered minor issues during her initial entry to Metaverse Fashion Week with somewhat old equipment, many people in various parts of the world may use even older devices and find it impossible to access the Metaverse platforms (Camara, 2023). The author's entry process reveals the existence of technology brand cliques that offer the smoothest access to Decentraland experiences.

Reminiscing the evolution of Web2, the emergence of easy access tools like credit card payments and email logins within Web3 raises questions about their potential to make people reliant on them, discourage the practice of anonymous internet use, and facilitate ongoing data collection and commissions by businesses. The author's experience with crypto wallet-free shopping using payment cards proves the need for strong authentication, potentially compromising anonymity. In contrast, using a crypto wallet login that only reveals one's public key, a long string of digits, can help preserve anonymity.

When logged in the centralized platforms with email, VR, simulation devices, and mobile phone applications may still collect user data for marketing purposes. This data can extend beyond Web2 user behaviour and include biometrics such as eye movement (Couch, 2023).

Apple, however, asserts that the iris identification feature of their recently launched headset serves only device unlocking, authorizing purchases, and password retrieval purposes (Clover, 2023).

The continuous development of technology and the common practice of planned obsolescence in device production (Pienipaavola, 2023) exploit people, particularly in less wealthy countries, where land is taken over by mineral mining, leading to the displacement of farmers. When the old operating systems of devices cannot be updated and cease to function securely, they must be replaced. In addition to huge garbage piles, frequent replacements result in increased emissions from factories, logistics, and travel for shopping. Additionally, high internet activity demands more fresh water for cooling data centres (Osaka, 2023) and leads to increased energy consumption. Regarding the author's equipment, a report by her electricity supplier shows that her daily energy consumption during Metaverse Fashion Week was four times higher than on a typical study day.

Influential individuals, often celebrities, play a role in promoting new devices, and receiving complimentary products for testing, and reviewing. Furthermore, these celebrities may be compensated for their endorsements, similar to how they are paid to attend fashion shows and endorse brands at physical fashion events (Achauer, 2022). These promotional expenses contribute to the overall cost of products (Weber, 2023), which can ultimately make them less accessible to the average consumer.

To strengthen creative individuals' positions and recognition, Sustainability Scientist and Design Researcher Ídil Gaziulusoy (2023) from Aalto University urges them worldwide to start their own businesses and collaborate with like-minded colleagues to drive effective sustainable transformations and foster healthy, meaningful work lives.

As entrepreneurs, individuals are recognized for both their successes and failures, serving as a powerful motivation to continually strive for success. This does not only benefit the client brands but also allows individuals to develop valuable business skills and a mindset that will help them confidently navigate the business landscape and serve them throughout their lives, even if their businesses cease to exist. Entrepreneurs also have the potential to positively impact numerous lives through their business practices and ethical principles. By doing so within a

community, the meaningful impact and lasting legacy can be multiplied, resulting in a more significant contribution to society (Sharara, 2023).

A notable example of these incentivized economies is the Fashion DAO. Functioning as a decentralized autonomous organization and a co-creation initiative with a public benefit focus it empowers creators and brands across the fashion industry and various other sectors to engage in initiatives related to environmental, social, and governance issues. As a part of their activities, the community collaboratively gathers resources to assist members who may lack access to necessary equipment. The Fashion DAO's overarching vision is to become the most equitable global organization, fostering an environment where every individual can contribute value responsibly (Faro, 2023).

4.2.1. DAOs

As a business model DAO shares similarities with traditional cooperatives but distinguishes itself by being governed by code, which ensures transparency and public disclosure (Reiff, 2023). DAOs are meticulously structured entities that use blockchain, digital assets, and related technologies to direct resources, allocate capital, and organize people. They are created as alternatives to centralized organizations with hierarchical decision-making structures restricted to a select few at the top and frequently prioritizing short-term objectives over broader societal concerns (World Economic Forum, 2023).

Many DAOs operate in decentralized finance (DeFi). They secure funding by exchanging government-regulated national currencies like USD or euro for their native tokens. The native token represents voting power and ownership proportion across members. The prosperity of a DAO hinges on the size of its community and the attainment of strategic objectives, which in turn drive up the value of its native token. This increased value allows the community to issue future tokens at higher valuations, thereby raising more capital (Reiff, 2023).

Apart from acquiring governance tokens through purchase, individuals can obtain them through designated contributions or services. This accessibility method enables those who may not have the financial means for membership but can contribute through activities such as marketing. However, this unregulated aspect of a DAO's structural design may introduce a level of volatility to the organization. Nonetheless, the risk of technical vulnerabilities can be

minimized through increased transparency and the automation mechanisms inherent in DAOs (World Economic Forum, 2023).

Web3 technologies enable ownership which is to direct equity and recognition for creators and owners throughout the products' lifespan. They also foster the development of incentivized economies. The two combined with the community power can effectively address the unsustainable, centralized mindset. The next chapter discusses the brand and consumer value of the transformation from centralized to decentralized strategies.

4.3. Community Collaborations

58) "***They're going in there thinking that they're going to turn their actual clients who are their Web2, let's say clients and Web1 clients, into like the Web3 world. But what in reality happened****, which I've learned with the Digi family project, for instance****, that like 99% of the audience, the people who bought the NFT's from Dolce and Gabbana were like the Web3 natives who have never before been involved in any business with like Dolce and Gabbana products.*** " *(MVFW2023 people)*

59) "***Collaborations between like Web3 communities and brands didn't really work. Because like the core audience weren't very interested with just being associated with the brands they were actually interested in, like the Web3 way of building things. They're not the buyers and they're not the ones who are going to develop initially in the first steps***. " *(MVFW2023 people)*

60) "*I prefer and would recommend larger brands that do not particularly have like a very technological innovative like history to.* ***When they try to design it their own way, no matter how open minded they are, they will still do it kind of the old way and they will not appeal to the web3 audience there***. " *(MVFW2023 people)*

61) "...***Decentraland looks like a video game from a movie made by people who have never played a video game***. " *(creators and consumers)*

MVFW2032 people highlight that although brands may have benefited from building extensive communities of followers in the realm of Web2, it is unrealistic to assume that they can effortlessly bring their existing clients to Web3 and expect seamless adaptation. According to Cassat (2022, 189), the shift to Web3 necessitates that once brands understand Web3 they not only accommodate a new audience and their values but also retain their brand identity and align their most successful products and strengths with the community's demands. When enough centralized companies can successfully navigate the transition to decentralization there is optimism for the success of overall decentralization, as it can gradually become the norm in

the way businesses operate. However, it remains a challenging task, particularly due to the deeply ingrained old habits within brands' operations.

> 62) "***Web3 Community aspect of connectedness unlocks the value for communities***. " *(MVFW2023 people)*

> 63) "***META PARTY and Community fashion show was all about different creators meeting up (every night) and presenting & promoting their creations***. *It brought to my mind the boy racers '****tyre kicking meet ups' where they present their customised cars and discuss how they achieved the features, and how to further develop.*** " *(creators anc consumers)*

The majority of Web3 communities are composed of gamer generations, including Millennials, Gen Z, and Alpha, as the youngest. These generations, particularly the latter two, spend a significant part of their time playing games together, whether digitally connected from various locations or physically gathered in the same room but still connected through technology. They engage in activities such as collecting, comparing, and trading digital collectables (Mileva, 2023)

For these digital natives, transitioning between physical and virtual realities is a natural part of their lives. They prefer digital assets over physical items as gifts because they view social 3D environments as natural spaces to build their identities and relationships. These communities, rooted in friendship and shared interests, wield substantial influence over the ideas and cultures they promote (Cassat, 2022, 44).

> 64) "***A great achievement would be to actually move from the point of view of having clients to the point of view of having communities.*** " *(MVFW2023 people)*

> 65) "***Community is built actually stronger. The strongest communities are built around. Culture and so in web three, we need more people that have that cultural equity and have that cultural understanding to take the lead.*** " *(MVFW2023 people)*

Despite today's extensive collection of user data, it remains nearly impossible for brands to accurately predict which designs will sell. Metrics like the number of visitors to product pages, loyalty program members, or even past sales do not tell what consumers truly think of the designs (Konttinen, 2023). As a result, production volume decisions are often based on the success of similar items sold in the past, with rough sales estimates for various retail and e-commerce environments added on top. However, establishing a genuine connection, actively

interacting with consumers, and co-creating wanted items together could offer a more reliable foundation for optimizing production volumes (Trombley, 2021).

Community building is about understanding customers and their needs beyond fashion preferences and consumer behaviour. Web3 audiences have diverse interests, including creating, and building virtual spaces and wearables, and assisting brands in adopting technology and tools. In return for their contributions, they seek recognition. Collaborations are a valuable way to foster a sense of community and generate fresh content that resonates with the audience (Valintina, 2023).

Anders Byriel, CEO of the global textiles design company Kvadrat, revealed in his keynote speech at Habitare 2023 the substantial revenue growth that the company has experienced through collaborations with architects, designers, and artists as contributors to contemporary culture. Every year, the company partners with a select group of creators on meaningful projects, helping them bring their ideas to life and advancing their careers by showcasing their work in global locations. In exchange, these creators pledge to entrust Kvadrat with any future work they or their communities may require.

The same rules apply to employer-employee relationships. Generations Z and Millennials, place a high value on work-life balance and meaningful careers that enable them to make a living while doing impactful work (Deloitte, 2023). To keep employees, as well as consumers, engaged and connected with their products, brands must align with these values.

66) ”***Humans. Are the same. We’re not changing. History repeats itself. So if you want to impact culture, you gotta ride with it***.” *(MVFW2023 people)*

Terry Irwin (2023), Director of the Transition Design Institute at Carnegie Mellon University, emphasizes the power of multidisciplinary teams in identifying primary problems and finding valuable solutions together. She highlights the importance of diverse perspectives and expertise in tackling complex challenges. Learning about people and cultures is crucial for understanding the nuances of problems and finding culturally sensitive solutions. Collaborative long-term strategy planning ensures that solutions are sustainable and aligned with broader goals. Focus on long-term profit margins, rather than seeking quick fixes, secures value creation over time.

67) ” ***Who’s the customer of digital fashion****? Curious, technology savvy.* ” *(MVFW2023 people)*

68) ”*Public perception is, yeah, like one thing,* ***we’re laying heavy into is while it was onboarding, because we think that all these technologies, It is like with the Atari Jaguar focusing on the technology destroyed the console because people don’t care, they just want something fun to play****.* ” *(MVFW2023 people)*

69) ”*Us not trying like here in Decentraland I see It is like a lot of people there.* ***They’re not like pushing to sell anything to each other****.* ” *(MVFW2023 people)*

Cassat’s (2022, 73) insights into advertising and community building highlight the importance of a nuanced approach. Paid advertising may not yield the desired results, particularly among Web3 developers who champion decentralization. From their perspective, Web3 projects should naturally attract community members who share the same interests and values, obviating the necessity for paid advertising. Furthermore, proficient coders consider advertising for an open-source project that targets them unnecessary, because they can figure it out themselves. Alternatively, fostering trust and cultivating enduring relationships with prominent figures in the media sphere within the field can be a more effective strategy for nascent projects. This involves translating complex concepts into non-tech language to reach a broader audience. (Cassat, 2022, 73)

Understanding the target audience and selecting the right channels for organic content distribution is crucial. Web3 marketing is about creating engaging content and fostering community growth rather than bombarding individual users with ads. This approach shifts marketing from metrics-driven Web2 practices to a more creative and community-centred approach (Cassat, 2022, 114).

Byriel’s (2023) perspective on the community as a social club that benefits every individual underscores the idea that strong communities are built on mutual support and growth. When community members can help each other improve and achieve their goals, it creates a positive and attractive environment that draws in new individuals.

The collaborative creation of fashion not only aids in optimizing production volumes but also plays a significant role in shaping the evolution of fashion. The next chapter will provide a more comprehensive exploration of this transformative process.

4.4. Identity Is Fashion

70) ”***In more magnified identity, stronger belonging to class/ group in virtual world, you can be anybody, anything. And it can be a creative force.*** ” *(MVFW2023 people)*

71) ”*I believe that in the end fashion has evolved with society,* ***since it is a large part of our day to day and our way of expressing ourselves but they don't realize that through their clothes they communicate what insecurities they have, what they feel comfortable with****... On the other hand, digital fashion exists because there is a digital world, where there are humans, there is an invented society, based on reality,* ***that is why digital fashion exists because all those people or characters need clothes just like us, to express their personality, character, emotions.*** ” *(creators and consumers)*

72) ”***Virtual worlds can inspire freedom in real life too, It is easier without history one has in real life and can be good for us when no-one's judging us. We can become less anxious when we have a voice.*** ” *(MVFW2023 people)*

Digital 3D fashion promotes unlimited self-expression for both individuals and brands. Digital identity is fluid, different identities can reflect the different roles that one has in real life or be completely new. It fosters connections with like-minded individuals and group affiliation, fueling creativity and well-being (Rosso, 2023; Bousis, 2023; Valintina, 2023).

73) ”*You know,* ***I tend to think that It is not about the expression of your wallet, It is more about the expression for your identity. The expensive items shouldn't be like anything else than expressing your life well and size maybe.*** ” *(creators and consumers)*

74) ”*Digital fashion****, if I identify myself, let's say a Gucci fan, I would probably buy a Gucci Roblox bag or something, no matter what the price is. And It is not for showing off. As a fan, maybe.*** ” *(creators and consumers)*

75) ”*No, there isn't any visible tags that OK you paid €2000 out of this. I guess It is more at least for me. Kind of* ***the reason why I bought for example world of women NFT is what that collection stands for and supporting women in the industry and overall in tech and empowering us women and I guess kind of related to digital fashion.*** ”*...* ” *So there are different NFT collections that offer represent a purpose or mission, yes, yeah.* ***You're connected to that mission or purpose...I'm kind of most likely to buy their NFT because I believe in that same, same thing. It is not only about NFT, It is about what they represent and and. Yeah, that that's important. At least to me, It is kind of find that connection.*** ” *(creators and consumers)*

76) ”***How to make outfits for the masses? People enjoy storytelling in games, we don't have to be gamers to enjoy this world****.* ” *(MVFW2023 people)*

Throughout history, fashion has served as a means of communicating social status and class, with the most exquisite designs and materials reserved for the wealthiest and most influential individuals seen as trendsetters (Barnard, 1996, 39-40). In contrast, digital fashion transcends

discrimination based on factors such as ability, age, gender, race, religion, political views, social status, or nationality. It operates without physical constraints and is not bound by practicality, rendering traditional trends and seasonal distinctions obsolete.

Over the past two decades, we have seen that the rapid turnover of fast fashion has also made conventional trends less relevant, and the changing climate, driven by global warming, has blurred the boundaries between seasons. Consequently, the fashion industry's focus has shifted from rigid notions of lines and lengths to a celebration of individual identity and diversity. Nevertheless, fashion collections are still primarily designed with a mass audience in mind.

Barnard (1996, 17) argues that the existence of fashion is contingent upon a specific type of social structure characterized by the presence of distinct social classes. These classes must be organized hierarchically and exhibit disparities in terms of power and social status. Flügel (1930, as cited in Barnard, 1996) further emphasizes that social mobility, the ability to move upward in class, must be both possible and desirable for fashion to thrive. Given that digital fashion embraces trend-free and hierarchy-free self-expression, can it still be classified as fashion by Barnard's and Flügel's standards?

The Oxford University Press (2023) gives to word identity two definitions: "the fact of being who or what a person or thing is" and "the close similarity" the latter meaning belonging to a group. Fashion often signals group membership and group identity, but not everyone desires a uniform appearance. Fashion evolves to fulfil the need for individuality and self-expression (Barnard, 1996, 11).

This explains the appeal of salesman sample collections the author has witnessed on their arrival at brand factory outlets. These collections are eagerly anticipated by customers because their pieces differ from those eventually included in the final production. Similarly, it must be the driving factor behind the long queues seen at fitting rooms and checkouts in UFF second-hand stores on Mondays when new items are placed on display.

In digital 3D fashion communities, success is often measured by the ability to sell non-branded unique designs to the community. These designs often contribute to the common good, such as charities (Abrams, 2023).

The author with a strong creative identity acknowledges that wearing the basic clothing provided by Decentraland for free avatar customization during a creativity-empowering fashion event was limiting. However, she found ways to differentiate herself from others by changing her avatar's hair colour and adding free items obtained from brand stores to her outfit. The outcome (Figure 16) garnered a couple of compliments from other avatars. While it didn't completely fulfil her creative desires, the positive feedback she received from strangers made her feel welcome at the event. She also saw it as the community's endorsement of her alignment with the principles of Web3 – adding value to free wearables and Decentraland by utilizing them creatively.

Figure 16. The author's Decentraland avatar customized with basic wearables, free shoes, and free beauty accessories claimed in brand stores.

The production of digital material involving a multi-disciplinary process (Pink et al., 2016, 10), and an artefact's utility being defined according to what it allows one to do (Leonardi, 2010) leads to the conclusion that there are as many utilities for an artefact as individuals are using them. Therefore, it is more appropriate to speak of individual, meaningful designs rather than fashion for the masses in the context of the digital realm.

While this approach would be an unsustainable practice in the context of physical fashion collections manufactured from new materials, it champions the development of distinctive physical collections through the upcycling of existing garments. When the initial items are of superior quality, the potential for upcycling is not restricted to a single iteration. To refine luxury with trash, as stated by Maria Uggla (2023), Head of Colour and Material at Polestar, upcycling should be incentivized. Tatum (2021) currently facilitates royalty disbursement to multiple creators of original artwork – could utilization of Web3 technologies for generating royalties for both the original designer and upcycling artist perhaps be a further advancement in NFT royalty programming?

In the upcoming chapter, the discussion will persist in exploring co-created, high-quality fashion and the pivotal role of long-term community building in fostering sustainable environmental, social, and economic value creation.

4.5. High-quality and Long-term Relationships

77) ”***Digital is not here to replace, but to add value.*** ” *(MVFW2023 people)*

78) ”…***craftmanship is even more important than It is been before. Both in physical and digital fashion.*** ” *(MVFW2023 people)*

79) ”***A time to be able to start from the get go in a sustainable manner, which is quite important...long term relationships***. ” *(MVFW2023 people)*

The importance of fashion heritage preservation for future generations is strongly emphasized by the MVFW2023 people. However, they do not envision a scenario where numerous garments solely reside in museums. Instead, what they aim for is for them to remain in circulation. Just like Dapps (Decentraland) and DAOs thrive when more individuals join and engage over time to achieve common objectives (Cassat, 2022, 65), circulation and sustained engagement maintain and increase the value of digital assets (Al Zarouni, 2023). Consequently, these assets are transformed into a legacy for future generations.

80) ”***in physical clothing, It is occasion and work tied, now this will change when occasions change.*** ” *(MVFW2023 people)*

81) ”***All clothes I sew in real life I sample them 100% digitally to avoid waste etc so already taking the perfect pattern that I need***. ” *(creators and consumers)*

82) ”***Digital creation allows us to cut down on waste and makes the design process more efficient. Also, it gives designers ways to be more size-inclusive with different avatar bodies. It is hard to talk about digital fashion as a sellable item.*** ” *(creators and consumers)*

83) ”***Can sample garments at a much faster rate and not have to worry about excess waste and once you've completed a garment you print out the pattern pieces sew and dress and boom your finished product***. ” *(creators and consumers)*

84) ”*Ever since the Tony Hawk games I've loved selecting the exact pieces for my character to wear.* ***Those skate games were my first introduction to fashion or streetwear...I was always so specific. If I was scared to try out a new style in real life I would try it out in a video game first (GTA or Skate) and I would grow from there***. ” *(creators and consumers)*

The saying "well begun, is half done" holds for the approach to slow fashion which Vito (2022) describes as a concept opposing fast fashion, and championing environmental and social responsibility in the fashion industry. Its central idea is to combat overproduction and excessive consumption.

The process of enhancing brand value through design entails the digital 3D modelling of all designs. Subsequently, these designs are showcased to a broad community, encompassing consumers and retail buyers, within a metaverse platform. The community engages with these designs through immersive experiences, such as gamified runway shows. They provide feedback and actively participate in the enhancement of the designs. These interactions inform decisions about optimizing physical production. Distributing complimentary wearables to community members to assess design suitability among consumers is a viable approach. However, it is vital to recognize that unless these items also hold practical value after the testing phase, such a practice may lack long-term sustainability. This method also facilitates the development of one's personal style in a sustainable manner, reducing shopping travel and e-commerce returns.

While slow fashion is often perceived as boring the timelessness of designs does not imply that they cannot incorporate intricate and functionally intriguing elements. These designs can stand independently from trends and seasons (Murray & Jackson, 2023). The price of a garment being influenced by its details, functionality, and the high-quality materials chosen for its construction, slow fashion is more costly. However, it is important to note that in the long run, slow fashion is much more economical to own, wear, and circulate compared to fast fashion.

Slow fashion designs are constructed in a way that allows for alterations and repairs over time, which extends their life. They are also intentionally created to be adaptable. A prime example is a pair of white leather trainers, crafted to perfect fit and designed to be cleaned, mended, and upcycled. Having gained public approval, white trainers complement a wide range of styles, from casual attire to formal debuts and professional business wear (Möller & Jaakkola, 2023; Nieminen, 2023). Items of this kind frequently retain a significant resale worth, even if they lack a well-known brand label. In particular, products with artistic enhancements by individuals later in their lifecycle enjoy substantial popularity (Tripathi, 2022). This serves as a distinct indication to brands regarding the imperative need for collaborative co-creation within the community.

85) ”***3D printing has been a big part of cosplay for a while.*** ” *(creators and consumers)*

86) ”***Digital fashion and 3D printing will someday combine and all these fantastic silhouettes and textures might be approachable in a physical setting.*** ” *(creators and consumers)*

87) ”*Will we one day have the ability to* ***download/buy clothes the same way? I pay for the model aka clothes that are made digitally, they’re then altered to my size and sent across on a digital medium. All I need now is the equivalent of a 3d printer****.* ” *(creators and consumers)*

3D printing is lauded for its efficiency and environmentally friendly aspects as it generates no waste, permits the use of recycled plastics, and allows for made-to-measure mass customization of designs. Furthermore, it facilitates the realization of intricate designs that might be challenging or even impossible with traditional crafting methods (Davey, 2022). This makes a 3D printer sound like a valuable tool for manufacturing individualized slow fashion both at home and within the fashion industry and it is often proposed as an alternative to slow fashion production methods.

However, it is crucial to note that the primary material for 3D printing is still plastics, albeit in a soft form. Consequently, the wearability of 3D-printed garments is somewhat limited to specific occasions, such as parties, cosplay, or activities benefiting from smart textiles and protective clothing (Sculpteo, 2023). While efforts are underway to develop more comfortable fibre blends to expand the wearability of 3D-printed items, the complete elimination of plastic is not feasible as it serves as a binder in these fibre mixtures (3D Natives,

2023). The production of plastic fibres, whether from fossil fuels or recycled plastics, is a major contributor to global pollution and one of the most energy-intensive manufacturing processes (UNEP, 2023a). Moreover, blending plastics with other fibres makes the resulting products challenging to recycle due to the lack of advanced sorting technologies (Pyy, 2018).

Despite the increasing speed of 3D printers, print size restrictions mean that pieces of a garment must be printed in several small parts, requiring skilled assembly upon completion of the printing process (Sculpteo, 2023).

4.5.1. Storytelling for Impact and Retention

88) ”*Fashion leans on storytelling**, fashion brands tell stories that extend the life of product. That’s why brands participate in technology**.* ” *(MVFW2023 people)*

89) ”*...**sustainability lense, new way to sell experiences that give value to brand identity and Business to customer relationships**.* ” *(MVFW2023 people)*

90) ”***Re-engaging with person who has item in their wallet, not ending it at point of sale**.* ” *(MVFW2023 people)*

91) ”***With the new generation. Communication is different so you have to embrace these new technologies without losing value and who you are**.* ” *(MVFW2023 people)*

Rather than spamming individuals with email ads and pushing sponsored content to their social media feeds, Web3 storytelling encompasses engaging experiences around products (Cassat, 2022, 114). This is to keep consumers with the brand for an as long time as possible and make them come back time after time.

92) ”***Last year at MFW, and this year as well, most brands opened digital storefronts and showcased virtual versions of their wares, but didn’t do much beyond those standard measures to actively court visitors**.”...”**There has to be more creativity within what platforms are offering as tools, and brands deliver as an experience**...**Just having a gallery of products with minimal interaction is not going to create excitement and engagement**.* ” *(media)*

93) ”***You don’t just want to recreate real life in the metaverse; you want to be pushing boundaries and going really crazy with your designs, show spectacles and the actual experience**.* ” *(media)*

94) ”***Web3 relatable to real world is way to educate people**.* ” *(MVFW2023 people)*

95) ”*I feel like that should be where companies focus their energy instead of creating clothes and avatars and deferring the* ***responsibility of educating why any of it matters onto the end-users themselves***.” *(creators and consumers)*

96) ”***Decentraland is a very international environment, people are from everywhere and we couldn’t assume that everyone would know who Vivienne Westwood is and about her work and what she did. But we don’t want to be educators, the space is not a museum piece. It is very much about exploration, play, and experience in that installation***.” *(media)*

While real-life relatable virtual world experiences are easier for most of us to grasp, for the gaming generations who are immersed in gaming as a daily activity, simply replicating it is not sufficient. Every visit should offer an unforgettable social experience to keep visitors engaged and returning to the platform (Activision Blizzard Media, 2022).

Alongside gaming, hanging out with virtual influencers, AI-driven avatars, or brand mascots, as suggested by Astrid Hiort (2023), Digital Media Consultant at Web3allstars, can enhance the experience. Using AI influencers allows brands to maintain control over their communication and reduce the risk of scandals. However, it is important to remember that AI lacks ethics and can learn biases if not properly managed (Marr, 2023). Virtual assistants can be programmed to deliver information in an automated manner, reducing the potential for it to be filtered by biased or misinformed human intermediaries. This can lead to more direct and accurate information dissemination, for example, in the context of garment care instructions (Martin, 2022). However, as Sam Zuckerswag (2023), founder of Deploy Labs emphasizes, genuine human interaction and connections with communities are still of utmost importance.

Lammi & Sirén (2023) and Dahle (2023) suggest that reshaping mindsets through engaging and entertaining content, as opposed to relying solely on traditional education methods, can be highly effective.

97) ”***The big opportunity is to combat overconsumption by creating a better experience accommodating for that emotion that gives us a sense of satisfaction when we walk out of a store with countless bags of clothes we wear once or never***.” *(creators and consumers)*

98) ”***When I go into like, say, a shoe store, I’m probably in there like 10-20 minutes and then I’m getting a little bit stressed and wanna get out. If you compare this to the hours that people are putting into these sort of gamified experiences and also on a regular basis, people might be playing that multiple times a week***.” *(creators and consumers)*

99) ”***In when it comes to digital fashion and the web three like. It is so much more fun. Real action as well***.” *(creators and consumers)*

Web2 social media platforms limit participant interaction during live events to chat-only engagement, whereas Web3 offers a more immersive, and creative constraints-free experience, making events feel like real-life actions. These unique and immersive experiences tend to create more enduring memories. Memories are typically formed within a familiar and stable context, aiding in information retrieval. Novelty, when encountered, disrupts our predictions about what should happen within that context, highlighting and reinforcing what is essential to remember (Ohio State University, 2017).

In the research data, gamified elements emerged not only as the most popular but also as experiences that engage users for the longest durations. Such experiences are essential for fostering interaction, which is the foundation of a healthy relationship between a brand and its community. As an example, the Finnish police have recognized the potential of gaming platforms and have introduced their own gamified experiences as an educational outreach method to engage with young players (Mattila, 2023).

100) ”*Companies can now use digital engagement to attract markets, where the context of digitalization (see games and social media) has seen* ***people pursue the digital space as a viable career path... It works on the same need video games came about: we pursue escapism***. ” *(creators and consumers)*

Creativity and imagination serve as therapeutic tools to alleviate an overloaded or negative mind. Art and crafts are recognized forms of therapy in modern medicine (Shukla et al., 2022). Additionally, engaging in transformative virtual games has been shown to make symptoms of depression less severe and enhance cognitive functioning (Aalto-yliopisto, 2023).

Games have also been found to hold the potential to raise awareness about the climate crisis and promote sustainable behaviour. In interactive games, players make decisions with consequences for the scenarios they encounter, such as deciding whether to save the planet from destruction or not. The Playing for the Planet Alliance, a collaboration between the United Nations Environment Programme and 25 leading video game companies, encourages developers and game manufacturers to incorporate eco-friendly messages in games, alongside entertainment, to increase environmental awareness and education (UNEP, 2020).

Humorous entertainment can be an effective educational tool. It can prompt individuals to take serious actions without taking themselves too seriously. Laughter triggers the release of oxytocin, fostering social bonding, trust, and generosity. Constantino (2022) argues that business leaders who share moments of laughter with their followers can establish stronger connections, making their messages more memorable. According to Summerfelt et al. (2010) humour, when used in marketing content to aid memory, should be integrated as closely as possible with the information to be remembered, thus helping to consolidate the recall of relevant information. Employing these methods can potentially enable players in virtual worlds to translate learned mindsets into real-life actions (UNEP, 2020).

> 101) "*Over Metaverse Fashion Week, French e-commerce platform Monnier Paris teamed up with Decentraland and digital fashion brand Republiq, on* ***a design competition for Web3 fashion creators****...****the aim is to spotlight digital talent and create a bridge with the real world.*** *We are convinced that they will massively shape the luxury fashion industry of the future.*" *(MVFW2023 people)*

Alongside art collaborations, such as those between Kvadrat and young global artists mentioned earlier in the context of community collaborations, digital 3D fashion design competitions emerge as an effective approach for engaging with communities and providing educational opportunities. These competitions, inspired by the hackathon concept, which initially focused on tech-related problem-solving, bring together participants for time-bound, collaborative challenges. They offer individuals the chance to develop crucial personal skills, including team building, project management, leadership, networking, creative problem-solving, risk-taking, personal agility, and more, all of which hold value in both entrepreneurial and employment contexts. Additionally, competitions provide participants with the opportunity to showcase their talent to brands and establish beneficial relationships with them (Lake, 2022; EU Business School, 2022). These competitions, from a brand perspective, can foster a devoted community of consumers. When consumers are allowed to influence the product development process and co-create the products they desire, they often become enthusiastic advocates and marketers for these products (Cassat, 2022, 88-89).

5. CONCLUSIONS

Through the course of this thesis, we have gained insights into the promising role of decentralization in promoting sustainable development. This is rooted in the understanding that centralization often leads to inequitable distribution of power and wealth. Web3 is evolving

through the collaboration of both decentralized and centralized companies. For the latter, achieving success in this space necessitates significant strategic adaptations to ensure alignment with the principles of decentralization. This is done on an open Internet instead of an Intranet, the strategic front is aligned with other companies and the value creation is maximized to move forward (Al Zarouni, 2023).

To nurture this transformation, Web3 technology companies must make a concerted effort to clarify and explain decentralized technologies in an accessible manner to media, organizations, and individuals, empowering everyone to become ethical co-creators. Their communication functions play a crucial role, similar to that of a media manager, in shaping the initial media perception of these technologies (Cassat, 2020, 138-139), which significantly influences how the public views them and ultimately impacts their success (Gorvett, 2020).

Al Zarouni (2023) suggests that governments contribute to efficient sustainable development by promoting extensive Web3 education and creating digital transformation initiatives to encourage the adoption and use of Web3 technologies. To ensure a safe and conducive environment for businesses and investors to foster innovation, institutional regulations should be in place to provide guidance and support.

Digital 3D fashion is often stated to be all-inclusive. However, this thesis highlights a significant gap: the absence of digital 3D fashion creator tools that can be accessed via mobile phones. This means that currently, these creator tools are out of reach for some of the least affluent individuals, for whom mobile phones are often the only devices they can afford to purchase and use (Camara, 2023). While access to digital fashion creator tools may not be the top priority for individuals struggling to meet their basic needs, it is essential to recognize that creativity is intrinsic to human nature. Creative endeavours frequently begin with the desire to improve current conditions (Caselli, 2014). Furthermore, a design that lacks an ethical focus can inadvertently impact our social development (Leander et al., 2022, 17). Therefore, it is imperative to develop mobile phone-compatible digital 3D fashion creator applications to promote inclusivity in fashion co-creation.

In the meantime, it is worth highlighting the rise of impact DAOs, the incentivized economies, with a focus on fostering positive social change (World Economic Forum, 2023). By embarking on entrepreneurial ventures and collaborating with like-minded peers, individuals have the

potential to become more significant contributors to long-term sustainable development and the creation of meaningful work-life (Gaziulusoy, 2023; Gaziulusoy & Brezet, 2015).

Barnard's argument (1996, 11) concerning individuation as a means of defining fashion prompts us to contemplate whether designing for mass consumption can be labelled as fashion. Moreover, recognizing that digital fashion is not meant to replace physical fashion but rather to add value to it, leads to the conclusion that for digital fashion to become a legacy to future generations, the production of physical fashion linked to it is to follow the principles of slow fashion, encompassing on-demand co-creation of innovative, trend-free garments crafted with high skill from durable, ecological and circulated materials.

However, the underdeveloped interoperability of Web3 worlds presents a challenge for digital 3D fashion assets, leading to concerns about their utility. Recent reports, like Yang's (2023), have highlighted the perceived inadequacy of many NFTs, casting doubt also on the viability of monetized digital fashion. Therefore, fashion brands may find greater value in employing digital 3D fashion and Web3 technologies as tools for design, production, marketing, and sales processes, rather than immediately venturing into NFT trading.

5.1. Digital 3D Fashion Value Proposition for Brands

Transitioning from physical sampling to full digital 3D modelling of fashion collections offers significant savings in terms of resources, and waste, not limited to the design and production phases. These digital designs can also be repurposed for marketing purposes, serving as photos and videos for social media, e-commerce, and even print media such as magazine editorials and advertisements. Furthermore, they find utility in outfitting virtual assistants and models in digital runway shows, facilitating an immersive and interactive experience. In retail and e-commerce settings, they seamlessly integrate with virtual fitting room technology, enhancing the consumer experience (Browzwear, 2023). Moreover, they can be utilized to enhance the value of physical items by minting them prudently as NFTs, equipped with programmed authentication and ownership verification, and entitling the original creator to royalties each time they are resold (Kirjavainen, 2022). Finally, the ease and speed of modifying digital 3D fashion allow for older designs to be used as templates for new ones, streamlining the coming design processes (Browzwear, 2023).

While the initial costs associated with adopting 3D modelling technology and fostering multidisciplinary collaborations may appear substantial, they will prove to be highly cost-effective in the long run, Web3 facilitating long-term community building and retention. – Once the Web3 *family* is established, marketing shifts from numerical analytics to its creative essence (Cassat, 2022, 114). The primary metrics for experiences designed for *family* engagement are impact and awareness (Konttinen, 2023). According to Eitow (2023), the most impactful experiences are inclusive and incentivized challenges that allow members to learn and create. The 3D-modeled collections can be easily shared with the *family*, allowing for interactive testing and co-creation within user-friendly metaverse worlds. This collaborative engagement with digital garments during the design phase enables brands to create collections that precisely align with customer desires and optimize production volumes based on demand. Co-creation with digital fashion gives new dimensions to physical fashion and leads to consistent product quality (Browzwear, 2023). When all members are offered equal opportunities to participate and get better (Byriel, 2023), the *family* naturally evolves into a dedicated marketing team (Cassat, 2022, 115). This transformation leads to growth, with members evolving alongside it. The term *family* is used instead of *community* to underscore the significance of nurturing familial, long-term relationships as the cornerstone of growth within the sustainable development landscape.

The study shows, that both physical and digital fashion have environmental, social and governance impacts. To mitigate these effects, the core concept is to ensure that all proposed actions aim at promoting development that effectively curtails fashion consumption. This involves a transformation in the mindsets of both producers and consumers.

Communication plays a huge role in the diffusion of innovation (Rogers, 2010, “Elements of Diffusion” section, para 3). Digital 3D fashion can be utilized Digital 3D fashion can be utilized in a new kind of engaging communication that lets us transform and be transformed while creating value.

5.2. Further Research

This thesis aimed to investigate how digital 3D fashion can contribute to a more sustainable fashion industry. Given the broad scope of this study, there are several avenues for further research to explore. While this thesis has offered analytical insights into digital 3D fashion based on limited immersion in experiences within Web3-enabled worlds, there is potential for

more extensive research into its materiality, encompassing perspectives of a wider range of creator and consumer cultures, in particular the less wealthy. Furthermore, the part of DAOs in the development of a sustainable fashion industry would be interesting to further explore. To strengthen digital transformation communication in support of sustainable development, a real-life case study that specifies the value proposition's added benefits in numeric form (Jalava, 2015) would be valuable.

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Appendices