LUISS

DEPARTMENT OF ECONOMICS AND FINANCE

CHAIR OF ENTREPRENEURSHIP, INNOVATION, AND TECHNOLOGY

TECHNOLOGICAL EVOLUTION IN THE LUXURY AND FASHION INDUSTRY:

FOCUS ON THE METAVERSE AND NFT

Prof. José D'Alessandro

Supervisor

Maria Vittoria Brienza 240541

Candidate

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I. INTRODUCTION

In an era in which technology pervades society's entire life, the fashion industry is trying to adapt to new changes in this sector. This study intends to highlight how the fashion industry adjusts to new technologies. This topic is interesting because the fashion market is among the sectors with the most significant potential for technological growth, thanks to its flexibility, creativity, and versatility.

The first section will analyze the most important fashion innovations of the last years. It will cover wearables technologies, 3D printing, and virtual influencers. Firstly, the study will investigate the history of wearables, electronic devices with wireless communication capabilities that may be worn or incorporated into gadgets, as well as more invasive variants such as microchips or smart tattoos. Then, the focus will shift to smart clothing and the various ways of classifying them. Therefore, there will examine 3D printing in textiles and fashion as a way to reduce costs and enhance the efficiency, rapidness, and complexity of the products, also covering some issues, such as durability and stability. Another essential element regarding the technological development of the fashion industry is the virtual influencer. The study will investigate what it is and state some examples and issues. Moreover, the research will examine how the fashion industry reacted to the Covid pandemic, specifically by exploring digital runways, virtual reality, and augmented reality. Lastly, the focus will shift to green fashion innovations, analyzing some exponent companies such as Timberland and Kampos.

The second section will investigate the Metaverse, providing the definition and in-depth analysis, starting from the seven rules, to better understand this new and multifaceted concept. Then there will be an evaluation of which consumers are more willing to adopt the Metaverse in the future, thanks to the data from Forrester's November 2021 Consumer Energy Index and Retail Pulse Survey. The study will highlight that only Digital Immersive and Digital Socialites will be considered the more plausible early adopters. Therefore, the research will focus on what led to the Metaverse, examining the five phases of development and its three-layers architecture, composed of the ecosystem, interaction, and infrastructure. Lastly, the investigation will highlight the main challenges people have to deal with while developing the Metaverse.

The last section will investigate how the fashion industry adapts to this new concept of "second life," starting from the world of gaming. Being the most crucial Metaverse's precursor, the study will analyze the market of skins, new sales approaches through virtual and augmented reality and virtual fashion shows. Lastly, the focus will shift to the NTFs. The definition and its application to the world of fashion will be specified. Specifically, success factors and inhibitors will be analyzed, exploring the well-known Birkin Case.

II. GREATEST INNOVATIONS IN THE FASHION INDUSTRY

A. *Analysis of the Last Greatest Fashion Innovations*

i. Wearables and Smart clothes

The term wearables," or "wearable technology," refers to small electronic devices with wireless communication capabilities that can be worn or incorporated into gadgets, or even invasive versions such as microchips or smart tattoos. Wearable devices nowadays are mostly treated as "smart." However, people tend to forget that "smartness" is not only intended as processing data by chips but rather by providing a better life for the user. Hence, wearable adoption is expected to grow steadily over the next few decades, with a major shift from wristbands and sports trackers to smarter, more feature-rich wearables. Wearable technology is having a significant impact on the ICT industry, and smart wearables are expected to disrupt most of the personal and business sectors such as industry, healthcare, and sports. In addition, the global enterprise wearable market alone is projected to exceed €18 billion in 2017 and grow at a compound annual growth rate (CAGR) of 11.8% during the forecast period 2019-2026. Details of market changes and the future outlook are shown in Figure 1.

To highlight this concept, the next section will give a brief historical overview of the main innovations of the past centuries in the field of "wearables". (Aleksandr Ometov, 2021)

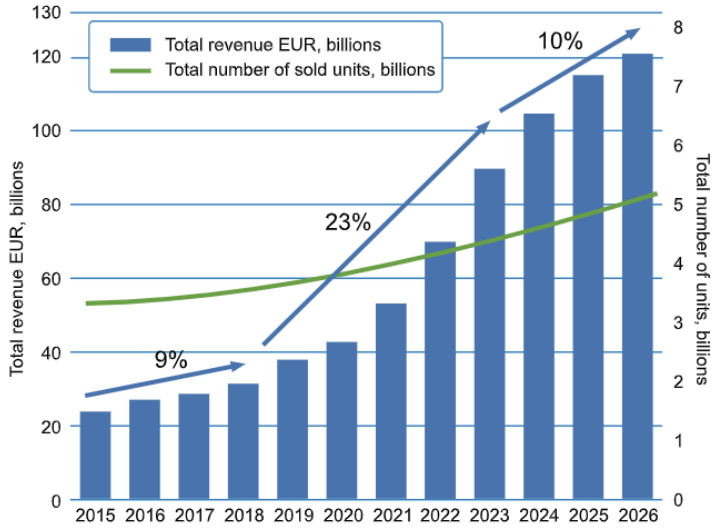

FIGURE 1 - WEARABLE MARKET GROWTH FORECAST

Around the 16th century, Peter Henlein invented the first portable watch. It was not very precise, but it enhanced the trend of having a wearable watch, followed by the invention of more than ten other models in the following years. It was beneficial, especially for the military. Another invention to highlight is the abacus ring. They were designed to help especially traders. It led the way toward wearable computers and modern smart rings. In 1961, MIT researchers Edward O. Thorpe and Claude Shannon created a timing device so little that it could be inserted into a shoe. During the 90s, Olivetti Research developed The Active Badge, the first portable indoor location tracker. The importance of this innovation consists of the fact that the Identifiable Infrared (IR) signals could transmit a person's location. It could be treated as the birth of the Smart Room concept. One of the main innovations in wearable technology is, without any doubt, the collaboration of Levi's Industrial Clothing Division (ICT) with Philips. Massimo Osti, that brought forth the ICD (Industrial Clothing Division) line before his passing in 2005, designed a jacket made of technological material capable of interconnecting electronic gadgets, thanks to a self-contained, removable 'Body Area Network,' which was essentially a series of connected wires that the gadgets could be plugged in to. In those times, this innovation was beneficial because people were bringing with them many electronic devices which were heavy and bulky. (Alistair, 2019)

FIGURE 2 - MASSIMO OSTI'S SMART JACKET

One of the most widespread fields of wearable technology is Smart Clothing. It consists of functional clothing that undergoes perception, feedback, and reaction. Its surface is a hardware device supporting software and cloud interaction. They combined aesthetics with practical necessities such as medicine, sports, and location tracking. Although they are not as popular as other smart products, their popularity has grown so fast that the most influential fashion brands are directed towards their development in recent years.

There are many ways of classifying Smart Clothes, throughout the different parts of the body to which they can be adopted, the software used, the similarities they have, and the function they are absolving. The more straightforward way to classify them is, without any doubt, the field in which they could be applicable. The major areas are medical, military, life entertainment, and positioning. Regarding the smart positioning, the main targets are children and older adults, since families need very often to track their family members throughout real-time location, and outdoor athletes, who need positioning and navigation maps, which are helpful to know how far they are from their destination and how long will it take to arrive. Smart clothes are also handy medical monitoring tools to identify and monitor body data, such as heart rate, pulse, and body temperature. These new wearable technologies could also be used as military protection devices, able to detect enemies, or risks to which soldiers are often injured, such as bullets, germs, and harmful gases… These smart military clothes could also be adept at emitting visible light, such as infrared rays and lasers, at detecting enemy situations. Another application is in life entertainment. Being not a protection tool, the demand is not so big. An example of such usage could be a dress, capable of changing color regarding the emotions of who is wearing it. In 2017, a British wearable technology company, Cute Circuit, developed a clever little dress made of graphene material capable of changing color according to the wearer's breath. If the wearer has a short breath, the dress will turn purple; if the breath is smooth or deep, the color turns green. (Xie, 2020)

Although wearable technology is still in its infancy and has several criticisms, such as data acquisition and hardware limitations, it is an essential building block in the future of Information and Communication Technology (ICT).

ii. 3D PRINTING IN THE TEXTILE AND FASHION INDUSTRY

During the exhibition #techstyle in 2016, a new type of dress ran. The Museum of Fine Arts (MFA) commissioned a 3D printed dress to Nervous System. This new way of producing

clothes explores the synergy between fashion and technology and how it is not only changing the way designers design but also the way people interact with their clothing.

In the 21st century, many innovations hit the world of fashion; one of these is undoubtedly the usage of three-dimensional printing (3DP) or additive manufacturing (AM). Although it is not widely adopted nowadays, the implications it could have in the future are assured. The AM makes the production of highly complex products easier, more rapid, and more efficient. It also has shorter production cycles and lower costs. Another essential feature is enhancing the firm's sustainability, which adopts this new method.

The fashion industry is starting to use the AM to produce mass customized wearing. This method makes it easier and faster to design a product directly based on consumer preferences and the wearer's body. In the Balenciaga's Autumn-Winter 2018 (GlobalNews, 2022) collection many pieces were printed, and each model's exact measurements were recorded and input into the computer to be printed as per the fitting requirements. This makes the 3DP a beneficial tool for customized products also because through the 3D body scan firms could find a better size and shape for the wearer.

Another pro the AM has is the designer's freedom to find new shapes and structures. In 2016, as cited before, the Museum of Fine Arts of Boston commissioned Nervous System to create the Petal Dress. It is composed of 1600 unique pieces interconnected by more than 2600 hinges. This dress can be customized on the model's body through the 3D scan, and each element can be individually customizable in its direction, shape, and length. Even if the textile is rigid and made of nylon plastic, the significant number of pieces and interconnections make the dress move like a continuous textile. (System, 2016)

In the world of fashion, the technique of 3DP is widely used in the field of jewelry and accessories. The main issue is that people prefer unique and handmade products, especially regarding luxury. Even though, when the consumer purchases a luxury product, it does purchase not only the quality of the fabric but also the time in producing that item. (GlobalNews, 2022) With the AM, there is the risk that people would give less value to that specific product even if the material used is valuable.

In addition to this, the 3DP has other issues, which are needed to be considered talking about this new technique. (Kan, 2022) Indeed, the adhesion, durability, and stability of textiles are tough to control, mainly due to the limitation of raw materials. Nowadays, the materials used to print are various (plastic, resin, rubber, ceramics, gold, platinum, silver, iron, titanium…). Still, they are pretty rigid, leading to the product's difficult flexibility, scalability, and

stretchability; this is the new method's main limitation. Moreover, the textiles mainly used in the 3DP, thermoplastic polymers, also have low air permeability and poor comfort. To remedy this, Wu e al. (Wu M.-j. , 2021) invented Cotton-contained 3D printing. Research shows that this new fabric is soft and abrasion-resistant and that it can provide the wearer a closer experience to that of cotton fabric.

FIGURE 3 - PETAL DRESS HTTPS://N-E-R-V-O-U-S.COM/PROJECTS/ALBUMS/KINEMATIC-PETALS-DRESS/

iii. VIRTUAL INFLUENCERS

In the 90s, there was a substantial increase in the number of media, banners, and other types of advertisements, as well as television, press, radio, and outdoor advertising. That was the beginning of the era of "customer empowerment". The phenomenon of word of mouth (WOM) has radically changed the concept of brands; if at first the reputation, the perception of the same, came exclusively from what was "told" to the consumer, today it is the latter who determines them, by sharing their opinions and experiences. Moreover, the health emergency caused by the coronavirus has accelerated a digitalization process that was already underway, creating new needs such as, for example, making the experience of the customer engaging and of quality. (Sotto, 2020/2021)

The world of marketing is complex and constantly evolving. Advertising techniques evolved following consumer changes and, above all, with the development of advertising channels. Social networks have outclassed marketing platforms in the last few years, and

empathy e loyalty has become two essential characteristics brands need to transmit. If the consumer identifies with the brand and with the messages and values communicated by the same, a valid and sustainable link will be established in the long term. With social media propagation, a new figure emerged in marketing: the influencer. Considered the evolution of celebrity endorsement or a modern form of WOM (Word of Mouth), it is "a person or thing that influences somebody/something, especially a person with the ability to influence potential buyers of a product or service by recommending it on social media". (Dictionary) Influencer marketing radically changed the traditional advertising model. The origins of social influencer marketing are attributable to the so-called "testimonials" then, with the development of social media, blogs took a back seat. Testimonials were replaced by ordinary people who had been able to gain the trust of their audience simply by telling themselves: the "influencers" or creators.

In the last five years, influencer marketing has made great strides. Today one no longer must be human to be identified as an opinion leader. Virtual influencers, or CGI influencers, start-up products specialized in robotics and AI (artificial intelligence), become part of the new marketing era. They are Computer Generated Imagery influencers with well-defined personalities and a credible story behind them, with which many people can identify with. Their behaviors mimic the human ones so much that most people admit that they have not noticed, at least at the beginning, their digital nature.

FIGURE 4 - @LILMIQUELA

In the 2016 Brud created Miquela Sousa. She, who goes by @lilmiquela, has racked up to 3 million followers on Instagram. She is one of the 25 most influential people on the internet by Time magazine in 2018. She also collaborated with Baauer on one of her songs, "Hate Me," and has several tracks on her Spotify profile, with almost 200.000 monthly listens. Miquela appeared in a Calvin Klein commercial with Bella Hadid, but it sparked much criticism.

Even though there are some negative aspects to this new movement, Jemie Love, CEO and founder of Monumental Marketing, highlighted that the CGI influencers can "eliminate human errors and allow you to be more direct with expectations and have more control over the campaign". (Dodgson, Fake, computer-generated Instagram influencers are modeling designer clothes, wearing Spanx, and attending red carpet premieres, 2019) They don't have to deal with entering contracts, setting fees, and shipping products. These "avatars" are then more adaptable and cost-saving. Statistics confirm that they have higher media likes, media comments, influencing value, and, above all, higher engagement rates than the real influencers, so they can reach a much wider audience. Furthermore, it is essential to point out that each avatar has its ideas, likes, dislikes, and emotions, and above all, takes positions regarding social and political issues of particular importance. (Senatore, 2020/2021)

While CGI influencers have many positive effects, they are overrun by critics. Many people affirm that they represent unreal standards opposite to the current body positivity movement in fashion. The fashion photographer Cameron-James Wilson turned 3D artist and created the world's first digital supermodel Shudu. Even if she has a very natural aspect, Wilson responded to a myriad of criticisms regarding the body positivity movement by stating that the fashion industry is still very polarized and creating Brenn, a curvier model with visible stretch marks on her skin, "to show that 3D models aren't all about barbies and they can represent reality". (Senatore, 2020/2021)

Another reason why the propagation of CGI influencers is nowadays limited is their inability to build trust. People tend not to trust and be very skeptical about what they propose, mainly when they advertise food and drink, beauty, and everything that involves the use of the senses. This is a big problem because trust is essential for influencer marketing. (Senatore, 2020/2021)

There are certain limitations (Federal Trade Commission guidelines) on what influencers may or may not publish and how they may do so to prevent unfair commercial practices. These characters must reveal any relationship with brands. The ultimate aim of these consumer protection laws is to promote transparency. Here the issue is that people ask themselves if these

laws apply to Virtual influencers, regardless of their digital nature. (Dodgson, Fake, computer-generated Instagram influencers are modeling designer clothes, wearing Spanx, and attending red carpet premieres, 2019)

B. COVID 19 AND ITS IMPACT ON THE FASHION INDUSTRY

In the last decade, the world of fashion had to move online, especially after the beginning of the Covid pandemic. The first quarantine led to the total abandonment of shopping in physical stores. The consumers had to shop exclusively online. This brought many difficulties for fashion brands which experienced a decrease in sales and customer engagement. The fashion industry had to change and readapt to an exclusively online approach. In 2021, people spent an average of four hours on their mobile phones. This includes about two and a half hours of scrolling through social media. Of the fashion customers who switched to online shopping channels in 2021, 48% cited pandemics as a reason, 27% cited convenience, and 11% cited product availability and promotion. Pandemics have also boosted digital brand relationships, saying that 72% of customers have interacted with brands online in 2021. Digital engagement could stabilize at an average of around 66% next year as restrictions will be relaxed in some regions. (McKinsey, 2022) Many firms understood that the future was in Virtual Reality (VR) and Augmented Reality (AR). (Silvestri, 2020)

i. DIGITAL RUNWAYS

Through technology, fashion brands needed to differentiate themselves from competitors, and, in this case, Covid-19 served as a proper accelerator. In the future, the fashion industry expects that the impact of technology on people's lives may accelerate. By 2024, more than 75% of the data generated by the enterprise can be processed via cloud or edge computing. This provides a more flexible and scalable foundation for brands to build their technical products. By 2030, more than 80% of the world's population should have access to 5G networks. This enables, among other things, faster connections and data transmission over the Internet of Things devices. (McKinsey, 2022)

The first sector in the fashion industry which was dramatically affected was fashion week. The first one challenged by the Coronavirus was the Paris Fashion Week. Even with some notable moments, Paris Fashion Week Autumn/Winter 2020 seems destined to be remembered as the “coronavirus fashion week.” Many stylists, such as Felipe Oliveira Baptista, Loewe, and Dries

Van Noten, decided to offer masks and to put security guards to advise people to use antibacterial hand sanitizer. Despite it, many shows were canceled, which also led to the cancellation of the Tokyo Fashion Week. (BINKLEY, 2020)

London decided to reinvent its fashion week during the summer, transforming it into the first all-digital European fashion week. LFW developed a website accessible to all, in which people could participate remotely on every single catwalk. Social media were overrun by videos of fashion bloggers and fashion influencers parading in their houses to show their outfits. The interesting is that, even if nowadays there is the possibility of having a fashion show "in the real world," the website is still working and in preparation for the LFW 2022. (Week, 2020)

The significant problem digital fashion weeks had to face was the lack of the sensory approach: the opportunity to see fabrics, and details, to interact with garments and people. The solution could be VR and AR. Companies like ORDRE are working to revolutionize the world of fashion as we know it today. It is a company founded in 2014 by Simon and Kirsten Lock to provide "an additional and complementary channel to facilitate the management of luxury wholesale networks globally through the presentation of seasonal collections through online showrooms". (Ordre) They created an integrated ecosystem to digitalize fashion brands. ORDRE takes care of the retail network, online showrooms, 360° images, virtual reality, showroom app… "New technologies are at the core of reinventing the business of fashion. The images and content on the ORDRE platform enable the management of global wholesale networks online for the first time." (Ordre) This company represents the future of fashion after the covid pandemic.

i. VR AND AR FOR SHOWROOMING

Due to the restrictions, people couldn't go shopping in stores during the first quarantine, which led to a considerable increase in online sales. Fashion brands have started implementing their online strategies to make the experience more attractive for the customer. VR and AR could be the solution. They could be helpful for size testing, make the experience more realistic, and better analyze the garments' textiles. An example of the application of AR is the GAP AR app. It enables the customer to try a selected style on a 3D and 360° rotatable virtual mannequin. The user can choose between five different body sizes, and this should have diminished the risk of having to return the outfit to the store and increased the shopper's confidence in making its purchase. This app should also let the customer try the catalog in their house without going into the physical store. The app was only available on Google Tango-enabled phones. This

represented a problem in the new strategy of Gap. The downloads were only between 1000 and 5000, and the rating review scored 3.5 out of 5 stars. From the review's side, the main problem was the limited choices of the body sizes. Gap may develop in the future another app with mannequins more customizable or even with a self-model scan function for creating personalized virtual mannequins. (Nah Zheng Xiang)

Virtual reality is not only helpful related to a single garment but also related to seeing an entire fitting room or store. The company Obsess is trying to use virtual reality fitting rooms for "fashion gamification." Researchers have been focusing more on this topic as online shopping has evolved to become a significant channel for merchants. Customer experience has become a critical determinant for success in today's retail environment, necessitating companies to go beyond price tactics and product innovation. Transferring consumer experience from an offline to an online setting poses hurdles, unlike pricing and product aspects. The use of game concepts in online purchasing, a technique known as "gamification," is how merchants have begun to improve the online customer experience. For example, popular web services, such as Facebook, Twitter, Foursquare, and eBay, all include gaming aspects to promote client engagement with their sites. To do this, the company Obsess is committed to "turn online shopping into an experience. And replace the monotonous grid ecom interface that hasn't changed since Amazon created it 25 years ago to sell books". (Obsessar) The founder Neha Singh created Obsess as a Virtual Store platform for experiential e-commerce. The firm makes 3D 360 virtual stores accessible from any device and place. As an increasingly important phenomenon, the list of Obsess' clients is long, in which Ralph Lauren, Fendi, and Christian Dior emerge.

C. GREEN FASHION INNOVATION

Even before the pandemic, sustainability in fashion had become a hot concern. The fashion industry is acknowledged as one of the world's worst pollutants, and several studies have been undertaken to address this issue from both an environmental and social standpoint. For example, the growing desire from Millennials and Generation Z for fashion labels to contribute to ecosystem wellbeing has prompted businesses to take specific actions. To mention a few, there are eco-design, corporate social responsibility, sustainable manufacturing, and sustainable reporting. However, with increasingly complicated and frequently ambiguous requirements, greenwashing difficulties, a lack of adequate data, and overall implementation delays, sustainability remains challenging in the fashion industry.

i. TIMBERLAND

Timberland is a multinational firm with worldwide distribution, really committed to sustainability. A turning point for Timberland in sustainability was in 2011 when V.F. Corporation announced the purchase of the company. Having in its portfolio brands sensitive to environmental impacts, such as The North Face, had been the start of a path towards greater sustainability, pushing the multinational company to limit the ecological footprint of some products and adopt some measures to combat climate change, to embrace the interests of its stakeholders.

Timberland wants "to equip people to make a difference in the world. They do this by creating outstanding products and trying to make a difference in the communities they live and work. They demonstrate this philosophy across all facets of the company from their products to their employee involvement in their communities". (Timberland, About Us) Due to this mission, the company started a program to encourage reuse and recycling, called "Timberloop," in collaboration with Soles 4 Souls, a European foundation. At the end of their life, the company will return footwear, gear, and accessories and replace them with new ones, guaranteeing that those items never wind up in a landfill. Thanks to this project, consumers can deliver unused shoes to one of the 178 Timberland stores around Europe. The circularity platform refurbishes worn items for resale or, if they are beyond repair, they dismantle them and repurpose or recycle the parts into new materials. To invite consumers to make this kind of donation, Timberland offers a prize to those who bring their unused shoes to the store.

In addition, Timberland also specifies the vision for 2030, stating that their purpose is that all their product will create a net positive impact on the environment, giving back to nature more than they take. They intend to leave Nature in a better state with a net positive impact than they found it. For example, they are removing from the atmosphere more carbon than is emitted or boosting biodiversity, water quality, and farmer happiness. One way to get there is their Timberloop program, which reduces waste. Timberland also uses natural materials sourced through regenerative agriculture, which helps rebuild our ecosystem by drawing carbon from the air into the soil. The company states that "100% sustainability is hard. Creating a net positive impact on the environment will be even harder. But it is what we intend to do by 2030". (Timberland, Responsibility)

The company developed many eco-innovations in the last few years. They use Recycled, Organic, or Renewable (ROR) Product Features and Technologies to produce their products. They use five types of leather; the most innovative one is regenerative leather. Regenerative farming methods allow the ground to rest, letting it absorb carbon, retain water, and restore biodiversity to the pastures where cattle graze. That involves reducing adverse effects and

having a net beneficial influence on the environment. Grazing stimulates herd movements, enabling natural grasses to thrive while restoring biodiversity, removing carbon from the atmosphere, and creating healthy, productive soil. It also assists farmers in achieving economic stability. Another interesting raw material is the "better leather," which is supplied from a tannery graded in terms of environmental responsibility, according to the standards of the Leather Working Body, an evaluation group with many stakeholders. (Timberland, Responsibility)

Timberland also innovates the sector of the outsoles, fabrics, and insulation; using extremely innovative technology, this company is in the first line to combat in favor of sustainability.

ii. KAMPOS

Kampos is a luxury brand made in Italy, founded by Alessandro Vergano in 2019. He was a manager in design and luxury, then decided to devote his life to sustainability. Kampos designs sustainable clothes, swimwear, and accessories, such as perfumes. In addition to not using plastic at all, using recyclable packaging, and the fact that Kampos is an official partner of the Coral Conservation Project, the most exciting thing is that products are all made with sustainable materials regenerated and regenerable textiles. The company uses recycled plastic bottles, organic fabrics, abandoned fishing nets, and recycled nylon, transforming marine pollution into luxury. (Kampos)

For its commitment, Kampos has obtained the Butterfly Mark accreditation, which has demonstrated the recognition of positive socio-environmental impact for its commitment to tackling the problem of pollution in the Mediterranean Sea. Suffice it to say that, thanks to the sales of the summer season alone, the brand was able to recycle about 11 thousand PET plastic bottles and almost 2 thousand kg of abandoned fishing nets and other nylon. (Maddalena, 2020)

III. THE NEW ERA: THE METAVERSE

A. INTRODUCTION

"The Metaverse is the post-reality universe, a perpetual and persistent multiuser environment merging physical reality with digital virtuality. It is based on the convergence of technologies that enable multisensory interactions with virtual environments, digital objects, and people such as virtual reality (VR) and augmented reality (AR). Hence, the Metaverse is an interconnected web of social, networked immersive environments in persistent multiuser platforms. It enables seamless embodied user communication in real-time and dynamic interactions with digital artifacts." (Mystakidis, Metaverse, 2022) The world Metaverse is a compound of two worlds: Meta (Greek prefix meaning post, after, or beyond) and the universe.

Despite the hype, today the Metaverse still does not exist. The 30-year-old terms of the Neal Stephenson's novel, Snow Crash, are not real because the Metaverse is years from actualization. For example, interoperability across the platforms still needs to be developed. Moreover, it is misleading to refer to any extended reality as "the Metaverse", because these are simply single-vendor platform activations, and only Metaverse precursors, exactly as virtual worlds, like Roblox, are just a virtual island.

Even if the Metaverse is still far from actualization, the industry FOMO is already widespread, particularly among VCs, media, and tech companies. 76% of US B2C marketing executives are planning to invest in metaverse-related activities in 2022. Unfortunately, it is different for consumers. Of the online adults who understand what the Metaverse is, only 34% in the United States and 28% in the United Kingdom are excited about the Metaverse, and only 29% in the United States and 25% in the United Kingdom see the Metaverse as good for the society. (Mike Proulx, 2022)

Metaverse is an immersive experience of interoperable and connected environments delivered to a variety of devices, from smartphones and VR headsets to other unthinkable form factors. It is the flat web we know today, transformed into a multi-dimensional, multi-sensory experience. On 2D smartphone displays, the Metaverse interface conveys 3D space from a flat perspective while taking full advantage of the full 360-degree stereoscopic view of the headset. The metaverse is spatial in nature, and these spaces are bidirectional. Real-world elements are displayed in virtual space, and virtual elements are displayed in real-world space.

i. THE SEVEN RULES OF THE METAVERSE

The strangeness and novelty of this new digital feature are causing confusion. There are many ideas that are separated from practice and reality. To avoid further confusion, and to build a metaverse that means maximum profit for the maximum number, with the sole purpose of keeping all eyes on the award, explanations and instructions are needed. In this section, the seven rules that make up the metaverse to guide the work in progress and assess the progress are displayed. (Parisi T. , 2021)

Rule #1: There is only one Metaverse. The Metaverse, like the World Wide Web, is a unique phenomenon. Links (also known as "portals") include different environments, but users can move from one particular location in one environment to a particular location in another. This means that you don't have to quit one brand's app and launch another brand's app to get to your destination.

Rule #2: The Metaverse is for everyone. The Metaverse system needs to consider the different possible use cases and the personality of the user for which they are designed. Virtual presence is not a requirement or definitional characteristic. Users may or may not have an avatar to interact with within the Metaverse. Not all use cases need to exist or be materialized. Virtual environments are the main type of experience in the Metaverse, but they are not prerequisites or definitional features. It integrates simple 3D objects with basically all media types.

Rule #3: Nobody controls the Metaverse. For example, unlike Second Life, an early virtual world that was introduced in 2003, the Metaverse is not hosted by a single entity. However, full decentralization is unlikely. The big tech companies claim to already dominate. According to Forrester, 47% of online adults in the United States associate Meta (formerly Facebook, Inc.) with Metaverse. (Mike Proulx, 2022)

Rule #4: The Metaverse is open. Open and interoperable technology provides the safest way to scale the metaverse. Closed systems and proprietary technologies have inherent scalability limitations while offering short-term benefits. Not a single product or product suite solves all problems. Interoperable products allow for more flexible combinations that can meet more needs.

Rule #5: The Metaverse is hardware-independent. The Metaverse is characterized by spatially organized, mostly real-time 3D content. To make this content accessible to everyone, you need to be able to view it on as much hardware as possible, including devices that you already own. The Metaverse content can be 3D, but the display technology does not have to

be 3D. In addition, it is important to state that VR headsets are just one of many entry points into the Metaverse. It is not necessary to have a VR headset or smart glasses to experience the Metaverse.

Rule #6: The Metaverse is a Network. Technically, the Metaverse is a network of computers that deliver and display digital information. Its strength and novelty are that it can present this information to users in the form of 3D spaces, objects, and text to facilitate communication in a variety of applications.

Rule #7: The Metaverse is the Internet. It is enhanced and updated to provide consistent 3D content, spatially organized information and experiences, and synchronized real-time communication. Conversely, the Internet is not yet a metaverse. Today's Internet is slowly approaching its potential and will form the basis of tomorrow's Metaverse.

ii. Consumer Metaverse Adoption

Forrester developed a model regarding how consumers immersed in Metaverse precursors are willing to move to the Metaverse. First of all, it is fundamental to state some assumptions of the model. The first one regards the fact that gaming and entertainment are the obvious launch point for the Metaverse. In immersive game platforms such as Fortnite and Roblox, users are able to create and customize their own avatars, attend virtual concerts, and meet friends. In addition, the world of social media is investing a lot in immersive tech, Meta alone is investing $10 billion annually.

Collecting data from Forrester's November 2021 Consumer Energy Index and Retail Pulse Survey, Forrester identified four groups of online adult consumers in US and UK to detect which consumer group is more willing to enter the Metaverse. As shown in table 1 the segments are Digital Immersive, Digital Socialites, Digital Commoners,

				
Gaming behaviors (do this often)	**Digital Immersives (22%)**	**Digital Sicialites (25%)**	**Digital Commoners (27%)**	**Digital Disconnected (26%)**
Play multiplayer games	58%	24%	3%	2%
Use a VR headset	49%	13%	0%	0%
Use Discord to communicate with friends	56%	13%	3%	2%
Gaming behaviors (have ever done)				
Built or earned digital assets/gear that I have sold	24%	11%	4%	0%
Purchased digital assets/gear to decorate a virtual room/office	12%	8%	3%	1%
Purchased digital assets/gear to enhance my abilities in a game	23%	11%	4%	1%
Earned money through affiliate programs for creators	31%	16%	4%	2%
Set up a dedicated room in my home to play virtual reality or multiplayer games	16%	11%	2%	1%
Purchased gaming-specific furniture	26%	9%	4%	1%
Purchased a Valve headset	6%	3%	0%	0%
Purchased an Oculus headset	20%	9%	2%	1%
Purchased haptic rigs and gear	15%	5%	2%	1%
Digital behaviors (do this often)				
Use augmented reality filters/lenses on social media	51%	26%	2%	2%
Buy digital products	51%	15%	0%	0%
Social media behaviors and attitudes (agree, strongly agree)				
I frequently change my profile picture	79%	20%	20%	0%
I enjoy personalizing my profile with a custom banner image/cover photo	85%	27%	29%	0%
I like to use mu app's creative tools make my content stand out	88%	22%	15%	0%
Life attitudes				
Coronavirus will have a positive long-term impact on the quality of my life	24%	11%	5%	5%
Life attitudes (describes me)				
I like to try new thing for fun	64%	39%	39%	30%
I prefer exploring new places rather than staying home	56%	32%	36%	34%
Brands help me show others who I am	55%	22%	18%	9%
Life attitudes (agree, strongly agree)				
I plan to change my job in the next six months	53%	24%	15%	11%

TABLE 1- FORRESTER'S NOVEMBER 2021 CONSUMER ENERGY INDEX AND RETAIL PULSE SURVEY

and Digital Disconnected. Among them, only Digital Immersive and Digital Socialites are considered the more probable early adopters of the metaverse.

Regarding Digital Immersive, according to Forrester's analysis, 22% of online adults in the United States and the United Kingdom show intense gaming and social media behavior that leads to early adoption of the Metaverse. Not only do they love living online, but they also create a personalized social media presence. Half of this group declared the use of VR headsets and 15% bought haptic rings to improve their experience. Moreover, Digital Socialites enjoy multiplayer online games and immersive experiences, but not at the same level of adoption and strength as the digital immersive segment. For example, only 5% of digital social notables use VR headsets "very often". However, they have invested in content creators. 26% frequently use AR filters on social media, 27% prefer to personalize their online profile with custom banners/cover photos, and 22% use creative tools. Identity, creation, and customization are important Metaverse beliefs.

B. Journey Toward the Metaverse

i. Five Phases of Virtual World Development

On the way to exploring the Metaverse, there is a very rich literary background. In this section, the paper will analyze the remarkable forerunners and illustrate a timeline, as shown in table 2. The development of the Metaverse concept could be divided into five phases. (John David N. Dionisio, 2013)

The first phase starts in the late 1970s and it is characterized by text-based virtual worlds, "complex, interactive simulations in which text describes the game state and players make progress by entering text commands". (Marc-Alexandre Côté, 2019) Text-based Interactive Games build an online platform where the player can communicate through texts and play collaboratively. They emerged in two varieties: MUDs or multi-user shared dungeons, text-based virtual reality with multiple simultaneous users, and a shared database modifiable for inside the "rooms", and MUSHs or multi-user shared hallucinations. Examples of this phase are Tolkien's Lord of the Ring or the role-playing dice game Dungeons and Dragons.

The second phase developed its graphical interface and commercial applications. It starts in 1984 with William Gibson in the science fiction novel Neuromancer, in which he established the term "Cyberspace," already used in Burning Chrome, as a concept in the public consciousness, beyond just science fiction fans. Neuromancer introduced Habitat for the

Commodore 64 (1986), Fujitsu (1989), and Colossal Cave Adventure (between 1995-1997). Colossal Cave is an interactive fiction game in which the computer simulates a situation the user must type what to do next. It is set in a fantasy setting and the user becomes part of an ongoing story, in this case, an exploration of Colossal Cave in Kentucky. In this phase, the concept of "avatar" was born. The term comes from Sanskrit, meaning "the deliberate appearance or manifestation of a deity on earth". Today this term acquired a new connotation: the movement from a human body to a digital representation.

The third phase began in the mid-1990s. It is characterized by user-created content, 3D graphics, open-ended socialization, and integrated audio. During this phase, the most remarkable examples are Web World (1994), World, Inc. (1995), and Activeworlds (1995). Specifically, Activeworlds is based entirely on the vision expressed in the novel Snow Crash, published by Neal Stevenson in 1992. It is set in the early 21st century after the global economy collapsed and federal governments lost their powers in favor of big corporations. The protagonist, to escape from that world, take refuge in a virtual world, seen as an escape. He spends a lot of time in this virtual universe composed of a street and entertainment points all around, such as parks, shops, and offices. (Jr., 2021)

The fourth phase occurred at the beginning of the postmillennial decade. During those years, there was a major expansion in commercial virtual world user bases, increased institutional presence, and improvement in graphical fidelity. Exponents of this phase are Second Life (2003) and Blue Mars (2009). During those years, there also is the development of Massive Multiplayer Online Video Games (MMO), which have 3D environments with convenient communication, UGC creation, economy, and VR/AR. The most meaningful examples are Second Life, Roblox (2006), Minecraft (2011), and Fortnite (2017). (Haihan Duan, 2021)

The last phase began in 2007 and reaches up to the present day. It is characterized by an open decentralized development. Unlike MMO video games, decentralized virtual worlds are powered by blockchain technology with a built-in economy that impacts the real economy. Major exponents are Solipsis (2007), Cryptovoxels (2018), and Decentraland (2018). (John David N. Dionisio, 2013) Decentraland is a virtual world built on Ethereum, which "provides a flexible and secure platform to build, connect, and monetize an ever-expanding ecosystem of decentralized applications (dApps)." (Staff, Ethereum Explained: A Guide to the World Supercomputer, 2021) This virtual world is owned by its users and organized through a decentralized autonomous organization (DAO). The DAO is a blockchain organizational model founded on the principal-agent dilemma, which states that in the relationship principal-agent the agent could act in accordance with its interest, even if its job is to make decisions in the

First Phase	1974	Dungeons and Dragons
Second Phase	1984	Neuromancer
	1986	Habitat for the Commodore
	1989	Fujitsu
	1994	Web World
Third Phase	1995	Colossal Cave Adventure / World, Inc. / Activeworlds
Fourth Phase	2003	Second Life
	2006	Roblox
	2007	Solipsis
	2009	Blue Mrs
	2011	Minecraft
	2017	Fortnite
	2018	Decentraland / Cryptovoxels

TABLE 2 - THE FIVE PHASES OF VIRTUAL WORLD DEVELOPMENT

interest of its principal. Decentraland has three native tokens: LAND, parcels of digital lands, Estate, merged parcels of digital lands, and MANA, the digital currency. Like other virtual worlds, it is possible to experience the Decentraland metaverse through an avatar and explore its map of digital destinations. Activities such as purchasing digital art at the Crypto Valley Art Gallery and studying at Decentraland University are possible only with digital tokens. However, Decentraland tokens are programmed to promote real-world asset value and transferability. (Staff, Decentraland (MANA) : A Virtual World Built on Ethereum, 2022)

ii. THE ARCHITECTURE OF THE METAVERSE

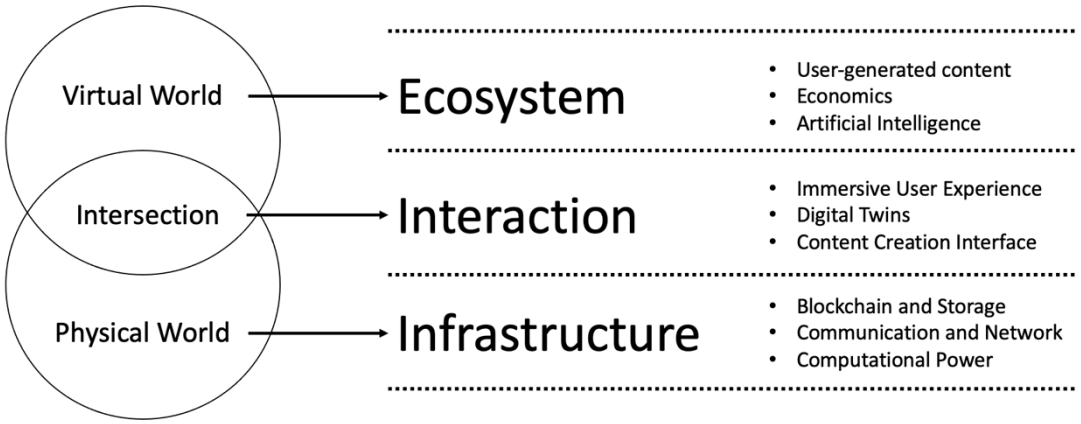

FIGURE 5 - THE THREE LAYERS ARCHITECTURE OF THE METAVERSE

The definition of the structure of the Metaverse is still at its early stage, therefore it is not possible to build an ultimate architecture. For example, Jon Radoff theorized a seven-layer metaverse architecture, where the layers are: experience, discovery, creator economy, spatial computing decentralization, human interface, and infrastructure. Although Jon Radoff used an industrial division-based view to build its architecture, another idea could be adopted: the macro perspective. As shown in figure 3, the architecture proposed is divided into three layers: ecosystem, interaction, and infrastructure. All of them are analyzed from the physical world to the virtual one, as shown on the left side of figure 3. (Haihan Duan, 2021)

The infrastructure layer consists of the essential necessities for assisting the operations of the digital world, together with computation, communication, blockchain, and storage. The system needs a massive number of calculations and a vast amount of data to be processed, connecting everyone in the world and being accessible at any time and any place. Moreover, blockchain technology provides a unique level of security, transaction transparency, digital information reliability and integrity, and data ownership in a pre-defined protocol consensus mechanism for mediator trust. Transactions can be processed not only on the blockchain but also on predefined transaction protocols, also known as smart contracts. Smart contracts, developed by Szabo (1997), are software that stores specific rules for negotiating contract terms, validating contracts, and automatically executing those terms each time. Then, using blockchain technology as an infrastructure of the Metaverse can increase decentralization and fairness.

The second layer is the interaction one, consisting of a part that connects the physical and virtual worlds. Immersive user experience, digital twins, and content creation interface are part of this layer. The immersive user experience could be rich through two main elements:

collecting the data from the physical world and using VR/AR and Haptic feedback, as in the case of the Nintendo Switch. Digital Twins, are defined as "a set of virtual information constructs that mimics the structure, context, and behavior of an individual or unique physical asset, that is dynamically updated with data from its physical twin throughout its life-cycle, and that ultimately informs decisions that realize value" (Association, 2020), are objects or things in the physical world that could interact with the metaverse. The content creator interface is another significant component for user interactions and metaverse. It is complementary to the UGC: while the operations build the essential elements the user-generated content (UGC) fulfills the universe through users.

The third layer is the ecosystem which provides a parallel living world. UGC, economics, and artificial intelligence are fundamental for the ecosystem layer. The UGC is undoubtedly part of the ecosystem. User-generated Content is everything created by users rather than developers/operators. Unlike traditional online game platforms, where users move into their worlds to pursue the developer's rules, in the Metaverse, they could explore them freely and create their own contents in the metaverse. For this reason, UGC is heterogeneous and requires ownership. Part of this layer is economics. At present, the main economic activities in the metaverse include an auction of virtual assets, such as lands, scarce items, and precious real estate, and profit from investing in cryptocurrency. (Haihan Duan, 2021) AI promotes our physical life in many areas such as Intelligent Transport Systems, Environmental Monitoring, and Public Safety. An important concept in the Metaverse lies in advanced data analysis for understanding, monitoring, regulation, and planning therefore AI-controlled NPCs will be an integral part of the Metaverse. Specifically, NPCs are computer-controlled characters that act as enemies and partners, supporting characters, providing challenges, providing support, and supporting storylines. State-of-the-art AI makes breakthroughs in computer vision (CV) and natural language processes (NLP), primarily using deep learning (DL) and reinforcement learning (RL). (Haihan Duan, 2021) AI is also helpful to develop accurate avatars, for example using 2D user photos or 3D scans. Artificial Intelligence can help break down languages, converting them into machine-readable formats, and translating them into every possible language, guaranteeing high multilingual accessibility. AI is also useful for human-computer interaction (HCI). Wearing a sophisticated AI-enabled VR headset, the sensor can read and predict electrical and muscle patterns to know exactly how you want to move in the Metaverse.

From the architecture just described, it is helpful to analyze the seven main features of the Metaverse, as shown in table 3. Drawn from the table, Text-based Games have only the creator and UGC in common. In contrast, Virtual Open Worlds, specifically Active World, also have economics and AI as essential components. It is possible to notice that the MMO Video Games have many features, including VR/AR and digital twins. Still, only with Decentralized Virtual Worlds, it is possible to notice the introduction of the blockchain to maintain decentralization and autonomy. (Haihan Duan, 2021)

Metaverse Examples		Infrastructure	Interaction			Ecosystem		
		Blockchain	VR/AR	Digital Twins	Creator	UGC	Economies	AI
Text-based games	MUDs & MUSHs	✗	✗	✗	✓	✓	✗	✗
Virtual opens worlds	Active Worlds	✗	✗	✗	✓	✓	✓	✓
	Solipsis	✗	✗	✗	✓	✓	✗	✗
MMO virtual worlds	Second Life	✗	✗	✗	✓	✓	✓	✓
	Roblox	✗	✓	✗	✓	✓	✓	✓
	Minecraft	✗	✓	✗	✓	✓	✓	✓
	Pokémon Go	✗	✗	✓	✗	✗	✓	✓
	Super Mario Maker 2	✗	✓	✗	✓	✓	✓	✓
	Fortnite	✗	✗	✗	✓	✓	✓	✓
	Animal Crossing: New Horizons	✗	✗	✗	✓	✓	✓	✓
Decentralized central worlds	Cryptovoxels	✓	✗	✗	✓	✓	✓	✓
	Decentraland	✓	✗	✗	✓	✓	✓	✓

TABLE 3 - FEATURES OF REPRESENTATIVE METAVERSE EXAMPLES

iii. METAVERSE FOR SOCIAL GOOD

In the Metaverse, being a realistic society with more direct and physical interactions, concepts such as gender, race, and physical disability would be weakened. It could significantly positively impact the real world, especially in terms of accessibility, diversity, equality, and humanity.

Regarding accessibility, the virtual world would be able to reduce geographical distances, making transportation costs lower and security higher. An example of this is the Berkley university which, during the Covid pandemic, held its graduation ceremony on Minecraft. Humanity is, without any doubt, one of the most important positive takeaways the Metaverse could have on the art world. It makes cultural communication and protection possible, especially

throughout the digital reconstruction of cultural relics. It is sufficient to think of the Notre Dame de Paris, destroyed by fire in 2019 and reconstructed by Ubisoft in Assassin's Creed Unity. (Haihan Duan, 2021)

While social impact depends on the ecosystem, it is crucial to consider many aspects of it, such as the potential for increased social inequality. In addition, limited resources in the real world lead to over-competition and social side effects. However, in the metaverse, it is possible to use an infinite amount of resources created indefinitely online rather than a deduction compensation from limited resources in the real world. This is different from the real-world reward system. Therefore, it can reduce the competition among users and is an opportunity for growth for the common good. (Park & Kim, 2022)

C. Main Challenges

Some of the main challenges of the metaverse are strictly related to AR and VR. Both technologies have a huge barrier to mass adoption, for example, the high cost of equipment, which goes against the second rule of the Metaverse: the Metaverse should be for everyone. (Parisi T. , 2021)

Risks related to AR and VR are many; among these, it is necessary to highlight the physical, psychological, and ethical ones. These programs can distract attention from elements of the bodily international and cause accidents, even deadly ones. These threats to physical consumer protection want to be addressed with the utmost care, particularly in markerless, location-primarily based AR. Psychological consequences encompass statistics overload due to multimodal stimuli and superrealism. (Athanasios Christopoulos, 2021) In addition, VR could cause motion sickness, nausea, dizziness, and head and neck fatigue if used for a long time. Moreover, VR causes social isolation, addiction, and abstinence from actual, physical life, often combined with body neglect. (Mystakidis, Metaverse, 2022)

Among the challenges, there are also enhancements to today's supporting technologies. Some formats are already emerging, such as the 3D file format. It is already widely accepted but its adoption is not guaranteed. On the other hand, there are formats not yet developed or adopted, such as interconnectivity and portability. Without software enhancements, widespread adoption would not happen. Another point is that being the Metaverse, such as an extension of the real world in the virtual one, it has to be as realistic as possible. It means that advancement in high-quality 3D experiences, locomotion, object manipulation, and mechanisms for control and command navigating are fundamental for the wide adoption of the Metaverse.

Even the fields of laws and governance represent a big challenge. It is necessary to develop norms for data privacy and protection. Data series and sharing with different events constitutes the hazard with the broadest implications concerning privacy. Metaverse collects more data than user conversations and internet history; this leads to greater attention by the user regarding its private data. The avatar two-factor authentication and protection of transmitted data are essential, and people need to be much more vigilant. (Park & Kim, 2022) This means that without a solid digital ID system, the Metaverse cannot flourish. In addition, laws often do not extend to the digital world; this could lead to crimes in the real world that would not be punished.

Another problem is that commercial models are not reliant on the exploitation of user data. This means that even if there is a mix of license-based and freemium options in the gaming world that will continue to exist, there is lots of talk about migrating from an ad-supported business model. Still, it is necessary to say that there is little concrete evidence of what such a model will look like. Another open issue is that regulators and legislators need to be more involved to address many gray areas concerning ownership and sale of tokens and digital goods, tax implications, and digital IP rights for physical items. (Mike Proulx, 2022)

IV. THE FASHION INDUSTRY IN THE "SECOND LIFE"

A. OVERVIEW

In an extremely digitalized world in which teenagers and adults spend almost eight hours per day looking at their screens, the world of the metaverse would represent the next frontier for brands. In this section, the focus will shift to one of the first industries investing in this new reality: the fashion industry. As already stated, the metaverse does not exist yet. Brands are experimenting with the Metaverse throughout its forerunners, such as virtual fashion, extended reality, gaming, and NFT. Global spending on virtual assets reached around $110 billion in 2021 (Paribas, s.d.) and is expected to grow to about $135 billion by 2024 (Company, 2022). The main aim of fashion brands today is to transform unproven technologies into sustainable revenues, differentiating the hype from reality. It is expected to have more than 5% of revenues by investing in virtual activities today over the next two to five years. It is essential to state that the Metaverse could offer sustainable revenue streams even if achieving an entirely alternative world is uncertain (table 4). This represents the most significant opportunity for the fashion industry since the introduction of e-commerce. As in that case, mass consumer adoption could represent a significant obstacle to its propagation. One of the main problems for mass adoption is the lack of physical interaction; 78% of people who have already ventured into virtual worlds say they miss physical interaction when doing so (Group, 2021).

Firms, at this moment, can engage in the metaverse across five dimensions: digital assets, digital experience, gaming (or gamified experience), platforms, and virtual worlds (Table 5).

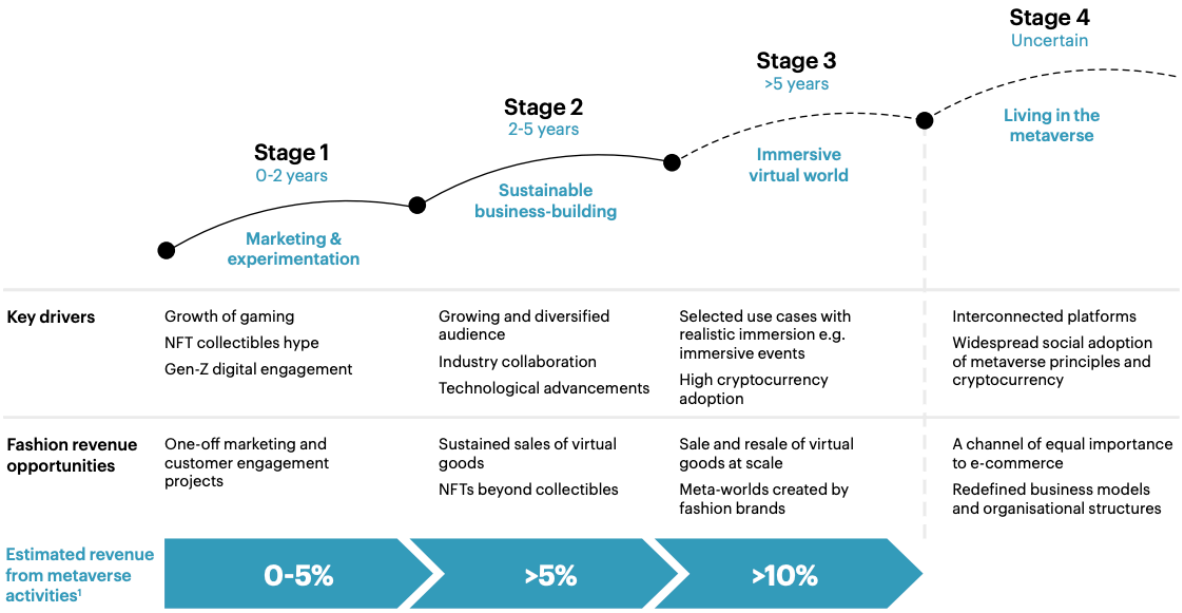

TABLE 4 - MCKINSEY ANALYSIS

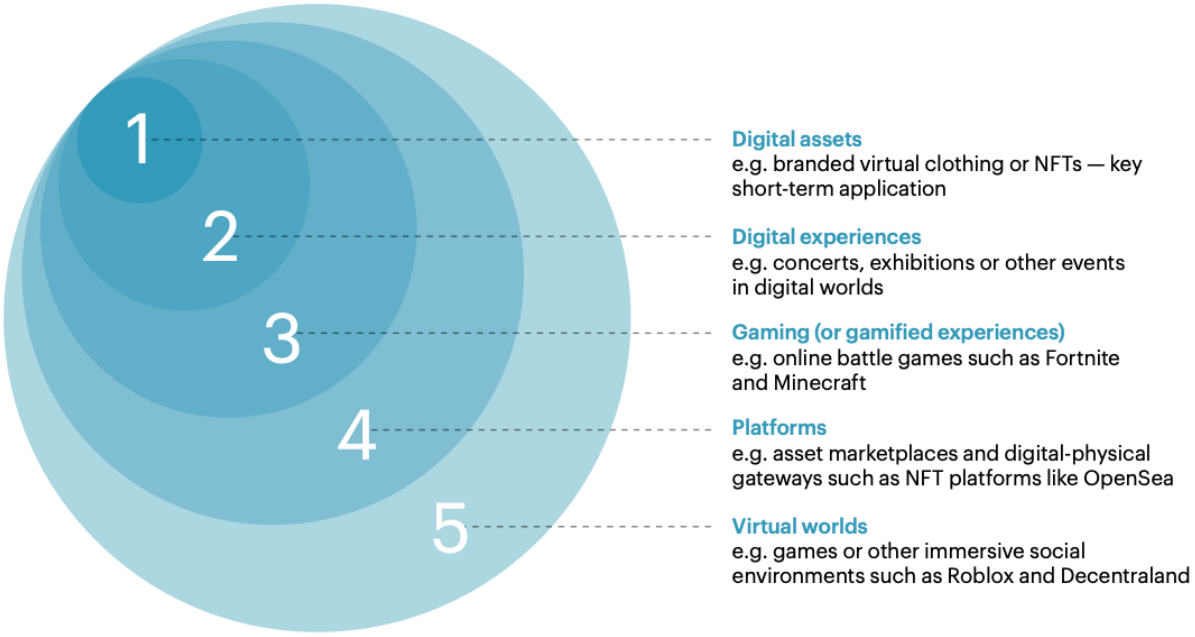

TABLE 5 - MCKINSEY ANALYSIS

Innovative brands that do not want to miss the opportunity to diversify revenue streams and target Gen-Z and Millennials consumers, but lack internal capabilities, can partner, build, or acquire. Fashion brands can create partnerships with gaming or high-tech companies, such as Gucci did with Zepeto. The Italian luxury fashion brand Gucci has partnered with Zepeto, a metaverse app and social media aimed at the creation of virtual worlds that can be personalized with avatars. Through the collaboration, users will be able to dress their avatars in Gucci garments through in-app purchases. Zepeto x Gucci also includes a Gucci villa to explore (Gucci, s.d.) (figure 5). Also, Burberry partnered with Tencent, an internet and technology company that develops innovative products and services to improve the quality of life. The luxury fashion brand launched a limited edition scarf with the Chinese virtual influencer Ayayi (Lung, 2021).

Fashion companies can also build their skills by hiring talents with technical skills, along with a deep understanding of the Metaverse and its community. An example of this is what Balenciaga is doing with its new "metaverse business unit," dedicated to the metaverse marketing and commerce (Williams, 2021).

Another possibility to enter the world of Metaverse is acquiring tech companies. In 2020, Nike acquired the virtual fashion platform RTFKT. Founded in January 2020, RTFKT quickly started to lead its sector, with a monthly revenue in May 2021 equal to $4.5 million and in 2020, similar to a fraction of that at $600,000 (M.C. NANDA, 2021). (figure 4)

FIGURE 6 - ZEPETO X GUCCI

FIGURE 7 - RTFKT X NIKE

B. THE INFLUENCE OF THE GAMING

Even if the Metaverse does not yet exist, firms are developing their technological skills to be prepared. The best proving ground is, without any doubt, the Gaming. The gaming market is the one that better gets closer to the one of the Metaverse. The world of fashion has always belonged to that of video games; it is sufficient to think of the online game Stardoll. It is a virtual environment for girls ages 9 to 17 who enjoy fashion, shopping, decorating, creativity, and meeting new people worldwide. It was born to fill a gap in the video game sector, specifically aimed at girls. Stardoll is the world's largest teen site, with 135 million MeDoll avatars created and a new player joining every second! The company is situated in Stockholm, with offices in Los Angeles and London, and is supported by Sequoia Capital and Index Ventures, two of the world's top venture capital firms. It is possible to dress each avatar in more than a billion ways, chat with friends, and participate in competitions. It is also possible to become a stylist, creating each own garments and selling them, obtaining "stardollars," the in-game currency. Gamers started creating real-life inspired garments inside the game. Examples of these are Gucci t-shirts, Fendi monogrammed bags, and Dior caps.

Today it is possible to see the influence of the fashion market in the videogames, observing the "skins," i.e., clothing for avatars. Skins need to be functional to the game activities,

but gamers need to differentiate themselves from their "playmates," precisely as in the real world. The possibility of launching virtual skins for avatars in video games is already a challenge for some brands. (Pompili, 2020/2021)

This chapter will be divided into two parts. The first one will provide an analysis of digital fashion garments, with particular attention to the market of skins. The second one will provide an analysis of the major virtual sales channels influenced by the world of the videogames.

i. Digital Fashion Garments - The Market of the Skins

Boosted by the COVID-19 pandemic, the world of digital fashion has become the next frontier for the fashion industry. The manifesto of this movement is The Fabricant. It is a Dutch fashion house that creates digital garments that can be worn on any platform: social media, video games, and any kind of virtual universe. Initially, the company produced only the garments ordered by the consumers; then, it decided also to design a collection "Pret-a-porter," specifically available on the platform Leela. The most important achievement of The Fabricant is the Iridescence, the first digital-only dress. It was sold for $9500 through a blockchain transaction, thanks to which it is traceable, tradeable, and collectible. The owner, Mary, spoke about his dress: "I had to imagine what it would look like to wear the dress. There was a huge element of surprise that you wouldn't get with physical garments. It is like a green screen; you

FIGURE 8 - THE IRIDESCENCE

have to imagine what it will look like since the dress will be added in post-production. Of course, this was the first of its kind, but I would love to be able to use the dress more often, and wear it wherever I like, not just limited to the pictures I got, but it should be something I can endlessly use over the pictures being taken so I can wear it in different situations. In the future, it would help if digital clothing could be cheaper than physical clothing, so the element of pricing would be more attractive for people to purchase a digital item instead of a physical one. It would be amazing to wear the outfit on TikTok to express yourself in these apps and have an extra special layer to use." (Mary) She highlighted some limitations of virtual fashion. She also desires to wear her new dress on other platforms, not yet prepared for the virtual garments, for example, on Tik Tok. Another limitation is the price. It is high for something only digital. She expected in the future that digital pieces would be less expensive than the real ones to boost even more their widespread.

Another forerunner of virtual fashion is Carlings, a Scandinavian retail brand and market leader in denim. It launched an entirely digital collection on Carlings' webshop. The consumer will buy the garment, and the 3D designers adapt it to make it perfectly fit to picture you send.

They are challenging the traditional conception of clothing and accessories, stating: "We waste nothing but data and exploit nothing but our imagination. Operating at the intersection of fashion and technology fabricating digital couture and fashion experiences." (Fabricant) From this new vision, something fundamental comes to mind: sustainability. Virtual fashion is indeed favorable to the sustainable movement, pervasive at this moment.

Gucci is making the most outstanding effort in the virtual world among traditional fashion brands. In 2021 it created digital shoes. They could be bought on their website for $10 and worn similarly to the one of a "filter."

In video games, the decline of virtual fashion has more practical applications. The most well-known example is Louis Vuitton, the luxury label that partnered with the computer game League of Legends. The firm collaborated with Riot Games for the 2019 League of Legends World Championship Finals in Paris, concluding with the Louis Vuitton Cup delivery. It has also designed an LV monogram bag in which the up was stored. The company released a collection composed of dresses, accessories, and a smartwatch developed by Nicholas Ghesquère. The capsule collection entitled LVxLoL includes items for men and women. Among these is possible to find sportswear such as the €850 Archlight sneakers, the €1200 jogging pants, and more elegant pieces such as the iconic €1280 Speedy bag or the €360 Monogram scarf: all inspired by the themes of the Riot Games.

Burberry carries out a similar partnership with Honor of Kings, a famous Chinese video game. Burberry has designed a skins collection that features Burberry's signature trench coat and tartan, available only in China. (Criddle, 2021)

Also, the Maison Gucci started a collaboration with Tennis Clash. Gucci x Tennis Clash is the new collaboration that revisits some garments from the Florentine Maison in a digital version to recreate the game's skins and setting. Tennis Clash players would be able to discover exclusive Gucci outfits and participate in a particular tournament. Moreover, the gaming experience joins the retail, and users will be able to purchase the items that appear on the screen directly from the Gucci website. In addition, Gucci and Tennis Clash have included an in-game tournament with a dedicated arena named Gucci Open. (Renato, 2020)

Moschino's partnership with The Sims 4 is remarkable because the Italian brand has created a physical collection inspired by The Sims' aesthetic. Moreover, months later, Moschino's creative director Jeremy Scott contributed to the creation of an extension of the video game. Besides having the stuff pack the possibility to have different Moschino garments, it is the first time that a new career, as a fashion photographer, is added to those available to The Sims. (Bergeretti, 2019)

ii. New Sales' Approaches

E-commerce has grown very fast during the last few years, thanks to the COVID-19 pandemic. This section analyzes the most important sales channels: e-commerce platforms, physical stores, and others.

E-commerce platforms have already acquired significant importance; however, due to an excellent need for personalization arisen, some improvements are required by customers. They are willing to be entertained as if the customer is inside the shop. One example is the Italian fashion company YOOX. Four years ago, YOOXMIRROR*, a product powered by Artificial Intelligence, was introduced to the market for the first time. As a result of the rise of influencer-driven styling, customer self-styling, and image creation on social media among the younger generation of customers, the YOOX virtual-styling suite has become even more personalized and interactive, with a brand-new layout and an expanded catalog of exclusive items to choose from. The upgraded version of YOOXMIRROR, which was created to entertain YOOX customers by allowing them to express their style and combine their favorite things from the YOOX catalog, now offers 50,000 fully digitized products from which customers can choose to personalize their avatars using a series of in-app algorithms. With the overhaul, the whole eight by YOOX collection has been entirely digitized and made available for customers to

experience in their virtual dressing room and the clothing and accessories of the many brands represented on YOOX. The finishing touch is the share function, which allows all users to share their favorite looks on social media, letting their friends participate in an unprecedented virtual shopping experience. The app offers different themes and model options to create "stories" to let the customers post their outfits on social media. (YOOX, 2020)

Remarkable is also Drest, in collaboration with Farfetch. This platform was created by Lucy Yeomans, the former Editor in Chief of Porter, Net-a-Porter, and Harper's Bazaar UK, as a smartphone app designed for those who want to style their avatars with the latest trends. Her idea was to combine the desire for styling with a gaming experience by providing players with a selection of fashion items and a virtual model to dress up. The app has its in-game currency and a reward system. The user can earn money thanks to actions like shooting and attending events. The app has also been enhanced with the possibility to purchase each piece in real life, thanks to a partnership with the shop Farfetch. Furthermore, the avatars are inspired by top models. (Patel)

There is also MOD4, which is needed to be highlighted. It is a platform that mixes online shopping with interactive gaming. MOD4 is a dress-up simulation game that turns users into genuine stylists by filling the virtual wardrobe with exclusive online products at LuisaViaRoma. MOD4 allows users to build an avatar that could be fully customized, from the hairstyle to the cosmetics to the shape of the nose and the color of the eyes. In terms of shopping, the avatar may try on an endless number of combinations of garments and accessories accessible on the official LuisaViaRoma website. Each user could appear in the MOD4 Trend section as Best Players or Top Stylist, but above all, they could win prizes, including LVR Points, to get exclusive online shopping benefits like free shipping. There also is a voting system for the outfits that will determine the winners. (Vertua, 2020)

Even if the e-commerce platforms integrate their technology with AR and VR, people still feel the desire to go to physical stores. There are some examples of stores combined with AR and AI, one of them is the Burberry Social Store in Shenzhen, China.

Among the other examples, also Nike Reactland is significant. Nike, Inc. teamed with advertising agency Wieden + Kennedy Shanghai to produce Reactland, a side-scrolling video game created to promote the brand's Epic React shoe in China, allowing players to test the new model on a treadmill. Customers must visit one of the activations at select Nike shops in Shanghai, Beijing, Guangzhou, and Chengdu to participate in the game. Players put on a pair of Nike Epic React sneakers and design their avatar, which they control by jogging on a treadmill set up in front of a giant screen. The high-energy game intends to emphasize the distinct qualities

of the new shoe type, which is touted as bouncy, light, and long-lasting. Reactland is also a continuation of Nike's more prominent inventions seeking to utilize technology to gamify often solitary sports hobbies via applications such as Nike+ Run Club and Nike Training Club. Currently, there are no plans to expand the Reactland experience outside China. (Driver, 2018)

Besides physical stores and e-commerce platforms, there are many other ways to generate conversion to extended reality and virtual reality. An example is Versace's digital fashion ComplexLand, the world's first immersive virtual destination combining fashion, art, musical events, cultural dialogues, and much more. This free digital event will include a unique Versace shoe release and an ad hoc digital experience. For the first time, Donatella Versace will morph into a stunning avatar, communicate with the participants, and guide them through discovering the new Trigreca shoes, which are created in a limited run of only 100 pieces. Three pieces of these unique shoes include the famous Greca symbol, a homage to Magna Graecia that has long been part of Versace's legacy.

FIGURE 9 - VERSACE'S TRIGRECA SHOES

iii. Virtual Fashion Shows

In the latest years, the way people live fashion is changed. Consumers prefer to be more involved and have a more interactive view of the industry. In 2016 Louis Vuitton partnered with the video game Lightning for its campaign. The origin of such a movement is, without any doubt, the cosplay, dressing up as a fictional character. In 2020 Gucci launched on The Sims 4, the sustainability campaign "Off the Grid."

Harrie, a London-based developer, built The Sims 4's campaign setting, combining her usage of sustainable resources such as reclaimed wood, wind turbines, green-roofing, and

recycled furniture. She then adorned the area with Off the Grid collection items. The ad, which debuted in June, included Jane Fonda, Lil Nas X, King Princess, and others, who posed for images in an urban treehouse. (Harwood) Grimcookies, content creator, developing cc for The Sims 4, has recreated certain items from the collection, which are now available to Sims 4 users that have downloaded the modifications. The Sims avatars may wear hats and shoes authentic to the original designs, while players can employ bags and other accessories as aesthetic components. Grimcookies has also digitized the Gucci Off the Grid campaign pictures, which star Jane Fonda. (Schieppati)

Another trend to be highlighted is Gucci with Animal Crossing: New Horizons. The new island takes visitors to the varied world of Gucci and Gucci Guilty. Custom features include a dedicated island, a range of exciting mini-games, and take-away products inspired by the film's iconic aspects and the aroma of the perfume #ForeverGuilty campaign - a celebration of freedom and liberty. The #ForeverGuilty campaign sees Gucci Guilty

FIGURE 10 - GUCCI'S SUSTAINABILITY CAMPAIGN "OFF THE GRID"

appropriately paired among unusual locations such as a laundry, a supermarket, and a hairdresser. GG Island, created by LexPlay, contains countryside-inspired places reimagined in Animal Crossing style. Users are greeted by an avatar of award-winning actor and musician Jared Leto and guided by Guilty, the House's longstanding collaborator and Gucci's face, as a resident representative. Visitors may discover a paparazzi area where gamers can shoot photographs in front of them. An orchard area comprises materials that symbolize the scents' prominent olfactory notes: mandarin, lilac, and patchouli. Moreover, creator Canton Crossing has curated a collection of takeaway elements that users can bring back into their games,

including a Jared Leto outfit, a perfume shelf filled with scents, a tiger poster reminiscent of the film's fearless creature, and a picnic blanket replica of a real GG blanket. (Gucci collabora con Animal Crossing, 2021)

FIGURE 11 - GUCCI X ANIMAL CROSSING

Moreover, due to the COVID-19 quarantine, many fashion industry sectors could not proceed. Therefore, firms tried to experiment with new ways to do business. Examples of this are the fashion shows, which have become virtual. Burberry has shown its Spring Summer 2021 collection live on Twitch, Amazon's live streaming platform.

In addition, Gucci has created its GucciFest. It is a digital and unique fashion and movie festival and will be aired on YouTube Fashion, Weibo, and Gucci YouTube and featured on the dedicated website Guccifest.com. On this occasion, the new Gucci collection "OUVERTURE of Something That Never Ended" will be unveiled, presented by creative director Alessandro Michele in the form of a mini-series of seven episodes, which will be aired one at a time, and day after day. The seven-part series, shot in Rome and co-directed by Gus Van Sant and Alessandro Michele, has as protagonist the actress, artist, and performer Silvia Calderoni in a surreal daily routine in different scenarios of the city, while meeting a series of international talents and friends of the house, including Paul B. Preciado, Achille Bonito Oliva, Billie Eilish, Darius Khonsary, Lu Han, Jeremy O. Harris, Ariana Papademetropoulos, Arlo Parks, Harry Styles, Sasha Waltz e Florence Welch. The series is a joyful story that disregards the conventional concept of seasonality in favor of imagination and inventiveness. The tale combines rules and genres and draws on new environments and novel language codes to produce something never seen before. (Brusa, 2020)

C. FASHION NFTS

i. DEFINITION

NFTs are non-fungible tokens, this means that they are digital tokens or assets which have ownership of physical or digital items and a license to use them for a specific aim. The central concept to highlight is fungibility. A fungible item is an item that can be exchangeable and is defined by its value and not by its unique property. On the contrary, a non-fungible item is not convertible because each token is unique thanks to the digital ledger platform where it is stored, the blockchain. Due to this, each NFT is different from the others, then it cannot be replaced, stolen, or erased. On the other side, it can be downloaded, copied, and shared, maintaining its original ownership.

The main question that arises when talking about NFTs is how they work. Different types of digital goods could be tokenized, such as art, in-game items, and even videos. They are created on the Ethereum blockchain, which is the platform where tracing and verifying ownership is possible. Minting of NFTs can be done throughout smart contracts. The ownership of NFTs is transferred to the users' wallet via a public address, and each token is linked to a private key, which is a sort of unique ID or credential representing the proof of ownership.

The major marketplaces where NFTs can be traded are Foundation, OpenSea.io, Rarible, Nifty Gateway, and SuperRare. Foundation is a public platform where the users need to be invited by other users already existing on the platform. OpenSea.io is a peer-to-peer platform, and it is the largest marketplace. It is sufficient just to open an account to find collectibles. Similar to that, there is Rarible, which is public and uses RARI tokens to reward the platform member. Nifty Gateway and SuperRare are focused on the artwork. The first one is. Used by big-name brands and athletes, and it calls their collectible Nifties.

As already stated, the pros of NFTs are many, among them, there is the fact that they are unique and collectible, give the owner the possibility to earn a profit, and, due to their blockchain-based, are immutable, and they can never be altered, replaced, or erased. Conversely, the cons are that they belong to a speculative market, full of questions that have complex answers. In addition, even if the blockchain base makes them very safe platforms, where they are traded could not be that secure. Therefore, there is the possibility that they could be stolen. (UMER, 2021/2022)

The blockchain is a decentralized ledger of all computer system transactions. The participants may confirm transactions without the requirement for a central certified body. The primary goal of a blockchain network is to allow digital information to be precisely recorded and not altered or hacked. It is a method of storing data that cannot be modified or

compromised. When someone conducts a transaction on this platform, a record of that transaction is recorded in each participant's ledger. This is an example of Distributed Ledger Technology (DLT), in which several users manage a decentralized database, and information may only be added according to standard rules. Distributed ledger platforms are classified into DL Permissioned Platform/Blockchain and DL Permissionless Platform/Blockchain. The first one is also known as permission sandbox and is a closed network where users need to be registered and validated by a central authority. The other one is open, and each user can participate without authorization. Simply said, a blockchain is a block-structured database that is linked online, and each block of the chain contains information on transactions (the data of an operation, identity, action, agreement, contract, and so on). When a transaction is completed on this platform, it must be certified not only by the network itself but also by an examination of every single block of the network, which is why blockchain is sometimes referred to as a trust mechanism. When a validated transaction joins with other transactions, a new data block is formed and added to the blockchain, by creating the network that shares all databases, each node in the network controls and approves all transactions.

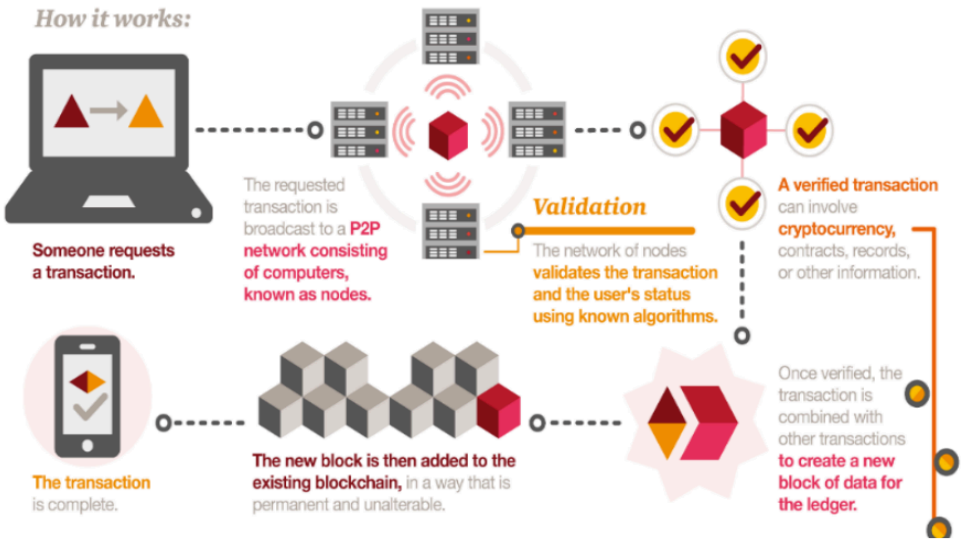

FIGURE 12 - A LOOK AT THE BLOCKCHAIN TECHNOLOGY HTTPS://WWW.GARYFOX.CO/BLOCKCHAIN-APPLICATIONS-INFOGRAPHIC/

The most well-known application of blockchain is cryptocurrency. Cryptocurrency is a digital currency (or tokens) such as Bitcoin and Ethereum that is safe because practically hard to counterfeit. It can be used to purchase goods and services using blockchain technology to record and protect each transaction. It is very safe because each currency has its own identification number; therefore, the owner can be easily traced. Moreover, cryptocurrencies have reduced

the dependence on central banks and individualized currencies. Their market is very speculative and not regulated, which led the cryptocurrencies to be very volatile. (UMER, 2021/2022)

ii. The Usage of NFT in the Fashion Industry

One of the primary industries that could be more affected by the invention of NFTs is fashion, especially luxury. They have many common similarities that boost the investments of the fashion industry into the world of NFTs. Among the similarities, there is exclusivity. Being NFTs blockchain-based, they are unique such as unique designer pieces of luxury brands. An example is the famous Birkin bag by Hermès and one of the top-selling NFTs. They are both highly desired and extremely hard to get, therefore highly-priced.

Moreover, luxury fashion garments could be considered collectible art forms, such as NFTs, which are collectibles being by nature created as unique pieces. In addition, one of the success factors is also that bringing luxury fashion into the world of NFTs could reduce the effort of washing, changing, and taking care of the garments creating timeless fashion. (Kirjavainen, 2022)

One of the essential advantages of NFTs for the luxury fashion business is their ability to renew old luxury companies' brand image and match evolving customer needs. NFTs provide nearly limitless opportunities for luxury fashion firms to diversify their collections, produce designs that would otherwise be impossible to make, and stay modern. (BENISSAN, 2021) While customers' self-expression used to be solely tangible, it is now rapidly joining with the internet. This is especially true for Millennials and Generation Z, which are the demographic segments that luxury fashion businesses should be targeting today. As a result, fashion NFTs might be a successful method for exposing prominent luxury fashion businesses to modern consumers. Rebecca Minkoff was the first premium designer to launch an NFT line. Minkoff went all-digital for the 2021 New York Fashion Week, making her the first female American designer to make NFTs. The designer unveiled her fall-holiday range at Spring Studios in collaboration with Yahoo as a series of photos photographed by photographer Cass Bird. The photographs include models wearing new collection styles and are complemented by special QR codes that, when scanned, take viewers to an augmented reality experience where they may bid on the images and choose styles from the line. (Minkoff, 2022)

Another success factor is the non-copiability of the NFTs. While traditional luxury items have the problem of being reproduced by fast fashion brands and purchased by people seeking ownership status without paying a high price, NFTs offer the advantage of being

impossible to reproduce. Especially in light of the ever-expanding global counterfeit market and the rise of secondhand fashion, which has also resulted in an increase in the sale of counterfeit luxury goods, NFTs' strong authentication and traceability features are a welcomed relief for luxury fashion brands and a possible long-term solution in the fight against the fake product market. LVMH, Richemont, and Prada have already joined forces to test this novel blockchain endeavor for tracking and validating luxury brands' goods. LVMH has launched Aura, a platform designed to provide adequate product monitoring and tracking services to the whole luxury business, in collaboration with blockchain companies ConsenSys and Microsoft. The Aura Blockchain Consortium is the first effort driven by luxury companies to become a brand technology center beyond traditional boundaries. Aura SaaS, a game-changing cloud-based SaaS solution, is introduced by LVMH, the Prada Group, Cartier (Richemont Group), and the OTB Group. It aims to be the first blockchain-based platform tailored for luxury companies, assisting the sector in adopting blockchain in daily business operations such as supply chain, customer service, marketing, manufacturing, sustainability, purchasing, logistics, and legal. (COUGOT, 2022)

Besides success factors, some inhibitors also need to be considered before implementing the fashion industry with the NFTs. Among these, there is the intangible characteristic of NFTs. The key elements of the luxury fashion industry are materials and craftsmanship, which are absent in the NFTs market. Therefore, they are what differentiates the luxury market from fast fashion. For this reason, the focus should be the digital design and the quality of coding. Another issue regards sustainability. As already stated, there is an increasing commitment to sustainability, leading firms to focus on more environmentally friendly supply chains.

In contrast, the NFT minting process is not sustainable in the short run because of the immense amount of energy required for the minting of assets on the blockchain. For example, annually, Ethereum generates 62.86 MT CO_2 which is comparable to the carbon footprint of Montenegro and Serbia. Therefore, firms need to evaluate where the advantages outweigh the disadvantages.

Among the inhibitors, there also is the fact that the regulatory system is not ready yet, due to the relative newness of NFTs and, more in general, Metaverse. Therefore, each case involving NFT is analyzed singularly and becomes a precedent for the other. This is the case with the well-known Birkin Hermès bag. Hermès entered into a lawsuit with Mason Rothschild, who created a collection of 100 NFTs of the Birkin. The luxury fashion brand brought the action against Rothschild because of the trademark infringement, regarding the unauthorized usage of a trademark which could confuse the minds of consumers about the source or sponsorship of the good. Hermès registered the Birkin trademark with USPTO before filing this complaint. It

succeeded in demonstrating that “the marks are so similar and the goods for which they are used are so related that consumers would mistakenly believe they come from the same source.” (USPTO) There is also the Hermès claim about trademark dilution, stating that MetaBirkins “dilute the distinctive quality of the Birkin mark and the goodwill associated with it.” (Hermès International et al. v. Rothschild, 2022) Trademark dilution happens when an accused breach devalues a well-known trademark by distorting its uniqueness or ruining its reputation by associating it with anything objectionable. The Birkin symbol is unmistakably related to the Hermès brand, thus, it is well-known. Hermès prides itself on the extreme exclusivity and scarcity of Birkin bags, with a waitlist that must be asked to join, so it's easy to see why Rothschild's “everyone can have a MetaBirkin” approach is criticized by Hermès. (Yoder, 2022)

V. CONCLUSION

The study aimed to understand better how technology had radically changed the fashion industry. Enhanced by the Covid-19 pandemic, the world of fashion has been fundamentally affected by digitalization.

The first segment led to a more profound knowledge of the history of this technological development, of which the literature is rich. The research has highlighted the importance of wearable technology and 3D printing in the fashion industry, as well as their critical issues. Moreover, the recent phenomenon of virtual influencers was analyzed. They are relatively new but have an exponential potential to grow. They are more easily "controlled" concerning real influencers because of the anonymity of creators behind them.

Furthermore, the impact of Covid-19 is studied. It is highlighted the fashion industry's reaction throughout virtual runways, especially during the first quarantine but popular still now, and the application of virtual reality and extended reality for showrooming. Finally, the concept of sustainability is scrutinized because of its importance nowadays. Timberland and Kampos, two of the most important exponents in this field, were investigated.

The second section emphasized that investments are enormous, although the Metaverse still does not exist. Firms are developing new ways of conceiving the digital life, starting from the gaming world. Augmented reality and artificial intelligence are the leading actors in this progress. This section also helped acknowledge the Metaverse concept as a unique phenomenon, available for everyone, not entirely decentralized, and hardware-independent. Furthermore, its architecture is deeply described. It comprises three layers: ecosystem, interaction, and infrastructure analyzed from the physical and virtual worlds. Lastly, the study examined the main challenges of this new world. Most of them are related to AR and VR, as well as the needing for enhancements to today's supporting technologies.

In the last section, the study highlighted the future frontiers of the fashion industry in the Metaverse. The essential precursor in which the fashion market entered some years ago is the world of gaming. It gave the industry the possibility to be more interactive and widespread. The skins market is the most prevalent application of fashion in the gaming market. Moreover, with the evolution of the after-Covid technologies, e-commerce platforms, physical stores, and other sales channels totally changed their approach, becoming more interactional and digital.

Last of all, the research also has analyzed NFTs as fundamental for the Metaverse development. They have many advantages, such as their ability to renew old luxury companies'

brand image and match evolving customer needs, their non-copiability, and their security due to the blockchain base. Besides their success factors, there are also some disadvantages, such as their intangible characteristic, their short-term non-sustainability, and the fact that regulatory systems are not updated with the new technology.

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