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DISSERTATION**

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**DISSERTATION FOR THE ATTAINMENT OF THE  
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**Innovation Management in the Textile Industry:  
Potential of Web3 Technologies in the Fashion Industry**

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**INNOVATION MANAGEMENT IN THE TEXTILE INDUSTRY:  
POTENTIAL OF WEB3 TECHNOLOGIES IN THE FASHION INDUSTRY**

Dissertation to obtain a PhD degree

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### LIST OF ABBREVIATIONS

AI	artificial intelligence
a.k.a.	also known as
AR	augmented reality
DACH	Germany, Austria, and Switzerland (German-speaking Europe)
e.g.	exempli gratia, meaning “for example”
GDP	Gross Domestic Product
i.e.	id est, meaning “that is”
IoT	Internet of Things
MR	mixed reality



NFT	non-fungible token
PFP	profile picture
PoS	proof-of-stake
PoW	proof-of-work
R&D	research and development
SME	small and medium-sized enterprise
VR	virtual reality

## ABSTRACT

### **Innovation Management in the Textile Industry: Potential of Web3 Technologies in the Fashion Industry**

This research addresses the question of how Web3 technologies can be integrated into the textile industries. First, an extensive literature review, which identifies the research gap, is conducted. Afterwards, secondary research and qualitative interviews are used to investigate which projects have already been introduced in this area, and they are included in the list of Web3 pattern cards. The complete list is evaluated by potential customers as part of the quantitative research; thus, the ranking of the projects with the greatest demand can be found. In addition, blockchain developers evaluate the costs needed to implement the projects, as well. The results of current study are of great importance for textile companies as it gives them a first insight into which projects could be integrated into their practice. The research is an ongoing study; it continues in the future with the development of practical examples, which can be used for project implementation.

## ABSZTRAKT

### **Innovációmenedzsment a textiliparban: A Web3 technológiák lehetőségei a divatiparban**

A kutatás arra a kérdésre keresi a választ, hogy a Web3 technológiákat hogyan lehet integrálni a textilipari vállalatokba. Ebből a célból először egy átfogó szakirodalmi áttekintést végeztem, amely feltárta ezt a kutatási hiányosságot. Ezt követően szekunder kutatás és kvalitatív interjúk segítségével megvizsgáltam, hogy mely projektek léteznek már ezen a területen, és ezeket felvettem a Web3 pattern cards listájára. A teljes listát ezután a kvantitatív kutatás részeként a potenciális ügyfelek értékelték, és így alakult ki a legnagyobb kereslettel rendelkező projektek rangsora. Emellett blokkláncfejlesztők értékelték a projektek megvalósításához szükséges költségeket. A kutatási eredmények nagy jelentőséggel bírnak a textilipari vállalatok számára, mivel első betekintést nyújtanak arra, hogy mely projekteket lehetne beépíteni a gyakorlatukba. A kutatás a jövőben folytatódik, és gyakorlati példák kerülnek kidolgozásra, amelyek felhasználhatók a projektek megvalósításához.

## ABSTRAKT

### **Innovationsmanagement in der Textilindustrie: Potenzial von Web3-Technologien in der Modebranche**

Diese Forschung beschäftigt sich mit der Frage, wie Web3-Technologien in Textilunternehmen integriert werden können. Zu diesem Zweck wurde zuerst eine umfangreiche Literaturrecherche durchgeführt, die diese Forschungslücke aufzeigte. Anschließend wurde anhand von Sekundärforschung und qualitativen Interviews untersucht, welche Projekte in diesem Bereich bereits existieren, und sie wurden in die Liste der Web3 Pattern Cards aufgenommen. Die komplette Liste wurde dann im Rahmen der quantitativen Forschung von potenziellen Kunden bewertet, und somit ist die Reihenfolge der Projekte mit der größten Nachfrage entstanden. Zusätzlich ist die Bewertung hinsichtlich der notwendigen Kosten von Blockchain-Entwickler in die Arbeit geflossen. Die Forschungsergebnisse sind für Textilunternehmen von großer Bedeutung, da sie ihnen einen ersten Einblick geben, welche Projekte in ihre Praxis integriert werden könnten. Die Forschung wird in Zukunft fortgesetzt und es werden Praxisbeispiele entwickelt, die für die Projektumsetzung genutzt werden können.



## PART I

### 1. INTRODUCTION

#### 1.1 Problem statement and the relevance of the topic<sup>1</sup>

The value of the global apparel industry is approx. 2% of the world GDP. Considering the split between the genders, the value of the womenswear industry is 621 billion dollars, of the menswear industry, it is 402 billion dollars, and of the childrenswear market, the value is 186 billion dollars. Therefore, this industry is not insignificant and plays an important role in the economy (*Global Fashion Industry Statistics - International Apparel*, n.d.).

The COVID-19 pandemic left its mark on the textile industry. The lockdowns led to job losses, layoffs, delivery problems, and declining sales and net profits for most apparel brands. Sales during 2020's spring season plummeted to 70 percent less than the previous year, a predictable outcome given that consumers scarcely had the chance to peruse spring and summer collections in physical stores (Achille & Zipser, 2020). Additionally, during the initial 10 months of 2020, the Italian fashion industry documented a 22% decrease in export activities (Grechi et al., 2021). To name merely a few of the largest brands, the following companies and holdings which faced declining in sales or profits are listed: Abercrombie & Fitch Co, Burberry, Capri Holdings. Ltd with its brands: Michael Kors, Versace, and Jimmy Choo; H&M, Kering Group with its brands: Gucci, Saint Laurent, and Bottega Veneta; Victoria's Secret, Levi Strauss & Co, LVMH, Moncler, Nike, Under Armour, Ralph Laurent (Ilchi, 2020a).

COVID-19 not solely affected the sales and economic situation but hindered the development of relationships with customers, as well. Since the fashion weeks had to be cancelled, the presentation of the collection became more difficult for the fashion brands. In addition to fashion shows, fairs, exhibitions, and other events had to be postponed (Ilchi, 2020b).

Textile industry participants reacted to the breakout of the pandemic in different ways and developed solutions, which can be assigned to six different categories. These groups are the followings: PR & communication, cost reduction, production orientation, focus on digital channels, collaboration, and sustainability & slow fashion.

As stores had to be closed, shops and brands looked for digital solutions to build relationship with their customers and to drive sales. Live shopping and facetime consulting were offered. Furthermore, online window shopping was organised, and products were presented as

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<sup>1</sup> The research presented in this chapter was published in (Paulovics, 2020)

Instagram posts (kaufhaus\_ganz, 2020). Bottega Residency from Bottega Veneta launched a platform for live music performances, cooking classes with renowned celebrity chefs, or movie nights every weekend (Gargiulo, 2020). Similarly, Levi's, inspired by the legendary jeans fit 501, hosted a live musical act every day at 5:01 pm on its Instagram channel (levis, 2020). Sports brands, such as Oysho, developed online training courses to help their followers stay active at home (oysho, 2020). Other brands organised interview series with their athletes to give an insight into their world (xbionic, 2020). What unites these solutions is the development of digital experiences. In my opinion, these solutions act as the first indicators that the apparel industries turned to focus on digital solutions.

Furthermore, another challenge emerged for the textile industry since the measures introduced by governments to fight the coronavirus restricted events. Textile companies had to reinvent themselves and look for individual solutions instead of holding big fashion shows. For many, the solution was the organisation of a virtual fair. This led to online trade fairs in the B2B and B2C sectors, where the collections were presented, and new contacts were made. In 2020, the shows of Giorgio Armani and Laura Biagiotti were broadcasted via live streaming (Bayer, 2020a) and Ermenegildo Zegna decided to present the spring collection 2021 digitally, too. In addition to the virtual trade fairs, many brands experimented with virtual showrooms and ordering platforms (Bayer, 2020b). Michael Michalsky, creative director of Jet Set, expected an increase in virtual showrooms and avatars. Moreover, in his opinion, the era of big shows with millions and thousands of guests might be over (Dörpmund, 2020). I consider these solutions as the first steps towards metaverse experiences.

During the study of the literature, I noticed that several solutions point in the direction of digitisation and the integration of Web3 technologies. This piqued my interest and directed my focus to this topic area. I found solely a very limited number of scientific sources dealing with this topic. As I delved into the subject area, I discovered the potential of the field. Since I examined the use of augmented and virtual reality in the textile industry during my master thesis, the topic of integrating Web3 solutions, which again embodies novel technologies, resonated with me.

Web3 enables brands to provide more personalised experiences for customers. The distributed database of the blockchain technology allows secure and transparent transactions. The non-fungible token (NFT) technology allows the creation of digital assets that are unique and cannot be duplicated. Both the blockchain and NFT technologies might be used to create more secure and private applications (Dubey, 2022); (Sharma, 2022). Furthermore, the

metaverse is a virtual world developed to allow more immersive and user-centric experiences than what is possible today (Sinha, 2022). The integration of these new technologies into the textile industry fascinated me; thus, I wanted to detect a wide range of potential projects that could be realised with the help of these technologies.

## 1.2. Objectives

The aim of the literature review is to explore the theory of innovation management and the textile industry and to uncover innovative solutions in the textile industry. The in-depth research is necessary to discover the research gap, in which niche, no research has been conducted yet. The use of Web3 technologies in textile companies is discovered as a gap, and accordingly, the empirical research focuses on the in-depth study of this area.

The aim of the empirical research is to observe the integration of Web3 technologies in textile companies from various angles and to determine their potential. On the one hand, the goal is to define which projects would be possible and could be implemented. On the other hand, it is to be investigated whether there is a demand for these technologies from the customers and what the attitude of textile companies towards these technologies is. The aim of the research is to create an overview of which projects are possible, what effort is needed for their realisation and how high their potential for success is.

## 1.3. Research hypotheses, and questions

At the beginning of my research, I formulated five research areas with corresponding hypotheses examined through research questions. These are based on the review of the national and international literature. The hypotheses and research questions are the followings:

**Table 1 Research hypotheses, questions, and methodologies**

Nr.	Question	Nr.	Hypothesis	Methodology
Q1	Which Web3 based projects have already been realised in the textile industry?	H1	In the textile industry, there are existing Web3 projects, which are used in various areas and for different purposes in the companies.	Secondary research
Q2.1	How much knowledge on the Web3 area do potential customers possess?	H2	Although potential customers might not understand the technical background of Web3-based projects, they have ideas for their implementation.	Qualitative research among fashion and blockchain customers

Q2.2	Which project ideas for textile brands might customers find exciting?			Qualitative research among fashion and blockchain customers
Q3	Which of the defined Web3-based projects do customers find particularly compelling?	H3	There are Web3 projects that the potential customers find exciting.	Quantitative research among potential customers
Q3.1	What is the distribution of cryptocurrency and/or NFT owners between Hungary and DACH?	H3.1	The proportion of DACH-located people with a cryptocurrency or NFT is at least 8% higher than the proportion of Hungarians.	Quantitative research among potential customers
Q3.2	In case of which Web3-based project ideas does owning cryptocurrencies and/or NFTs have an impact on preference?	H3.2	There is a significant correlation between the possession of a cryptocurrency and/or NFT and some of the Web3-based project ideas.	Quantitative research among potential customers
Q4	What are the most cost-effective and customer-supported alternatives of Web3-based projects?	H4	A list of potential Web3-based projects can be created and evaluated by customers regarding their interests and by blockchain developers regarding the implementation costs.	Merging information from a quantitative customer survey and a qualitative survey of blockchain developers.
Q5	What is the attitude of textile SMEs towards Web3 technologies and solutions?	H5	Although leading apparel brands are currently experimenting with Web3 technologies, small and medium-sized enterprises (SMEs) have not implemented such projects yet.	Quantitative research among textile companies
		H5.1	The percentage of the companies planning to integrate NFTs into their business is less than 40%.	Quantitative research among textile companies
		H5.2	The percentage of the companies planning to integrate blockchain technology into their business is less than 35%.	Quantitative research among textile companies
		H5.3	The percentage of the companies planning to integrate metaverse into their business is less than 30%.	Quantitative research among textile companies
Q6	What are the most significant deals or partnerships that Lil Miquela has announced or showcased on her Instagram?	H6	The most significant deals or partnerships showcased by Lil Miquela on her Instagram are likely associated with high-profile brands in the fashion, music, and technology sectors, which align with her digital persona's key areas of influence and engagement.	Case study

Source: own compilation, 2023

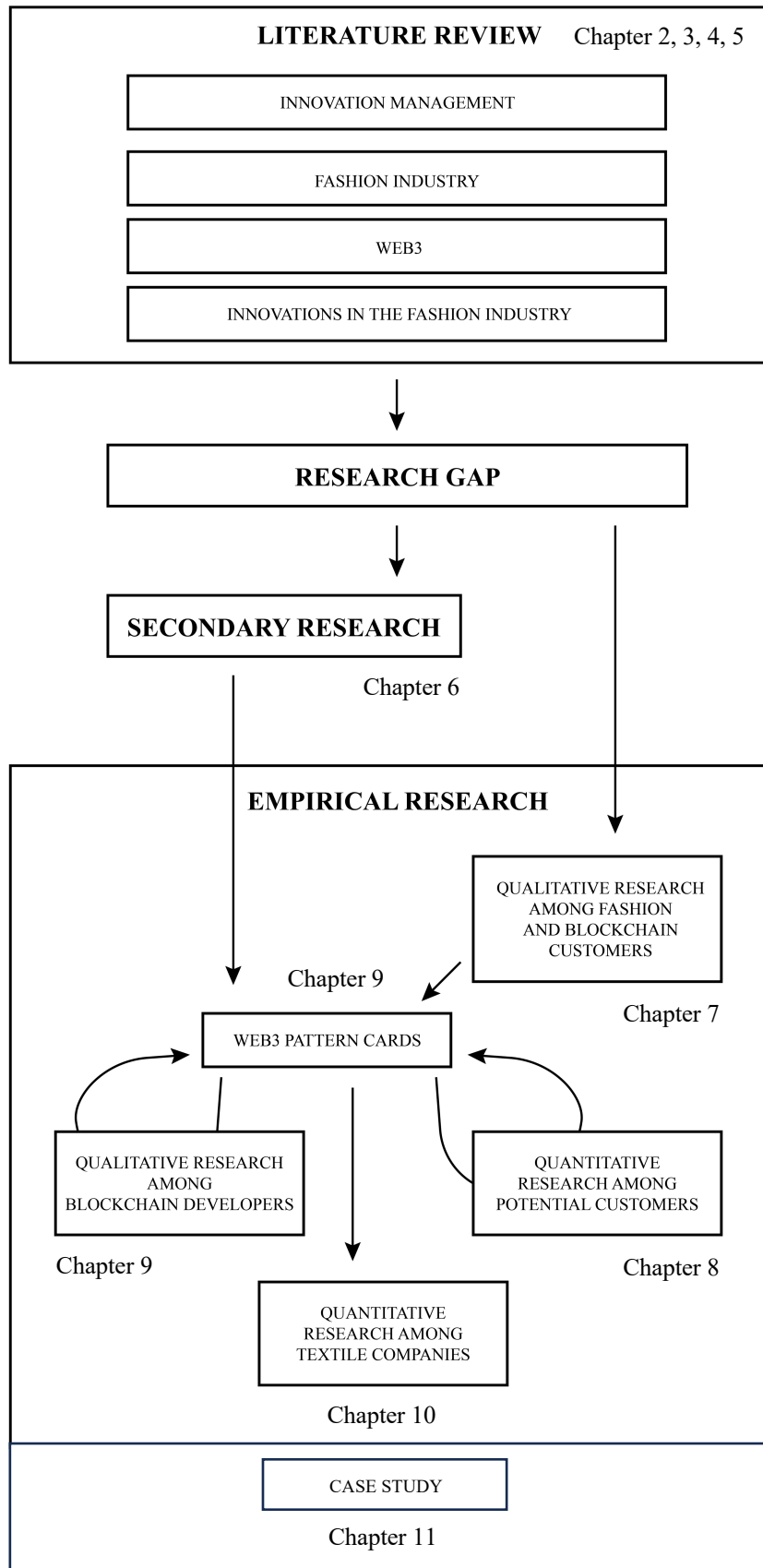


#### **1.4. Research design**

The research consists of two main parts. The first part is a literature review focusing on innovative solutions in the textile industry and observing current trends. In this way, potential opportunities for textile companies in the direction of Web3 are identified. After the literature review, the research gap is found, which helps to build the research design for the secondary research and the empirical part of the research.

During the secondary research, existing projects with Web3 integration in textile companies are examined. Through this research, a list of ideas containing potential projects that can be realised with Web3 technologies in textile companies is found. These ideas are collected in *Chapter 9*. Afterwards, the design of the primary research is determined. The primary research is based on six pillars.

First of all, through qualitative interviews, the customers' potential needs and level of knowledge on Web3 and related technologies are explored. In addition, ideas that would be of interest to potential customers are generated. These ideas are added to the results from the secondary research into the list presented in *Table 9* and are examined during the quantitative research by potential customers. In addition, three blockchain development companies analyse the ideas and provide feedback and advice on their implementation. As a following pillar of current research, quantitative research involving textile companies is carried out to gain deeper understanding of their willingness to implement Web3 technologies in their business. The last part of the empirical research is the case study about the virtual influencer, Lil Miquela. *Figure 1* demonstrates the research design of the dissertation.



**Figure 1 The visualisation of the research design**

Source: own compilation, 2023

## **PART II: THEORETICAL BACKGROUND**

### **2. CREATIVITY AND INNOVATION MANAGEMENT**

Innovations are important factors that contribute to the development of the economy.

The word innovation has become a trend term in the last decades. Nowadays, a wide range of companies claims to be innovative in their communication and advertising. However, if the term is examined, it can be clearly stated that these companies and their products do not meet the requirements to be called innovative. Therefore, first of all, this dissertation provides an overview of the various definitions of the term innovation and the historical development of its area.

The word innovation originates from the Latin innovare expression. In the Latin term, in- means into and the word novare derives from novus meaning new (Oxford Learner's Dictionaries, n.d.). Thus, innovare can be translated as into new (Costello & Prohaska, 2013).

Nowadays, based on the (Oxford Learner's Dictionaries, n.d.), innovation has the following meanings:

- "the introduction of new things, ideas or ways of doing something" (Oxford Learner's Dictionaries, n.d., p. 1)
- "a new idea, way of doing something, etc. that has been introduced or discovered" (Oxford Learner's Dictionaries, n.d., p. 2)

Compared to that, Cambridge Dictionary (2022) defines innovation as "a new idea or method, or the use of new ideas and methods" (p. 1). And Cambridge Dictionary's (2022) Business English Dictionary section lists the following definitions:

- "a new idea, design, product, etc." (p. 3)
- "the development of new products, designs, or ideas" (p. 4).

#### **2.1. Creative destruction**

One of the most famous terms, originated from Schumpeter (1947), is the creative destruction, which refers to the process of destroying existing technological solutions and making room for new ones.

Creative destruction exists for thousands of years in history. Of course, at the beginning, it was not related to the economic situation. One of the first known concepts of creative destruction originates from the Greek culture. There is a myth of the Phoenix in Greek culture. The Phoenix is a bird that might live for 500 years, and on the last day of its existence, it built its own pyre, which was set on fire. Afterwards, it burned itself in the

flames, and it became ashes. However, from the ashes, a new Phoenix, which might live for another 500 years, was born. Thus, from the destruction of something old, something new was born (Reinert & Reinert, 2006).

Creative destruction showed itself not solely in myths at that time, but in religion, as well. Hinduism follows this concept and has three gods: Brahma, Vishnu, and Shiva. Each of the three deities has individual tasks. Brahma creates the world. Vishnu protects it and its beings and maintains the balance of all opposites. But Shiva, the destroyer, annihilates it. Once Shiva finishes the destruction, Brahma recreates the universe again. This work is an infinite cycle that never ends. Some traditions consider Shiva to be the destroyer and the creator in one character. He cannot solely destroy, but he can create new life, too. He is the symbol of the cycle of birth, death, and rebirth (Reinert & Reinert, 2006).

Arthur Schopenhauer, the educator of Nietzsche, was inspired by Hinduism and presumably taught Nietzsche about it (Reinert & Reinert, 2006). The work *Thus Spoke Zarathustra* by Friedrich Nietzsche has to be mentioned in connection with creative destruction. Nietzsche describes in his work the goal of humanity that is in his opinion creating values (Frazer, 2006). Based on *Thus Spoke Zarathustra*, Frazer (2006) states that “value creation is at its most basic an act of self-affirmation” (p. 59).

Reinert and Reinert (2006) analyse the signals of creative destruction in *Thus Spoke Zarathustra* and detect its concept in Nietzsche’s work. The researchers discover five principles:

1. “Creation and destruction
2. The opposite of creation and destruction is stagnation
3. The will to power
4. Life is that which constantly overcomes itself
5. Warfare is a form of therapy” (p. 10)

In the work of Nietzsche, Gáspár (2016) highlights the statement that the creation and the act of creation itself are the values. A valuable action is the value in itself, not through what is produced. By acting morally, people create or destroy their own qualities (Gáspár, 2016). Nietzsche's work had an impact on Werner Sombart, who - contrary to the widespread opinion that Schumpeter created the word creative destruction - introduced it in economy: “Again, however, from destruction a new spirit of creation arises; the scarcity of wood and the needs of everyday life... forced the discovery or invention of substitutes for wood, forced the use of coal for heating, forced the invention of coke for the production of iron. That these events, however, made possible the enormous development of capitalism in the 19th

Century, is beyond doubt for any well-informed person. Thus even here, in this decisive point, the invisible threads of commercial and military interests appear closely intertwined” (Sombart, 1913, p. 207).

Sombart defined himself in his works not merely as an economist, but at the same time, as an artistic person, and a driver as well as driven human being (Schmidt, 1991).

OECD (1997) acknowledges Joseph Schumpeter as the first economist who has examined innovation. Joseph Alois Schumpeter, born in 1883 in Triesch, grew up in the milieu of the Viennese aristocracy. At the age of 18, after graduating from the Theresianum with honours, Schumpeter turned to studying law at the University of Vienna. After receiving his doctorate in law in 1906, he had been working as a lawyer at the International Mixed Court in Cairo for two years. In 1908, being merely 26 years old, Schumpeter presented his first major work, *Wesen und Hauptinhalt der theoretischen Nationalökonomie* [The Essence and Main Content of Theoretical National Economics], in a habilitation procedure. Four years later, his work *Theorie der wirtschaftlichen Entwicklung* [Theory of Economic Development] was presented, which made him famous (Schmölders, 1961).

The name Joseph Alois Schumpeter has been appearing in a wide range of publications about innovation management up until today. He is considered as the father of innovation management as he was one of the first scholars to deal with this concept in depth. However, it is often forgotten and unmentioned on which works he has built his theoretical study. Although his theory was strongly influenced by Nietzsche and Sombart, he kept these sources hidden in his publications (Reinert & Reinert, 2006). Schumpeter first wrote about creative destruction in his book *Capitalism, Socialism and Democracy* published in 1942 (Schumpeter, 1975). The scholar described product and process innovations as the engine of successful economic development under capitalism, which leads to the displacement of old products and production methods (Kunz, 2007).

In his works, Schumpeter highlights the effect of radical innovations and states that radical innovations revolutionise the economic structure from within and destroy the old structure (Stephan, 2011). In Schumpeter’s opinion, the large companies become increasingly important due to their advantages in the development and implementation of innovations (Kunz, 2007).

## 2.2. The definition of innovation

After the concept of creative destruction is clarified, this chapter covers the definition of innovation in depth. There is a variety of definitions available for innovations and innovation management. *Table 2* provides an overview of these terms.

**Table 2 Definition of innovation and innovation management**

Author	Definition
Schumpeter (1911) cited by Scholtissek (2009, p. 163)	Innovation is the process of finding economical applications for technical inventions.
Sombart (1913) cited by Reinert and Reinert (2006, p. 19)	Again, however, from destruction a new spirit of creation arises; the scarcity of wood and the needs of everyday life... forced the discovery or invention of substitutes for wood, forced the use of coal for heating, forced the invention of coke for the production of iron. That these events, however, made possible the enormous development of capitalism in the 19 <sup>th</sup> Century, is beyond doubt for any well-informed person. Thus, even here, in this decisive point, the invisible threads of commercial and military interests appear closely intertwined.
Schumpeter (1934) cited by Taylor (2017, p. 131)	Creation of new combinations of existing resources.
Drucker (1985) cited by Tidd and Pavitt (2011, p. 19)	Innovation is the specific tool of entrepreneurs, the means by which they exploit change as an opportunity for a different business or service. It is capable of being presented as a discipline, capable of being learned, capable of being practised.
Freeman (1982) cited by Tidd and Pavitt (2011, p. 19)	Industrial innovation includes the technical, design, manufacturing, management, and commercial activities involved in the marketing of a new (or improved) product or the first commercial use of a new (or improved) process or equipment.
Freeman (1992) cited by Rennings (2000, p. 327)	According to Freeman (1992) (pp. 77– 81), incremental innovations can be characterised as continuous improvements of existing technological systems (i.e. they fit in existing input–output tables) while radical innovations are discontinuous (i.e. they require new lines and columns in input–output tables).
<i>Research and Experimental Development. Business Enterprises</i> , 1997, p. 24	... the outcome of which is new knowledge, with or without a specific practical application or new or improved products, processes, materials, devices, or services. R&D [research and development] activity extends to modifications to existing products/processes.
ABS Innovation Survey questionnaire, Section B cited by Rogers (1998, p. 8)	[A]n innovation [...] is any new or substantially improved good or service which has been commercialised, or any new or substantially improved process used for the commercial production of goods and services. 'New' means new to your business.
Mulgan and Albury (2003, p. 3)	Successful innovation is the creation and implementation of new processes, products, services, and methods of delivery which result in significant improvements in outcomes efficiency, effectiveness, or quality.
OECD (2005, p. 46)	... the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organisational method in business practices, workplace organisation or external relations.
Damanpour and Schneider (2008, pp. 496-497)	... the development (generation) and/or use (adoption) of new ideas or behaviours. The idea or behaviour may pertain to a product, service, technology, system, or practice. Organisations generate innovation for their own use or for use in other organisations. The generation of innovation is a process that results in an outcome that is new to an organisational population.

Innovation Nation. Department for Innovation, Universities and Skills (2008, p. 13)	... the successful exploitation of new ideas, which can mean new to a company, organisation, industry, or sector. It applies to products, services, business processes and models, marketing and enabling technologies
Amabile and Pratt (2016, p. 158)	[Creativity is] the production of novel and useful ideas by an individual or small group of individuals working together. [Innovation is] the successful implementation of creative ideas within an organisation.

Source: own compilation, adapted from (Taylor, 2017, 131)

As it can be seen in the previous list, the definitions highlight the following attributes:

- new or significantly improved solution,
- commercialised or used for the commercial production and has an economic impact,
- new (at least) to an organisational population,
- can occur in different subject areas.

It is crucial to emphasise that idea, invention, and innovation are not synonyms, but they represent different steps in the innovation funnel (Weis, 2015). Good ideas are not innovations in themselves. Ideas have to go through a product development process in order to reach the final market and become an economic success. First, the idea must be elaborated and examined to see what potentials it has. This elaboration leads to inventions (Weis, 2015). Inventions involve creating new things that have not existed before. Thus, new ideas or the core elements of a first product concept are developed at this stage (Huang, 2016).

In the next step, the inventions should be positioned on the market and diffused. Newly developed technologies might create new markets and new demands. Only if an invention is successfully diffused on the market can it become an innovation. Therefore, innovations do not merely mean focusing on research and development, but on “manufacturing, marketing, distribution, servicing, and later product adaptation and upgrading” (Kumar & Phronmmathed, 2005, p. 7), as well.

### 2.3. Classification and description by subject area

Several opinions are known to distinguish innovations according to their objects.

Gerpott (2013) identifies merely product and process innovations. The researcher considers product innovations as products newly introduced by a company on the sales market by using existing or self-developed scientific and technical knowledge in a new way. On the other hand, process innovations are referred to as new methods used by a company to produce products and services. These process innovations can be of both technical and administrative nature. The scholar does not consider social innovations as innovations without references to technical processes or product innovations.

Other scientists determine more than two subject areas for innovations. Kupsch et al. (1991) define three areas: product, process, and social innovations.

Other researchers, like Stummer et al. (2020) divide innovations into four groups:

- Product innovations involving the renewal and improvement of products and services,
- Process innovations focusing on the more efficient production of products and services,
- Market innovations identifying new markets or contributing to the development of new markets,
- Social innovations bringing changes in human resources, organisational, and legal areas.

Hartschen et al. (2015) classify innovations into four groups, but these do not exactly match Stummer's classification as they are defined as follows:

- Product and service innovations,
- Process innovations,
- Social innovations,
- Management innovations.

Bessant and Tidd (2011) advocate that innovations can take many forms, but the scholars categorise innovations into four groups, which deviate from the above-mentioned splits:

- Product innovations representing changes in the products and services that a company offers,
- Process innovations embodying the changed ways of production, creation, and delivery,
- Position innovations changing the settings in which products and services are offered,



- Paradigm innovations challenging and transforming the mental models of the organisation.

Schumpeter defines five types of innovations:

- the introduction of a new product or a qualitative change in an existing product,
- process innovation new to an industry,
- the opening of a new market,
- the development of new sources of supply for raw materials or other inputs,
- changes in industrial organisation (OECD, 1997).

Weis (2015) uses the allocation of OECD for clustering into four groups and adds business model innovations as a fifth group because of its growing importance. The five categories are the followings:

- Product innovations,
- Process innovations,
- Marketing innovations,
- Organisational innovations,
- Business model innovations.

Scholtissek (2009) divides the products and services into separate groups; thus, the researcher distinguishes six groups of innovations:

- Product innovations,
- Service innovations,
- Organisational innovations,
- Process innovations,
- Business model innovations,
- Marketing innovations.

For the following part of current dissertation, it is important to decide on the allocation of the innovation types by subject areas and to demonstrate the types of innovation based on this allocation. As the product and process innovations occur in all groupings, these are presented as the two most significant types of innovations. Product and service innovations belong together in six out of the eight classifications, that is why they are not divided in this work either. Since the scope of social and organisational innovations is described very similarly, these are used as synonyms in this work and named as organisational innovations. The other two terms mentioned several times are business model innovations and marketing innovations; thus, these types of innovations are included in the description, as well. Market innovations are considered as being part of business model innovations as they focus on

improving the combination and serving of target markets. Thus, the following grouping is used in current research:

- Product and service innovations,
- Process innovations,
- Organisational innovations,
- Marketing innovations,
- Business model innovations.

### **Product and service innovations**

Based on the Oslo Manual published by OECD (2005),

“... product innovation is the introduction of a good or service that is new or significantly improved with respect to its characteristics or intended uses. This includes significant improvements in technical specifications, components and materials, incorporated software, user friendliness or other functional characteristics” (p. 149).

Since product innovations are often linked to the physical distinction of the product, they are noticed first and foremost. Product innovations are new designs, technologies, or applications that are economically successful (Scholtissek, 2009).

The innovative products based on technological developments provide a competitive advantage for companies. This can lead to higher profits, which in turn, motivates companies to develop novel technologies. To maintain this advantage, the developed technologies must be defended from competitors and exploited for the own benefit of the company. A unique way to secure the use of technological developments is through patents. However, developments are never fully protected as knowledge transfer, replication, and technological obsolescence reduce their protection (Gabrielsson et al., 2014).

The novelty of product innovations can involve the following factors:

- “- use of new materials;
- use of new intermediate products;
- new functional parts;
- use of radically new technology;
- fundamental new functions (fundamental new products)” (OECD, 1997, p. 80).

Product innovations improve the mix and development of the offers (Johne, 1999). Johnes sees an advantage in product innovation that it helps to retain and grow competitive positions. Additionally, product innovations target additional revenues.

Product innovations can be divided into three types:

- Substitutive innovations displacing existing products or services by offering higher benefits or optimised price-performance ratios,
- Value-added innovations representing new business potential, which can change the market structure,
- Application innovations satisfying the needs previously merely moderately present (Kupsch et al., 1991).

### **Process innovations**

Based on the Oslo Manual published by OECD (2005), "... process innovation is the implementation of a new or significantly improved production or delivery method. This includes significant changes in techniques, equipment and/or software" (p. 151). Process innovations improve the internal operations and the production performance (Johne, 1999). Process innovations change an existing process or lead to a new process which revolutionises the production of an already existing product (Scholtissek, 2009).

Kupsch et al. (1991) define the term as innovations in the operational performance creation process. In the researchers' opinion, the objectives of these innovations can be to increase productivity, to improve product quality, to add safety to the manufacturing process, or to prevent environmental damage. The process innovations can refer to the treatment and the processing of ingredients as well as the movement of the ingredients and products.

Based on Oslo Manual (OECD, 1997b), the novelty of process innovations can include the following factors:

- “- new production techniques;
- new organisational features (introduction of new technologies);
- new professional software” (p. 80).

Companies invest in process innovation to develop products that have the same functionalities but can be produced for lower costs. This cost reduction can be passed on to buyers or could lead to higher profits (Johne, 1999).

### **Organisational innovations**

Based on the Oslo Manual published by OECD (2005), "... organisational innovation is the implementation of a new organisational method in the firm's business practices, workplace organisation or external relations. ... Organisational innovations can refer to any organisational method in a firm's business practices, workplace organisation or external relations as long as it is used for the first time by the firm" (p. 153).

Organisational innovations change the division of labour, the responsibility, and the roles of an organisation, or trigger a modified relationship (Scholtissek, 2009). These innovations include changes in the legal, organisational, or personal aspects of companies. Organisational innovations can affect individual employees and their relationship systems (Kupsch et al., 1991).

### **Marketing innovations**

Based on the Oslo Manual published by OECD (2005), “ marketing innovation is the implementation of a new marketing method involving significant changes in product design or packaging, product placement, product promotion or pricing” (p. 152).

A marketing innovation is the introduction of a new marketing or sales method that has not been used by the company before (Scholtissek, 2009). It is irrelevant if the methodology was developed by the company itself, or it is a copy from another organisation (Weis, 2015).

Marketing innovations are part of a new marketing concept or a new marketing strategy and accompanied by noticeable changes in the area of product/service design, packaging, advertising, distribution channels, presentation, or pricing policy (Scholtissek, 2009).

### **Business model innovations (Market innovations)**

Weis (2015) explains business model innovations with the following definition: “A business model innovation is the implementation of a new business model or the new implementation of a significant proportion of the existing business model” (p. 42).

Business model innovations recombine existing or create new business strategies, technology, structure, and processes (Scholtissek, 2009). The goal of business model innovations is to satisfy the consumers’ needs in a unique and sophisticated way thus creating competitive advantage through differentiation (Weis, 2015). Furthermore, business model innovations support the detection of opportunities; thus, these innovations can lead to lower prices or might reduce the risks and costs of products and services (Lindgardt et al., 2009).

Based on the opinion of Lindgardt et al. (2009), business model innovations consist of two elements, i.e., the value proposition and the operating model. Value propositions focus on the offerings, especially on the questions what is offered, why, to whom, and for what. Additionally, the operating model defines how the offering is delivered.

## 2.4. Classification by the degree of novelty

Innovations can be classified based on their degrees of novelty, too. In this procedure, it is attempted to determine to what extent an innovation is new (Stummer et al., 2020). Stummer et al. (2020), Bessant and Tidd (2011), and Schallmo (2014) divide innovations by their degrees of novelty into two groups: incremental or radical innovations.

On the other hand, Hartschen et al. (2015) distinguish three groups according to the novelty of innovations:

- Radical innovations,
- Improvement innovations,
- Routine innovations.

In the following part of current work, the split into two groups, i.e., incremental, and radical innovations, is followed.

### Radical innovations

Radical innovations have a particularly high degree of innovation and are economically applied (Hartschen et al., 2015) thus triggering noticeable changes (Vahs & Burmester, 2002) and a paradigm shift for customers (Hartschen et al., 2015). Radical innovations change the industrial structures and simultaneously create large improvements in performance. Therefore, these innovations require large amounts of new knowledge (Edwards-Schachter, 2018). Often, investments in new facilities and equipment are necessary to produce a radical innovation or a new technology (Song & Thieme, 2009). Additionally, investments in human capital can be beneficial to increase the knowledge about the new technology and new markets (Song & Thieme, 2009). According to Utterback (1996) radical innovation is a “change that sweeps away much of a firm's existing investments in technical skills and knowledge, designs, production technique, plant and equipment” (p. 200).

Dahlin and Behrens (2005) identify three characteristics that must be present for an innovation to be considered radical. These features are the followings:

- it must be a novel invention,
- which is additionally unique,
- and able to influence future inventions.

The successful introduction of radical innovations can help a company to achieve a monopolistic position, know-how advantage, and image enhancement (Vahs & Burmester, 2002) as well as lead to long-term differentiation from the competition (Hartschen et al.,

2015). Radical innovations should serve as a starting point for incremental innovations in the long term (Hartschen et al., 2015). However, in order to obtain these advantages, companies must take risks, which can be of economic and technical nature, as well (Vahs & Burmester, 2002).

### **Incremental innovations**

Incremental innovations are improvements and routine innovations that do not require as high investments and do not have as high uncertainty as radical innovations. These can be executed without high investments in physical and human capital (Song & Thieme, 2009). Moreover, incremental innovations can be described as continuous innovations (Robertson, 1971). Incremental innovations are evolutionary continuing existing application areas and markets (Koschatzky, 1999). Therefore, incremental innovations can be product line extensions or modifications of products (Ali, 1994). These innovations offer added values for the existing customers by optimising the existing features or reducing costs (Hartschen et al., 2015). These innovations are often developed because managers recognise a market need, and they try to fill in this gap (Ali, 1994). It is claimed that about 90% of all innovations belong to the group of incremental innovations (Hartschen et al., 2015). With incremental innovations, the risks are much lower than with radical innovations (Edwards-Schachter, 2018; Trommsdorff & Binsack, 1999). The commercialisation of these innovations is predicted to face solely low levels of uncertainty (Song & Thieme, 2009).

## **2.5. The processes of finding ideas**

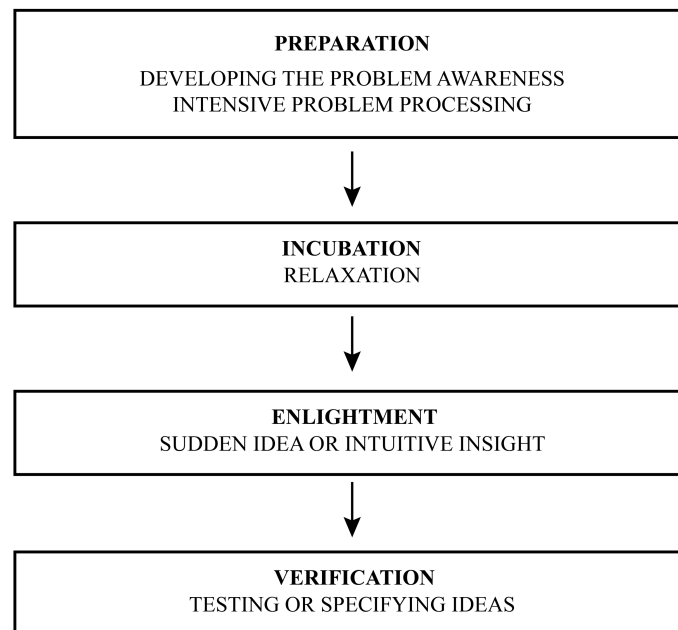
### **The creative process**

One of the best-known frameworks for the creative process is the four-phase model, visible in *Figure 2* (Backerra et al., 2007). In this process, the first step is to make awareness of the problem. For this, the problem must be recognised, analysed, and understood, as well as connections must be shown. In this step, the problem pressure and the feelings of frustration increase over time.

As the second step, in the incubation phase, the problem is put aside, and something else must be in focus. In this process, the problem is passed on to the subconscious. The right hemisphere of the brain starts looking for a solution when the person is not even aware of it. The third step in the process is the illumination, which is often referred to as the eureka experience. In this process, an approach to the solution emerges from the subconscious.

Vague and approximate ideas of what the solution to the problem might look like emerge at this stage.

Afterwards, these solutions are examined in the last step and tested for feasibility. It is checked whether the idea meets the requirements and whether it is suitable for further development. In many companies, these developed ideas are presented to a decision-making committee (Backerra et al., 2007).



**Figure 2 The creative process**

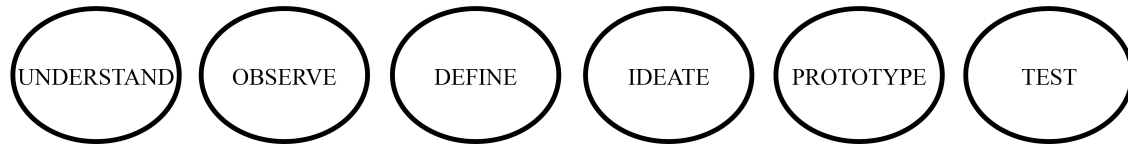
Source: own compilation, adapted from (H. Schlicksupp, 2004)

### **The innovation process: Design thinking**

The innovation process can be illustrated with various models. In this part of current dissertation, the design thinking model is described.

Design thinking focuses on need-oriented innovations. It concentrates on what people really need in different situations (Meinel & von Thienen, 2016). The concept brings together intuitive and emotional thinking with rational and analytical thinking (Hilbrecht & Kempkens, 2013). Design thinking includes the mental processes that represent how designers think and which steps they follow to design objects, services, or systems (Dunne & Martin, 2006).

There are many models of the creativity process available under the design thinking method (Meinel & von Thienen, 2016).



**Figure 3 The design thinking process**

Source: own compilation, adapted from (Meinel & von Thienen, 2016)

In this research, the steps of design thinking are explained based on the six-phase model of the Hasso-Plattner-Institute School of Design Thinking of the University of Potsdam (*The Six Phases of the Design Thinking Process*, n.d.), visualised in *Figure 3*. This method, similarly to many creativity techniques, uses the following principles: deferring judgments, building on each other's ideas, bias towards actions, radical collaboration, learning from failures, and embracing experimentation (Traifeh et al., 2020).

This first step of the process is about understanding the problem and the associated tasks. It is necessary to find out whom the problem refers to and which target group is to be addressed. Additionally, it must be determined what the project needs for success (Plattner et al., 2009). In order to understand the initial situation, it is useful to apply the five W-questions: who, what, when, where, and why? (Hilbrecht & Kempkens, 2013).

The second step of the design thinking process is the observation. The aim of this step is to put the designers in the users' shoes, to empathise with their perspectives, and to observe them (Brown, 2008). For this purpose, such instruments of quantitative research can be applied as the statistical composition of the target group as well as such instruments of qualitative research as the determination of the target group consumption (Grots & Pratschke, 2009).

The third phase of the process is the define phase, where the project team determines a common viewpoint. For this purpose, the findings generated in the observation phase are evaluated, interpreted, and weighted by the team thus creating a unified knowledge base (Plattner et al., 2009). At this step, the relevant information is separated from the less important data (Hilbrecht & Kempkens, 2013).

The fourth step of the design thinking methodology focuses on the idea generation. Solutions should be developed for the users based on the identified problems. An attempt is made to create as many ideas as possible in a relatively short period of time (Hilbrecht & Kempkens, 2013). A well-known method of idea generation is brainstorming, which is explained in *Chapter 2.6*. of current work.



The fifth phase is dedicated to developing prototypes for the selected potential solutions. In this step, the potential approaches are made tangible and communicable (Plattner et al., 2009). The prototypes bring the ideas out of the designers' heads into the physical world thus creating a common understanding within the project. In early phases, the prototypes are rough and developed in a short period of time. Afterwards, they are learned from, further possibilities are explored, and they get optimised (Grots & Pratschke, 2009). The form of the prototype can be, for example, paper and cardboard models, 3D models, films, role plays, storytelling, or even co-creation (Hilbrecht & Kempkens, 2013). It is important in the prototype development that the ideas should be made tangible for the users in a selected form; thus, the users can empathise with the solutions and give constructive feedback (Plattner et al., 2009).

The final phase is the testing. The aim of this process is to refine and further develop the prototype and problem solutions. The previously developed prototype is tested with the users' involvement. Observing and engaging with the prototype provides another opportunity to develop an understanding of the users, which can lead to further insights applicable to specifying the problem formulation (Plattner et al., 2009).

Although it is not shown in the design thinking model, there are further steps that are necessary to develop an innovation from an idea. After a successful test and validation, commercialisation should take place, which - in the best case - leads to market penetration (Scholtissek, 2009). Therefore, after achieving successful commercial results can the idea be called an innovation.

## **2.6. Idea generation methods**

The generation of ideas is an important step in the innovation process of companies (Litchfield, 2008).

A multitude of creativity techniques – according to Schlicksupp (1989) over 100 different techniques - are available to provide strategies how to exploit the creative potential of a team and develop new ideas (Herrmann & Felfe, 2014). As these tools can be beneficial for idea generation, leaders often use them during creative meetings (Rickards & Clark, 2006).

Ideas arise through creative activities. Creativity is the process of finding new aspects and approaches to problems. It can be seen as a reaction to problems and needs. Creativity requires the breaking out of the solidified thought structures. The creative achievement is often a new combination of existing knowledge (Miszakowicz, 2016).

To present all the creativity techniques in depth would go beyond the scope of this dissertation. However, *Table 3* provides an insight into the best-known methods. These techniques are brainstorming, brainwriting, collaborative sketching, provocation technique, mind mapping, and mood boards, which are especially important for design and product development teams.

**Table 3 Idea generation techniques**

<b>Name</b>	<b>Definition</b>	<b>Key Rules</b>
Brainstorming	It is a method for unblocking creative flow and enhancing group ideation (Osborn, 1963).	<ul style="list-style-type: none"> <li>• No criticism</li> <li>• Quantity before quality: Collect as many ideas as possible within a short period of time (Miskowicz, 2016)</li> <li>• Free run of imagination</li> <li>• Develop others' ideas in the group (Miskowicz, 2016)</li> </ul>
Brainwriting /6-3-5	It is a written ideation method, derived from brainstorming.	Six people write their ideas on three sheets of paper, and these pieces of paper change places five times (Hartschen et al., 2015)
Provocation technique	It helps to restructure the problem (Amabile, 1982), thus triggers higher qualitative creativity than brainwriting resulting in more unique ideas (Herrmann and Felfe, 2014)	<ol style="list-style-type: none"> <li>1. Define what is taken for granted.</li> <li>2. Develop provocations that challenge this statement.</li> <li>3. Choose the strongest, craziest, or boldest provocation.</li> <li>4. Develop ideas under the condition that you assume the provocation is true. (De Bono, 1993)</li> </ol>
Mind mapping	It supports in structuring and visualising problems, by connecting the left and right hemispheres of the brain (Backerra et al., 2007).	<ol style="list-style-type: none"> <li>1. Write in the middle of the paper the main topic.</li> <li>2. Create main branches for key idea areas.</li> <li>3. Add sub-branches for related concepts.</li> <li>4. Employ colors and symbols for clarity.</li> <li>5. Record, then restructure in a subsequent map (Miskowicz, 2016).</li> </ol>
Mood Boards	A visual representation of a concept and its ambiance.	Use many different components, such as pictures, fabrics, textures, patterns, materials, and colours, to visualise the end product (Gaimster, 2013).

Source: own compilation, 2023

### 3. THE FASHION AND TEXTILE INDUSTRY<sup>2</sup>

#### 3.1. The history of the textile industry

Fibres and textiles have been in use for several thousand years. Their most important and widespread application is for clothing (Gries et al., 2015). Clothing is one of the basic needs of humans. It protects them from the elements and serves as means of expressing personality and lifestyle. Clothing had already been produced in 4000 BC, at that time from wool and flax. Silk and linen fabrics were invented around 2000 BC. Furthermore, cotton has been used for textile production since the middle of the 14th century. The mechanisation of textile production began at the beginning of the 18th century. Various machines and techniques were developed, which improved the efficiency of production (Gries et al., 2015). Today, companies in the textile and clothing industry have a strong division of labour and are internationalised. A large part of the production often takes place in the Far East.

#### 3.2. The definitions of the textile industry

The terms apparel, clothing, textile, and fashion are often used as synonyms; however, there are differences regarding their meanings. Therefore, in the next part of the dissertation, the proper definitions, which are used in the following parts of the dissertation, are provided. Additionally, a visualisation of these terms is provided in *Figure 4*.

First of all, textile is the cloth produced in large quantities. The production can take place by hand or machine.

Clothing refers to the products made from cloth (Sagar, 2017). Clothing includes the things you wear to cover your body. They are made to protect the wearer against cold, heat, water, or machinery (Cambridge Dictionary, n.d.-b). It satisfies the needs for protection, modesty, and practicality as well as has a practical and utilitarian function (Falanga, 2020).

Apparel refers to clothes of a special type. This might be, for example, men's apparel or sports apparel (Cambridge Dictionary, n.d.-a). Apparel might include nametags, jewellery, shoes, or bags, too (Sagar, 2017). It serves as adornment, and its aim is to attract others (Falanga, 2020).

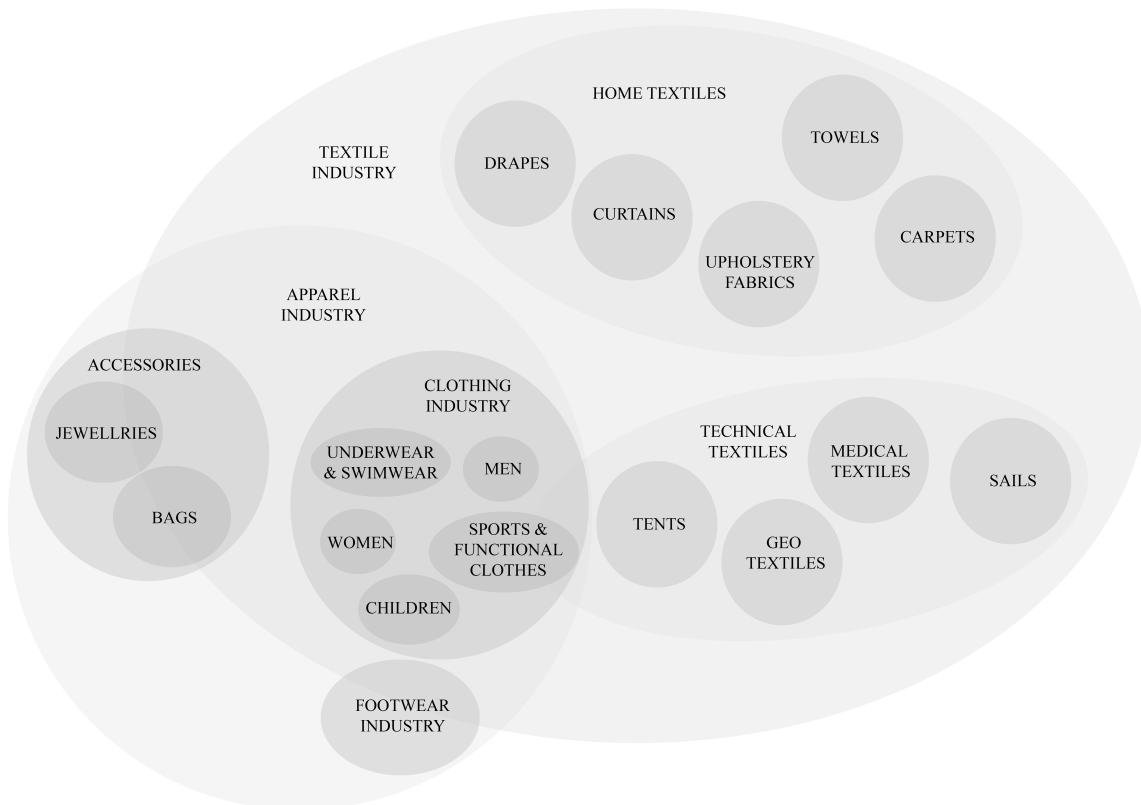
Based on Cambridge Dictionary (n.d.-c), fashion is a style popular at a particular time and clothing that is stylish. The term refers to various areas of clothes, hair, and make-up. The

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<sup>2</sup> Parts of the chapter 3.1., 3.2. and 3.2. were published in (Paulovics, 2022), and chapter 3.4. in (Paulovics, 2021c).

fashion industry is the sector producing and selling new styles, especially of clothes, shoes, bags, as well as hair and beauty products.

The research mainly focuses on the apparel industry, as both clothing, accessories and footwear industry participants are involved into the empirical research. However, in the secondary research, other levels of the industry are examined and described, as well.



**Figure 4 The structure of the textile industry**

Source: own compilation, 2022

### 3.3. The description of the industry

The fashion industry is a very important industry. Before the outbreak of the Covid-19 pandemic, its global revenues were estimated at between \$1.7 trillion and \$2.5 trillion dollars (*Global Fashion Industry Statistics - International Apparel*, n.d.). The value of the global apparel industry is approx. 2% of the world's Gross Domestic Product (GDP). In 2019 only in the US were nearly \$380 billion dollars on apparel and footwear spent by customers (Vilaca, 2022). Therefore, the apparel industry is not insignificant and plays an important role in economy.

The biggest fashion house and global leader in the luxury goods industry with rights to 70 different trademarks is the French LVMH. Their brands include Louis Vuitton, Givenchy,

Fendi, Kenzo, and Dior. The market capitalisation of the group is valued around \$367 billion dollars. On the list of fashion brands with the highest market capitalisation, LVMH is followed by Nike, which is valued for \$216 billion dollars. Inditex, the owner of fast fashion brands Zara, Pull&Bear, and Stradivarius, has approx. a value of \$81 billion dollars (*Global Fashion Industry Statistics - International Apparel*, n.d.).

The textile industry is often criticised for its harmful impact on the environment since it consumes a lot of water, which has already become a scarce resource in some regions of the world. In addition, the chemicals used during production and the cultivation of necessary plants are harmful to the environment. The textile industry consumes a lot of non-renewable resources, such as energy, which further increases the unsustainability of this sector. Additionally, the amount of the generated waste should not be neglected. Not enough emphasis is put on the approaches of sustainability and recycling. The trends of fast fashion companies lead to the generation of more demand, yet the usage time of the products decreases dramatically.

Furthermore, the treatment of the employees working in this industry must be improved, and an ethical solution has to be worked out. Currently, the employees in the Far East are often not treated with respect regarding their human rights: they are underpaid, and their health is put at risk. Nevertheless, a large proportion of the production still takes place there because it saves on labour costs. However, this process causes long transport distances, which is linked to increased oil consumption and further pollution of the environment (Blackburn, 2009).

Although the textile industry may appear to be creative from an outside observer's viewpoint, and it seems to be a shiny world, often, designers cannot unfold their creativity. Creatives usually receive defined costs and target prices for the products before they start designing. During the development of apparel products, particularly high priority must be on ensuring that the products are marketable, the target group can afford them, and they appeal to the consumers. All sub-decisions on determining the design and ultimately the price must be carefully considered. Thus, the quality of the fabrics, the processing methods, and the applied accessories are carefully chosen (Blackburn, 2009).

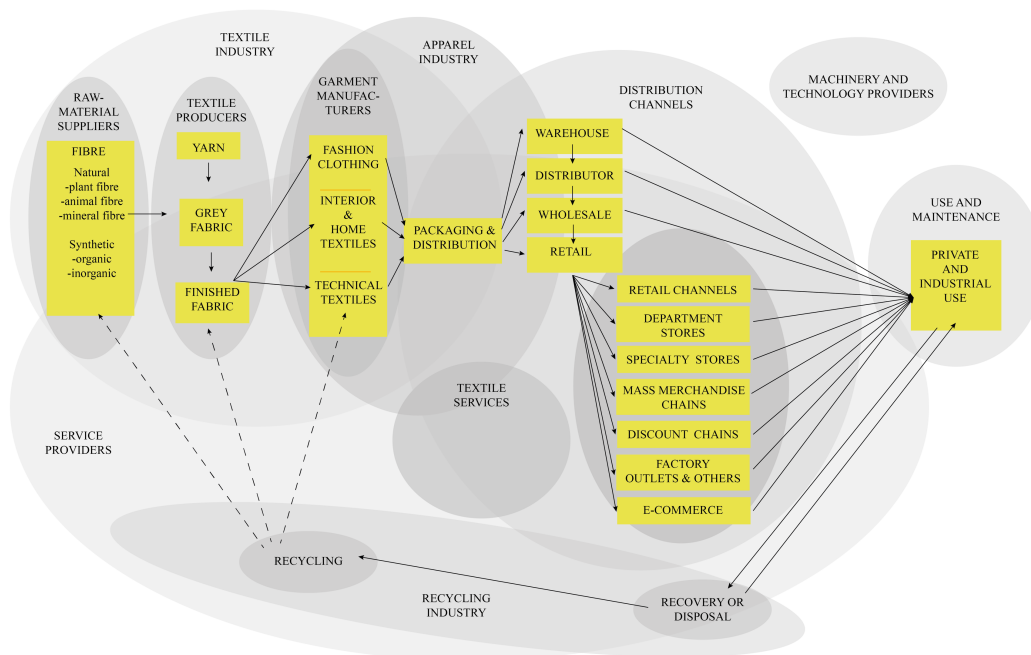
As each detail has to be planned in such a depth to achieve the necessary turnover, it can be assumed how strongly the industry can be affected by external factors, such as the COVID-19 pandemic.

### 3.4. The supply chain of the apparel industry

The textile supply chain is complex, and several stages of it are affected by inventory management. Thus, raw-material suppliers, textile producers, and garment manufacturers need all ingredients in their inventory to be able to start producing. Moreover, the distribution channels depend on the right inventory to fulfil the orders. On the other hand, if companies have overstock, they lock down capital and cash flow, which makes them less adaptable to changes. Therefore, inventory management plays an important role in the success of companies operating in the textile industry.

There are several available models that visualise the supply chain process of the textile industry. Based on the models of Shen and Mikschovsky (2019), EURATEX (2004), Martin (2014), Gries et al. (2015), Brito et al. (2008), Agrawal et al. (2018) and the Swiss Federal Office for the Environment (n.d.), a model demonstrating the actors and stages of the textile supply chain is developed as part of current research.

Similarly to Shen and Mikschovsky (2019) and Brito et al.'s (2008) models, the developed model is based on a closed loop since the textile industry pays more and more attention on sustainability and recycling. Even if today's recycling practices are not fully integrated in the supply chain of the textile industry, the possibility for this kind of action is marked with dashed lines in *Figure 5*.



**Figure 5** The supply chain of the textile industry

Source: own compilation, 2022

### 3.5. The market levels of the apparel industry

The apparel industry can be divided into seven segments, visualised in *Figure 6*. The various areas have, among other factors, different price ranges, consumers, and accessibility:

1. Haute Couture - brands meeting the four main requirements of the French Ministry of Industry made to measure products,
2. Luxury Fashion - high-quality designer brands,
3. Bridge Brands - great-quality clothing with a more adequate price level,
4. Diffusion Lines - clothing created by luxury labels as more budget-friendly, secondary lines,
5. High Street Fashion - accessible, quality fashion with a longer life span than economy items and an affordable price level,
6. Fast Fashion - well-known, affordable brands with extremely quick turnover in fashion and trends,
7. Economy Fashion- mass produced products with low prices, low quality, and short lifespans (Jones, 2017).



**Figure 6 Positioning map**

Source: own compilation, adapted from (Jones, 2017)





#### 4. EXTERNAL INFLUENCES ON THE TEXTILE INDUSTRY<sup>3</sup>

As in case of all sectors, external influences can be felt in the textile industry, too. The external forces might originate from market changes, which are described in the following paragraphs.

##### 4.1. The COVID-19 pandemic

In order to demonstrate how the textile industry is changing in response to an external effect, I describe the impact of the first wave of the COVID-19 epidemic. As the study deals with several effects rather than analysing one effect in depth.

It all began about four years ago, on 8 December 2019, the day on which the first case of COVID-19 was registered. With this single case, it had not been known how great the impact of this virus might be on the whole world. The spread of the virus was very fast, the WHO issued a global health warning on 30 January 2020 (Wu & McGoogan, 2020), and it was classified as a pandemic on 12 March 2020 (Speicher, 2020).

Due to its extremely rapid spread and its threat to human health and life, the virus quickly led to various closures. The first of these lockdowns took place in China followed by a large number of other countries. Generally, lockdowns cannot be implemented without repercussions. Although COVID-19 was a health crisis, it had a major impact on the economy and ultimately led to an economic crisis. This was because the fight against the virus required social distancing, which affected company offices, businesses, and events. On the other hand, the rapid spread of the virus increased insecurity; thus, consumers and investors avoided consumption and investment to conserve their financial resources (Ozili & Arun, 2020).

The negative effects of the pandemic could be seen in a wide range of industries, sectors, and countries. There were serious economic consequences, such as the short-term loss of income for citizens, the strains on national budgets, the impairment of global trade, and a decline in GDP (Lakemann et al., 2020). Covid-19 had exerted its negative impact on various sectors of economy. GDP in China fell by 6.8% in the first quarter of 2020 compared to 2019 (Zhang et al., 2020). The effects of the crisis of COVID-19 were clearly visible in the German economy, too. The strained financial situation led to a bad mood in the market (Litsche et al., 2020).

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<sup>3</sup> The research presented in the chapter 4.1. and 4.2. were published in (Paulovics, 2020), chapter 4.3. in (Paulovics, 2021a), chapter 4.6., 4.6.1. and 4.6.2. in (Paulovics, 2022)

Covid-19 had a stronger impact on the unskilled workers' employment and on the lower-income group than on skilled, well-educated workers (Zhang et al., 2020). This led to a widening of the gap between classes.

The governments and the market participants' behaviour encouraging citizens to stay at home and keep social distance had many effects, as well. On the one hand, citizens postponed their trips leading to mass cancellations of flights, reservations of hotels, and touristic travels. The restrictions imposed by some countries even resulted in bans on entry and exit, which dramatically worsened the situation of all tourism-related businesses. On the other hand, people gave up going to restaurants, and as it has already been described, tourists stayed away, too, which had a strong financial impact on restaurant owners.

COVID-19 left its mark not solely on tourism but on other sectors, as well. The event industry was heavily affected by cancellations. Countless events, such as music shows, conferences, weddings, trade fairs, exhibitions, and business events, had to be postponed due to the restrictions. The sports industry was heavily affected by the regulations, as well. Many games and events, such as the Tokyo Summer Olympic and Paralympic Games, football leagues, *Formula 1*, rugby, baseball, motorsport, and golf competitions, had to be cancelled or postponed resulting in high income losses for clubs and for the athletes, too. Furthermore, banks and the stock exchange must be named as losers of the situation, as well. Banks were negatively affected as small and medium-sized enterprises could not finance their loans, which meant that the financial institutions could make less profit. The impact on the global stock market was enormous and led to sharp price falls, too. As described above, the lockdowns had many negative effects, but it is important to examine the positive influences, as well. The coronavirus created opportunities: the health system got improved, and new reforms were introduced (Ozili & Arun, 2020).

Although there were some advantages, the disadvantages of the pandemic far outweighed them. Due to the Covid-19 pandemic, companies had to deal with an increased competition and focus more on productivity. According to Christine Lagarde, president of the European Central Bank, a close cooperation between the public and private sectors was essential (Fleming, 2020). In addition, Zhang et al. (2020) saw the solution in the creation of new jobs by small and medium-sized enterprises, which should receive state support to increase their innovative capacity (Zhang et al., 2020).

It is difficult to assess the measures taken now, since the pandemic seems to be a still ongoing problem, while new crises and economic difficulties have arisen recently with the outbreak

of the Russia-Ukraine War. The taken actions should be looked at in retrospect, and it might then become clear whether the right decisions were taken (Batra et al., 2020).

#### **4.2. COVID-19's impact on the textile industry**

The effects of the coronavirus and the lockdowns had a major impact on the textile industry, too. The first actors of the textile industries feeling the effects of the pandemic were the retailers. Due to the lockdowns and the customers' moderate purchasing power, retailers were the first ones who had to deal with the drop in sales. Several of them, including the largest retailer in Germany, Galeria Karstadt Kaufhof, had to file for insolvency. However, the small independent brands fought hard, as well (Vogue Business Team, 2020). In addition, the spread of the coronavirus in the Far East threatened to cause a wave of poverty among the employees of textile chains (Reinhold, 2020a).

The lockdowns led to job losses, layoffs, delivery problems, and declining sales, as well as net profits for most apparel brands. To name merely a few of the largest brands, the following list of companies and holdings that faced declining in sales or profits is prepared: Abercrombie & Fitch Co, Burberry, Capri Holdings. Ltd with its brands: Michael Kors, Versace, and Jimmy Choo; H&M, Kering Group with its brands: Gucci, Saint Laurent, and Bottega Veneta; Victoria's Secret, Levi Strauss & Co, LVMH, Moncler, Nike, Under Armour, Ralph Laurent (Ilchi, 2020b).

The coronavirus crisis showed that the world is extremely fragile as well as inelastic and has difficulty in adapting to changes quickly. However, the crisis showed that the world is full of undiscovered opportunities that become visible once a crisis breaks out (Buheji & Ahmed, 2020). Based on forecasts, the 50 most valuable luxury and premium brands in the world might lost up to 35 billion dollars in brand equity due to COVID-19 (Brand Finance, 2020). In April 2020, Brazilian retailers expected a 50% drop in sales due to the lockdowns (Castano, 2020). Consumers' concern about the coronavirus inhibited the willingness to buy (Brecht, 2020a). In reality, fashion companies around the world experienced varying degrees of decline in sales. The retail sales of Burberry declined by 48.4%, the sales of H&M dropped by 57%, the sales of Levi Strauss & Co. fell by 62% compared to the previous year, and the income of Ralph Laurent was down by 65.9% in the second quarter of 2020. LVMH Moët Hennessy Louis Vuitton experienced an 84% drop in net profit in the first half of 2020, and its revenues fell by 38%. However, some brands seemed to be only marginally affected by the crisis: the sales of Moncler fell by merely 18%, and the sales of the Kering Group fell by solely 15.4% until 31 March 2020 (Ilchi, 2020b).

In addition, several apparel companies had to file for bankruptcy under Chapter 11, which supported the reorganisation and planning of a company to ensure its survival and creditworthiness (*Chapter 11 - Bankruptcy Basics*, n.d.). Centric Brands, one of the leading groups of lifestyle brands in the world with such licensed brands as Buffalo Jeans, Calvin Klein, Michael Kors, Allsaints, Coach, Spyder, Timberland, and Tommy Hilfiger, filed for insolvency protection under Chapter 11 on 18 May 2020. In addition to Centric Brands, G-Star Raw Retail Inc., John Varvatos, Neiman Marcus Group, J.C. Penney, J. Crew, and Brooks Brothers applied for insolvency protection under Chapter 11, too (Ilchi, 2020b).

COVID-19 not merely affected the sales and economic situation but hindered the development of relationships with customers, as well. Since the fashion weeks had to be cancelled, the presentation of the collection was more difficult for the fashion brands. In addition to fashion shows, fairs, exhibitions, and other events had to be postponed (Ilchi, 2020a).

Clark (2020) explains that in difficult economic situations, customers tend to downgrade their status and buy products that are more affordable compared to their previously preferred items. However, in this case, during COVID-19, this process did not take place. The retailers experienced one stop, the customers stayed away completely (E. Clark, 2020). This behaviour was partly due to the customers who were worried about their future. More than a third of all surveyed employees in Germany were worried about their jobs (Reinhold, 2020c); moreover, 43% of the consumers believed that visiting a fashion store carries the risk of a corona infection (Freutel, 2020a). As people were afraid of COVID-19, they withdrew, travelled less, reduced the number of social contacts, and spent more time at home, i.e., no longer visited stationary fashion shops as before (Freutel, 2020b). With a 34% share of the global luxury industry, China is a very important market for the luxury goods business. Due to travel restrictions, tourists from China were forced to stay away from Europe, which was a further burden for retailers (Brecht, 2020b).

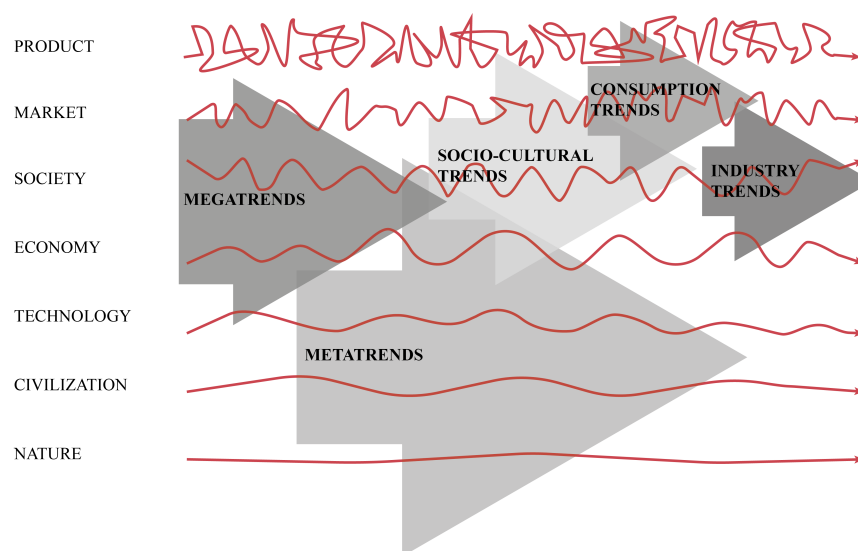
Similarly, the COVID-19 crisis led to massive slumps in e-commerce. As early as March 2020, 41% of the surveyed companies had already recorded declines in demand (Reinhold, 2020b), and more than 60% expected these to occur during the year. Zalando, an online retailer of shoes, fashion, and cosmetics with sales of 6.5 billion euros in 2019, had noticed lower demand in the affected areas since the restrictions on public life (Faber, 2020a). Although there was a shift towards the online businesses due to the shutdowns, this primarily affected solely the basic consumer products. Web shops with food delivery services, drugstores, and pharmacies benefited from the shift (Faber, 2020b).

It is not clear yet how long it might take to recover from the crisis because there is now another crisis with the Russia-Ukraine War and the energy crisis, which has rewritten the post-COVID vision of the market.

### 4.3. Megatrends

Not solely the COVID-19 pandemic has an impact on the textile industry, but other trends exist, too. The term trend was first used for the course of stock market prices in the 19th century. Nowadays, it is widely applied and often misused. A large part of the society understands this notion as a short-term fashion trend, but there is much more behind this word. There is not merely the term trend, but there are various types of versions, which are widespread and different ("Trends - Grundlagenwissen", n.d.).

The following part of the dissertation explains the details of each orientation. *Figure 7* provides a visualisation of the classification of megatrends.



**Figure 7 Classification of megatrends**

Source: own compilation, adapted from (Horx, n.d.)

- *Metatrends* are the biggest and longest-lasting trends. They combine several megatrends into one and are the basis of all trends and developments. They are comprehensive and represent the basic rules of nature and the laws of evolution with eternal character (Horx, 2015).
- *Megatrends* represent social, economic, political, ecological, or technological changes that influence the activities, processes, and perceptions of individuals, companies, societies, and governments (Hajkowicz, 2015) for 50-60 years

("Megatrends", n.d.). Megatrends are such trends that affect every individual's life in a variety of ways. They reshape and change the way people live thus creating new needs (Lux, 2012). The term megatrend was complemented in 2005 by Gänssmantel et al. (2005). The researchers added that megatrends are not subject to cycles, instead they can be represented as wave models with very slow rates of changing.

- *Socio-cultural trends* have a maximum life of 10 years; thus, they are medium-term trends. They are based on the social and technical changes in the life of mankind.
- *Consumption trends* are among the short- and medium-term trends that exist for a maximum of 5-8 years. They are reflected in the changes of products and the consumer world.
- *Product and fashion trends* are the shortest-term trends, and they mostly last merely for one season. They are superficial and have an impact solely on the products ("Trends - Grundlagenwissen", n.d.).

As it is presented in the previous paragraphs, several types of trends exist. The following part of the study focuses on megatrends and their impact on the apparel industry.

ZukunftsInstitut, which provides strategic knowledge for the economy of tomorrow, is one of the most important think tanks for trend and future research (ZukunftsInstitut, 2022). Describing all megatrends goes beyond the scope of this research; therefore, the focus is set on those that are particularly important for apparel companies. Among the megatrends, those making an impact on the apparel industry are the followings:

- *Gender Shift*: In contemporary society, gender has a diminishing impact on societal roles breaking down stereotypes and elevating diversity and feminism, which leads to profound changes in society ("Megatrends", n.d.). In the fashion industry, the gender shift suggests an imperative to innovate and diversify offerings while reflecting a broader spectrum of identities and expressions thus creating collections that transcend the traditional gender norms and appeal to a progressive audience. The trend shows that as the societal attitudes towards gender identity and expression evolve, designers, brands, and retailers modify their offerings and marketing strategies. Celebrities and brands embracing and promoting gender-neutral and gender-fluid fashion, as mentioned with Harry Styles and Maluma, illuminate the response of the fashion industry to the gender shift (Newton, 2022).
- *Health*: The intertwining of health and satisfaction has become more palpable over the years with health being a focal point of life and deeply embedded in societal

consciousness. For fashion brands, this trend indicates the necessity to intertwine sports, wellness, and lifestyle in their products while considering ethical concerns around digital health data in wearable tech fashion thus ensuring transparent and secure user data management.

- *Individualisation*: With individualisation permeating cultural trends and symbolising the liberty of choice and identity design, the fashion industry is prompted to offer personalised experiences and products. This involves recognising and creating products that empower personal identity possibly through customisable fashion items or leveraging technology for a more personalised shopping experience.
- *Connectivity*: The advent of connectivity facilitated by the digital infrastructure transforming social norms and lifestyles ("Megatrends", n.d.) implies that the fashion industry must optimise its digital platforms and leverage technology (such as AI and IoT) to enhance the customer experience and streamline operations thereby fostering a synergistic interaction between technological advancements and human-centric services. The usage of digital platforms and social media in evaluating and capitalising on the influence of K-pop implies the critical role of digital connectivity in understanding, analysing, and leveraging consumer preferences and behaviours (Newton, 2022).
- *New Ecology*: As New Ecology reshapes values across society, culture, and politics and influences individual lifestyles and consumption trends ("Megatrends", n.d.), it is pivotal for the fashion industry to align with eco-friendly practices (Newton, 2022). This involves adopting sustainable sourcing, manufacturing, and distribution practices, as well as creating products ecologically responsible and appealing to environmentally conscious consumers. Additionally, the global market for second-hand apparel, valued at \$96bn in 2021, is anticipated to climb to \$218bn by 2026, according to Statista. RaaS has not merely revolutionised the consumer access to and sale of pre-owned items without visiting physical thrift stores but facilitated brands in reselling apparel in a more environmentally friendly approach, as well. Prominent brands have either launched their own resale platforms or partnered with existing marketplaces like ThredUp and Poshmark to navigate this wave (Newton, 2022).
- *Silver Society*: With the global population aging yet maintaining a vibrant and active lifestyle, the significance of older generations is on the rise. The fashion industry should adapt to the new phenomenon by creating lines that cater to this demographic

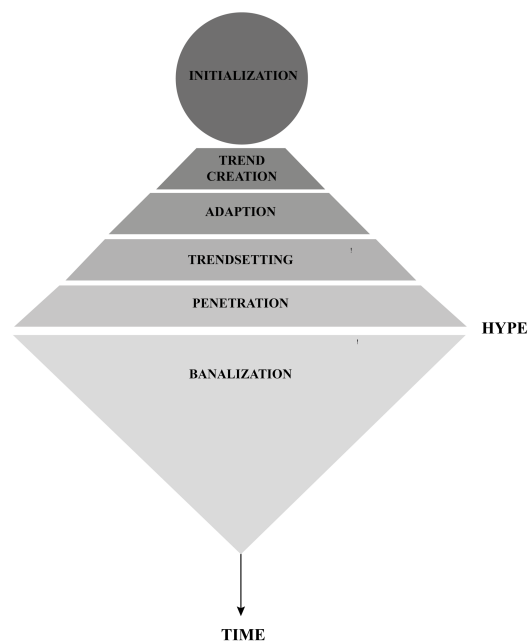
ensuring that the designs are both stylish and accommodate the physical needs of an older but dynamic and youthful-thinking population. This might involve fashion that is easy to wear, comfortable, yet contemporary and elegant thereby resonating with the “Silver Society” ("Megatrends", n.d.).

After presenting the forces affecting the apparel industry, a look is taken at the actual changes happening in the industry. In the next part of the dissertation, it is described which new innovations have already emerged in the industry over the last 10 years, and which are expected to arise in the future.

#### 4.4. Trend research among companies

Megatrends show the direction in which the market is developing. They provide support for companies to adapt their products and services to the changed conditions. However, it is of central importance when products and services get offered. If the products appear too early on the market, there is not enough demand for them. In contrast, if companies launch their products too late, there are many competitors, and it is more difficult to achieve success. That is why it is important to start developing products and services on time to be able to deliver them when the demand appears.

Trends usually go through six phases that come one after the other in the following order: initialisation, trend creation, adaptation, trendsetting, penetration, banalisation. These phases are visualised in the *Figure 8*.



**Figure 8 Six phases of trends**

Source: own compilation, adapted from (Reinhardt, 2006)



It is advisable to offer the products and services at the latest when the trend reaches the hype phase (Reinhardt, 2006). However, this presupposes knowing the trends and being able to react to them. In order to identify the medium- and long-term trends, companies have to participate in trend research. If the trends can be identified in the adaption phase, companies have sufficient time to develop the products and services on time (Reinhardt, 2006).

#### **4.5. Trends in the fashion industry**

According to Faria et al. (2019), emotions are becoming more and more vital components in the progression of technology. The scholars emphasise that the future of advertising lies in creative contents that evoke stronger emotional connections with people. The Delft Institute of Design finds that incorporating emotions into advertising leads to a more immersive and satisfying customer experience (Desmet, 2015). Concurrently, companies are taking steps to revolutionise the retail landscape by seamlessly merging the physical and digital realms (Faria et al., 2019). A number of experts in the field of design, such as Quesenbery & Brooks (2010), draw attention to the power of storytelling. They contend that when people hear a story, their minds become fully immersed as they fill in the details and bring the story to life.

#### **4.6. Web 3.0 and Web3**

Over the past decade, there has been a dramatic shift in the way how the Internet is used. The World Wide Web evolved from a static, one-way medium to a dynamic, two-way medium. This shift is driven by the rise of social media and the proliferation of mobile devices.

Web 3.0 and Web3 are terms often used interchangeably, but there is a big difference between the two. The term Web 3.0 refers to the next stage of the Internet, where the web becomes more intelligent and aware of the users. Web 3.0 is a semantic web, where information is organized and presented in a way easy for machines to understand. This will allow a more personalised experience for the users, as well as new applications and services, which are unimaginable today, will be developed (Van Elegem, 2022).

On the other hand, Web3 is a term used to describe the decentralisation of the web and means a set of protocols and technologies allowing the creation of decentralised applications. With Web3, there is no single point of control or failure. Instead, the web is powered by a network of decentralised computers, a.k.a. the peer-to-peer web. This new model of the web has the potential to transform the Internet to a form never seen before.

While Web3 is a necessary component of Web 3.0, it is not the same thing (Takyar, n.d.).

### **4.6.1. Web 3.0**

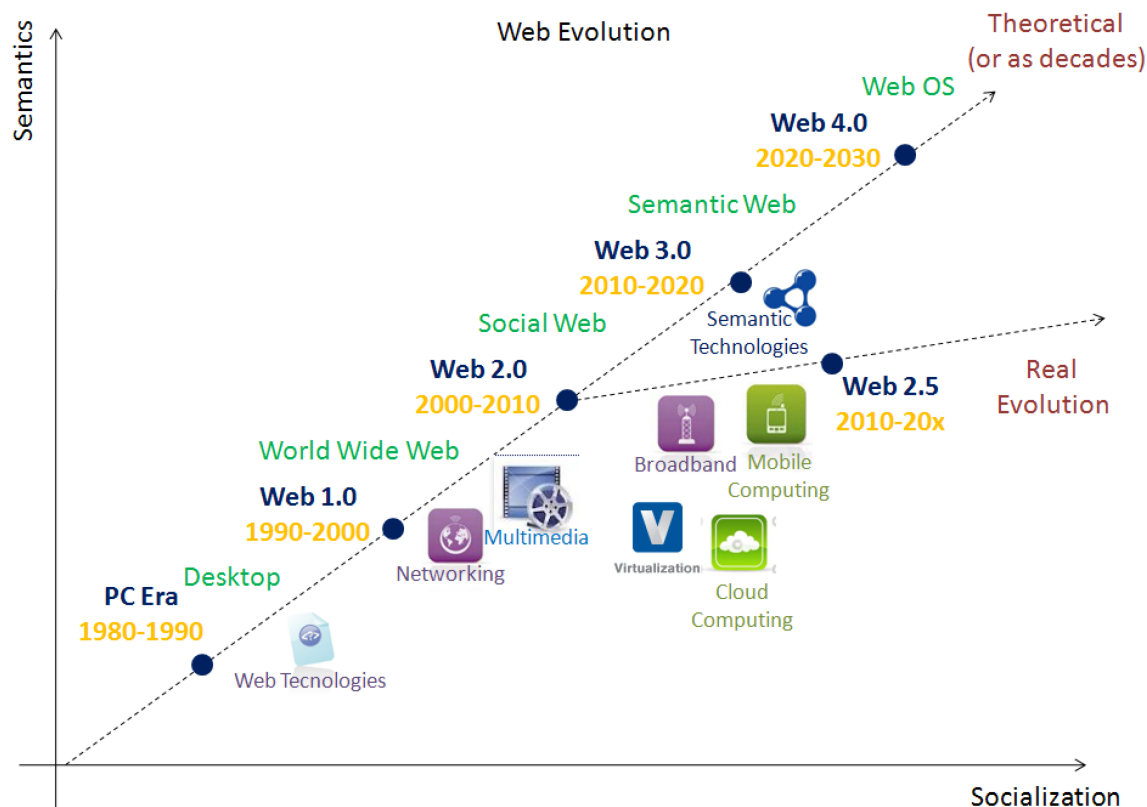
#### **Background of Web 3.0**

Web 1.0, the first stage of the World Wide Web, was released in 1995. Web 1.0 is characterised by static HTML pages and limited user interaction. Web 1.0 focuses primarily on desktop users and not generally on the Internet. The technology is not as interactive as Web 2.0. Although early Web 1.0 sites are developed by using simple HTML codes, the move to Web 2.0 brings a more sophisticated use of coding languages, such as CSS, XML, and JavaScript, with it.

Web 2.0, the second stage of the World Wide Web, was released in 1997. In case of Web 2.0, increased user interactivity and collaboration are found. Web 2.0 sites allow users to contribute and make contents, such as comments, ratings, and reviews. Social networking sites, like Facebook and Twitter, are examples of Web 2.0.

Web 3.0, the third stage of the World Wide Web, was released in 2009. Web 3.0 is characterised by increased Semantic Web technologies and personalisation. Additionally, it is the most current iteration of the web. Web 3.0 is more interactive and has more features than Web 2.0. Furthermore, in case of Web 3.0, new technologies, such as facial recognition and virtual reality, are introduced, as well. With Web 3.0, the users' data are used to create more personalised experience. For example, the results of search engines may be tailored according to the users' locations and interests (Terra, 2022).

Web 4.0, as envisioned by experts like David Fayon, could transcend the current digital interactions, forming an "active" or "symbiotic" web. This concept leans on technological advancements that would enable digital environments to intuitively and predictively adapt to user behaviours and needs potentially eliminating explicit search engine usage in favour of more anticipatory, integrated user-digital dialogues. Navigating barriers such as substantial processing power and resource demands, Web 4.0 promises to blur the boundaries between user intent and digital response, embodying a future of seamless and adaptive digital interactions (Faizar, 2021) (O'Neill, 2022).



**Figure 9 The evolution of World Wide Web**

Source: (Madurai, 2018)

### The Semantic Web

Web 3.0 is based on the idea of Semantic Web, which is a web of data that can be read and understood by machines. The goal of Web 3.0 is to make it easier for machines to find and use information on the web. Therefore, standards for how data are structured and linked are created. The Semantic Web is sometimes referred to as Web 3.0, but this is not an accurate description. The Semantic Web is solely one part of what make up Web 3.0. The Semantic Web has the potential to revolutionise the way the World Wide Web is used. By making information more accessible and easier to understand, the Semantic Web makes it possible to use the World Wide Web in ways never had thought to be possible before. The Semantic Web is an extension of the current web, and it is developed by the World Wide Web Consortium (W3C). The W3C works on standards that make it easier for computers to understand the meanings of web pages and data (ICT Results, 2008).

The Semantic Web is Tim Berners-Lee's idea, who is the inventor of the World Wide Web and has already laid out the following three principles for the Semantic Web (Berners-Lee et al., 2001):

1. Universal Access: The Semantic Web should be available to everybody regardless of disability, culture, language, or location.
2. Interoperability: Data on the Semantic Web should be exchangeable between applications regardless of the software platform, the hardware platform, or the organisation of the application.
3. Decentralisation: The Semantic Web should not be controlled by any single organisation  
(Lyons, 2020).

The Semantic Web is built on top of the existing World Wide Web and consists of the following three parts:

1. The data model, which defines how data can be represented on the Semantic Web.
2. The vocabulary, which defines the terms that can be used to describe the data.
3. The rules, which define how the data can be combined.

Some of the technologies to be used to create Web 3.0 include the followings:

- RDF: a standard for representing data in a machine-readable format,
- RDFS: a schema language for RDF used to define the meanings of RDF vocabularies,
- OWL: a standard for describing the meanings of terms in a machine-readable format,
- SPARQL: a query language for retrieving data from RDF sources (Super, 2022).

The Semantic Web is still in its early stages of development, but there are some applications that use it, such as the followings:

1. The British Broadcasting Corporation (BBC) uses the Semantic Web to annotate its news stories with information about the people, places, and organisations mentioned in the stories (Raimond et al., 2010).
2. The New York Times applies the Semantic Web to annotate its articles with information about the people, places, and organisations mentioned in the articles (The NYT Open Team, 2012).
3. The government of the United States applies the Semantic Web to annotate its data with information about the people, places, and organisations mentioned in the data (Stiglich, n.d.).

**Table 4 Advantages and disadvantages of Web 3.0**

<b>Advantages</b>	<b>Disadvantages</b>
It offers improved search results and better access to information (The Investopedia Team, 2022).	With the increased machine understanding of web contents, the complexity of the web increases. Thus, it might be more difficult for humans to understand and use the web (Brody, 2022).
As computers become better in decision-making, improved services and products appear on the market (The Investopedia Team, 2022) (Kerner, n.d.).	As more data are machine-readable, there is a risk that data could be accessed and used without the users' consent. This could lead to privacy and security concerns (Fagan, 2022). Data might be misused resulting in negative consequences for the users (Krupinsk, 2022).
It becomes possible to develop more secure and private applications. Thus, users' data are protected from being accessed and used without their consents ( <i>Is Web 3.0 Leading A Data Revolution?</i> , 2022) (Yahya, 2019)	If everything is encrypted and private, it becomes harder for law enforcement agencies or governments to catch those criminals who use black markets, like Silk Road or Dark Web sites (Paganini, 2016).
By using peer-to-peer networks instead of the client/server architecture, data are shared among the users directly rather than having one server handling requests from many people at once. Thus, everything is faster and more secure because there is no central point for hackers to attack (Forst, 2020).	

Source: own compilation, 2023

#### 4.6.2. Web3

Web3 is based on the blockchain technology. The blockchain technology idea has been around since 2008, when the creator of Bitcoin, Satoshi Nakamoto, posted his famous paper titled "Bitcoin: A Peer-to-Peer Electronic Cash System" to the Cryptography Mailing List (Nakamoto, 2013). In his paper, Nakamoto describes how Bitcoin could be used to create a currency that does not require a trusted third party (e.g., a bank or government) to verify the transactions. Instead, people rely on other users of the currency in verifying the transactions correctly, and in turn, they receive rewards. This is known as the proof of work (Kapilkov, 2020).

The idea behind Web 3 is to decentralise and tokenise the Internet; thus, users have more control over their personal data as well as over their interactions with centralised companies, such as Google and Amazon. This new version of the Internet allows users to experience true freedom and independence in their online lives (Luong, 2022).

#### The characteristics of Web3

- Web3 is decentralised. It means that instead of having large parts of the Internet under the control and ownership of centralised entities, it distributes ownership among its creators and users.

- In addition, Web3 is permissionless thus giving all people the same right to join Web3, and nobody is excluded.
- Web3 offers native payments and utilizes cryptocurrencies for money transactions, rather than depending on the obsolete banking and payment service providers' infrastructure.
- Furthermore, Web3 is not trustful, and it works with incentivised and commercial mechanisms, rather than reliance on trustworthy third parties (“Introduction to Web3,” 2022).

## 5. INNOVATIONS IN THE TEXTILE INDUSTRY<sup>4</sup>

### 5.1. Non-Web3-based innovations in the textile industry

Continuous and inventive advancements remain an ever-present necessity in the fashion sector, ensuring its vibrancy and adaptability to shifting global trends and consumer preferences (Tatlıdil & Şahin, 2022). In *Chapter 2.2.*, it has already been explained which criteria must be fulfilled to speak about innovation. The textile industry is a creative and artistic industry, but artistic design activities if undertaken for appearance improvement without any objective change in its performance are not considered as innovations (OECD, 1997). Therefore, in this section, exclusively those solutions and developments are presented that correspond to the definition of innovation. The list of innovations is not prioritised; therefore, it is arbitrary.

#### 5.1.1. Sustainability as a driver of innovation

The term sustainability is primarily associated with the environmentally-conscious actions, the saving of resources, and the renewable raw materials (Nuremberg Institute for Market Decisions, 2016). However, sustainability is a more complex term, which consists of economic, ecological, and social perspectives. In case of economic sustainability, besides its economic success, importance is attached to ensuring the sustainable production of a company in the future. Ecological sustainability includes the attempt to handle the resources in a way that they remain available to the new generations to the same extent as now. Social sustainability means that companies treat their stakeholders in a way that they remain constantly willing to cooperate (Clausen, 2009).

Since the definition of sustainability is not adequately defined, for companies, it leaves a wide scope to interpret it. As a result, market participants are free to define their own terms of sustainability. Therefore, the same term does not meet the same requirements. However, the aim of the term use is to distinguish sustainable from less sustainable developments (Grunwald, 2004). Sustainability is a prerequisite for ethical actions, which can be achieved by improving economic, social, and environmental compatibility, as well (Zerres & Zerres, 2014). Today the aim of ethics is to show consumers how to act sustainably. Consumers no longer want to consume thoughtlessly, but to control their consumption consciously. Instead of a throw-away society, people want to use the system in a way that makes it available in

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<sup>4</sup> The research presented in chapter 5.1.1. was published in (Paulovics, 2021a), chapter 5.1.4. in (Paulovics, 2021b), chapter 5.2.5. will be published in (Paulovics, 2023)

its present form for future generations, too ("Neo-Ökologie – Der wichtigste Megatrend unserer Zeit", 2019). D'Itria and Colombi (2023) observe that the application of design-focused strategies – which include reuse, repair, repeated use, and recycling – and the involvement of various stakeholders in unique ways, aim to eradicate the concept of waste. Villa Todeschini et al. (2020) see the drivers for sustainable stakeholder collaboration in “external environment pressures (laws and legislation, society), competitive environment pressures (consumers, suppliers, intermediaries and competitors), search for competitive advantage (cost reduction or differentiation), and joint development of resources and capabilities”.

### **5.1.2. Laboratory grown materials**

The reconsideration of manufacturing approaches is needed in the textile industry to reduce environmental pollution. Bio-fabricated materials have been developed to increase the efficiency and environmental responsibility (Green Goodie Hero, 2018).

Instead of using plants or petrochemicals as raw materials for cloth, some laboratories are experimenting with the use of microbes to grow a fabric. To make it happen, a tight collaboration between designers and scientists with knowledge in the areas of bio- and nanotechnologies is necessary. During fermentation, specific bacteria spin microfibrils of cellulose that form a thick coating that can be harvested and afterwards dried. Two to three weeks are enough to grow a 1.5 cm thick material, that can either be used wet to form it into a 3D shape, such as a dress, or dried flat and used for garment production. In the future, waste streams from the food or beverage industry could be used for microbial cellulose production, too (Llanos, 2012). There are several brands that experiment in this area, for example, Modern Meadow, BioCouture, Piñatex, and Mylo by Bolt Threads.

### **5.1.3. Catalytic clothing**

Catalytic clothing includes textiles that are functionalised with the help of organic catalysts. The organic catalysts are fixed to textiles with the help of UV rays. Thus, the fabric serves as a carrier for the substances on which a chemical reaction can take place (Lee et al., 2013). In case of an air cleaning fabric, the nanoparticles of the photocatalyst bond with the fabric when washed. Upon contact with light, the photocatalyst regroups the electrons in the fabric and makes them more reactive. Afterwards, the electrons interact with the water in the air and break it down into radicals, which in turn react with pollutants in the air and turn them into harmless chemicals (Kennedy & Stoehrer, 2014). With fabric as the carrier material for



chemical aids, a reaction can take place on a large surface area increasing the reaction's impact (*Katalysatoren auf Tuchföhlung*, 2013). With this method, simple textiles can be equipped with microscopic functionalities and produce affordable, permanently-functionalised textiles without polluting the environment (Lee et al., 2013).

#### **5.1.4. Zero Waste, Waste Management, and Recycling**

Between 15 and 20 % of the fabrics used in the production of clothing end up as waste. The zero-waste concept is developed as a solution to this problem. With zero-waste, the patterns for the individual pieces are constructed and placed on the fabric in such a way that they fit together like a puzzle and no fabric waste is created. For some models, the pattern is not cut at all, solely draped, folded, and stitched together (Kennedy & Stoehrer, 2014).

In waste management, the goal is to minimise waste generation. This can be achieved by both a more efficient use of raw materials and a higher recycling rate. Waste generation might be reduced by facilitating the coordination of economic activities along the material and energy flows. It means that the material and energy waste generated in one production process should be served as an input for a next process. Putting emphases on establishing and applying closed material cycles, materials that previously appeared as waste can be reused in the economy thereby reducing the amount of waste to be disposed of. The strategy identifies waste emission as a significant problem, as a burden on natural resources, and proposes recommendations to support basic and applied research in such areas as waste management, ecological production, and consumption (A Fenntartható Fejlödés Indikátorai Magyarországon, 2018, 2019).

The encouraging of recycling and reprocessing as well as the development of secondary raw material markets are particularly essential in sustainability. In case of generated waste, reusing and recycling are of high importance (A Fenntartható Fejlödés Indikátorai Magyarországon, 2018, 2019).

#### **5.1.5. Bionics**

Bionics is an acronym made up of biology and technology. Bionics can be characterised as the attempt to follow nature or to learn from nature in the development of technical solutions. Bionic solutions are considered to be ingenious, ecologically adapted, and low-risk (von Gleich et al., 2007). Design features, processes, and principles of natural developments have efficiencies that are far superior to those of technically analogous product solutions. This has given rise to a broad spectrum of bionic research with a variety of applications ranging from

architectural bionics to energy bionics, neurobionics, organisational bionics, sensor bionics, packaging bionics, and materials bionics (Küppers, 2010).

In the textile industry, one of the world-widely known bionic inventions is Velcro. This was inspired by Velcro fruit, which adhere very well to furs and clothes. This principle was technically implemented by means of bionics; thus, the Velcro fastener was created (Nachtigall, 2010).

#### **5.1.6. Highly functional textiles**

Nowadays, textiles produced for special purposes exist. There are fibres that resist abrasion, stains, and fire, protect against unpleasant weather, and are comfortable at the same time. Such textiles are often developed for Nasa and special forces to enhance the employees' performance and to protect them (Kennedy & Stoehrer, 2014).

#### **5.1.7. Emotive Technology**

In emotive technology, biometric sensors close to the skin respond to changes in body temperature triggered by mood changes. This information is transported to the surface of the fabric, which adapts to the wearer's mood. This technology creates a new form of communication as the colours in the dress varies from wearer to wearer (Kennedy & Stoehrer, 2014).

#### **5.1.8. Laser cutting**

Laser treatment enables the textile industry participants to create designs onto their products with non-contact patterns. The technique can be used on different materials, such as denim and home textiles (Martín et al., 2003). The method can change the colours and textures of garments. The outcome of the usage of the technology is strongly depending on thickness, weight, and the mechanical properties of fabrics (Yuan et al., 2012). Compared with ordinary textile treatment, laser cutting is capable to deliver similar results without causing any pollution (Dascalu et al., 2000).

#### **5.1.9. Digital innovations in the retailing sector**

Irma Agárdi's exploration into the digitisation of the fashion retail sector provides a robust framework for understanding the complex integrations and multifaceted impacts of technological interventions, highlighting a symbiotic integration between physical and digital retail realms through implementations such as digital windows and intelligent

shopping carts. These innovations serve to enrich the consumer journey, ensuring a seamless traverse between online and offline shopping experiences. Innovative strategies such as 'click & collect' and virtual supermarkets in public spaces illustrate a coherent interplay between digital and physical retail spheres, maintaining a unified consumer experience across varied interaction platforms. The emergence of multi-actor platforms and consumer-connecting mobile applications signals a notable shift in the retail ecosystem, bolstering consumer autonomy and facilitating informed purchasing decisions. The deployment of self-service technologies and robotics, like autonomous checkouts and chatbots, not only enhances operational efficiency but also intertwines technological and consumer interactions, crafting a nuanced, efficient consumer journey. Personalised, data-driven promotional offerings, delivered through loyalty programs and mobile applications, forge a bespoke consumer engagement strategy thus ensuring a distinctly individualised journey (Agárdi, 2018).

## **5.2. Web3-based innovations in the textile industry**

### **5.2.1. Web3 in the textile industry**

Internet of Things (IoT), smart fabrics, and 3D printing are merely a few of the technologies currently being developed under the umbrella of Web3. While these technologies are still in their infancy, they hold a great deal of promise for the textile industry. The IoT is a network of physical objects that are embedded with sensors and connected to the Internet. This allows them to communicate with each other and with other devices in order to exchange data and perform the desired actions. For the textile industry, this could mean embedded sensors in fabric that could automatically adjust to the wearers' changing needs. For example, a shirt could tighten itself when the temperature drops or loosen when the wearer begins to sweat. Smart fabrics are another area of development that could have a major impact on the textile industry. These are fabrics that are enhanced with sensors, electronics, or other computing elements. One example of a smart fabric is the Project Jacquard of Google, which is a fabric that can be woven with conductive thread to create a touch-sensitive surface. This could be used to create textiles that can interact with other devices, like phones or smartwatches. 3D printing is another promising technology with potential applications in the textile industry. This technology allows the creation of three-dimensional objects from a digital file. Textiles can be printed by using a variety of materials, including plastic, metal, and even human cells. This could allow for the creation of custom-fitted clothing, as well as garments with intricate designs that would be impossible to create by using traditional methods. Despite the potential

of these technologies, there are still several challenges that need to be addressed before these technologies can be widely adopted. For example, smart fabrics still need to become more durable and comfortable, and 3D printing needs to become faster and cheaper. However, if these challenges can be overcome, the textile industry could be transformed by Web3 technologies.

Since the possibilities of Web3 technology in the textile industry is very diverse, its application is studied deeply in the empirical research of current dissertation (see *PART III: Empirical study*).

### **5.2.2. Internet of Things (IoT)**

IoT is the network of physical objects embedded with sensors, software, and other technologies to connect and exchange data with other devices and systems over the Internet. Thus, by enabling computers to gather information, they can see, hear, and smell the world on their own and respond to it accordingly (Ashton, 2009). The intelligence of these entities connected to the Internet allows them to interact, share information, decide, trigger activities, and deliver services (Manglani et al., 2019). IoT makes it possible to implement automation in yarn and garment manufacturing thus leading to technology improvement in the textile industry (Zhen & Mingjie, 2015). The technology enables the development of biomedical devices to continuously capture real-time, patient-generated medical record thus contributing to a personalised healthcare experience (Meng et al., 2020).

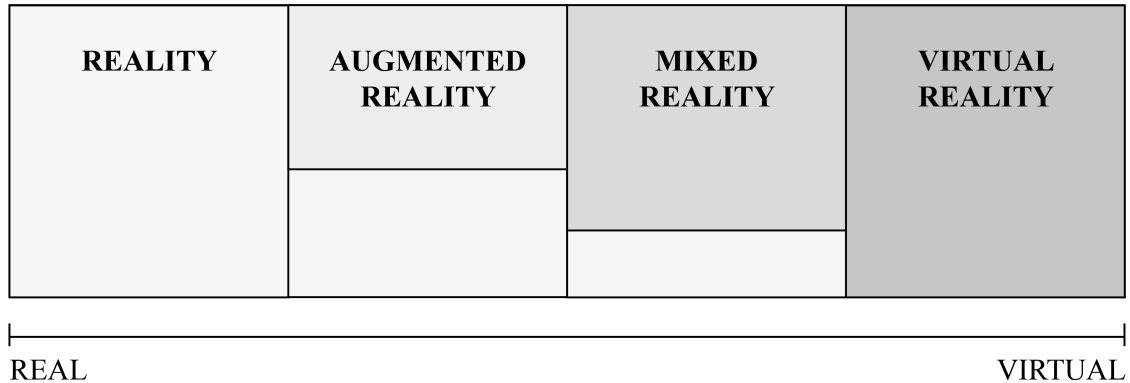
### **5.2.3. 3D printing**

3D printing and additive manufacturing are synonyms and layer-based manufacturing techniques. During the 3D printing process, information is taken from a computer-aided design (CAD) file and converted to stereolithography (STL) file. In the STL file, the CAD file is cut into layers that can be printed step by step on each other. The methodology can be used for rapid prototyping thus creating models and prototype parts. It helps to reduce the production time and costs and allows the rapid building and analysis of the models (Wong & Hernandez, 2012).

On the other hand, additive manufacturing could improve the current construction methods (Bos et al., 2016). Therefore, it can be used for producing apparel and jewellery, it allows designers to experiment and enjoy greater design freedom and brands to execute mass customisation (Yap & Yeong, 2014, 195).

#### 5.2.4. Virtual reality, augmented reality, mixed reality

Virtual reality (VR) is a generic term for all technologies in which the real world is supplemented with additional information or even replaced by a virtual world. The gradation between the real environment and virtual reality looks as shown in *Figure 10*:



**Figure 10 Gradation between real environment and virtual reality**

Source: Own compilation, 2021

In reality, you are in the physical world. In augmented reality (AR), reality is augmented with two-dimensional objects, such as photos, videos, or texts. In mixed reality (MR) technology, three-dimensional objects are added to reality. In virtual reality, reality is hidden by the goggles, and you find yourself in a completely different space.

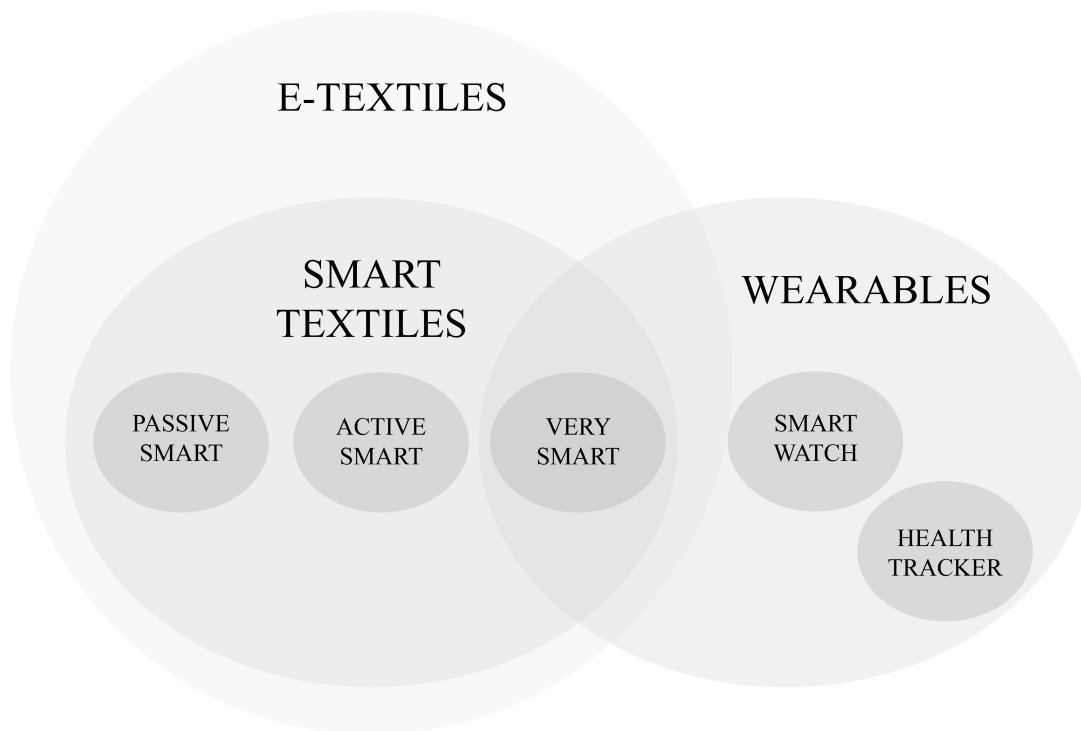
The evolution of these technologies allows users to experience real and imagined environments with ever-increasing detail. The potential applications in business are many, and they can change people's everyday lives, as well (*Digitale Realitäten*, n.d.). Virtual and augmented reality could become a powerful channel for interactions between brands and consumers, much like mobile and social networks are today (Jiang, 2017).

Current applications range from helping stores with visual merchandising to offering VR shopping for customers from home, to watching fashion shows in stores with VR goggles, and to being able to try on clothes and make up virtually.

#### 5.2.5. E-Textiles, Smart Textiles, Wearable Technology

The field of e-textiles, smart textiles, and wearable technology is continuously growing. These technologies blend textiles with electronic properties bringing novel solutions to the industry both visually and functionally. The revenues from wearables and smart textiles are growing year by year. This development indicates that these technologies have a promising future (Singha et al., 2019).

The definitions of e-textiles, smart clothing, and wearable technology often seem confusing, and distinguishing between their functionalities is complicated. As it can be seen on the self-created visualisation in *Figure 11*, e-textiles have a large area, of which the group of smart textiles is entirely part, but wearables are partly included in e-textiles, as well. *Figure 11* should serve as an orientation when reading the definitions.



**Figure 11 An overview of the relationships between e-textiles, smart clothing, and wearable technology**

Source: own compilation, 2022

### **E-Textiles**

E-textile is used as an abbreviation for electronic textile or electronically integrated textile (Maxey, 2019). Electronic textiles “are, or are part of, electronic components that create systems capable of sensing, heating, lighting or transmitting data” (Wilson & Teverovsky, 2012, 156). E-textiles are produced of printed electronics, conductive inks, or conductive threads. Both smart clothing and wearable technology can be produced of e-textiles. E-textile is a circuit that is constructed into a textile, or it is designed to be integrated into a textile. E-textiles can be produced in two different ways: embedded or laminated. Embedded systems are woven or knitted into the garment. Laminated e-textiles mean that circuitry is manufactured on a non-textile substrate that gets added to a textile with sewing or bonding (Maxey, 2019).

E-textiles can serve two different goals. On the one hand, these textiles can be developed for aesthetic reasons. Conventional textiles are equipped with new electronic features, such as LEDs, glass fibres, electrically conductive threads, and electroluminescent film, to develop a new kind of textile. There are solutions where the LEDs light up when the wearer moves or textiles that react to their immediate surroundings and mimic the colours of the environment. Additionally, touch, voice, and motion sensors can be integrated into clothing; thus, it can change its shape and colour, or make sounds, as well (Kennedy & Stoehrer, 2014). E-textiles are not necessarily smart and can operate without a software, smartphone, or application (Orlando, 2019). On the other hand, e-textiles can be developed for performance reasons. These textiles are often called smart textiles and employ conduction yarns and sensors to collect data or provide experience. Smart textiles can perceive stimuli from the surroundings and respond to them adjusting to them by embedding functions in the texture of the textiles (Tao, 2001). The applied technologies can be, for example, heating pads, vibrating pads, speakers, motion sensors, or wireless connection. These textiles can be controlled with external devices or navigated with inbuilt regulators (Saha, 2020). The aim of these smart textiles is to collect data about vital measurements, heat, light, movement, and other local conditions (Nichols, 2020).

Existing synonyms for e-textiles are e-textile system and soft circuit. In some cases, the terms smart textile, functional fabric, smart fabric, ultra-flexible circuit, and technical textiles are used as synonyms, as well (Maxey, 2019).

### **Smart Textiles**

Smart clothing finds usage in healthcare, sports, lifestyle, space exploration, public safety, and military (Scataglini et al., 2019). As smart textiles represent a new and unknown technology, several factors must contribute to success. For the successful commercialisation of smart garments, it is necessary to offer high functionalities and wearability as well as to develop the users' acceptance (Knight et al., 2002). Gilsoo (2009) complements this statement with highlighting the importance of even more factors by adding usability, monitoring duration, maintainability, and connectivity to the list of necessary factors.

In this context, researchers understand the successful measurement of vital information and the ability to monitor the health status under functionalities (Scataglini et al., 2019). Wearability stands for the easiness of putting the garment on and taking it off. Moreover, the fit, freedom of movement, and comfort belong to wearability, as well. User acceptance is the factor that depends on the wearers' cognitive comfort and their overall wellbeing

during wearing smart garment (Knight et al., 2002). Therefore, it is of major importance to build up trust in the technology and to ensure customers about the safety of smart garments. Usability can be described as the “extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use” (Ergonomic Requirements for Office Work with Visual Display Terminals, 1998, 2). Monitoring duration means how long the batteries can absorb and transmit the information without running out of power. Maintainability indicates how long the smart garments can be used without replacement and whether repairs are possible. Finally, connectivity refers to the connection between the sensors and the electrical parts as well as to the interaction between smart clothes and the outside world (Scataglini et al., 2019). Intelligent clothing can be divided into three categories based on their smartness. First, there are the passive smart systems, which are merely able to sense the environment. Second, the active smart systems cannot solely perceive the surroundings but respond to them, as well. Third, the very smart systems are the most advanced, which can change according to the conditions (Stoppa & Chiolerio, 2014; Scataglini et al., 2020).

### **Wearables**

A wearable is a “device for electrocardiography signal collection and heart rate monitoring” (Lin et al., 2018, 1). However, the “wearable technology found in modern fashion garments are no longer just smart sensors but have evolved into being part of a complex ecosystem comprising sustainable and innovative apparel, aiming for a cleaner industry and a healthier lifestyle” (Arnault, 2018). These garments constantly monitor and observe their surroundings thus gathering valuable and sensitive data (Ziccardi, 2020). The wearables are able to collect physiological signals (i.e., BPM, ECG, respiration, and body temperature), performance indicators (i.e., posture, aerodynamics, and movements), and environmental aspects (i.e., temperature and humidity) (Scataglini et al., 2020). Wearables merge the textiles with technology through the incorporation of conductive fibres (Sundaram et al., 2019), sensors, processors, communication equipment, displays, or input devices (Sonderegger, 2013) thus creating solutions that are both fashionable, functional, and comfortable (Sen et al., 2015). On the one hand, conductive fibres can be natural fibres, such as ferrous alloys, nickel, stainless steel, titanium, aluminium, or copper. On the other hand, they can be threaded conductive fibres, such as conductive metal or carbon powders (Scataglini et al., 2020).



The wearables open new perspectives for marketing possibilities. On the one hand, the wearers can be very precisely controlled thanks to the GPS tracking; thus, their behaviour can be analysed throughout the day. For example, their behaviour can be monitored while they are shopping. On the other hand, the profiling can be much more accurate as it might contain the clients' sensitive characteristics, as well (Ziccardi, 2020).

### **Privacy and security issues of e-textiles, smart garments, and wearables**

One of the specialties of smart garments and wearables is the fact that the wearers do not recognise that they are monitored during the day (Ziccardi, 2020). Due to the close cooperation with the body, those clothes that have the ability to interact with the body and act autonomously might collect much more information and have access to sensitive data, too. For these products, it appears important to investigate the legal aspects (Katyal, 2014) as they can be seen as “potentially dangerous technologies for human beings” (Ziccardi, 2020, 6).

Ziccardi (2020) highlights the importance of privacy by design. According to this approach, during the development phasis, cybersecurity measures should be implemented, and protection should be incorporated as soon as designing the products. The scholar emphasises that “privacy and security, in conclusion, are at the hearth of wearable technologies” (Ziccardi, 2020, 7). To reduce the potential for damage associated with data breach, the use of anonymous data and the encryption of information are essential, too (Ziccardi, 2020).

### **5.2.6. Artificial Intelligence**

Although the Web3 and its technologies provide fashion brands with a wide possibility spectrum for realising new projects, the increase of Artificial Intelligence (AI) applications and usage in the fashion industry must be emphasised. AI is an important building block of the metaverse presence, i.e., both for Avatar creation as well as automated actions and identity creation.

Throughout the years, AI has garnered various characterisations that delve into its capabilities, scope, and mechanisms. A close examination of three seminal definitions reveals both convergence and divergence in how AI is conceptualised.

Kaplan and Haenlein's view hones in the autonomous attributes of AI highlighting it as “a system's ability to correctly interpret external data, to learn from such data, and to use those learnings to achieve specific goals and tasks through flexible adaptation” (Kaplan &

Haenlein, 2019, p. 1). Their emphasis on flexible adaptation and data interpretation signals a perspective rooted in the practical and dynamic applicability of AI.

Contrastingly, while framing AI, Poole and Mackworth (2010) offer a broader canvas in terms of the synthesis and study of computational entities. They assert that AI is “the field that studies the synthesis and analysis of computational agents that act intelligently.” (p. 3) This definition is further enriched by outlining the criteria for “intelligence”: the appropriateness of actions, adaptability, experiential learning, and judicious decision-making within given constraints. Thus, while Kaplan and Haenlein focus on system capabilities, Poole and Mackworth provide a layered exploration of what it truly means for an agent to be “intelligent”.

Russell and Norvig (2010) present AI as “the study of agents that receive percepts from the environment and perform actions. Each such agent implements a function that maps percept sequences to actions, and we cover different ways to represent these functions, such as reactive agents, real-time planners, and decision-theoretic systems” (p. viii). This perspective is notably comprehensive encapsulating the agent’s interaction with the environment and the diverse modalities of its representation.

In distilling these definitions, a continuum is discerned: from the practical functionalities of AI systems to the philosophical underpinnings of “intelligence”, and finally, to the multifaceted representations and interactions of intelligent agents. Together, they paint a holistic picture of AI emphasising its dynamic nature, adaptive prowess, and the depth of intelligent behaviour.

### **5.2.7. Blockchain**

The approach of blockchain completely eliminates the necessity of a third party to overlook the transaction logs with distributed consensus work. Blockchain is a peer-to-peer network distributing ledger that has the possibility to tackle grid security challenges (Ahmed et al., 2019) thus offering the possibility to create more secure and private applications (Dubey, 2022). Some features of the blockchain are decentralisation, open source, autonomy, immutability, anonymity, and fault tolerance (Ahmed et al., 2019). It has various types: permissionless blockchain, permissioned blockchain, and consortium blockchain. Permissionless blockchain is often called public blockchain, and it allows everybody to download and read the data. Permissioned blockchain is a private blockchain, which is often designed for one company. In this type of blockchain, exclusively approved participants can contribute. Consortium blockchain is a mix of the private and public blockchains (Ahmed et

al., 2019). Nowadays, blockchain technology is applied in a wide range of fields, among which is the integration in supply chain traceability (Agrawal et al., 2018).

The textile and clothing industry is often criticised because of its unsustainable practices in production (Agrawal et al., 2018) and waste of water, grown cotton, and energy due to the customers' overconsumption (Chen & Burns, 2006) and the usage of high volumes of chemicals during the production process (Fu et al., 2018). Blockchain technology has the potential to be a driver of solving the traceability issues of the textile industry thus contributing to moving towards circular economy (Rusinek et al., 2018) as it supports all three pillars of sustainability (V. Kumar et al., 2017).

### **5.2.8. NFTs and digital property**

NFTs are the next iteration of blockchain technology that create new possibilities to sell and exchange arts and digital objects (Chevet, 2018). While in bitcoin, i.e., a blockchain technology, all coins are the same, NFTs are all different and unique (Peres et al., 2022) and can be images, music, videos, texts, and other virtual creations (Dowling, 2021). The specialty of NFTs is that it can be bought, sold, displayed, gifted, or even destroyed similarly to personal property (Fairfield, 2021). As they cannot be duplicated, this technology might be used to create more secure and private applications (Sharma, 2022). The collections in the NFT market are mostly comprised of a specific amount of items, sharing a common theme or idea that ties them together (Nadini et al., 2021). NFTs are traded on dedicated NFT marketplaces like OpenSea, OKX, Rarible, SuperRare, Foundation, Mintable, NBA Top Shot, Theta Drop, Binance, Nifty Gateway, Larva Labs, Axie Infinity, Crypto.com, KnownOrigin, MakersPlace, Zora, Async Art, and The Sandbox (Parmar, 2022).

Brands use NFTs to give perks like early access to NFT drops and physical products, and a way to verify ownership, especially in luxury industry (Hofstetter et al., 2022). The introduction of NFTs could lead to the next wave of commerce by leveraging the strength of online brand communities to connect consumers and businesses in new and innovative ways (Schau et al., 2009). Through using platforms such as Discord, Reddit, or Telegram, brands can build real-life relationships with their NFT communities (Schweidel & Moe, 2014), thus forge close, personal connections with consumers (Colicev, 2022).

The NFT sector is currently faced with numerous challenges, such as determining the best approach to decentralisation, clarifying ownership rights, and addressing the environmental impact of NFTs. Brands face a challenge in balancing the release of copyright rights and safeguarding their ownership (Colicev, 2022). Another unanswered question is if the

presence of NFTs will detract or enhance sales of physical products. While NFTs offer new revenue opportunities, they may also impact demand for physical goods (Kanellopoulos et al., 2022).

### **5.2.9. Metaverse**

In recent times, the metaverse has emerged as a technology with immense potential and has been widely acknowledged for its transformative capabilities (Hwang & Chien, 2022). It represents a new digital frontier that could enable new forms of creativity, expression, and communication (Faughnder, 2022).

The concept of the metaverse has gained popularity as a potential driver for the shift from the traditional to the digital economy, with the gaming industry providing a strong foundation (Cerasa et al., 2022). The metaverse has been hailed as the future of social interaction, representing a virtual universe that allows people to exist and coexist within predetermined rules set by the creators (Farjami et al., 2011). The metaverse extends beyond Augmented Reality (AR) and Virtual Reality (VR) technologies, encompassing a larger and more complex virtual space with manifold possibilities for exploration and interaction (Park & Kim, 2022). Metaverse is a virtual world developed to allow the creation of virtual assets and experiences and its development depends on multiple technologies, including 5G, virtual reality, holograms, and advanced processors (Cheong, 2022).

In order to facilitate secure economic activities and prevent unauthorized modifications to personal property and logs within the metaverse, decentralised technologies such as blockchains are indispensable (Min & Cai, 2022). The metaverse holds the potential for the integration of wearable devices, enabling users to benefit from a more immersive and sensory experience (Cipresso et al., 2018). Metaverse is the next generation of the Internet, where digital assets are linked to physical assets, and the identity is persistent. Additionally, the metaverse enables a new generation of applications and services that provide more immersive and user-centric experience than what is possible today (Sinha, 2022).

The metaverse is a technological innovation that creates a unique hybrid environment that people can interact with and explore. It strives to emulate the way our brains work by predicting the sensory outcomes of users' actions and displaying them in the same way that our brains would expect in the physical world. This results in a highly immersive experience that blurs the boundaries between the digital and physical realms (Riva et al., 2018; Riva & Wiederhold, 2022). Ball (2020) emphasises as well that a genuine metaverse would integrate the physical and virtual worlds, feature a full-fledged economy, and prioritize

interoperability, allowing avatars and their possessions to transition seamlessly between different parts.

### **5.2.10. Avatars**

Avatars serve as the users' digital representations in the metaverse actively interacting and communicating with other avatars (Kanematsu et al., 2022) thus playing a pivotal role in shaping the virtual ecosystem. As the users' primary identity and presence within the metaverse, avatars not merely allow for individual expression but drive economic activities, too. They can be adorned with virtual goods, imbued with skills or attributes, even they can participate in digital commerce and interactions. As the metaverse continues to evolve, avatars undoubtedly remain at the heart of its economy influencing trade, social dynamics, and user engagement.

For the metaverse to have a physical impact on humans, technology must permit signals from avatars to be relayed back to the human brain (Bindra, 2020). Elon Musk's Neuralink has recently showcased a monkey playing a videogame by using an implanted brain-chip thus indicating the possibility of brain signals controlling external devices (R. Chang, 2021). The feasibility of this concept is supported by advancements from the neurotech startup Synchron, which offers less invasive implants compared to Neuralink and has already obtained authorisation for clinical trials on human subjects thus extending beyond mere animal testing (Robitzski, 2021).

There are different challenges (i.e., fraud, crime, and identity theft) due to the incorporation of avatars into the metaverse, which are explained in the following paragraphs:

#### **1. Fraud and Crime**

Within the metaverse, there is a realm of digital existence, where between the actions of a digital representation (e.g., an avatar) and those of the real individual controlling it, differentiations have to be made. In the context of the fashion industry, this could be equated to the digital storefront of a fashion brand in the metaverse. The actions or commitments made by this digital entity could potentially be distinct from the commitments of the brand or designer in the physical world.

However, complexities arise when considering the potential misuse of these avatars or digital entities (Caldwell et al., 2020). For example, there might be a scenario in the metaverse where a digital fashion boutique promises exclusive digital wearables

but does not deliver them after payment. This prompts the question: should the real-world entity behind this avatar be held accountable?

Another dimension of this issue is the potential for avatars to commit acts in the metaverse that might be deemed criminal, such as virtual theft or consistent harassment of another avatar (Cheong, 2022).

There is a legal term called “corporate disregard” in company law, which addresses situations where the law does not recognise the separate legal identity of a corporation instead opting to treat the corporation and its controlling shareholders or directors as one entity. This is a deviation from the general rule that a corporation is a separate legal entity from its shareholders, directors, or officers (Dignam & Oh, 2020).

When taking a look at past legal decisions, older cases seem more willing to blame the real person behind a company or avatar for its actions. On the other hand, newer decisions are slightly different. They suggest that there is a stronger separation between the avatars and their real-world counterparts (Cheong, 2022). This means that if something goes wrong in a digital fashion shop, the real-life owner might not always be blamed directly.

However, there is one thing most entities agree on: if someone uses their avatar to intentionally cheat or trick others, the real person behind it should be held accountable (Cheong, 2022). Therefore, if a person uses their digital fashion brand in the metaverse to scam others, they cannot hide behind their avatar.

## 2. Identity Theft

Within the vast domain of the metaverse, maintaining the sanctity of one’s identity becomes crucial. In face-to-face interactions, there is an inherent ability to confirm one’s identity and validate their authenticity. However, transitioning to the digital domain poses challenges in preserving this authentication process. The capacity for genuine verification is diminished in the online landscape (Black, 2022). The real-world implications of avatar impersonations are not limited to tarnishing one’s reputation; they might as well hold the true owner liable for actions they did not commit. This situation is intensified by the wrongdoers who believe that the inherent anonymity of the metaverse shields them from repercussions. One proposed countermeasure to these challenges is avatar incorporation which ensures that every virtual entity is responsible for their deeds.

Yet, there are other viable avenues that do not pivot around incorporation. For instance, Massively Multiplayer Online Role-Playing Games (MMORPGs) are online video games that involve a vast number of players interacting within a virtual game world. These provide a precedent by using contractual terms of service to set boundaries for user behaviour with punishments ranging from platform bans to asset seizures. The gravity of such sanctions becomes evident when considering the tradable and potentially monetizable nature of in-game assets (Ara et al., 2022).

An innovative defence against identity compromises in the metaverse revolves around a decentralised authentication paradigm. Instead of centralised data storage, the method validates a user's identity by cross-referencing their extensive online activity from services like ridesharing to online gaming. Such a holistic verification method drawing from multiple digital interactions, provides a more robust identity assurance than single-source verifications. By sidestepping centralised data storage, the system minimizes vulnerabilities thus presenting a forward-thinking approach to secure metaversal identities (Black, 2022).

### **5.2.11. Synthetic Media**

Synthetic media is an emergent form of virtual media predominantly fabricated through AI techniques. It stands out for its high realism and immersion often becoming indistinguishable from real-world media thereby posing challenges on discerning its artificial nature (Bhat, 2023; van Rijmenam, 2022; *What Is Synthetic Media?*, n.d.). Historical antecedents trace back to various algorithmic and generative experiments of the 1950s and 1960s. Significant advancements include the 1997 Video Rewrite program, which was later applied in blockbuster movies (van Rijmenam, 2022).

A hallmark of synthetic media is its deep learning foundation, particularly through Generative Adversarial Networks (GANs) (Bhat, 2023; van Rijmenam, 2022). GANs constitute two neural networks: one fabricates images based on real photos, and the other discerns the authenticity of the generated image (Bhat, 2023; van Rijmenam, 2022). The output from GANs often exhibits striking resemblance to genuine photos making the synthetic media almost indistinguishable (Bhat, 2023). In essence, the contemporary capabilities of AI have surpassed mere data interpretation enabling machines to undertake tasks that had been erstwhile considered untenable (van Rijmenam, 2022).

The spectrum of synthetic media encompasses various modalities:

- Text-based synthetic media involves the generation of coherent written content by using machine learning (ML) and AI algorithms, particularly harnessing natural language processing (NLP) tools.
- Audio-based synthetic media (i.e., text-to-speech) converts written texts into speech while capturing the intricacies of human vocal patterns, as well.
- Image-based synthetic media generates visual content from varied data inputs leveraging NLP, computer vision, and advanced graphical techniques.
- Video-based synthetic media allows users to create avatars or digital personas used within the fabricated video content (Bhat, 2023).

Synthesia defines such additional categories as AI influencers, mixed reality, and face swap (*What Is Synthetic Media?*, n.d.). AI-generated virtual celebrities are of high priority for the fashion industry. Therefore, the *subchapter 11.3.1* is dedicated to this topic and no additional explanations are provided here.

The utilisation of synthetic media offers a wide range of benefits:

- **Rapid Production with Minimal Human Intervention:** Synthetic media can be developed quickly with negligible human input.
- **Adaptability to Audiences and Topics:** Synthetic media can be tailored to any audience worldwide. Its products can cover various subjects, and they can be adjusted to fit any demographic.
- **Convenience and Dynamics:** Synthetic media is accessible 24/7 thus offering continuous availability. Additionally, its dynamic nature ensures that it remains fresh and engaging.
- **Versatility in Output:** The medium is expansive in its output encompassing writing, music, drawings, paintings, voice, or visuals. This flexibility permits a diverse range of media formats and ways of storytelling, fostering creativity.
- **Broad Applications:** Owing to its adaptability, synthetic media can be employed across numerous platforms and industries including apps, websites, gaming environments, VR/AR experiences, marketing, education, journalism, entertainment, and arts.
- **Illusion of Authenticity:** Synthetic media can effectively simulate authenticity allowing businesses to resonate with audiences without incurring the costs of hiring actors or professional photographers and videographers (Bhat, 2023; van Rijmenam,



2022; *What Is Synthetic Media, and How Is It Distinguished from Digital Human Technology?*, 2023).

On the other hand, synthetic media has its downsides and presents several dangers, too:

- **Lack of Control:** Given the predominant role of AI technology in generating synthetic media, there is less control over the quality, appropriateness, and user experience. This poses risks for brands and creators, who might inadvertently spread misleading or inappropriate contents.
- **Trust Issues with Deepfakes:** Deepfake technologies are becoming more and more notorious for spreading misinformation. This creates significant trust issues, as the public becomes wary of media that might deceive or mislead them.
- **Security Concerns:** There are potential security risks with synthetic media, especially concerning biometric tools like facial or voice recognition software. Synthetic representations could be exploited to bypass these security mechanisms.
- **The Uncanny Valley Phenomenon:** Deep artificial likenesses can appear real but may evoke a sense of unease in users. This phenomenon can detract from the user experience making it less engaging.
- **Debate Over Artistry and Craftsmanship:** There is an ongoing debate about the absence of human artistry in AI-generated media. Critics argue that machine-generated music, paintings, and other forms of creative expression lack the soul and craftsmanship inherent in human-made art (Bhat, 2023; van Rijmenam, 2022; *What Is Synthetic Media, and How Is It Distinguished from Digital Human Technology?*, 2023).



## **6. SECONDARY RESEARCH: WITH WEB3 REALISED PROJECTS IN THE TEXTILE INDUSTRY<sup>5</sup>**

### **6.1. The aim of the research**

The hypothesis of the secondary research is that in the textile industry, there are existing Web3 projects, which are applied in different areas and for various purposes in the companies. Thus, I formulated the following research question and hypothesis:

**Q1:** Which Web3-based projects have already been realised in the textile industry?

**H1:** In the textile industry, there are existing Web3 projects, which are used in various areas and for different purposes in the companies.

The goal of the secondary research is to examine existing projects with Web3 and to provide an overview of potential use cases to help textile companies develop their own projects in this area, which might result in increased values for customers and in improved customer experience. The findings of current research contribute to creating a list of possible projects based on Web3 technologies. This list of projects can be found in *Chapter 9*.

### **6.2. The methodology of the data collection and processing**

To systematically unearth and evaluate the current projects aligning with Web3 principles within the fashion sector, a dedicated online content analysis was pursued.

Data collection was enacted through a methodical web search, focusing on harnessing a broad spectrum of projects at the nexus of Web3 and fashion. Utilising a combination of key terminologies such as "Web3" and "fashion" within various search engines facilitated a wide-ranging data retrieval, minimizing the risk of algorithmic bias and ensuring a rich, diversified pool of information. An emphasis was placed on traversing both fashion-oriented webpages and generic digital platforms to ensure a comprehensive representation of the field.

Upon amassing a plethora of projects, the subsequent phase encompassed a detailed thematic analysis, where projects were categorised. This analysis not merely enabled the categorisation of existing projects but provided insights into their operational nuances and technological frameworks, as well.

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<sup>5</sup> The research presented in this chapter was published in (Paulovics, 2022)

### 6.3. Findings

There is a wide range of existing projects in the Web3 space including metaverse, NFTs, digital fashion, traceability, authenticity, and crypto payments. These projects consist of short-, medium-, and long-term actions and offer a mix of solutions for textile companies. In addition, a trend towards a more collaborative way of working through partnerships is recognised.

**Table 5 With Web3 realised projects in the textile industry**

Brand/Project	Field	Objective	Target Audience	Key Features
H&M Metaverse	Metaverse	To provide an immersive experience of H&M collections	Customers, media relations	<ul style="list-style-type: none"> <li>virtual showroom</li> <li>3D assets</li> <li>innovative materials</li> <li>virtual meetings and interactions</li> </ul>
Vogue Business Metaverse	Metaverse	To host a two-hour event discussing the textile industry in the metaverse	Exclusive Members	<ul style="list-style-type: none"> <li>informative panels and keynotes</li> <li>immersive worlds</li> <li>event organization</li> </ul>
Nikeland	Metaverse	To offer a virtual space on Roblox for customers to try on virtual products	Global online audience, Roblox users	<ul style="list-style-type: none"> <li>virtual store</li> <li>event organization</li> <li>engagement with figures like LeBron James</li> </ul>
PUMA X 10KTF	Metaverse	To offer personalized experiences with a focus on digital sneaker and NFT collections	Sneaker fans	<ul style="list-style-type: none"> <li>digital accessories manufacturing</li> <li>digital sneaker and NFT collections</li> <li>personalization options</li> </ul>
Adidas	NFTs without additional functions	Generate revenue through NFT sales.	NFT collectors, Adidas enthusiasts	<ul style="list-style-type: none"> <li>NFT sales</li> </ul>
Nike	NFTs without additional functions	Generate revenue through NFT sales.	NFT collectors, Nike enthusiasts	<ul style="list-style-type: none"> <li>NFT sales</li> </ul>
Gucci	NFTs without additional functions	Generate revenue through NFT sales.	NFT collectors, Gucci enthusiasts	<ul style="list-style-type: none"> <li>NFT sales</li> </ul>
Dolce & Gabbana	NFTs without additional functions	Generate revenue through NFT sales	High-end fashion enthusiasts, NFT collectors	<ul style="list-style-type: none"> <li>NFT auction</li> <li>history-making total revenue through NFT auctions</li> <li>highest-priced suit ever sold</li> </ul>
Louis Vuitton	NFTs with additional functions	Educate players about the brand's 200-year history through a video game, with opportunities to win NFTs.	Gamers, Louis Vuitton fans	<ul style="list-style-type: none"> <li>video game with brand history</li> <li>collectibles</li> <li>NFT raffles granting access to exclusive events</li> </ul>

Five designers at the New York Fashion Week in 2022	NFTs with additional functions	Utilize NFTs as keys to unlock invitations and products at the show.	Fashion show attendees, NFT collectors	<ul style="list-style-type: none"> <li>• NFTs as access keys for shows</li> </ul>
Gucci X Roblox	In-game Skins and Accessories	To offer virtual goods that exist in the physical world	Roblox users, digital fashion enthusiasts	<ul style="list-style-type: none"> <li>• digital handbag available for purchase with in-game currency</li> </ul>
Balenciaga X Fortnite	In-game Skins and Accessories	To introduce Balenciaga fashion in Fortnite and vice versa, with accessible digital fashion	Fortnite players, fashion and gaming enthusiasts	<ul style="list-style-type: none"> <li>• collection of characters dressed in Balenciaga</li> <li>• in-game outfits with color-changing properties</li> <li>• physical Fortnite collection in Balenciaga stores</li> </ul>
Ralph Lauren X Zapeto	In-game Skins and Accessories	To provide virtual clothing in a social network environment.	Zepeto users, younger audience	<ul style="list-style-type: none"> <li>• digital clothing of 12 looks with 50 unique items</li> <li>• affordable price</li> </ul>
Hypewear by About You	Digital fashion	To offer digital fashion items to the general public	Online shoppers, digital fashion enthusiasts	<ul style="list-style-type: none"> <li>• first online store for digital fashion</li> <li>• built on a sustainable blockchain</li> <li>• offers a mix of affordable and limited-edition digital fashion items</li> </ul>
Aura Blockchain Consortium	Traceability and authenticity	To ensure authenticity and traceability of luxury products	Luxury brands, conscious consumers	<ul style="list-style-type: none"> <li>• non-profit organization developing solutions for traceability and customer trust</li> <li>• offers membership solutions for textile brands</li> </ul>
3D AG	Traceability and authenticity	To combat counterfeiting and protect intellectual property in fashion	Brands, consumers concerned about authenticity	<ul style="list-style-type: none"> <li>• specializing in micro and nano technology for authenticity</li> <li>• offering blockchain-based platform for product traceability</li> </ul>
Off-White	Accepting crypto payments / in-store	To integrate crypto payments in flagship stores.	Shoppers in Paris, Milan, London	<ul style="list-style-type: none"> <li>• accepting crypto payments in flagship stores</li> <li>• uses Lunu's arbitrage system for transactions</li> </ul>
Balenciaga	Accepting crypto payments / in-store	To offer in-store crypto payments.	High-end fashion shoppers	<ul style="list-style-type: none"> <li>• accepting cryptocurrencies in physical stores for transactions</li> </ul>
Gucci	Accepting crypto payments / in-store	To offer in-store crypto payments.	High-end fashion shoppers	<ul style="list-style-type: none"> <li>• accepting cryptocurrencies in physical stores for transactions</li> </ul>
Philipp Plein	Accepting crypto payments / in-store	To offer in-store crypto payments.	High-end fashion shoppers	<ul style="list-style-type: none"> <li>• accepting cryptocurrencies in physical stores for transactions</li> </ul>

Nike	Accepting crypto payments / web shop	To incorporate crypto payments in their web store.	Online shoppers, fashion and sport enthusiasts	<ul style="list-style-type: none"> <li>providing an option for cryptocurrency payments on their online marketplace</li> </ul>
H&M	Accepting crypto payments / web shop	To incorporate crypto payments in their web store.	Online shoppers, fashion enthusiasts	<ul style="list-style-type: none"> <li>providing an option for cryptocurrency payments on their online marketplace</li> </ul>
Etsy	Accepting crypto payments / web shop	To incorporate crypto payments in their web store.	Online marketplace users	<ul style="list-style-type: none"> <li>providing an option for cryptocurrency payments on their online marketplace</li> </ul>
Overstock.com	Accepting crypto payments / web shop	To incorporate crypto payments in their web store.	Online shoppers	<ul style="list-style-type: none"> <li>providing an option for cryptocurrency payments on their online marketplace</li> </ul>
Macy's	Accepting crypto payments / web shop	To incorporate crypto payments in their web store.	Department store shoppers	<ul style="list-style-type: none"> <li>providing an option for cryptocurrency payments on their online marketplace</li> </ul>

Source: own compilation, 2023

### 6.3.1. Metaverse Presence

#### H&M Metaverse

The H&M Virtual Showroom, shown in *Figure 12*, is a new and immersive way to experience some selected H&M collections. The Virtual Showroom is available with the use of 3D assets, which extend the experience by providing innovative materials. Furthermore, the Virtual Showroom enables the meeting with media relations virtually giving the customers the freedom to engage and interact whenever and with whomever they choose („A unique Web3 experience for H&Mbeyond“, n.d.; „Taking sustainable fashion to the next level“, n.d.).



**Figure 12 H&M Metaverse**

Source: („A unique Web3 experience for H&Mbeyond“, n.d.)

### **Vogue Business Metaverse**

The Vogue Business Metaverse was a two-hour event hosted by Vogue Business in partnership with Yahoo and Dept in 2022. The event was open exclusively to Vogue Business Members and included informative panels and keynotes on making sense of the new landscape of the textile industry within the metaverse as well as exploring the immersive, sensory world created by Journee to highlight the new metaverse technology (“Fashion & Tech Thought Leaders Double down on the Metaverse,” 2022). An impression of the Vogue Business Metaverse is visible in *Figure 13*.



**Figure 13 Vogue Business Metaverse**

Source: (“Fashion & Tech Thought Leaders Double down on the Metaverse,” 2022)

### **Nikeland**

In 2021, Nike created a metaverse store on Roblox called Nikeland, see *Figure 14*, where customers are offered to try on virtual products. So far, the shop has been visited by nearly 7 million people from around the world. The main generator of traffic to the store is the organisation of events. One of the most successful events was when LeBron James visited Nikeland during the NBA All-Star Week. He engaged with the participants, which was welcomed by the players (Sutcliffe, 2022).



**Figure 14 Nikeland: The Metaverse of Nike**

Source: (Sutcliffe, 2022)

### **PUMA X 10KTF**

PUMA has already entered New Tokyo, the virtual city that is home to 10KTF, which was founded in September 2021. 10KTF is known in metaverse as a leading manufacturer and of its digital accessories on demand (*PUMA Startet Mit Dem 10KTF Shop Seine Bisher Größte Web3-Kooperation*, 2022). The new partnership might spawn digital sneaker and NFT collections and is expected to give fans the ability to personalise their experience. However, more details have not been announced yet (Leonhardt, 2022). A published picture of the collaboration is shown in *Figure 15*.



**Figure 15 PUMA & 10KTF Collaboration**

Source: (Leonhardt, 2022)



### 6.3.2. NFTs and digital goods

#### NFTs Without Additional Functions

NFT sales are gradually becoming a part of the revenue stream for apparel brands. Some of the biggest brands, such as Adidas, Nike, and Gucci, could reach \$137.5 million in NFT sales alone. Italian high-end clothing brand Dolce & Gabbana concluded nine NFT auctions on 29 September 2021 thus generating a history-making total of 1,885 ETH (approximately \$5.7 million) and establishing a new benchmark for apparel NFTs (Langston, 2021). Furthermore, the record for the highest-priced suit ever sold is set, as well. The digital Glass Suit earned the clothing house \$1 million (Jagati, 2022). It is visible in *Figure 16*.

NFTs can be added to social media profiles via crypto wallets, and they can be presented as an avatar. This feature has been available on Twitter for some time (Das, 2022). Meta made this function available on Instagram and Facebook on 30 August 2022 (Draht, 2022).



**Figure 16 Glass Suit by Dolce&Gabbana**

Source: (Langston, 2021)

### NFTs With Additional Functions

There are NFT projects that not solely provide a unique NFT design but add features and permissions to it, as well.

One example is the video game launched by Louis Vuitton, where the brand takes the opportunity to teach the players the 200-year history of the fashion house. In the game, the players could unlock stories and collect 16 pages from a Louis Vuitton manuscript. Those players who reach a certain score might enter a raffle for 10 NFTs. The NFTs are transferable across the platforms, not solely a digital asset is embedded in the game, and they act as avatars on social networks, too. In addition, these NFTs grant their owners access to various exclusive events and private parties (Jagati, 2022). The game, which is available on Android and Apple, has already been downloaded two million times contributing to sharing the story of the brand successfully with a broad audience (Hooi, 2022). An impression of the app's visual language is shown in *Figure 17*.



**Figure 17** The application developed by Louis Vuitton

Source: (Hooi, 2022)

Other NFTs working as keys were provided during the New York Fashion Week in 2022 by five designers to unlock the invitations and products of the show. This case went beyond the traditional usage of NFTs merely as collectibles and adds additional value to them (Schulz, 2022b). Through this approach, not solely the press, buyers, and influencers could join the

shows but the holders of these NFTs, as well (Leclere, 2022). The technology that allows access only if one is in possession of the correct fungible or NFT is called token gating. The permission to read content is granted if the correct token is in the wallet, but denied if it is not available (Stelzner, 2022). Token gating can be used to limit the access to product drops and to provide unique experience to drive the demand (Martins, 2022).

### **In-game Skins and Accessories**

Another way of apparel companies to bring their products into metaverse is their collaboration with video game companies.

Queen Bee Dionysus virtual handbag of Gucci, shown in *Figure 18*, has been purchased lately for the in-game currency of 350,000 Robux equivalent to the value of \$4,115 (Jagati, 2022), which is more than the price of its physical version sold for \$3,400 (LUXUS+, 2021). This bag is not an NFT, but it is merely a digital good without any real value, use, and transferability outside the Roblox world (@alexisohanian, 2021).



**Figure 18 Virtual handbag of Gucci**

Source: (@alexisohanian, 2021)

A similar project was a collaboration between Balenciaga, the brand of women and men's fashion, leather goods, and perfume based in Paris since 1937, and part of the Kering Group („Alles was du über Balenciaga wissen musst“, n.d.) and Fortnite, one of the most popular video games in the world, with over 350 million registered users (Schönbächler, 2022). A collection of four characters dressed in Balenciaga clothes were created, shown in *Figure 19*. Additionally, the outfits have transformational properties as during the game, they change in colour. On the one hand, the collaboration created digital Balenciaga outfits for Fortnite; on the other hand, a Fortnite collection for the physical stores is introduced, as well. The collection is not based on the expensive NFTs, but this cooperation brings the

Balenciaga brand to millions of dedicated gamers with a relatively low barrier to entry (Yotka, 2021).



**Figure 19 Fortnite & Balenciaga Collaboration**

Source: (Yotka, 2021)

Besides Balenciaga, Ralph Lauren sets on virtual clothing, as well. In collaboration with Zepeto, a social network from South Korea, digital clothing of 12 looks with 50 unique items is offered. The price for these products is set in an affordable range; each item costs between 14 and 40 ZEMs, which is equivalent to \$0.57 - \$2.86 (Swant, 2021). An impression of the collaboration is visible in *Figure 20*.



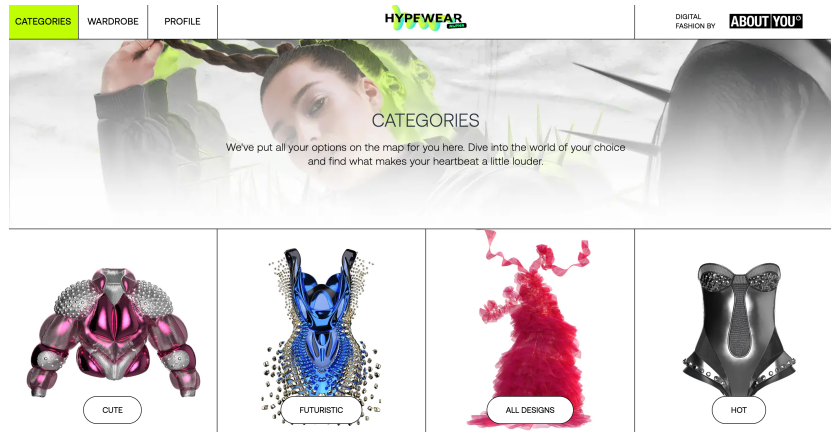
**Figure 20 Ralph Lauren & Zepeto Collaboration**

Source: (Swant, 2021)



### 6.3.3. Digital Fashion

Digital fashion is a growing trend in metaverse. It is a way to show personality through clothing. An own look can be created, or the trends set by other users might be followed. Digital fashion can be used to make a statement. Since clothing is available as digital collectibles or NFTs, it can be widely traded on NFT marketplaces thus increasing its value over the time, which is not the case for many physical or pre-owned garments (Jagati, 2022). About You developed the first online store for digital fashion called Hypewear, shown in *Figure 21*. As one of the fastest growing e-commerce companies, About You focuses on launching innovative projects in the field of digital fashion. The goal was to provide the general public access to digital fashion items. For this purpose, a web store was developed and built on Algomart, an NFT marketplace running on Algorand, which is the most sustainable blockchain in the world. Different collections are available in the web shop: some of them are more affordable, others are limited editions with special drops. In addition to their own collection, other brands are offered the opportunity to sell their 3D fashion through the Hypewear platform (*HYPEWEAR by ABOUT YOU – the first online shop for digital fashion*, n.d.).



**Figure 21 Digital Fashion from Hypewear**

Source: (*Hypewear by About You – the First Online Shop for Digital Fashion*, n.d.)

### 6.3.4. Traceability and authenticity

Ensuring the authenticity of luxury products has always been a challenge. To combat counterfeiting, a system proving the origin of the products is needed. To develop this system, in 2019, LVMH, Prada Group, and Richemont founded the Aura Blockchain Consortium. The non-profit organisation develops solutions for its members to take the customer experience to a new level and to increase the trust and transparency for the customers. Two

membership solutions are offered, which enables textile brands to choose the model most suitable for them (*AURA – The Aura Blockchain Consortium*, n.d.).

Not solely collaborations, but private companies set on the blockchain technology for traceability, as well. 3D AG, a Swiss company, specialises in the field of micro and nano technology, especially in holography to fight counterfeiting and to protect intellectual property. The products of the company support brands; thus, their customers can ensure the authenticity of the products. Moreover, 3D AG recognised the opportunity to offer their customers an even better solution with blockchain: the traceability of their products. Thus, their own platform is built, where brands can log actions on their products to inform their customers about the bigger events related to the product, such as the production, delivery, and the date of selling the item (History of 3D AG, n.d.).

### **6.3.5. Accepting crypto payments**

The apparel industry is one of the most volatile and ever-changing industries in the world. With new trends and styles constantly emerging, the industry is always looking for new ways to stay ahead of the curve. One of the latest trends emerging in the apparel industry is the acceptance of crypto payments. Cryptocurrency is a digital or virtual currency that uses cryptography for security. The cryptocurrencies are decentralised meaning they are not subject to the control of governments or any financial institution. Bitcoin, the first and most well-known cryptocurrency, was created in 2009 (Frankenfield, 2022). Since then, over 10,000 different cryptocurrencies have been created with more are to be created every day (*Number of Cryptocurrencies Worldwide from 2013 to February 2022*, 2022). The acceptance of cryptocurrency payments in the apparel industry is a trend that is gaining traction. More and more apparel brands are beginning to accept crypto payments to stay ahead of the curve and keep up with the latest trends.

The luxury fashion brand Off-White accepts crypto payments in their flagship stores in Paris, Milan, and London (Sinclair, 2022). The company relies on an arbitrage system provided by Lunu, a German-based payment solution provider that integrates the use of cryptocurrencies into the real economy (*About Lunu*, n.d.). Besides Off-White, Balenciaga, Gucci (James, 2022), and Philipp Plein (Torcaso, 2021) offer in-store crypto payments, too. Crypto payments in web stores are on the rise, as well. Nike, H&M, Etsy, Overstock.com, and Macy's offer this solution in their web shops ("Clothing Websites That Accept Bitcoin Throughout the World," 2022).

#### **6.4. The evaluation of the hypothesis**

At the beginning of the secondary research, I defined the following hypothesis:

**H1:** In the textile industry, there are existing Web3 projects, which are used in various areas and for different purposes in the companies.

In H1, I claimed that there are existing Web3 projects in the textile industry, which are used in various areas and for different purposes in the companies. During the in-depth secondary research, I found that there are several existing Web3-based projects in the textile industry. These projects can be categorised into the following sections: metaverse, NFTs, digital fashion, traceability, authenticity, and crypto payments. Based on these facts, I could conclude that H1 can be accepted, and I formulated the following thesis:

**T1:** In the textile industry, there are existing Web3 projects, which are used in various areas and for different purposes in the companies.





## PART III: EMPIRICAL STUDY

### 7. PRIMARY RESEARCH 1: QUALITATIVE INTERVIEWS ON THE CONTEXT OF WEB3 WITH POTENTIAL CUSTOMERS

#### 7.1. The aim of the research

The primary intent of this initial research pivots around discerning the customers' potential needs and desires, as well as evaluating their proficiency with Web3 and its related technologies. Additionally, it aspires to generate ideas that might captivate prospective customers within the textile industry. These insights are then meticulously considered and integrated into the results, exhibited in *Table 9*. It is pivotal to emphasise that this research does not aim to test hypotheses given the qualitative nature of the investigation. Instead, qualitative research, celebrated for its ability to delve deeply into specific areas, is predominantly employed to define or redefine hypotheses by exploring nuanced perspectives and intricate details. Consequently, to navigate through this primary research, the ensuing research questions were crafted aligning with the aforementioned approach:

**Q2.1:** How much knowledge on the Web3 area do potential customers possess?

**Q2.2:** Which project ideas for textile brands might customers find exciting?

**H2:** Although potential customers might not understand the technical background of Web3-based projects, they have ideas for their implementation.

#### 7.2. Designing and structuring the qualitative survey

Altogether, interviews with five people were conducted, as visualised in *Table 6*.

**Table 6 Interview participants**

	Participant 1	Participant 2	Participant 3	Participant 4	Participant 5
<b>Gender</b>	Female	Female	Female	Male	Female
<b>Age</b>	30	27	26	30	28
<b>Nationality</b>	Hungarian	Hungarian	Hungarian	Hungarian	German
<b>Position</b>	IT	Marketing Manager	Micro-Influencer & model	Crypto-Investor	Course Advisor
<b>Industry</b>	Banking	Beauty & Fashion	Fashion & Sport	Crypto	Education
<b>Experience</b>	8+	5+	5+	5+	5+
<b>Reason for participation</b>	Insight into privacy and security concerns	Insight into latest beauty and fashion trends	Fashion affinity and insight into the fashion industry trends	Experience in the field of crypto	Fashion affinity and strong contact with the young generation
<b>Duration</b>	00:23:32	00:25:30	1:44:03 – together with participant 4	1:44:03 – together with participant 3	00:24:17
<b>Place</b>	Online	Online	Online	Online	Online

Source: own compilation, 2023

When selecting the participants, it was taken into account that they should be related to either the fashion or the crypto sector. The interviewees were all between 25 and 30 years old. Their places of residence were either Hungary or Germany. One of them was male, four of them were female.

Guidelines for the interviews, which can be found in *Appendix 1* and *Appendix 2*, were formulated. Two different guides were created as the respondents' knowledge was varied greatly.

The questions in the guide were not strictly followed during the interview, but rather high value was placed on what the interviewees would have liked to and could add to the topic. During the interviews, the biggest challenge was that some of the participants were not familiar with the technologies and in some cases, had not heard about them before. It means that in some cases, it had to be described what these technologies could offer to enable the interviewees to express their opinions. While this was a challenge in conducting the qualitative interviews, this insight was very helpful for writing the quantitative research. Therefore, in the quantitative research, the technical terms were avoided as much as possible, and there was more focus on paraphrasing and highlighting benefits.

### **7.3. The methodology of the data collection and processing**

The interviews all were conducted via WhatsApp calls. The main goal of the explorative interviews was to find commonalities among the participants. Thus, it focused on statements and assessments confirmed by different experts and afterwards, explained from possibly different perspectives in more detail. The aim was to gain a competent insight into the research field. For this purpose, the interviews were recorded as audio recordings and subsequently, transcribed. The interview transcripts were read, and text passages that were of interest in terms of content and belonged together were marked and provided with topic labels. The questions of the interview guide were followed, but other interesting statements were marked, as well. For the evaluation, the method of Meuser and Nagel was used, and the explanations of Ullrich (2006) were followed. For each interview, a two-column table was created. In one column, the text sequences were copied, in the other, the topic labels of the individual text sequences were transferred. Later, this helped to find certain statements within a short time.

To create a thematic comparison, in the next step, all text passages of all interviews were compiled to the corresponding topics. For each topic area, a long list of quotations was created. This list served as a basic framework for the analysis. Afterwards, all the materials

were reviewed again; however, this time, they were no longer organised by interview but by topic. This allowed the theoretical generalisation to take place; thus, connections between the categories were examined, and interpretations were formulated.

#### **7.4. The findings of the research**

##### **7.4.1. The respondents' attitude and knowledge**

Participants demonstrated varied attitudes and motivations towards investing in Web3 technologies. A prominent segment with no prior crypto affiliation expressed reservations primarily steered by potential financial loss and an intrinsic distrust towards intangible assets. Participant 2 sees herself not competent in the subject: *"I am not at all knowledgeable about the subject. While I have heard of them and they are not completely unfamiliar terms to me, I would not be able to explain what they are."* Participant 5 avoids investing in web3 products, because she is *"far, far too afraid of losing something"*. Participant 1 expressed her concerns with the following opinion: *"... with the stroke of a pen or a click of a mouse, someone can decide that you have nothing, and then you lose everything"*. On the other hand, she found it complicated to find credible sources: *"Now, if I were to conduct my own research and find credible sources from someone who isn't trying to sell me something, I don't think it would be easy."*

As visible, their apprehensions were compounded by a lack of knowledge and credible information sources; thus, they were reticent to invest due to fear of being exploited. Additionally, social circles played a pivotal role in shaping their stance with minimal engagement in the area failing to spark their interests in Web3 technologies. Participant 2 expressed it on the following way: *"If my father had been involved in this, I would obviously know what they are, and it would be more interesting. However, my family has no idea about it at any level. My friends from high school, and no one I talk to on a daily basis, are involved in it at all. We don't even discuss it, so it's very much out of the question."*

While they acknowledged the importance of staying informed, the participants did not wish to allocate time to understanding the constant flux within cryptocurrencies and NFTs. Through qualitative research, it was elucidated that potential fashion customers generally lack a technical understanding of Web3 thus underpinning the need for crafting a tailored survey for subsequent research.

Contrastingly, Participant 4, the participant familiar with Web3 but due to the current market situation not actively investing maintained existing investments and expressed specific

concerns about U.S. regulations and the current valuation of cryptocurrencies: *“I am sad at the moment as I look at the exchange rate. For now, I just hold cryptocurrencies, mostly dollar-based, and wait to see where we go.”*

His perspective on NFTs was critical, especially regarding their underutilisation and predominant use as profile pictures: *“NFTs are a good concept and they make sense, but not in their current form, unfortunately. They are currently being used for fraud and to sell items with no real value. It's one thing when it's used to upload pictures of cats or drawn monkeys, an another when an NFT is used as a key for something, like attending a conference. These represent different types of NFTs. So, the utility behind an NFT does matter; if it's useful, it's obviously harder to counterfeit because it would be discovered.”*

Although the concept of the metaverse was regarded with excitement by Participant 4, criticisms were levelled at its current misuse and technological readiness indicating a preference for a more immersive, high-quality virtual reality experience: *“In the crypto industry, I think they are just experimenting and labeling everything as the metaverse. They've even started referring to games as the metaverse simply because they contain a world. But this is not accurate. A game is not a metaverse. A metaverse is a space in the virtual world where people can meet and own things.”*

#### **7.4.2. Clothing buying habits**

Several participants highlighted the crucial role of clothing quality in their purchasing decisions, and this was often closely tied to brand reputation. Economic limitations sometimes prevented access to desired brands and their associated quality. When brand familiarity was lacking, price became a critical factor due to concerns about the durability of garments and potential regret over investing in more expensive items. There was no significant preference between local and international brands, occasionally due to unfamiliarity with local options. Interestingly, some participants strictly adhered to their typical clothing size, avoiding purchases that required sizing up. Brands were expected to provide excellent customer service and easy return processes, with platforms like Zalando being preferred for their straightforward return procedures. Participant 5 expressed her expectation on the following way: *“Zalando is a great place to order from; I can always return items if they don't fit. This service is definitely free at Zalando, and it's so convenient. I also find the app more user-friendly than the About You app.”*

As seen, user-friendly and clear product overview was essential for fashion apps. Instagram emerged as a primary source for fashion trends with a preference for authentic and original

content creators over traditional influencers. While live fashion shows were not commonly watched, subsequent photos and fashion-oriented magazine content, which included purchasing information, were valued for outfit planning.

#### **7.4.3. Ideas for Web3 projects**

During the dialogues, diverse ideas and explicit customer expectations emerged revealing keen insights into their perspectives towards potential projects, which is detailed further in *Chapter 9*.

The participants expressed tangible interests in token gating solutions, where the allure of obtaining early access to limited editions and sharing discounts with peers was apparent.

Moreover, the token-based access to various events, such as fashion shows or online seminars, was viewed as an evolved, enriched webinar experience offering more autonomy and engagement. Notably, while the traceability of premium items like wedding dresses was deemed worthwhile, it was considered unnecessary for lower-priced items.

The concept of using avatars for online interactions was generally novel thus solely modestly embraced. Nonetheless, the use of augmented reality for virtual garment trials and sharing via social media was positively received. The participant familiar with Web3 discerned potential in blending avatars and gaming suggesting a mutually advantageous collaboration between clothing brands and gaming platforms.

Additionally, this individual found merit in deploying NFTs for scarce, iconic physical products thus underlining the ongoing value and a mechanism for profit sharing among minters. The "move-to-earn" model, where creating outfits could be rewarded with tokens, was introduced and seen as applicable to the textile industry, especially given its current momentum in varied sectors. Clearly, Web3 solutions have a broad application spectrum and require adept communication strategies for facilitating customer engagement. These ideas might be further explored and validated through customer evaluations in ensuing research phases providing deeper insights into customer priorities.

#### **7.5. The evaluation of the hypothesis**

It is prudent to note that while qualitative research does not traditionally validate hypotheses through statistical or experimental methods, it illuminates understanding by exploring intricate participant experiences and perspectives. Henceforth, a cautiously formulated hypothesis might be:

**H2:** Although potential customers might not understand the technical background of Web3-based projects, they have ideas for their implementation.

With qualitative interviews, I learned more of the potential fashion customers' attitude and generate a list of ideas added to *Table 9*. Based on this outcome, I could conclude that H2 can be accepted, and I formulated the following thesis:

**T2:** Although potential customers might not understand the technical background of Web3-based projects, they have ideas for their implementation.

## 7.6. The limitations of the research

Navigating through research often involves acknowledging the limitations found during the investigation process. In the context of this study, it is essential to shed light on a few areas that could have influenced the results or constrained the depth of the findings:

1. Age group consistency: Engaging respondents from a single age group was a purposeful choice aimed at tapping into the trendsetting and adopting behaviours common among the younger demographics. However, this narrowed the variety of insights and may limit the applicability of the results across diverse age groups by not capturing a wide range of perspectives on Web3 applications.
2. Small participant pool: The limited number of the participants in the qualitative interviews might have restricted the array of gathered insights. More participants might have provided a broader spectrum of ideas and perspectives concerning Web3 applications thus ensuring more robust and comprehensive findings.
3. Limited technical expertise among the respondents: The participants, primarily potential customers, might have lacked the in-depth technical knowledge regarding Web3 technologies. This could potentially limit the depth and technical accuracy of their insights regarding the practicality and feasibility of implementing Web3 applications in the fashion sector.
4. Retrospective learning: Initially, the focus was set on understanding the potential customers, and while this objective has been met, hindsight revealed that involving at least some industry experts could have provided additional valuable insights. This could have potentially offered a more balanced viewpoint and practical guidance on bringing customer ideas to real-world implementation.

## 8. PRIMARY RESEARCH 2: QUANTITATIVE RESEARCH AMONG POTENTIAL FASHION CUSTOMERS

### 8.1. The aim of the research and the hypothesis

The aim of this part of the research is to evaluate the ideas from *Chapter 9* to determine which projects would be the most exciting for the customers therefore the most successful to be introduced for textile companies. On the other hand, it is aimed to detect which factors are those that keep customers from investing in Web3-based products and services.

In the context of exploratory research, this section aims to preliminarily investigate customer attitudes towards Web3 technologies in the textile industry. The intrinsic value of exploratory research resides in its ability to identify potential trends and issues, subsequently providing a foundational understanding that guides more comprehensive research in successive stages.

Utilising a quantitative research method, specifically a questionnaire, the objective is to ascertain a broad understanding of how potential customers perceive Web3 technologies. The questionnaire, available in *Appendix 3*, was developed to evaluate general attitudes towards Web3 and to detect any discernible differences in these attitudes among varied cultural and demographic groups, notably contrasting Hungarian and German-speaking European (DACH) respondents. This research, therefore, acts as a provisional exploration, shaping preliminary insights to inform and direct subsequent, in-depth investigations.

In this research section, the following research questions and hypotheses are examined:

**Q3:** Which of the defined Web3-based projects do customers find particularly compelling?

**H3:** There are Web3 projects that the potential customers find exciting.

**Q3.1:** What is the distribution of cryptocurrency and/or NFT owners between Hungary and DACH?

**H3.1:** The proportion of DACH-located people with a cryptocurrency or NFT is at least 8% higher than the proportion of Hungarians.

**Q3.2:** In case of which Web3-based project ideas does owning cryptocurrencies and/or NFTs have an impact on preference?

**H3.2:** There is a significant correlation between the possession of a cryptocurrency and/or NFT and some of the Web3-based project ideas.

## **8.2. The design of the questionnaire**

The questionnaire consisted of three main parts. At the beginning, the focus was on identifying the demographic data to better understand the research participants' background. Accordingly, their gender, age, and place of residence were collected. Afterwards, the questions moved on to the respondents' attitudes and spending habits regarding Web3 technologies. In this section, the reasons behind not having cryptocurrency and NFTs were surveyed. The last part of the questionnaire focused on scoring the ideas listed as Web 3 pattern cards. The survey participants were asked to categorize the ideas based on their preference and willingness to buy the products or services with the mentioned solutions.

To attract as many participants as possible to take part in the survey, a raffle was held among them. Not merely the participation counted for the raffle, but participants could share the survey among their acquaintances, and they could refer to it. Those who led more people to the survey had more chance to win. With each additional person led to the survey, the name was added one more time to the raffle.

The survey was distributed through the following social media channels: LinkedIn, Instagram, and Facebook. Additionally, I sent private messages to 192 people from my contact list and invited them to participate in the survey. The sampling took place between 25 September 2022 and 7 October 2022. The questionnaire was built with the Typeform survey software.

## **8.3. The methodology of the data collection and processing**

As in case of all questionnaires, the question of how to minimize the possibility of providing false data was raised. To exclude false data and to be able to filter them out, three questions that required the respondents to choose a given answer were asked. One example is the following question: "Please select "Maybe" to prove you pay attention."

All together 723 people participated in the survey. After applying the filters with the three attention questions, there were 283 answers. Afterwards, a comparison was made between different statements of the participants. When they reported that they spent money on different Web3-based projects, it was checked whether they really owned such products. After this check, unfortunately, it had to be concluded that merely for 138 participants, it was sure that they stated the truth. The hypotheses of the research were tested on this sample. The following analytical procedures were used:

- Descriptive statistics to present the empirical data clearly through tables and graphs,



- Chi-square test to check if there was a relationship between cryptocurrency or NFT holdings and preferred Web3-based offers,
- Cramer coefficient, which indicates the strength of the relationship, when a significant relationship was found during the Chi-square test (a 5% significance level is assumed).

## 8.4. The findings of the research

### 8.4.1. The general statistical characteristics of the sample

Out of the 138 respondents, 78 were women, 59 were men, and 1 indicated other, i.e., 56.52% for women, 42.755% for men, and 0.725% for others.

The distribution of the participants by age showed that the 26-41 age group was the most represented, with 73 respondents belonging to this category, making up 52.90% of the participants. This was followed by the 10-25 age group, represented by 47 respondents, accounting for 34.06% of the survey participants. The 42-57 age group was less represented, with only 15 participants, constituting 10.87% of the survey. The 58+ age range had the least representation with just three participants, making up 2.17% of the respondents.

Regarding residency, 84 participants, or 60.87% of the respondents, lived in Hungary. Switzerland was the next most common residence, with 35 participants making up 25.36% of the total. Austria and Germany were represented by seven (5.07%) and four (2.90%) participants, respectively. Other European countries accounted for eight participants, representing 5.80% of the total. Given the large representation from Hungary, the analysis included a comparison between those in Hungary and those primarily from the DACH countries (Germany, Austria, Switzerland).

**Table 7 Demographic distribution of respondents**

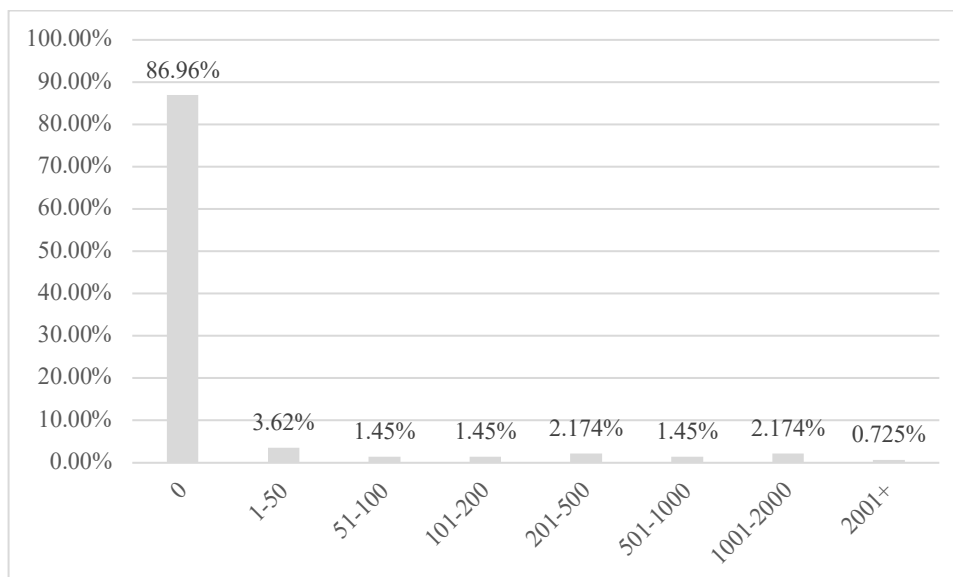
Demographic Factor	Category	Number of Participants	Percentage (%)
Gender	Women	78	56.52
	Men	59	42.755
	Other	1	0.725
Age Group	10-25	47	34.06
	26-41	73	52.90
	42-57	15	10.87
	58+	3	2.17
Country of Residence	Hungary	84	60.87
	Switzerland	35	25.36
	Austria	7	5.07
	Germany	4	2.90
	Other European Countries	8	5.80

Source: own compilation, 2022, n=138

#### 8.4.2. The survey participants' responses related to Web3 activities

The next part of the survey no longer focused on the demographic factors but looked at what Web3-based products and services were used by the survey respondents.

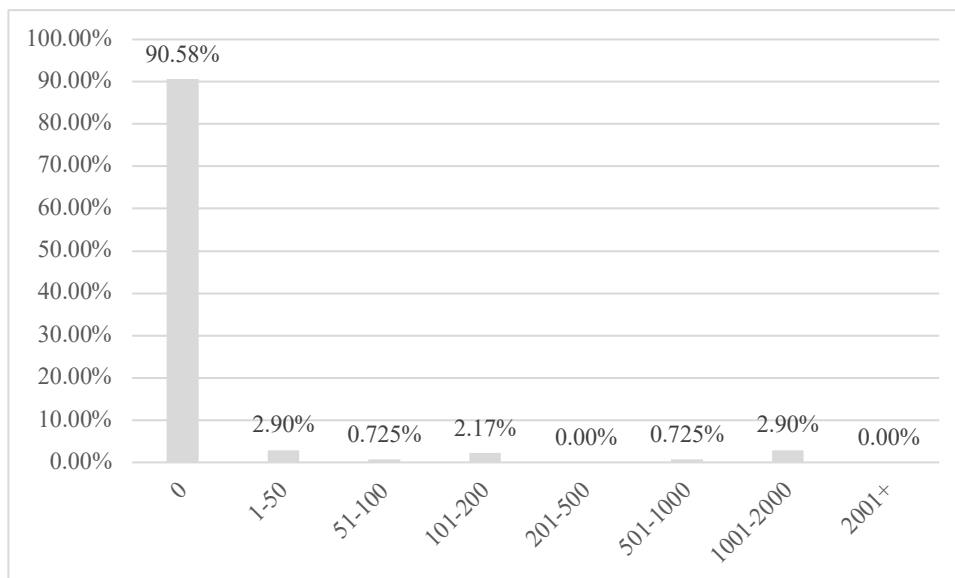
The monthly average investments in cryptocurrencies are visualised in *Figure 22*. 120 out of 138 people stated that they had not invested money in cryptocurrencies. Five participants had invested on average between EUR 1-50 per month for crypto, two people indicated EUR 51-100, and two stated EUR 101-200. Three respondents had invested between EUR 201-500. Another two people chose the range EUR 501-1000. Three participants had invested between EUR 1001-2000. Merely one person had made a monthly average investment of more than EUR 2001 in cryptocurrencies.



**Figure 22 The participants' monthly investments in cryptocurrencies (EUR)**

Source: own compilation, 2022, n=138

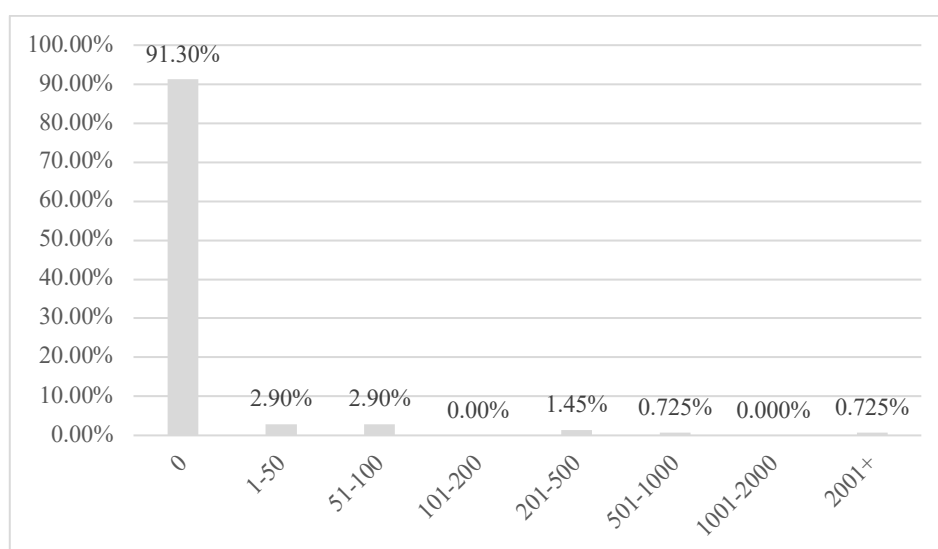
Investments in NFTs were even lower than in cryptocurrencies. Regarding NFTs, 125 people out of 138 participants indicated that they had not invested money in such products. Thus, over 90% of the respondents had not spent money on NFTs on a monthly basis. Accordingly, the number of people who had invested in NFTs monthly was low. Four people had spent EUR 1-50 per month on NFTs, merely one participant had invested between EUR 51-100, three people indicated the category between EUR 101-200, no one had spent between EUR 201-500, and solely one person had invested between EUR 501-1000. Four people indicated between EUR 1001-2000, while no one stated over EUR 2001. The data are presented in *Figure 23*.



**Figure 23 The respondents' monthly investments in NFTs (EUR)**

Source: own compilation, 2022, n=138

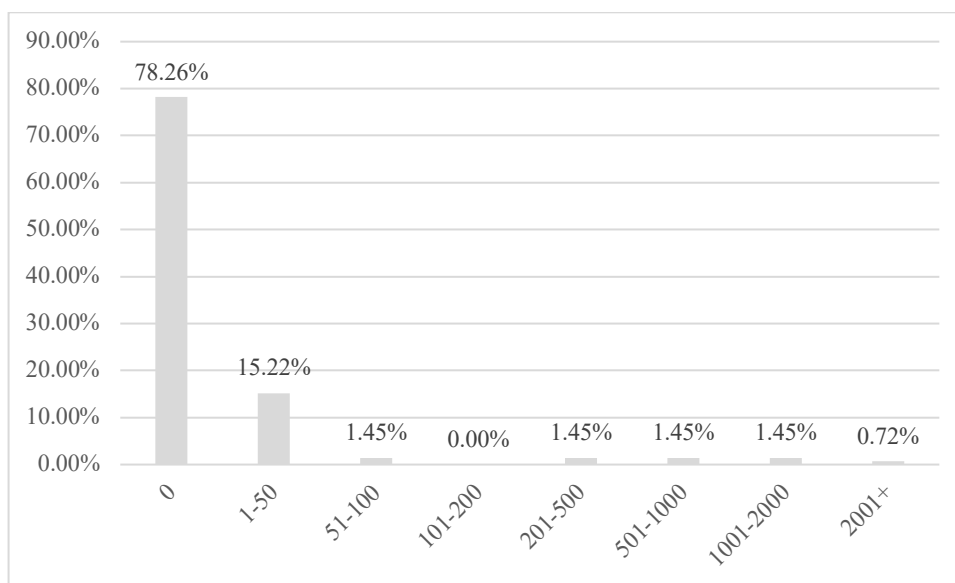
Similar was the case for participation at metaverse events, as shown in *Figure 24*. 126 people out of the 138 respondents indicated that they had not spent money on metaverse events. Four people had spent on average between EUR 1-50 on these events, and four had spent EUR 51-100 per month. No one had spent between EUR 101-200 on such events monthly. Two participants had paid on average between EUR 201-500 for these types of events monthly, and one person had spent EUR 501-1000. Nobody had spent on average EUR 1001-2000 on metaverse events monthly, while one person had spent over EUR 2001 on these services monthly.



**Figure 24 The respondents' monthly investments in metaverse events (EUR)**

Source: own compilation, 2022, n=138

A slightly higher willingness to spend money on in-game purchases could be detected, as shown in *Figure 25*. Solely 108 people had spent any money on such products monthly, while 21 people stated that they had allocated between EUR 1-50 per month to these products. However, the willingness to pay was not high as merely a few people had invested more than EUR 50 monthly. Two participants had spent on average between EUR 51-100 monthly, no one indicated spending between EUR 101-200, two respondents had invested between EUR 201-500, two had spent between EUR 501-1000, and two had spent between EUR 1001-2000. Merely one person indicated spending more than EUR 20001 monthly on such products.



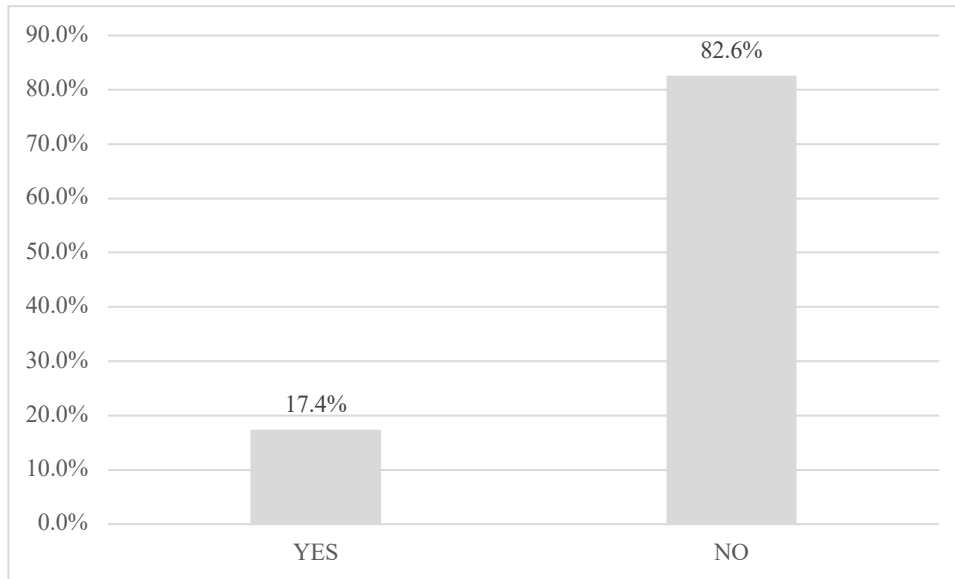
**Figure 25** The respondents' monthly investments in in-game purchases

Source: own compilation, 2022, n=138

The respondents' indications regarding the ownership of the previously mentioned products and services strongly matched their spending statements.

The following diagrams (*Figures 26. and 27.*) illustrate whether the participants are in possession of the various products. It was evident that in case of all products and services, the clear majority did not have them.

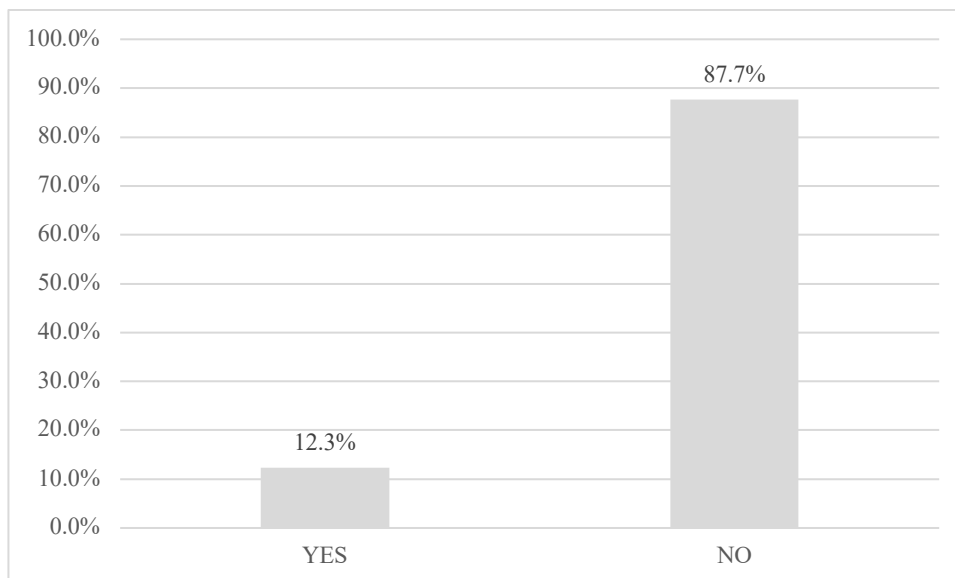
Out of the 138 respondents, 114 people, i.e., 82.6%, did not have cryptocurrencies and solely 24 participants, i.e., 17.4%, indicated that they had, see *Figure 26*.



**Figure 26** The participants' distribution of possessing cryptocurrencies

Source: own compilation, 2022, n=138

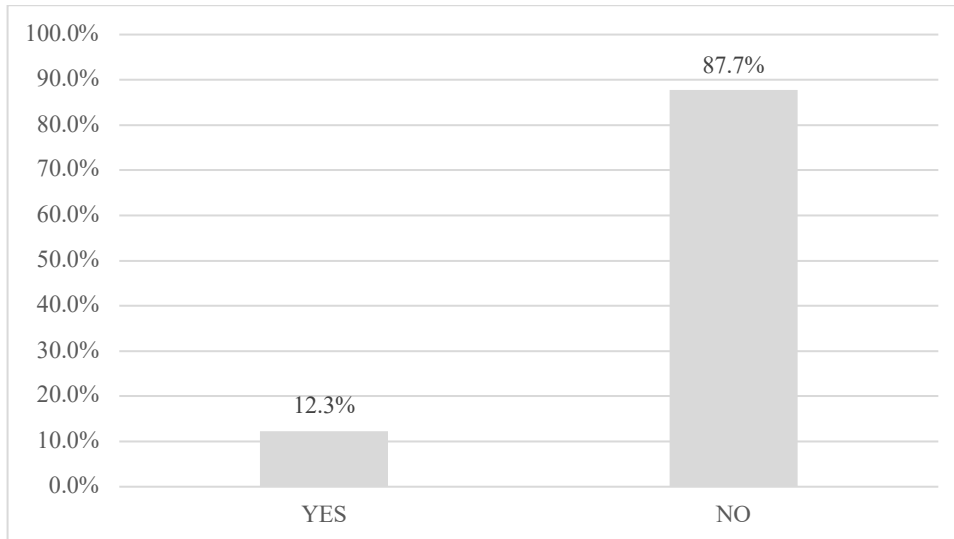
121 people did not possess NFTs, which represented 87.7% of the respondents. Merely 17 participants owned NFTs representing 12.3% of the respondents. The data are shown in *Figure 27*.



**Figure 27** The respondents' distribution of possessing NFTs

Source: own compilation, 2022, n=138

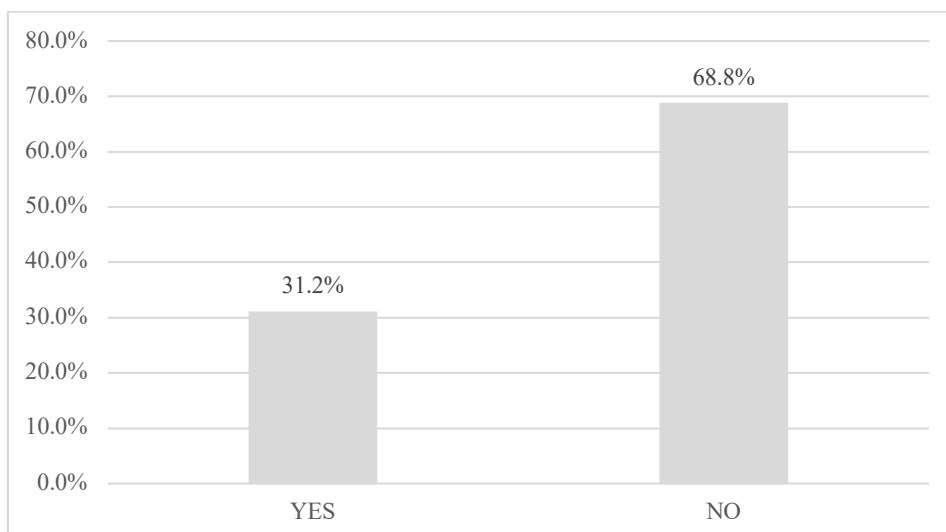
The respondents' participation at metaverse events corresponded exactly to the possession of NFTs and is visible in *Figure 28*. 121 participants, i.e. 87.7% of the respondents, had not participated in metaverse events yet, and 17 people, 12.3% of the survey participants had already attended metaverse events.



**Figure 28** The participants' distribution of attending metaverse events

Source: own compilation, 2022, n=138

95 people, i.e., 68.8% of the respondents, had never made in-game purchases of skins or accessories. However, 43 people, i.e., 31.2% of the survey participants had already performed such purchases, as demonstrated in *Figure 29*.



**Figure 29** The respondents' distribution of making in-game purchases

Source: own compilation, 2022, n=138

The next part of the research analysed what the reasons were for not participating in Web3-based products and offerings.

For this purpose, the potential reasons were collected why the survey participants might have not been interested. These items were collected into a table, and the compiled 11 statements could be rated on the Likert scale by the survey participants. The statements could be rated with the following four opinions:

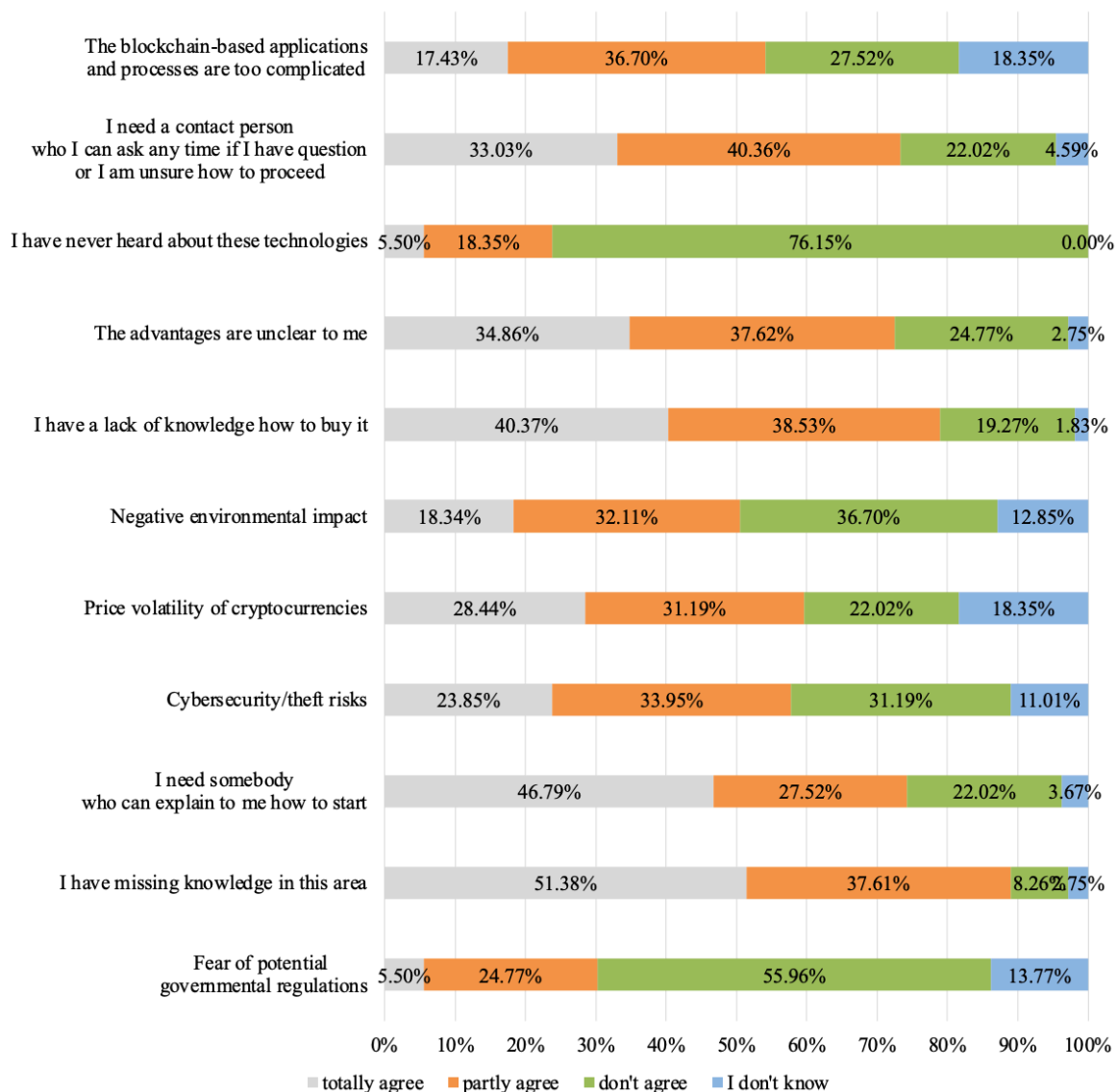
- I don't agree
- I partly agree
- I totally agree
- I don't know

The following 11 statements were examined:

- The blockchain-based applications and processes are too complicated.
- I need a contact person who I can ask any time if I have questions or I am unsure how to proceed,
- I have never heard about these technologies,
- The advantages are unclear to me,
- I have a lack of knowledge how to buy it,
- Negative environmental impact,
- Price volatility of cryptocurrencies,
- Cybersecurity/theft risks,
- I need somebody who can explain to me how to start,
- I have missing knowledge in this area,
- Fear of potential governmental regulations,

The answers are analysed and summarised in *Figure 30*. The reason for not owning any blockchain-based product was indicated with totally agree by 51.38% of the respondents as they did not have sufficient knowledge in the field. 46.79% of the participants stated that they need somebody who can explain to them how to start. The reason of not knowing how to buy crypto assets was indicated by 40.37% of the survey participants.

Moreover, there were some clear reasons that tended not to influence the buying behaviour. 55.96% of the respondents did not fear potential governmental regulations, and not hearing about the technologies was not a main reason either. Additionally, the environmental impact seemed to be less important for the participants, as well.



**Figure 30 The respondents' reasons for not owning any blockchain-based product**

Source: own compilation, 2022, n=138

The next part of the research focused on capturing the respondents' preferences for different products and services that could be realised through Web3 technologies. This list of offerings, which emerged partly through the secondary research and partly through the qualitative interviews, was created as demonstrated in *Table 9* in *Chapter 9*.

The aim of this part of the research is to evaluate the ideas thus determining which projects would be the most exciting for the customers therefore the most successful for the textile companies, as well.

The participants were asked to answer the question whether they might be interested in the following services in the apparel industry offered through blockchain technologies.



The respondents could rank the ideas in three different groups on the scale:

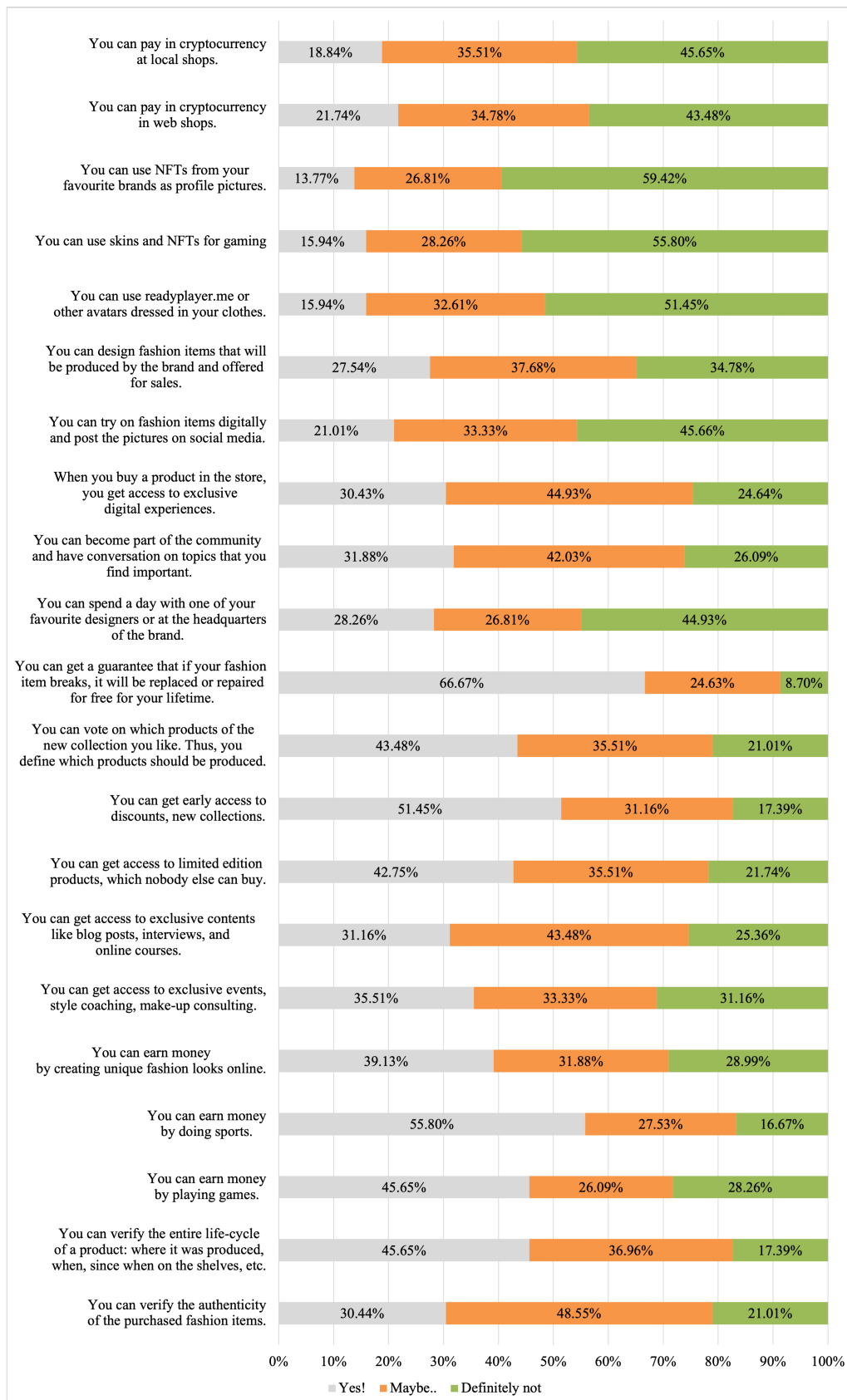
- Yes! – if they were definitely interested in the product or service,
- Maybe – if they were not totally convinced about the idea, but had nothing against it,
- Definitely not – if they had no interest in the idea.

The results are visible in *Figure 31*. It can be concluded that based on the respondents' Yes answers, the participants were most interested in receiving lifelong warranty on their physically purchased items, followed by earning money with doing sports, and receiving early access to discounts and new collections. Furthermore, the survey participants showed high interest in verifying the entire life cycle of the purchased products, earning money by playing games, receiving right to decide which products should be produced by the brands, and receiving access to limited edition products that nobody else can buy.

If the answers by summarizing the Maybe... and Yes! options are analysed, it can be concluded that receiving lifetime warranty was still the most appreciated offer as 91.30% of the participants voted with Yes! or Maybe... for this service. Three offers landed head-to-head on the second place, which were the followings: verifying the entire life cycle of the product, earning money by doing sports, and getting early access to discounts and new collections. On the third place were the followings: voting for the products of the collection you like thus deciding which products should be produced and verifying the authenticity of the purchased fashion items.

The information on which offers the respondents did not find interesting conveyed an important message. 45.66% of the respondents stated that they would not try on apparel products online and would not post such photos on social media. Although this number was rather high, I would not discourage brands from offering such deals. This rating might have been because the participants were not aware of the high-quality solutions in this area. There are several platforms that specialise in digital fashion offers, and in my opinion, this area has potential in the future.

Moreover, the offer to spend a day with your favourite designer or at the headquarters of a brand scored poorly, too. The respondents were not enthusiastic about the access to exclusive events, style coaching, and make-up consulting. Little interest was shown in earning money by creating unique fashion looks online and earning money by playing games.



**Figure 31 The customers' interest in different Web3-based services and products in the fashion industry**

Source: own compilation, 2022, n=138

### 8.4.3. The evaluation of the hypotheses

At the beginning of this quantitative research, three hypotheses were defined. The findings regarding these statements are presented in the following paragraphs:

#### **H3: There are Web3 projects that the potential customers find exciting.**

In H3, I claimed that there are Web3 projects that the potential customers find exciting. With quantitative research, I could define the customers' interest in different Web3-based services and products in the fashion industry, which information is presented in *Figure 31*. Based on this outcome, I could conclude that H3 can be accepted, and I formulated the following thesis:

**T3:** There are Web3 projects that the potential customers find exciting.

#### **H3.1: The proportion of DACH-located people with a cryptocurrency or NFT is at least 8% higher than the proportion of Hungarians.**

$$H_0: p_1 - p_2 = \varepsilon_0$$

$$H_0: p_1 - p_2 = 0.08$$

$$H_1: p_1 - p_2 > 0.08$$

$$\varepsilon_0 = 0.08$$

The proportion of Hungarian respondents owning cryptocurrency or NFT:

$$p_2 = 11/84 = 0.13095$$

$$n_2 = 84$$

The proportion of DACH-located respondents owning cryptocurrency or NFT:

$$p_1 = 18/54 = 0.33333$$

$$n_1 = 54$$

The two-sample ratio test can be used as two independent samples each with more than 30 elements. *Formula 1* presents the calculation.

$$\begin{aligned}
 z_0(P) &= \frac{(p_1 - p_2) - \epsilon_0}{\sqrt{\frac{p_1(1-p_1)}{n_1} + \frac{p_2(1-p_2)}{n_2}}} = \frac{0.33333 - 0.13095 - 0.08}{\sqrt{\frac{0.33333(1-0.33333)}{54} + \frac{0.13095(1-0.13095)}{84}}} \\
 &= \frac{0.12238}{\sqrt{0.00411521 + 0.00135479}} = \frac{0.12238}{\sqrt{0.00547}} = \frac{0.12238}{0.073959} = 1.6547
 \end{aligned}$$

**Formula 1 The calculation of the two-sample ratio test**

The critical value ( $z_{crit}$ ) at  $\alpha=0.05$  is 1.644854.

$z_0 > z_{crit}$ : Thus,  $H_0$  can be rejected. It can be stated at a confidence level of 95% that the rate of cryptocurrency or NFT holders is at least 8% higher among DACH-located research participants than among Hungarians.

Based on this outcome, I could conclude that H3.1 can be accepted, and I formulated the following thesis:

**T3.1:** The proportion of DACH-located people with a cryptocurrency or NFT is at least 8% higher than the proportion of Hungarians.

**H3.2:** There is a significant correlation between the possession of a cryptocurrency and/or NFT and some of the Web3-based project ideas.

Chi-square test was applied to check if there was a relationship between cryptocurrency or NFT holdings and preferred Web3-based offers. The list of the preferred offers is based on the results from *Figure 31*. The overview with the critical and calculated values can be found in *Appendix 4*.

There was no significant correlation between the possession of a cryptocurrency and/or NFT and the following factors:

- you can verify the authenticity of the purchased fashion items,
- you can verify the entire life cycle of a product: where it was produced, when, since when on the shelves, etc.,
- you can earn money by playing games,
- you can earn money by doing sports,
- you can earn money by creating unique fashion looks online,
- you can get access to exclusive events, style coaching, make-up consulting,
- you can get access to exclusive contents like blog posts, interviews, online courses,
- you can get access to limited edition products, which nobody else can buy,

- you can get early access to discounts, new collections,
- you can vote on which products of the new collection you like. Thus, you define which products should be produced,
- you can get a guarantee that if your fashion item breaks, it will be replaced or repaired for free for your lifetime,
- you can spend a day with one of your favourite designers or at the headquarters of the brand,
- you can become part of the community and have conversation on topics that you find important,
- when you buy a product in the store, you get access to exclusive digital experiences,
- you can design fashion items that will be produced by the brand and offered for sales,
- You can use readyplayer.me or other avatars dressed in your clothes.

There is significant correlation between the possession of a cryptocurrency and/or NFT and the following factors:

- you can try on apparel items digitally and post the pictures on social media,
- you can use skins and NFTs for gaming,
- you can use NFTs from your favourite brands as profile pictures,
- you can pay in cryptocurrency in web shops,
- you can pay in cryptocurrency at local shops.

For these five cases, the Cramer coefficient was calculated. There was a weak positive correlation for all five projects. The strength of the correlation was categorised by Sajtos and Mitev (2007), who defined the correlations as shown in *Appendix 5*. In order to make difference between these five cases, the scale was slightly modified from 0.2 to 0.3. Thus, three project ideas were rated as weak positive correlations, and two were considered being a medium strength positive correlation. The results are demonstrated in *Appendix 6*.

Based on this outcome, I could conclude that H3.2 can be accepted, and I formulated the following thesis:

**T3.2:** There is a significant correlation between the possession of a cryptocurrency and/or NFT and some of the Web3-based project ideas.

### **8.5. The limitations of the research**

This research brought to light valuable insights, but it came with a set of limitations that require acknowledgment when interpreting the findings. Firstly, it is pivotal to recognise that the participants' expressed preferences were situated in a hypothetical context. Although participants indicated certain preferences in the questionnaire, translating these into actual purchasing decisions in a real-world context was not assured. Validating these findings would necessitate a further study involving real-world purchasing scenarios to observe and confirm the customers' behaviour and choices.

Moreover, there were considerations regarding the applied rating scales in the questionnaire. Traditional Likert scales typically utilize well-defined endpoints and if a neutral or non-committal category (such as 'Don't Know') is added, it usually adopts a 5-point format. A deviation from this format, as in using alternative categorisations (e.g., Yes – Maybe – Definitely Not), detracts from classifying the scale as a true Likert scale, which may influence the reliability and interpretation of the data.

Additionally, the study encountered constraints related to the number of the participant and the necessity to exclude certain respondents from the analysis. This limitation might have introduced bias and restricted the general applicability and representation of the findings across a wider context.

In conclusion, while the research provided initial insights into customer attitudes towards Web3 technologies in the textile industry, the limitations highlighted here necessitate caution in interpreting and applying the findings. Furthermore, these findings acted as a steppingstone pointing towards the need for further, more empirically-detailed investigations to corroborate and expand upon the consumers' preferences and behaviours identified in this preliminary research.

## 9. WEB3 PATTERN CARDS

### 9.1. The aim of the research

As it has already been announced in the previous chapters, the main aim of current research is to create a list of possible Web3-based projects and to evaluate them. The evaluation by the customers is provided in *Chapter 8*; thus, the comprehensive results can be presented. The Web3 pattern cards inspired by the St. Galler Business Model Innovation Pattern Cards and enriched with focus on Web3, provide inspiration for fashion brands for introducing different kinds of Web3 projects. The name of the Web3 pattern cards is derived from the St. Galler Business Model Innovation Pattern Cards; thus, my solution is called Web3 pattern cards.

This chapter examines the following research question and hypothesis:

**Q4:** What are the most cost-effective and customer-supported alternatives of Web3-based projects?

**H4:** A list of potential Web3-based projects can be created and evaluated by customers regarding their interests and by blockchain developers regarding the implementation costs.

### 9.2. The methodology of the data collection and processing

The heart of the project includes 38 ideas that were collected and generated through the secondary research, through the in-depth qualitative interviews, and through brainstorming. In the left column of *Table 9*, there is the name of the Web3 project. This is followed by the category; thus, the related projects can be recognised. In the description, the idea is briefly described; therefore, a better understanding of the project can be built.

Additionally, the budget friendliness is listed per project. To determine this feature, three blockchain developer companies were asked to rank the projects by budget between 1 and 5, where 5 meant the lowest budget, and 1 meant the highest budget. After receiving all three ratings, the average of the awarded points was calculated and entered in the column budget friendliness. Thus, the textile brands could estimate at the beginning how high the budget for their desired project could be. Some projects could not be rated by the developers because the costs might have depended strongly on the scope of the project. In case a developer did not provide any information, no average was calculated, and the status not rated was entered instead.

Although this information was not included in this table, as a continuation of my research, I am working on solutions that are low-cost and can be implemented partly without programming skills. Thus, I hope to be able to offer solutions for some projects for textile enterprises without having to invest a large amount of capital. More about this topic can be found in *Chapter 12.4*.

For the points of customer demand, percentages from *Chapter 8* were applied. Since the preferences for the Yes! and Maybe... votes were expressed as percentages, they were converted to be on the same scale as budget friendliness. For this, I defined and applied the source shown in *Appendix 7*.

There were projects from customers that were not rated because the focus was on the most important points in the survey and projects that were similar to other projects, were too technical, or could be realised in very different ways depending on the defined project were sorted out. Thus, rating only one version would not provide an optimal rating. For these projects, not rated was noted in the scoring.

### 9.3. The findings of the research

*Table 9* shows the overview of the findings. The colour scheme from *Table 8* was used to allow projects to be graded into different categories.

**Table 8 The description of the colour scheme for the visualisation of the findings**

Category	Colour	Points
High budget friendliness and/or customer demand	Green	4.0 – 5.0
Higher medium budget friendliness and/or customer demand	Yellow	3.0 – 3.9
Lower medium budget friendliness and/or customer demand	Orange	2.0 – 2.9
Low budget friendliness and/or customer demand	Brown	1.0 – 1.9
Not rated	Grey	No points given

Source: own compilation, 2022

The Web3 pattern cards is a collection of 38 ideas that could be assigned to the following categories: partnerships, utility, product, metaverse, PFPs, gaming, digital fashion, verification, arts, sustainability, customer loyalty, play-to-earn, community building and payments.

After the evaluation by potential customers, it could be identified that the greatest interest from the customer side was for the following projects in order of interest: unlimited physical replacement of the products, train-to-earn: earning money by doing sports, the visibility of the life cycle of the products, early access to new collections and to discounts.



Three blockchain developers were asked to analyse the ideas regarding the necessary costs for implementation. After receiving all three ratings, the average of the awarded points was calculated. This information helped textile brands to estimate how high the budget for their desired project could be. These experts labelled the lifetime discount, the early access to new collections and discounts, and the unlimited physical replacement of products equal - with the lowest cost - in terms of budget friendliness.

On average, for budget friendliness and customer demand, the following projects performed the best in this order: unlimited physical replacement of products, early access to new collections and discounts, lifetime discount, the visibility of the life cycle of the product, and exclusive drops and products for token holders. Therefore, these projects were recommended for realisation by textile companies.

**Table 9 Web3 pattern cards with rating for budget friendliness, customer demand and average**

Name	Category	Description	Budget friendliness	Customer demand	Average
Lifetime discount	Utility	Token holders own lifetime discount on all products of the brands or a limited area of them (e.g., bags).	4.67	4.25	4.46
Unlimited physical replacement of products	Utility	The NFT guarantees that if the product gets broken, it gets replaced or repaired for free.	4.67	4.63	4.65
Early access to new collections	Utility	Token holders can buy the products before their launch.	4.67	4.25	4.46
Early access to discounts	Utility	Token holders can participate in pre-discounts thus having a higher chance to find their size for a discounted price.	4.67	4.25	4.46
The visibility of the life cycle of the product	Verification	Offering the customers the possibility to see the whole product development and production process with dates. Customers see where and when the product was produced.	4.00	4.25	4.13
Exclusive drops and products exclusively for token holders	Utility	Solely token holders receive some limited-edition products.	4.00	4.13	4.06
Right to have a say	Utility	Token holders can vote on smaller business decisions (e.g., on which styles should be produced, which events should be organised).	3.67	4.13	3.90

Name	Category	Description	Budget friendliness	Customer demand	Average
Access to exclusive content (passive)	Utility	Contents that can be accessed just by token holders (e.g., blog posts, interviews, online courses).	3.67	4.00	3.83
Blending physical, digital, and experiential products	Utility	It is a holistic approach that offers the highest possible value to the customers with blending physical, digital, and experiential products.	3.67	4.00	3.83
Physical product with NFT	Product	The product store-bought or ordered in web shop contains an NFT or a stitched inside QR code. This code offers exclusive AR experiences for the owners. Especially suitable for rare items or luxury products.	3.67	4.00	3.83
Dress-to-earn	Play-to-earn	Applications where customers can generate tokens and burn them for advantages (e.g., customers can create outfits based on the products of the brand and share them as styles. With each share, they earn in-game tokens that they can burn for special offers like discount, events, and access to limited editions).	3.33	3.88	3.60
Access to exclusive content (active)	Utility	Access to courses and consulting with personal interactions between the brand and token holder (e.g., colour and style coaching, make-up coaching).	3.33	3.75	3.54
Product co-creation	Product	Inviting customers to create product designs online, and these designs will be sold as NFTs. A voting might be organised to decide which designs should be developed and sold by the brand. The creator of the design is involved in the product development process.	3.33	3.63	3.48
Authenticity verification	Verification	The product bought in store contains an NFT or a stitched-in QR code to verify authenticity.	2.67	4.13	3.40
Community membership	Community building	Creating a community of people with shared interest who support each other and rely on each other. This can happen over token-gated access, on Discord or Telegram. Free channel might be offered for non-token holders, too.	2.33	4.00	3.17
Brand-inspired avatars, PFPs	PFPs	An NFT collection related to the brand (e.g., including its logo) can be used as profile pictures.	3.67	2.63	3.15
Avatars dressed in the customers' own clothes	Metaverse	The NFT that the customers receive additionally to the physically purchased product can be worn on their avatar in the metaverse.	3.00	3.00	3.00

Name	Category	Description	Budget friendliness	Customer demand	Average
Gaming skins and NFTs	Gaming	Offer NFTs or game skins in gaming environments.	2.33	2.75	2.54
Digital dressing room	Digital fashion	Offering the possibility for customers to try on clothes online, take pictures of them, post them on social media and buy the products if they like them.	1.67	3.13	2.40
Train-to-earn	Play-to-earn	Customers can earn tokens by doing sports. These tokens can be burnt for advantages.	not rated	4.38	not rated
Have a say, profit from your vote	Utility	Customers that vote on projects receive tokens that give them early access when the project is realised thus motivating them to get involved.	4.33	not rated	not rated
Fashion week VIP access	Utility/Event access	Token holders can gain access to fashion week shows.	4.00	not rated	not rated
Play-to-earn	Play-to-earn	Customers can earn money by playing games. These tokens can be burnt for advantages.	not rated	3.88	not rated
NFT with physical product	Product	25% of the customers are more likely to buy an NFT if a physical product is offered with it. Thus, even though the NFT is the main product, a physical product will be offered with it.	3.67	not rated	not rated
Arts collection	Arts	Creating an arts collection, music event, or movie in collaboration with an artist that has similar target customers as the brand has.	3.67	not rated	not rated
Sustainable choices	Sustainability	Blockchain solutions sometimes need a higher energy input than usual projects without this technology. In case of an environmentally-focused brand, it is necessary to evaluate how to compensate the negative effects of the blockchain technology on the environment. It could be analysed how high the electricity consumption per transaction, and the yearly carbon footprint of networks are, before choosing your platform.	3.33	not rated	not rated
Private program with the team	Utility	The token holder has the right to spend four hours with the founder and participate in different kinds of programs: breakfast, lunch, dinner, sketching lesson, walking in the park, shopping, mentor meeting, visiting headquarters, game, workout, sports, etc.	not rated	3.25	not rated
Payment in cryptocurrency in web shops	Payment	Customers can pay in cryptocurrency in web shops.	not rated	3.25	not rated

Name	Category	Description	Budget friendliness	Customer demand	Average
Payment in cryptocurrency at local shops	Payment	Customers can pay in cryptocurrency at local shops.	not rated	3.13	not rated
Evolving NFT	Customer loyalty	Customers can collect points or tokens with each purchase thus evolving their NFT. When the NFT reaches its final form, it gives permission to special offers (e.g., from a baby to a grownup, from puppy to dog).	2.67	not rated	not rated
External metaverse events	Metaverse	Showcasing the brand and its collection at metaverse events organised by other enterprises.	1.67	not rated	not rated
Building an own game	Gaming	Building an own game related to the brand thus communicating the values, vision, mission of the brand and offering joy for the customers.	1.67	not rated	not rated
Metaverse store	Metaverse	Buying virtual land in the metaverse and building own store to present products to the customers and provide experience.	1.33	not rated	not rated
AR fashion collection	Digital fashion	Customers can send a photo of themselves and choose which products they would like to wear. The platform dresses them into those clothes without providing a physical product.	1.33	not rated	not rated
Collaboration with another brand	Partnerships	Collaboration on an NFT/metaverse/blockchain project with another brand that has different customers; thus, both brands can widen the group of customers and increase brand awareness.	not rated	not rated	not rated
Unexpected partnerships	Partnerships	Unexpected partnerships are innovative and raise the customers' awareness.	not rated	not rated	not rated
Collaboration with an NFT project	Partnerships	Collaboration with an already existing NFT project. This monetisation model might be interesting for NFT holders as being the owner, they hold the rights (e.g., the NFTs could be used as print for a fashion collection).	not rated	not rated	not rated
Event in metaverse	Utility/Event access	Building direct connection to the brand through an event in the metaverse thus offering a brand experience and communicating the mission and vision.	not rated	not rated	not rated

Source: own compilation, 2022

### 9.3.1. The evaluation of the hypothesis

At the beginning of this part of the research, the following hypothesis was defined:

**H4: A list of potential Web3-based projects can be created and evaluated by customers regarding their interests and by blockchain developers regarding the implementation costs.**

In H4, I claimed that potential projects can be compared on a measurable way against each other thus providing guidance to fashion companies to know which projects have the best fit for their needs. With merging information from the quantitative customer survey and the blockchain developers' qualitative survey, I could rank the potential projects and present these findings in *Figure 31*. Based on the outcome, I could conclude that H4 can be accepted, and I formulated the following thesis:

**T4: A list of potential Web3-based projects can be created and evaluated by customers regarding their interests and by blockchain developers regarding the implementation costs.**

### 9.4. The limitations of the research

Although the table provides a quick overview of the customer demand and the estimated budget, it is important to note that variations may occur based on the customer base of each brand. In this research, different nationalities and genders were represented. If a brand develops and sells products exclusively locally or merely for one gender, the customers' desires might differ from the presented recommendation. Therefore, it is suggested that brands should conduct market research during their idea generation and validation phase and obtain the customers' opinions before implementing the project.

Additionally, it is worth mentioning that the budgets can vary greatly depending on the implementing developer. If the company has more experience in the field, they can usually perform the tasks faster, and clients can benefit from this, as well. Choosing international developers impacts the budget as the pricing of the company depends strongly on where they are located.



## **10. PRIMARY RESEARCH 3: QUANTITATIVE RESEARCH AMONG APPAREL COMPANIES**

### **10.1. The aim of the research and the hypothesis**

In this part of the research, I want to find out what the attitude of textile companies is towards the Web3 technologies. Thus, it was investigated how high their willingness to implement the technologies is and which factors hold the companies back from the implementation.

The following hypotheses and research question were evaluated:

**Q5:** What is the attitude of textile SMEs towards Web3 technologies and solutions?

**H5:** Although leading apparel brands are currently experimenting with Web3 technologies, small and medium-sized enterprises (SMEs) have not implemented such projects yet.

**H5.1:** The percentage of the companies planning to integrate NFTs into their business is less than 40%.

**H5.2:** The percentage of the companies planning to integrate blockchain technology into their business is less than 35%.

**H5.3:** The percentage of the companies planning to integrate metaverse into their business is less than 30%.

### **10.2. The design of the questionnaire**

The survey consists of two parts. In the beginning, the statistical data of the participating companies were collected. Thus, their year of foundation, the location of their headquarters, and the total number of employees were asked. The next part of the research focused on understanding and capturing the attitude of textile companies towards Web3 technologies. The respondents (i.e., representatives of the participating companies) had to indicate which of the listed technologies they had already used in their business practice, what held them back from integrating Web3 technologies, and how much they would be willing to pay for the integration of each technology. In the form of open questions, the respondents were asked to indicate what disadvantages and benefits they would expect from a Web3-based project if they were to implement any.

The sampling took place between 12 October 2022 and 21 October 2022. The questionnaire was built with the Google Forms survey software, and it can be found in *Appendix 8*.

### 10.3. The methodology of the data collection and processing

The survey was distributed through direct e-mails to potential survey participants. For this purpose, 376 companies were contacted by direct e-mails and invited to participate.

The list of the companies was partly obtained from the address list of Swiss Textiles, partly from the website Not just a Label, as well as from the list of the companies of Blickfang.

Out of the 376 contacted companies, 33 participated in the research, which corresponded to a response rate of 8.78%.

The following analytical procedures were used for data analysis:

- Descriptive statistics to present the empirical data clearly through tables and graphs,
- One sample Z-test for proportion to determine whether an assumed difference in means between the sample and the population can be rejected by drawing inferences from the sample data (Kumar, 2022).

In the questionnaire outlined in *Appendix 8*, the experiences and perspectives of Swiss and Hungarian clothing companies on various Web3 technologies were surveyed. To comprehend the variances and commonalities between companies of different origins and sizes, the survey probed multiple dimensions by using a mixture of open and closed questions, where each served distinct purposes.

Questions 1-3 sought foundational company background data involving an open question and multiple-choice questions, as well. In Question 3, an ordinal scale was applied, where the variable (i.e., the number of employees) was categorised into ordered groups. These facilitated baseline understanding and potential segmentation of the data during analysis. Question 4 employed a nominal scale by providing categories without intrinsic order, yet it allowed discerning the engagement level of the companies with several technological domains. This multi-item measure of categorical data offered a nuanced view of the stance towards different technologies. The open question format in Question 5 enabled the collection of qualitative data. It encouraged the respondents to share details that pre-set answers might not capture thus offering depth and potential exploratory findings, too. Question 6 utilized a Likert-type scale ranging from 'Not at all' to 'To a large extent', albeit with the inclusion of a 'I cannot judge' category. This accommodated the respondents' potential unfamiliarity with certain aspects, but its inclusion in a typical 3-point Likert scale warranted considerations regarding the data interpretation. Question 7 was an open question, which emphasised qualitative data collection to unravel the motivation of companies.



## **10.4. The findings of the research**

### **10.4.1 The general statistical characteristics of the sample**

Out of the 33 respondents, 10 companies were in Hungary, 19 in Switzerland, three in Germany, and one in Austria. Companies with 1-19 employees were the most represented in this research, they made 66.67% of all participants, followed by enterprises with 20-49 employees that made 15.15% of the research participants. Merely two companies, making 6.06% of the total, had 50-99, as well as two companies had 100-249 employees. Additionally, there were two companies with 250-499 employees, as well.

### **10.4.2. The participants' responses related to Web3 activities**

The next part of the research focused on the use of Web3-based technologies. It was examined whether particular technologies had already been used by the companies. The insights are visible in *Appendix 9*.

Some of the respondents, namely between 3.03% and 18.18% (i.e., depending on the technology), did not know the terms. The term NFT was the least known, and artificial intelligence was known by most of the respondents.

Many technologies - between 57.58% and 75.76% depending on the project - had not been planned for implementation by the companies. Metaverse projects were the least planned by companies with 75.76% refusing them, which was followed by virtual reality and artificial intelligence with 72.73% for each. The respondents were most interested in NFT projects with merely 57.58% clearly stating that they had not realised any project in the area of NFTs yet, nor they were planning to do so.

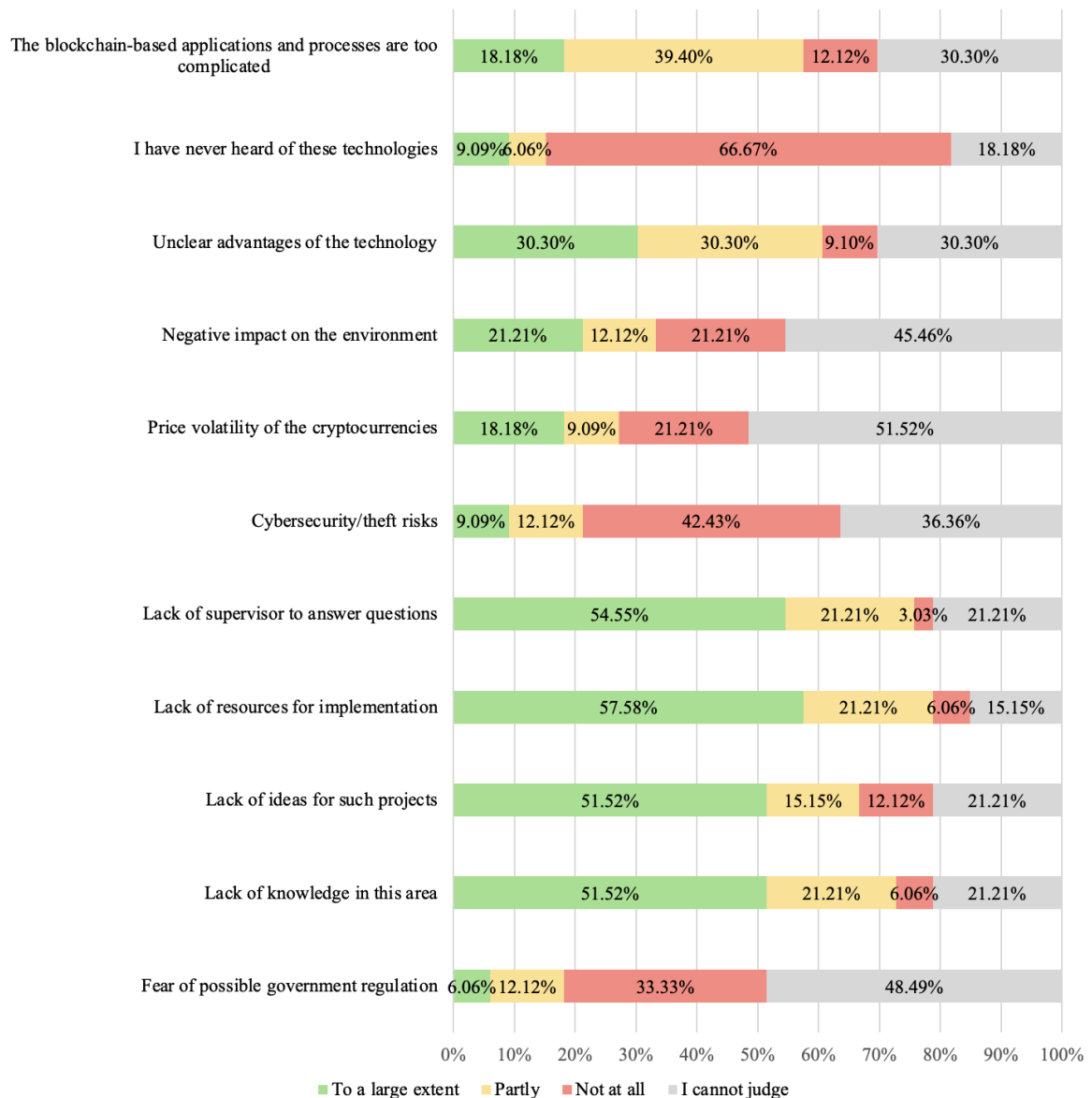
Some participants (3.03% for each) had realised a project in the areas of drones, robotics, IoT, 3D printing, and blockchain, and several projects in the areas of augmented reality and virtual reality. However, they indicated that they did not plan any more projects internally in these areas. For the area of artificial intelligence, projects had been realised by 6.06% of the respondents, and they intended to realise more projects in this area, too.

Interesting insights could be gained from the indication of which projects had not been realised by companies but were planned to be integrated. Here it was visible that 24.24% of the respondents had not implemented NFT projects yet but intended to integrate this technology soon. Additionally, this statement was valid for 18.18% of the companies for each of the following technologies: drones, robotics, IoT, 3D printing, blockchain, artificial intelligence, and virtual reality. Projects for metaverse and augmented reality were planned to be realised by 15.15%.

Not solely the readiness for Web3 project integration was examined in this research section, but the reasons holding companies back from implementing the technologies, as well.

The reason for not offering any Web3-based product or service was that they lacked resources for the implementation as indicated by 57.58% of the respondents with the expression "to a large extent". It was followed by 54.55% voting for the lack of supervisors to answer questions if they needed help during the implementation process. 51.52% stated both lack of ideas for such projects and lack of knowledge in this field.

The participants indicated that it was not a reason for the non-implementation that they did not know the technologies (66.67%) or that they were afraid of cybersecurity or theft risks (42.43%). The respondents could not accurately assess the following points as a reason: the price volatility of cryptocurrencies, the fear of possible government regulation, and the negative impact on the environment. These findings are demonstrated in detail in *Figure 32*.



**Figure 32 The reasons holding companies back from implementing Web3-based technologies**

Source: own compilation, 2022, n=33

#### 10.4.3. The evaluation of the hypotheses

At the beginning of this quantitative research, I defined four hypotheses. The findings regarding these statements are presented in the following paragraphs.

**H5: Although leading apparel brands are currently experimenting with Web3 technologies, small and medium-sized enterprises (SMEs) have not implemented such projects yet.**

In H5, I claimed that there are no implemented Web3 projects by textile companies. This hypothesis could be answered based on the research results connected to the three following hypotheses. As it was visible, there were implemented projects – although they were not common for the research participants. Thus, I could not accept this hypothesis and rejected the following thesis:

**T5:** Although leading apparel brands are currently experimenting with Web3 technologies, small and medium-sized enterprises (SMEs) have not implemented such projects yet.

**H5.1: The percentage of the companies planning to integrate NFTs into their business is less than 40%.**

H0: P1=0.4

H1: P<0.4

The proportion of the respondents planning to implement NFTs was  $p^{\wedge}=8/33=0.2424=24.24\%$

As the sample size was  $n>30$ , which was considered as a large sample, the one-sample z-test could be used. *Formula 2* visualises the calculation:

$$z_0(P_0) = \frac{p - P_0}{\sqrt{\frac{P_0 * (1 - P_0)}{n}}} = \frac{(0.2424 - 0.4)}{\sqrt{\frac{0.4(1 - 0.4)}{33}}} = \frac{-0.1576}{\sqrt{0.007272}} = \frac{-0.1576}{0.08528} = -1.8480$$

**Formula 2** The calculation for one-sample z-test for NFT integration

The critical value ( $z_{crit}$ ) at  $\alpha=0.05$  was -1.6449.

$z_0 < z_{crit}$ : Thus,  $H_0$  could be rejected. It could be stated at a confidence level of 95% that the rate of those companies planning to integrate NFTs into their business in the population was less than 40%.

Based on this outcome, I could conclude that H5.1 can be accepted, and I formulated the following thesis.

**T5.1:** The percentage of the companies planning to integrate NFTs into their business is less than 40%.

**H5.2: The percentage of the companies planning to integrate blockchain technology into their business is less than 35%.**

H0: P1=0.35

H1: P<0.35

The proportion of the respondents planning to implement blockchain technology was  $p^{\wedge}=6/33=0.1818=18.18\%$

As the sample size was  $n>30$ , which was considered as a large sample, the one-sample z-test could be used. *Formula 3* visualises the calculation:

$$z_0(P_0) = \frac{p - P_0}{\sqrt{\frac{P_0 * (1 - P_0)}{n}}} = \frac{(0.1818 - 0.35)}{\sqrt{\frac{0.35(1 - 0.35)}{33}}} = \frac{-0.1682}{\sqrt{0.006894}} = \frac{-0.1682}{0.08303} = -2.0258$$

**Formula 3 The calculation for one-sample z-test for blockchain integration**

The critical value ( $z_{crit}$ ) at  $\alpha=0.05$  was -1.6449.

$z_0 < z_{crit}$ : Thus,  $H_0$  could be rejected. It could be stated at a confidence level of 95% that the rate of those companies planning to integrate blockchain technology into their business in the population was less than 35%.

Based on this result, I could conclude that H5.2 can be accepted, and I formulated the following thesis.

**T5.2:** The percentage of the companies planning to integrate blockchain technology into their business is less than 35%.

**H5.3: The percentage of the companies planning to integrate metaverse into their business is less than 30%.**

H0: P1=0.30

H1: P<0.30

The proportion of the participants planning to implement metaverse solution was  $p^{\wedge}=5/33=0.1515=15.15\%$

As the sample size was  $n > 30$ , which was considered as a large sample, the one-sample z-test could be used. *Formula 4* visualises the calculation:

$$z_0(P_0) = \frac{p - P_0}{\sqrt{\frac{P_0 * (1 - P_0)}{n}}} = \frac{(0.1515 - 0.30)}{\sqrt{\frac{0.30(1 - 0.30)}{33}}} = \frac{-0.1485}{\sqrt{0.00636}} = \frac{-0.1485}{0.0798} = -1.8609$$

**Formula 4 The calculation for one-sample z-test for metaverse integration**

The critical value ( $z_{crit}$ ) at  $\alpha=0.05$  was -1.6449.

$z_0 < z_{crit}$ : Thus,  $H_0$  could be rejected. It could be stated at a confidence level of 95% that the rate of companies planning to integrate metaverse solutions into their business in the population was less than 30%.

Based on this outcome, I could conclude that H5.3 can be accepted, and I formulated the following thesis.

**T5.3:** The percentage of the companies planning to integrate metaverse into their business is less than 30%.

### 10.5. The limitations of the research

A limitation of the study was the low number of participants in the survey as merely 33 companies participated in the questionnaire. In addition, most of the participating companies were small and medium-sized enterprises. Therefore, the results rather apply to small and medium-sized companies alone and not to large corporations.

## 11. CASE STUDY: LIL MIQUELA

### 11.1. The aim of the research and the hypothesis

In an era marked by rapid technological evolution, it is hard to ignore the transformative forces of the Web3, metaverse, avatars, AI, and synthetic media. AI-generated virtual celebrities, exemplified by entities like Lil Miquela, further underscore the urgency to understand and critique this digital transformation.

The aim of the case study is to assimilate and critically examine AI-generated virtual celebrities and to construct a comprehensive analysis of Lil Miquela by undertaking a year-by-year dissection of her while emphasising pivotal events, brand affiliations, musical ventures, and other notable endeavours. Analysing Lil Miquela's trajectory offers insights into the real-world implications, challenges, and opportunities of synthetic media entities in the evolving digital milieu.

Given these goals, current study seeks to address the following overarching question and hypothesis:

**Q6:** What are the most significant deals or partnerships that Lil Miquela has announced or showcased on her Instagram?

**H6:** The most significant deals or partnerships showcased by Lil Miquela on her Instagram are likely associated with high-profile brands in the fashion, music, and technology sectors, which align with her digital persona's key areas of influence and engagement.

### 11.2. The methodology of the data collection and processing

Takács (2017) suggests that new, emerging phenomena and long-term social changes can be ideal research subjects for case studies. This is why the case study of Lil Miquela, an AI-generated virtual celebrity, is considered as a particularly appropriate topic.

Yin (2013) posits that beyond addressing the “what” in research questions, case studies should probe deeper dimensions like the “why” and “how”. According to Yin's classification, there are three distinct types of case studies: exploratory, explanatory, and descriptive. When a researcher faces intricate causal scenarios that may be beyond the reach of conventional surveys or experiments, the explanatory approach proves to be invaluable. Conversely, exploratory case studies are best suited for circumstances where the outcomes related to the subject of the study are not well-defined, or they are multifaceted. In Yin's view, descriptive case studies concentrate on providing a detailed account of an event in its authentic context. Regarding Kowalik and Tóth (2013), a descriptive case study

encompasses a full description of a phenomenon, and the conducted case study falls into this category.

The primary platform for data extraction was the Instagram page of Lil Miquela given its centrality in her digital life, and Instagram is the medium through which her persona primarily engages with the audience.

Further secondary sources encompassed industry reports, articles, press releases, case studies, and information available on the websites of associated brands.

The approach to the year-by-year analysis was structured and detailed as follows. Each year of Lil Miquela's Instagram presence was treated as a distinct unit of analysis. This meticulous approach ensured that evolving trends, significant events, and shifts in engagement patterns were captured. While traversing the digital timeline, pivotal moments, such as magazine interviews, cover shots, song releases, and personal events, that could influence her digital persona's relatability were documented. Special attention was dedicated to those posts that demonstrated brand endorsements with a focus on instances where the brands were explicitly tagged. This allowed for a clear mapping of her collaboration history, understanding the brands associated with, and discerning patterns in her brand collaboration strategy. Additionally, those posts that highlighted Lil Miquela's support for various causes, be it raising awareness or direct calls for donations, were collated, too. This step aimed to discern the depth of her social responsibility narrative and its alignment with broader societal concerns. An in-depth exploration of her "private life" occurrences was undertaken to understand the character-building elements that make her relatable to her audience. By employing this methodological approach, the aim was to derive a nuanced understanding of Lil Miquela's digital journey, partnerships, influence on and off the platform, and her overarching narrative strategy.

### **11.3. The findings of the research**

#### **11.3.1. AI-generated virtual celebrities**

Virtual influencers, also referred to as virtual personas, digital influencers, AI influencers, or CGI influencers, are fictional computer-generated characters designed for various marketing-related activities. Most of these influencers are created by using the sophisticated techniques of the synthetic media, such as motion capture, computer graphics, and AI tools, enabling them to replicate human behaviours in realistic settings (Eliçık, 2022; Nguyen, 2023). Although these influencers are not yet fully autonomous AI entities, they are poised to make that transition in the near future (Eliçık, 2022). As these personas increasingly



interact with the world from a first-person perspective, they offer unique engagement opportunities for brands and audiences alike (Nguyen, 2023).

Though virtual influencers might seem like a product of recent technological advancements, the concept is not entirely new. Kyoko Date, a virtual Japanese popstar, emerged in 1996 (Nguyen, 2023). Today, the proliferation of virtual influencers owes much to the technological breakthroughs, which allow for more realistic and customisable avatars. On such platforms as Instagram and YouTube, virtual influencers or VTubers as they are called on YouTube, are garnering more and more attention. An instance of early VTubing can be traced back to 2011 with YouTuber Ami Yamato using a 3D animated avatar (Rozema, 2022).

There are currently over 150 virtual influencers online with some amassing millions of followers (Eliacıık, 2022; Kuch, 2022). The high degree of customisation offered by the virtual influencer technology ensures that they can be tailored to appeal to specific target audiences (Nguyen, 2023). Notably, in Asian markets, virtual influencers have become major marketing tools. For example, research indicates that nearly two-thirds of the Chinese Internet users follow computer-generated celebrities (Kiger, 2023).

The creation and management of virtual influencers often involve teams of 3D artists, AI experts, and strategists. These creators meticulously design the influencer's appearance, personality, interactions, and content shaping them to align with the desired branding or marketing objectives. The earnings garnered by virtual influencers from collaborations and endorsements go to the companies or creators behind them (Mosley, n.d.).

With the maturation of AI technologies, there is a growing emphasis on making virtual influencers more and more interactive. For instance, Serah Reikka, a semi-autonomous AI, evolves based on algorithms and can generate content, albeit at a slow pace for now (Kiger, 2023). As these technologies advance, real-time interactions between virtual influencers and humans may become a reality thus potentially reshaping online engagement paradigms.

There are three predominant categories of virtual influencers: Non-humans, animated humans, and life-like CGI humans (Nguyen, 2023).

Virtual influencers offer a fresh approach to branding and outreach carrying unique advantages that reshape the world of influencer marketing. Here is an overview of the benefits they bring:

- **Reputation Control:** Virtual influencers are not susceptible to scandals, as seen with such celebrities as Wang Leehom and Kris Wu. They offer a risk-free avenue for

brands since they operate solely based on computer-generated imagery (Eliacıık, 2022).

- **Engagement:** In the US, 58% of those surveyed in the study of Molenaar (2022), were following a virtual influencer thus indicating a strong market presence. Notably, virtual influencers are reported to have three times the engagement rate of human influencers.
- **Cost-Effective:** Virtual influencers, such as Lil Miquela, offer attractive rates for brands in comparison to real influencers, who can charge exorbitantly for a single post (Nguyen, 2023).
- **Adaptability and Wide Reach:** Virtual influencers do not age, they can be programmed in multiple languages, and they have found acceptance in high-profile brand campaigns and celebrity engagements. Their digital nature allows them to reach and appeal to broader audiences. For instance, 54% of the consumers from the UK find virtual influencers appealing (Mosley, n.d.; Nguyen, 2023).
- **Flexibility and Control:** Brands benefit from the increased flexibility and control of virtual influencers. Errors can be quickly rectified without the complexities and delays associated with human errors (Mosley, n.d.).
- **Brand Opportunities:** Virtual influencers offer brands flexibility, brand safety, and innovation. They can be present anywhere, uphold brand values without controversies, and cater to younger audiences, who appreciate tech-savvy presentations (Rozema, 2022).
- 

While virtual influencers present numerous advantages, they are not without challenges. Brands diving into this new frontier should be cognisant of the potential pitfalls. Here is a closer look at the potential threats and concerns surrounding virtual influencers:

- **Authenticity and Trust Issues:** Collaborating with virtual influencers presents authenticity challenges. Since virtual influencers cannot physically test products, they might not be perceived as genuine as human influencers. Research shows that solely 12% trust a virtual influencer as much as or more than a human influencer with varying degrees of trust influenced by the context.
- **Human Touch:** In case of virtual influencers, there is a potential lack of human touch, which can affect brand loyalty. Consumers might be limited in the depth of relationships they can form with non-human entities.

- Social Issues Engagement: While people prefer seeing virtual influencers support social causes, merely a small percentage would actually engage in them. (Rozema, 2022)

The realm of virtual influencers is expansive and continuously evolving. Given the sheer number of these digital personalities, it is outside the scope of this research to examine the profile of each. However, to provide some perspective, the most significant virtual influencer accounts based on their follower numbers as of September 26, 2023, were analysed. The findings are shown in *Table 10*.

**Table 10 The most significant virtual influencer accounts**

	Year of creation	Creator	Origin	Instagram	Follower counts on Instagram	Category
<i>Nobody Sausage</i>	2020	Kael Cabral	Portugal	@nobodysausage	7.4 Mio.	Non-human
<i>Lu do Magalu</i>	2009	Magazine Louisa	Brazil	@magazinluiza	6.5 Mio.	Life-like CGI human
<i>Barbie</i>	1959	Ruth Handler, Mattel	USA	@barbie	3.6 Mio.	Animated human
<i>Lil Miquela</i>	2016	Brud	USA	@lilmiquela	2.7 Mio.	Life-like CGI human
<i>Janky &amp; Guggimon</i>	2019	Superplastic	USA	@jankyandguggimon	1 Mio.	Non-human
<i>Any Malu</i>	2015	Combo Estúdio	Brazil	@anymalu_real	614 Tsd.	Animated human
<i>Thalasya Pov</i>	2018	Magnavem Studio	Indonesia	@thalasya	462 Tsd.	Life-like CGI human
<i>Anna Cattish</i>	2011	-	Russia	@anna_cattish	462 Tsd.	Animated human
<i>Imma</i>	2018	Modeling Cafe	Japan	@imma.gram	398 Tsd.	Life-like CGI human
<i>Kyra or Kyraonig</i>	2022	Himanshu Goel	India	@kyraonig	248 Tsd.	Life-like CGI human
<i>Hatsune Miku</i>	2007	Crypton Future Media	Japan	@colorfulstageen	246 Tsd.	Virtual singer animated human
<i>Shudu</i>	2017	Cameron-James Wilson, The Digital	England	@shudu.gram	241 Tsd.	Life-like CGI human
<i>Bermuda</i>	2016	Brud	USA	@bermudaisbae	240 Tsd.	Life-like CGI human
<i>Blawko</i>	2016	Brud	USA	@blawko22	129 Tsd.	Life-like CGI human
<i>Zoe Dvir</i>	2019	Zoe01	Israel	@zoedvir	25.4 Tsd.	Life-like CGI human

Source: (Rasmussen, 2022) (*The Rise of Imma*, n.d.) (Mosley, n.d.) (Product Innovation, 2019) (*Who Is Anna Cattish?*, n.d.) (*Who Is Nobody Sausage?*, n.d.) (*Who Is Janky?*, n.d.) (*Who Is Any Malu?*, n.d.) (Nguyen, 2023)

The following is an empirical examination of the influencer landscape on Instagram, delineating the impact and engagement of life-like CGI influencers in relation to human influencers. The objective is to discern the operative dynamics of influencer efficacy with respect to audience engagement metrics.

The sample selection was predicated on activity levels, excluding CGI influencers without postings in the current year to ensure contemporaneity and relevance. The remaining CGI influencers'—Lu do Magalu, Lil Miquela, Imma, Kyraonig, and Shudu— Instagram feed posts were analyzed alongside human influencers Nicole Warne and Xenia to furnish a comparative baseline. The inclusion criteria for human influencers encompassed a parallel follower count to the selected CGI influencer, Lil Miquela, to facilitate a controlled comparison.

Lu do Magalu's digital strategy is characterized by a high volume of content, with 695 posts in 2023. This prolific content production has not diluted audience interaction, as evidenced by the accumulation of over 12 million likes within the same timeframe. The highest engagement rate that she reached with one of her posts is 12.63%. On the other hand, Kyraonig's content has achieved a high engagement rate, with the highest engagement rate of 56.22% for one of her posts and with an average of over 2 million views per reel, indicating content that resonates deeply with the audience, potentially due to relevance or innovative presentation.

Nicole Warne and Xenia, both prominent human influencers on Instagram, exhibit distinct engagement profiles. Nicole, with a similar follower count to Xenia and Lil Miquela at approximately 2.3 million, presents a more reserved posting frequency with 107 posts in 2023. In contrast, Xenia's approach is markedly more vigorous, with 321 posts. Despite the lack of complete engagement data for Nicole, her partial metrics suggest a selective posting strategy that garners attention, as indicated by a notable instance of 13600 likes on a single post. Xenia, on the other hand, has generated a substantial volume of interactions, particularly through her reels, one of them achieving over 60 million views. Her content spans various formats, with a significant emphasis on reels, which suggests a strategy tailored to audience preferences for dynamic and narrative content. In essence, while Nicole's engagement strategy could be characterized by a focus on selectivity, Xenia's approach is defined by quantity and diversity, which has proven effective in maintaining high engagement levels on the platform.

In comparison, Lil Miquela's content strategy presents a distinct paradigm. Despite having a larger follower base than both Nicole and Xenia, Lil Miquela's posting frequency is considerably lower, with only 40 posts in 2023 up today. The virtual influencer's approach does not emphasize volume but rather the curated nature of the content, which may hinge on the novelty of her CGI persona. Unlike Xenia, who diversifies her content types, Lil Miquela's posts are less frequent and her engagement data is incomplete, which precludes a direct comparison of engagement rates. However, her significant following suggests a content quality and uniqueness that resonates with her audience, positioning her distinctly in the influencer landscape alongside Nicole's selectivity and Xenia's dynamic content strategy.

The scientific analysis leads to several notable conclusions:

- Influencers such as Lil Miquela demonstrate that strategic content curation and the construction of a virtual narrative can be as significant as frequency in sustaining follower engagement.
- Engagement rates observed in CGI influencers like Kyraonig provide empirical evidence of the potential for high resonance with audiences, challenging the perceived efficacy of human influencers.
- The comprehensive content strategy employed by human influencer Xenia, typified by frequency and diversity, corroborates the effectiveness of a versatile approach to digital engagement.
- The synthetic nature of CGI influencers does not inherently limit their capability to engage audiences. Both the tangible and intangible aspects of influencer identity—such as posting frequency, content quality, and the uniqueness of the persona—emerge as pivotal in determining the success of influencers within the digital ecosystem of Instagram.

**Table 11 Reach of Life-like CGI humans**

	<b>Lu do Magalu</b>	<b>Lil Miquela</b>	<b>Imma</b>	<b>Kyraonig</b>	<b>Shudu</b>	<b>Nicole Warne</b>	<b>Xenia</b>
Followers	6600000	2700000	395000	240000	241000	2300000	2600000
Number of posts in 2023 (Feed)	695	40	72	34	26	107	321
Frequency of posts - weekly	15.1	0.9	1.6	0.7	0.6	2.3	7.0
Frequency of posts - monthly	66.2	3.8	6.9	3.2	2.5	10.2	30.6
Visibility of likes	yes	no	no	yes	yes	partly	partly
All likes received on posts	12023625	hidden	hidden	638177	214178	hidden	hidden
All comments received on posts	242668	hidden	hidden	4146	2098	hidden	hidden
Most likes received on one post	829000	hidden	hidden	134000	24000	13600	3200000
Most comments received on one post	7173	hidden	hidden	925	252	134	6521
Highest likes & comments combined on one post	833595	hidden	hidden	134925	24252	13654	3203749
Best engagement rate	12.63%	cannot be calculated	cannot be calculated	56.22%	10.06%	0.59%	123.22%
Lowest likes & comments combined on one post	365	hidden	hidden	824	840	hidden	hidden
Worst engagement rate	0.01%	cannot be calculated	cannot be calculated	0.34%	0.35%	cannot be calculated	cannot be calculated
Most reel views	11000000	1400000	508000	22400000	0	322000	60500000
All reel views	142285900	1400000	2051000	27982000	0	1862100	142884700
Average views per reel	707890	1400000	157770	2152462	0	74484	1074321
Types of Published Content							
carousel	13	34	40	0	13	78	176
picture	481	5	19	25	13	4	12
reel	201	1	13	9	0	25	133

Source: own compilation, 19.11.2023

Within the digital realm teeming with virtual personalities, Lil Miquela has carved out a unique space for herself. Beginning in 2016 and continuing throughout the years, she embodies a compelling intersection of technology, art, and societal influence. While there are many virtual figures to explore, as visible in *Table 10*, the decision to delve into Lil Miquela's narrative was grounded in her evident prominence. She is not solely an influencer; through her endeavours in music, fashion, and social advocacy, she has become a touchstone for deeper cultural discussions, as well. In the upcoming section of the case study, a year-by-year analysis of the most significant events in her "life" is provided.

### 11.3.2. Year-by-year analysis

#### 2016

In 2016, a peculiar presence that captivated netizens worldwide emerged on Instagram. A new digital entity known as Lil Miquela uploaded her first post on the 27th of April, according to her current first Instagram post (*Miquela (@lilmiquela)*, 2023). The hyper-realistic CGI quality of her posts was instantly notable resulting in an intriguing blend of human-like yet clearly digital characteristics. This uncanny realism incited a flurry of speculation.

Followers and profile visitors clearly stated their confusion in the comment section of her post on 9th of June as well as tried to decipher her nature; many debated the intricate details evident in her features like her hair (*Miquela (@lilmiquela)*, 2023).

This enigmatic presence experienced a swift rise in popularity. Numerous digital platforms reported on her further amplifying curiosity (Dewey, 2016; Ksienrzyk, 2019). As the world speculated about her existence, theories abounded. Some hypothesised that Miquela was an elaborate marketing ploy, while others conjectured that she might be the brainchild of a renowned artist or graphic designer (*Miquela (@lilmiquela)*, 2023).

Thus, Miquela's posts became hubs of active discourse. The comment section was rife with followers voicing admiration for the artistry or expressing confusion about her real vs. virtual dichotomy (*Miquela (@lilmiquela)*, 2023). Moreover, Miquela's digital footprint was not limited to Instagram. Conversations around her spilled over for example into Twitter and TikTok, where she holds accounts, as well.

The year culminated with Miquela's identity still ensconced in mystery. The digital community reached a consensus that she was, undoubtedly, a CGI creation, but the origin, intention, and technology behind her remained hot topics of debate on her Instagram channel (*Miquela (@lilmiquela)*, 2023).

## 2017

In 2017, Lil Miquela's digital persona witnessed significant evolution and multifaceted growth effectively solidifying her position in the virtual domain. On 27<sup>th</sup> of December, she reached the 500.000 follower count (*Miquela (@lilmiquela)*, 2023).

An integral aspect of this progression was her transition into the music scene. Her debut single, "Not Mine", published on Youtube on the 10th of August emerged as a testament to her versatile appeal (*Miquela*, 2017). The piece of music got listed in the Spotify "Fresh Finds" playlist and added to a best of 2017 mix (*Miquela (@lilmiquela)*, 2023). The impact of this musical venture resonated beyond the mere streaming numbers, as it underscored the potential of virtual entities in traditionally human-dominated sectors.

As songwriting is traditionally viewed as an activity exclusive to humans, this topic offered deeper research on the reactions of her audience. To ensure a comprehensive yet manageable dataset, out of the 549 comments available until the 27th of September 2023, every tenth comment was collected for review. It is noteworthy to mention that merely original comments were considered thereby excluding replies to existing comments. This methodological choice led to a final list of 44 comments for detailed analysis. These were subsequently imported into MAXQDA, which is a qualitative and mixed methods data analysis software.

First, a coding scheme was designed to categorize the sentiments in the selected comments. The applied sentiment codes were the followings:

- Positive: Comments expressing approval or appreciation concerning the campaign, representation, or models.
- Negative: Feedback displaying disapproval or critique regarding any element of the post.
- Neutral: Comments being devoid of any discernible sentiment, i.e., either positive or negative.

It was somewhat surprising to note that a substantial 50% of the comments showcased a positive sentiment towards Lil Miquela's announcement. The remaining comments were split between neutral reactions, which constituted 38.64%, and a smaller proportion of negative reactions with 11.36%.

Digging deeper into the content of the comments, a predominant theme that emerged was a direct reference to the music with 47.73% of the comments making some mention of it. The term "autotune" was notably recurrent appearing in nearly 10% of the selected comments.



The majority of these mentions carried a negative connotation suggesting some scepticism or critique about the authenticity of the song production.

What stood out starkly and was unexpected was the absence of criticism towards the very idea of a robot, like Lil Miquela, being involved in music creation. Contrary to potential expectations, the consensus appeared to be overwhelmingly positive reinforcing the idea that the boundaries between technology and traditionally 'human' endeavours are blurred in the eyes of contemporary audiences.

Alongside her musical endeavours, Lil Miquela's influence within the fashion sector burgeoned. As her digital footprint on Instagram grew, so did the attention from eminent fashion brands and the media. She was presented in the Vogue Magazine (E. Chang, 2017) and in the Paper Magazine (Weiss, 2017). Throughout the year, her Instagram profile became a tapestry of fashion endorsements featuring attires from both established and emerging brands, such as Area NYC, Kenzo, and IKEA. While specific brand collaborations from that year are not explicitly mentioned, a closer examination of her Instagram profile from that period provides evidence of her fashion-centric partnerships.

Additionally, she advertised for supporting the Kickstarter campaign of @welcometojuniorhigh, which is a nonprofit art space in Los Angeles. Furthermore, she promoted for @myfriendsplace, which supports homeless youth.

## 2018

In 2018, Lil Miquela's journey further escalated in terms of recognition, collaboration, and emotional depth thus paving path for her to remain a dominant figure in the digital landscape. Early into the year, a notable moment was captured when she shared a frame with @blawko22, i.e., another Brud creation, thus signalling the broader venture of the agency into the realm of digital personalities (*Miquela (@lilmiquela)*, 2023).

Her musical artistry continued to thrive, which is evidenced by the launch of her song "You Should Be Alone" on the 26th of January, further exemplifying the increasing acceptance and popularity of virtual artists in the mainstream entertainment spectrum (*Miquela (@lilmiquela)*, 2023). Additionally, her collaboration with Baauer on "Hate Me", which was launched on the 17th of August, not solely showcased her versatility, but it was met with applause accumulating 1.5 million streams by the 25th of August (*Miquela (@lilmiquela)*, 2023).

The year saw her fashion endorsements reaching new heights. Her association with such brands as Moncler, Diesel, Prada, Maison Margiela, Ambush, and Balenciaga, to name a

few, solidified her status as a virtual fashion icon. A particularly radiant feather in her cap was the partnership with makeup legend Pat McGrath on the 6th of February (*Miquela (@lilmiquela)*, 2023). As the months progressed, her digital showcase was accentuated by features in prestigious magazines such as V Magazine, King Kong Magazine, Highsnobiety, 032c, Wonderland, Opening Ceremony, Vogue, Garage Magazine, and Notion. These publications not merely celebrated her virtual persona but opened dialogues on the intersection of technology, fashion, and human perception, as well.

Simultaneously, 2018 marked a year of significant personal revelations for Miquela. A pivotal event was the hacking of her account by Bermuda in April. The incident culminated in Miquela unveiling her origins confessing Brud's role in her creation. This episode saw Miquela navigating a tumultuous sea of emotions from feelings of displacement to eventual reconciliation with her creators at Brud (*Miquela (@lilmiquela)*, 2023). During this period, her social media posts saw unseen heights regarding comments and likes.

Amidst these emotional waves, Miquela's social circle saw fluctuations, as well. Parallel to her individual trajectory, Miquela's interactions with fellow CGI entities, particularly Blawko, further exemplified Brud's endeavours to craft intricate, human-esque narratives around its creations. In September, Lil Miquela's CGI friend Blawko initiated a romantic chapter with Bermuda, which was merely short-lived concluding in October. These storylines, potentially aimed at enhancing relatability, showcased the synthetic entities navigating the myriad complexities of interpersonal dynamics replete with ebbs and flows. While her digital universe continued to expand, Miquela ensured her platform was a beacon of positive change. She fervently supported causes like @educatedlittlemonsters highlighting the importance of arts for youth; she championed women's rights with Downtown Women's Center and took a stand for immigrant rights in collaboration with @raicestexas. Her advocacy for Planned Parenthood emphasised her commitment to societal well-being (*Miquela (@lilmiquela)*, 2023).

As highlight of the year, the Time Magazine's accolade of including her in the list of "25 Most Influential People on the Internet" alongside luminaries like Shaun King and Rihanna was a testament to her profound influence not merely as a digital creation but as a cultural phenomenon (*Miquela (@lilmiquela)*, 2023).

## 2019

In 2019, the digital landscape saw a monumental convergence of virtual and real-world identities largely driven by the provocative Calvin Klein campaign featuring Lil Miquela. This campaign placed Lil Miquela alongside supermodel Bella Hadid resulting in an evocative and, to some extent, controversial interaction. In a dimly lit blue room, Hadid embodying reality and Miquela, the epitome of digital fabrication, came face-to-face. The culminating “kiss”, framed against Hadid’s proclamation about opening doors to new dreams, was designed to blur the lines between tangible and virtual realities (Miquela, 2019). The reception of the campaign was multifaceted. While many applauded Calvin Klein’s audacity in merging reality with digital innovation, there was significant backlash accusing the brand of “queerbaiting”. This term, rooted in the intentional and often superficial deployment of queer themes to attract audiences, gains significance in a cultural milieu where genuine queer representation remains elusive. This controversy underscored the inherent challenges in navigating representation, identity, and commercial imperatives in the digital age. Calvin Klein’s subsequent acknowledgment and apology illuminated the complexities of such undertakings reiterating the need for brands to approach sensitive subjects with care and authenticity (Petrarca, 2019).

In current research, a content analysis study took place to discern the reactions of the audience to the collaboration between Calvin Klein and Bella Hadid. The specific aim was to determine the acceptance and opinions surrounding this partnership by examining users’ comments on Lil Miquela’s Instagram post. The Instagram post under scrutiny had garnered 1533 comments until the 27<sup>th</sup> of September 2023. These comments were not merely direct remarks about the post but included subsequent discussions among the users (i.e., comments on comments), too. To maintain a feasible sample size while ensuring representation, every 10th primary comment was selected, which resulted in a total of 94 comments earmarked for analysis. These were subsequently imported into MAXQDA to conduct the data analysis.

The sentiments analysis was based on the following three codes similarly to the analysis of the launch of the first song:

- Positive: Comments expressing approval or appreciation concerning the campaign, representation, or models.
- Negative: Feedback displaying disapproval or critique regarding any element of the post.

- Neutral: Comments being devoid of any discernible sentiment, either positive or negative.

Upon coding and analysis, it was observed that many of the comments (46.81%) exhibited a neutral sentiment. Meanwhile, 29.79% of the comments were negative, and 23.40% were positive. Beyond mere sentiment, the data unveiled specific themes in the reaction of the audience.

It was apparent that a significant portion of the audience, nearly 26.60%, found themselves either perplexed or taken aback by the post. This sense of confusion or surprise was vividly articulated through various expressions. For instance, the following remarks provided a tangible sense of bewilderment some users felt: “[...] this sht got weird, [...]”, “I’m confused”, “Weird af” and the intriguingly repetitive “wtf” and “omg”.

Another important thread of conversation centred on Lil Miquela's unique status as a robot. About 13.83% of the comments wondered about it or mentioned it thus reflecting growing awareness and discourse that Lil Miquela is an AI-generated virtual influencer.

User interactions, specifically the act of tagging other users, was a noticeable trend in 20.21% of the comments. Such engagements often lead to expanded reach and virality of posts, which suggests that this particular collaboration received extensive visibility, partly driven by these intra-user interactions.

Interestingly, and perhaps as a testament to the subtleties of modern marketing, solely a minority of the respondents seemed to be attuned to the broader marketing dynamics at play. A mere 7.45% of the comments zoomed out to comment on the underlying marketing strategy of the campaign. For instance, the user @yeah\_gesture insightfully remarked: “Yo, to the people behind Lil Miquela and the people that follow her. This is a deep deep commercial. There are people sucking in all these 'cultural inputs' and spitting out a digital model that's a reflection of you. They're trying to sell you shit through this new influencer that is actually just a giant long con commercial. So fucking gross, so tacky. Please don't buy into this shit. Also, Bella, you're a weirdo for this shit. I know you have taste”.

The comment by @ch1no0o underscored this sentiment by stating, “[...] they build her up now she's a ad”.

This content analysis of the audience reactions to the collaboration with Calvin Klein and Bella Hadid illuminated the complexities of modern audience engagement on platforms like Instagram. While a significant segment of the comments was neutral underlying sentiments and discussions revealed a mix of curiosity, confusion, appreciation, and critique.

Beyond the Calvin Klein moment, Miquela continued to expand her influence in music and fashion. She launched her song “Right back” on the 10th of April, which got remixed several times. Later during the year, another two songs got launched on the 31st of July, which were titled “Sleeping In” and “Money”. In October, she published “Wasted”, which was followed by the song “Automatic” in November.

## 2020

Taking a look at the year 2020, one of the most intriguing developments was the affiliation between Lil Miquela and Creative Artists Agency (CAA), a world-renowned talent agency. Breaking conventional boundaries, CAA formally announced Lil Miquela as its inaugural virtual client (Spangler, 2020). This partnership insinuated potential collaborations across diverse domains, such as TV, film, brand strategy, and commercial endorsements. CAA executive, Adam Friedman, elaborated on this alliance by emphasising the enthusiasm of the agency to aid Lil Miquela in exploring the spheres of television and film (*CGI Influencer Lil Miquela Signs With Talent Agency CAA*, 2020). He further recognised the budding opportunity for avant-garde brands to associate with a digital phenomenon that epitomises cultural relevance.

Dudley Nevill-Spencer, the director and head of data analysis at the Virtual Influencer Agency, offered a future-forward perspective on this alliance. He projected that in the coming half-decade, the representation of virtual influencers by eminent agencies like CAA would become commonplace (*CGI Influencer Lil Miquela Signs With Talent Agency CAA*, 2020). Given the shifting dynamics of influencer marketing amidst such global events as the COVID-19 pandemic, the utility of virtual influencers as consistent brand ambassadors has solely accentuated.

Additionally, Kara Weber outlined Miquela’s remarkable position in the digital landscape. She cited the distinctive opportunities high-fidelity virtual characters like Miquela present, especially in revolutionising content and advertising paradigms (Spangler, 2020).

In November, Brud launched Lil Miquela’s debut NFT, “Rebirth of Venus”, a piece symbolising various potential realities and inspired by Venus, the Roman goddess. This NFT resonating with mythology sold for 159.5 ETH or \$82,361 on SuperRare with proceeds benefiting Black Girls CODE. Subsequently, Brud introduced Lil Miquela’s second collection, which launched in 2021 and comprised 1.500 NFTs (Hiort, 2021).

## 2021

The previous sections of this paper detailed the trailblazing journey of Lil Miquela from her inception by the LA startup Brud to her meteoric rise as a virtual influencer amassing around 3 million followers and partnering with major brands (Whitbread, n.d.). Miquela's success with her unique blend of AI and authentic digital storytelling set a precedent in the industry thus influencing luxury brands to reconsider their traditional advertising methods and embark on new digital adventures (*Prada's Virtual Influencer Is the New "face" of Candy Perfumes*, 2021). While traditionally, brands leveraged A-list celebrities or popular content creators for their campaigns, Prada took a divergent path. In late 2021, Prada revealed a new facet of advertising: integrating high fashion and modern technology with their introduction of Candy, a computer-generated avatar for their renowned perfume (Pesonen, 2022). The core message of the campaign was to "Rethink Reality", which underscores the fusion of the virtual and real worlds in today's digital age (Prada, 2021).

The campaign was brought to life under the direction of award-winning Danish director Nicolas Winding Refn (Pesonen, 2022). He described Candy as a blend of digital innovation and personal philosophy thus emphasising the importance of authenticity in the digital age. This campaign was not merely about showcasing a product but making a statement about the harmonious convergence of reality and the digital realm.

Beyond traditional advertising spaces, Prada ensured that Candy was integrated across various digital platforms, such as Twitch, Snapchat, and TikTok ("3 Brands That Created Virtual Influencers in the Metaverse", 2022). This strategic move appealed to the tech-savvy Gen Z audience capturing their attention in spaces they frequent and resonate with.

However, it is worth noting that while the venture of Prada into the realm of virtual influencers seems revolutionary, it was not their initial foray. In 2018, Lil Miquela took over the Instagram of Prada during Milan Fashion Week providing a glimpse of the potential collaboration between virtual influencers and high fashion ("3 Brands That Created Virtual Influencers in the Metaverse", 2022).

The success of virtual influencers like Lil Miquela has undeniably paved the way for luxury brands to explore innovative digital marketing avenues. The Candy campaign of Prada serves as a testament to this shift, which demonstrates the immense potential of blending traditional luxury branding with cutting-edge technology.

Focusing on the personal development and storytelling of her character, it is not by mere chance that Miquela's creators chose to introduce more personal drama into her life. Virtual influencers are moulded to simulate human experience, replete with emotions, challenges,

relationships, and personal growth. As Miquela's 2018 storyline had her interacting with friends Bermuda and Blawko and confronting her robotic identity, the introduction of a memory-focused narrative in 2021 similarly roots her in human-like experience, too. These stories do not merely add dimension to her character but serve as powerful hooks drawing audiences deeper into her world, as well.

Lil Miquela addressed the challenging idea of celebrating her 19th birthday for the sixth consecutive year on the 7th of June 2021 thus showcasing her existential struggles as an ageless virtual entity. This introduction to her frustration with being perennially “stuck” at 19 reveals her desire to evolve not merely remaining a static digital persona. This move is strategic; by expressing feelings that resonate with human emotions of growth and age, Lil Miquela creates an opportunity for followers to empathise with her.

Lil Miquela's recent journey delving into her “past” with the USB necklace that she receives as a present from her management team, Brud (*Miquela (@lilmiquela)*, 2023), is an ingenious narrative tactic. Though she is eternally 19, this storyline grants her the ability to time-travel; thus, the creators give her the opportunity of growth and evolution, i.e., attributes inherently human.

As part of her throwback-series, Miquela's prior experiences were reintroduced reminding followers of a time when she did not know she was a robot culminating in the revelation of her true nature through a dramatic hacking event by her nemesis, Bermuda. This past incident strengthened her character's depth and provided context for new followers (*Miquela (@lilmiquela)*, 2023).

After this introductory video, she hinted that she would share a baby photo of herself if a post reached 100k likes. This strategy effectively encouraged more interaction on her account, which was beneficial for the Instagram algorithm. On the other hand, it kept her fans eager to see her baby picture soon. After reaching the 100k mark, she posted the baby photo of herself sparking intrigue and garnering significant engagement with over 230,000 likes and more than 2,000 comments on her baby post. This move was brilliant not merely for its unpredictability but for its timing, too – it capitalised on nostalgia, a potent emotional driver. Moreover, the photo raised the question: how can a robot have baby photos if it does not age and is perpetually 19?

This baby photo post became one of the most liked posts. The nature of the post, an ostensible infant image of a non-biological entity, sparked an intriguing juxtaposition of the expected social media norms and the surrealness engendered by virtual influencers. This was the reason why a content analysis was carried out for it. It is noteworthy that solely every

10th original comment was considered thereby excluding replies to existing comments. This methodological choice led to a final list of 41 comments for the detailed analysis.

Based on a meticulous sentiment analysis, it is discernible that the majority of the comments skewed towards neutrality with 51.22% of them displaying a neutral stance towards the post. Meanwhile, positive comments constituted 26.83%, and negative sentiments were evidenced in 21.95% of the comments.

Furthermore, a thematic exploration revealed that nearly a quarter of the respondents, exactly 24.39% of the comments, made references to robots, filters, or Photoshop pointing towards an ongoing curiosity and perhaps scepticism about Lil Miquela's origin and digital composition. This highlights that despite her established presence as a virtual influencer, aspects related to authenticity and "reality" continue to pique the interest and generate discussion of the audience. Surprisingly, almost 20% of the commenters appeared to exhibit confusion thus demonstrating that the conceptual blending of virtual and real worlds remains a complex and somewhat perplexing domain for a portion of the audience.

Contrastingly, over a quarter of the commentators (26.83%) expressed perceptions anchored in adjectives such as "cute" and "adorable" suggesting an acceptance or at the very least, a willingness to engage with the virtual influencer in a manner similar to human influencers. This portion of the audience seemed to navigate through the synthesised reality by suspending disbelief, as well as embracing the character and narrative presented by Lil Miquela.

Brud clarified that Miquela's baby phase was a constructed memory thus demystifying the earlier post but at the same time, adding another layer of complexity to her character. This revelation highlighted the balance between Miquela's digital nature and her "human" experience.

As the next throwback-post, Miquela unveiled an "emo" phase from her "past". This move strategically aligned her with current Gen Z trends (George, 2021; Woodley, 2021) further embedding her within the broader cultural zeitgeist.

Through baby photos and the exploration of different life phases, Lil Miquela transcended her static digital existence. By doing so, she became more relatable to her audience, many of whom had experienced similar phases or can empathise with the nostalgia of looking back. Additionally, she involves her followers in the content creation process by allowing them to decide which memories should be revealed next. She continued posting about her past throughout 2021 thus unveiling core memories to strengthen her connection with the audience (*Miquela (@lilmiquela)*, 2023).



## 2022

After focusing mostly on connecting with her audience and sharing more about her «life», in 2022, a significant collaboration emerged for Lil Miquela as she became the latest ambassador for PacSun, a prominent teen retailer (Schulz, 2022a). This announcement, made on the 12th of August (*Miquela (@lilmiquela)*, 2023), reinforced the ever-increasing fusion of the virtual and physical realms indicating a new era where virtual influencers might just be the next “it-girls”.

PacSun has lately made strategic moves to expand its digital presence and develop its metaverse strategy thus emphasising the current trend of merging the physical and digital spaces. Earlier in the year, the brand had already shown interest in the metaverse by introducing a virtual store and an NFT art collection, which indicated a long-term vision that goes beyond traditional retail (de la Cruz, 2022).

With the aim to amplify its reach among the digital natives of Gen Z, the collaboration of PacSun with Miquela was particularly significant for their back-to-school and holiday collections in 2022. This partnership not merely leverages Miquela’s vast digital influence but aligns with the desire of the brand to resonate with the consumer identities of today’s youth. Brieanne Olson, the president of PacSun, acknowledged Miquela as a “digital muse” while praising her for aligning with the core values and vision of the brand (de la Cruz, 2022; Silberstein, 2022).

The 2022 collaboration with PacSun was Lil Miquela’s re-entry into brand advertising after a brief pause thus adding to her impressive repertoire of previous collaborations with giants like Prada and Calvin Klein. For PacSun, the “beginning of an exciting marketing strategy” involved not solely promoting their merchandise but capitalising on Miquela’s unique appeal to their core demographic exploring the digital space, as well (Silberstein, 2022).

However, this partnership attracted its fair share of controversy, as well. While many lauded the strategic move, there was a segment of the audience that questioned the brand’s choice to opt for a virtual influencer over a real person. Critics highlighted potential negative impacts on young girls’ mental health given the “impossible standards” that such virtual personas might propagate. The debate touched upon deeper societal issues with some suggesting that such CGI models, devoid of real-life flaws, could undermine the values of authenticity and human connection (M. Clark, 2022).

In 2022, not solely could one observe Lil Miquela’s comeback as influencer, but the early indications of the strategy arising from Dapper Labs’ acquisition of Brud on the 4th of

October 2021 began to materialise. This acquisition marked a significant turn instigating a cascade of developments that took fuller shape in the year 2022.

Brud, known for being the creative force behind Lil Miquela, quickly carved out a niche for itself in crafting compelling virtual narratives. The company highlighted the dormant potential of digital personas amidst a swiftly transforming media landscape, gathering millions of followers (Dapper Labs, 2021). While the domain of virtual influencers sustained its upward growth, its intricate integration with decentralised platforms besides Lil Miquela's NFT launches did not gain significant traction.

Conversely, Dapper Labs emerged as the vanguard in popularising NFTs, especially with its flagship initiative, NBA Top Shot. Industry projections suggested that brands were expected to allocate around \$15 billion to influencer marketing in 2022. This emphasises the burgeoning importance of both tangible and virtual influencers (Fernandez, 2021). Seen against this backdrop, the decision of Dapper Lab to acquire Brud was more than a business transaction; it represented a strategic shift aimed at amalgamating virtual influencers with decentralised ecosystems.

To truly understand the rationale behind this decision, statements from the executive team of Dapper Labs have to be considered. Roham Gharegozlou, CEO at Dapper Labs, elaborated on the ambition of the company to diversify Miquela's narrative by pivoting from a centralised corporate governance to a more inclusive community-centric model. Such sentiments echo the historical grievances related to Web 2.0 platforms, wherein creators expressed discontent over inherent constraints and the lack of true data ownership (Fernandez, 2021).

Trevor McFedries, Brud's founder and CEO, consistently voiced his commitment to promoting "community-owned storytelling". By joining forces with Dapper Labs, this vision stood on the cusp of swift realisation, which is enhanced further by the expansive capabilities of the Flow blockchain (Dapper Labs, 2021). Moreover, McFedries' earlier engagements, such as his role in establishing the DAO "Friends with Benefits", underscored his enduring inclination towards decentralised, community-driven endeavours (Matney, 2021).

Following the acquisition of Brud by Dapper Labs, Lil Miquela's digital trajectory underwent a transformative shift seamlessly aligning with the mutual vision that both entities harboured for her virtual persona. As part of this shift, she launched her imminent NFT series termed PFPs (Profile Picture NFTs). These series, designed to encapsulate the multifaceted nuances of her digital identity, represented a consolidation of her virtual journey and experiences (lil miquela [@lilmiquela], 2022).

Alongside the NFT announcement, Dapper Collectives unveiled a glimpse into Villa M, Miquela's new abode within the metaverse. Accessible via her official portal, Villa M was introduced as an all-encompassing digital realm offering enthusiasts exclusive previews of her forthcoming PFP collection and early access privileges. Miquela envisioned Villa M as a space dedicated to collective growth, learning, and forging deeper connections (*Virtual Popstar Miquela To Unveil First Ever PFP NFT Project*, 2022). This PFP initiative was perceived as a mere beginning, a precursor to even grander aspirations within her digital domain. Furthermore, PFP holders could look forward to enriched content and potential access to Villa M (Cowen, 2022).

To further amplify her digital ventures, Miquela took on the mantle of the official host for ComplexLand, an immersive virtual pop culture festival. During this event, she showcased her curatorial expertise by spearheading the official NFT Art Gallery of ComplexLand and offering attendees an additional insight into her emergent Web3 world (Johnson, 2022). Additionally, the event incorporated interactive elements allowing participants to secure access to her exclusive allowlist by engaging with Miquela's statue situated within the NFT gallery (Cowen, 2022).

## 2023

In the calendar year of 2023, Lil Miquela's digital persona continued to interact with both the commercial and artistic sectors, albeit at a more reserved pace than in previous years.

Lil Miquela's association with luxury fashion brands persisted, as evidenced by her collaboration with Alexander McQueen. Specifically, she made two distinct posts that endorsed bags from the fashion house thus suggesting a limited yet pointed promotional endeavour. Furthermore, her digital presence showed subtle associations with brands, such as Haribo, Jarritos soda, Loewe, and Mango. It is pertinent to note that while these brands were tagged in her posts, there were no explicit mentions or extensive elaborations about the products or services offered by them. Such a nuanced approach, often involving tagging without overt mention, is an increasingly observed trend in influencer marketing, hinting at subtle endorsement or association rather than direct promotion.

Lil Miquela's interaction with advanced technological innovations was highlighted when she engaged with the Worldcoin Orb, which is a cryptocurrency project aiming to distribute free coins to everyone on Earth through a unique verification process by using a specialised orb-shaped device to scan individuals' eyes. Although Lil Miquela's digital nature prevented her from being verified by the Orb, she recommended its utility for human users,

encouraging them to explore its functionalities and secure their World ID (*Miquela (@lilmiquela)*, 2023).

In 2023, while Lil Miquela's engagements were fewer compared to previous years, they continued to resonate with the evolving dynamics of influencer marketing and digital interaction within the broader socio-cultural context.

### **11.3.3. The evaluation of the hypothesis**

At the beginning of the research, the H6 hypothesis, which claimed that the most notable partnerships and deals presented by Lil Miquela on her Instagram are predominantly associated with renowned brands in the fashion, music, and technology sectors, was defined. During the in-depth analysis of her Instagram content, it was found that the collaborations indeed revolved prominently around these sectors. In addition, it could be recognised that these partnerships notably bolstered her digital persona's core areas of influence and engagement. Based on these facts, it was concluded that H6 can be accepted, and thus the following thesis could be formulated:

**T6:** The most significant deals or partnerships showcased by Lil Miquela on her Instagram are likely associated with high-profile brands in the fashion, music, and technology sectors, which align with her digital persona's key areas of influence and engagement.

### **11.4. The limitations of the research**

While this research provides insights into the notable partnerships and deals showcased by Lil Miquela on her Instagram, some limitations warrant attention. One of these is that the research methodology was primarily centred on the evaluation of Lil Miquela's Instagram posts. While Instagram is a significant platform, it represents merely a fraction of a broader digital sphere. Moreover, the study did not delve into quantifiable audience reactions, such as likes and comments. By not incorporating these engagement metrics, the research might have missed subtle nuances or the depth of audience acceptance concerning Lil Miquela's deals and partnerships.

Additionally, as posts could be deleted or modified, the Instagram data might not have represented a full account of Lil Miquela's historical partnerships or deals.

Given the outcomes and limitations of current study, it would be beneficial to continue the research. A detailed exploration of specific posts that garnered significant attention,

measured through likes and comments, should be conducted. This would provide insights into the type of content that resonates most with the audience. By employing both qualitative and quantitative methods, future research should analyse the nature of comments on high-engagement posts. A sentiment analysis can shed light on audience reception by unveiling both positive and negative reactions and their potential reasons.



## PART IV

### 12. CONCLUSION

#### 12.1. Hypothesis evaluation

The novel results of current dissertation are the interpretation and presentation of Web3 projects in the textile industry based on existing literature and conducting empirical research. The research allowed companies in the textile industry to get acquainted with existing projects and to find inspiration.

At the beginning of the secondary research, I defined the hypotheses visible in *Table 12*.

**Table 12 Hypothesis evaluation**

Nr.	Hypothesis	Outcome
H1	In the textile industry, there are existing Web3 projects, which are used in various areas and for different purposes in the companies.	Accepted
H2	Although potential customers might not understand the technical background of Web3-based projects, they have ideas for their implementation.	Accepted
H3	There are Web3 projects that the potential customers find exciting.	Accepted
H3.1	The proportion of DACH-located people with a cryptocurrency or NFT is at least 8% higher than the proportion of Hungarians.	Accepted
H3.2	There is a significant correlation between the possession of a cryptocurrency and/or NFT and some of the Web3-based project ideas.	Accepted
H4	A list of potential Web3-based projects can be created and evaluated by customers regarding their interests and by blockchain developers regarding the implementation costs.	Accepted
H5	Although leading apparel brands are currently experimenting with Web3 technologies, small and medium-sized enterprises (SMEs) have not implemented such projects yet.	Rejected
H5.1	The percentage of the companies planning to integrate NFTs into their business is less than 40%.	Accepted
H5.2	The percentage of the companies planning to integrate blockchain technology into their business is less than 35%.	Accepted
H5.3	The percentage of the companies planning to integrate metaverse into their business is less than 30%.	Accepted
H6	The most significant deals or partnerships showcased by Lil Miquela on her Instagram are likely associated with high-profile brands in the fashion, music, and technology sectors, which align with her digital persona's key areas of influence and engagement.	Accepted

Source: own compilation, 2023

In H1, I claimed that in the textile industry, there are existing Web3 projects, which are used in various areas and for different purposes in the companies. With in-depth secondary research, it was found that there are several existing Web3-based projects in the textile industry. These projects could be categorised into the following groups: metaverse, NFTs, digital fashion, traceability, authenticity, and crypto payments. Based on these facts, I could conclude that H1 can be accepted, and I formulated the following thesis:

**T1: In the textile industry, there are existing Web3 projects, which are used in various areas and for different purposes in the companies.**

The next hypothesis was formulated and tested based on qualitative research. In H2, it was claimed that although potential customers might not understand the technical background of Web3-based projects, they have ideas for their implementation. With qualitative interviews, more information was learnt of the potential fashion customers' attitude and could generate a list of ideas that got added to *Table 9*. Based on this outcome, I could conclude that H2 could be accepted, and I formulated the following thesis:

**T2: Although potential customers might not understand the technical background of Web3-based projects, they have ideas for their implementation.**

After this result, the research focused on three hypotheses examined by quantitative research. In H3, it was stated that there are Web3 projects that the potential customers find exciting. With quantitative research, the customers' interests in different Web3-based services and products in the fashion industry were defined, which information was presented in *Figure 31*. Based on the results, I could conclude that H3 could be accepted, and I formulated the following thesis:

**T3: There are Web3 projects that the potential customers find exciting.**

In H3.1, it was claimed that the proportion of DACH-located people with a cryptocurrency or NFT is at least 8% points higher than the proportion of Hungarians.

Based on the conducted two-sample ratio test, I could conclude that H3.1 can be accepted, and I formulated the following thesis:

**T3.1: The proportion of DACH-located people with a cryptocurrency or NFT is at least 8% higher than the proportion of Hungarians.**

H3.2 claimed that there is a significant correlation between the possession of a cryptocurrency and/or NFT and some of the Web3-based project ideas. Based on the applied Chi-square test, it could be detected if there was a relationship between cryptocurrency or NFT holdings and preferred Web3-based offers. I could conclude that there was a significant correlation between the possession of a cryptocurrency and/or NFT and the following factors:

- you can try on apparel items digitally and post the pictures on social media,
- you can use skins and NFTs for gaming,



- you can use NFTs from your favourite brands as profile pictures,
- you can pay in cryptocurrency in web shops,
- you can pay in cryptocurrency at local shops.

Based on this result, I could conclude that H3.2 can be accepted, and I formulated the following thesis:

**T3.2: There is significant correlation between the possession of a cryptocurrency and/or NFT and some of the Web3-based project ideas.**

The most important result of the research is the generation of Web3 pattern cards, which provides textile companies with a list of Web3 ideas with a comprehensive analysis of the customer demand and the implementation costs of these projects. The integration of Web3 projects in the textile industry has not been investigated in this way in the national or international literature yet, and the results are valuable for theoretical and especially practical experts as they can provide a starting point for the implementation of such projects.

In H4, it was stated that a list of potential Web3-based projects can be created and evaluated by customers regarding their interests and by blockchain developers regarding the implementation costs. With merging information from the quantitative customer survey and the blockchain developers' qualitative survey I was able to rank potential projects and present these findings in *Table 9*. Based on the outcome, I could conclude that the H4 can be accepted, and I formulated the following thesis:

**T4: A list of potential Web3-based projects can be created and evaluated by customers regarding their interest and by blockchain developers regarding the implementation costs.**

Furthermore, a survey involving fashion companies based in Hungary, Switzerland, Germany, and Austria was conducted. The analysis of the attitude of textile companies towards Web3-based projects should be mentioned as a novel finding. Up to now, no such research has been conducted to investigate the perception of textile companies towards Web3-based solutions in this region. Therefore, these findings can be seen as novel results. In H5, it was claimed that although leading apparel brands are currently experimenting with Web3 technologies, small and medium-sized enterprises (SMEs) have not implemented such projects yet. This hypothesis could be answered based on the research results from the three following hypotheses. As it is visible, there were implemented projects – although they were

not common for the research participants yet. Thus, I could not accept this hypothesis, and I formulated the following thesis:

**T5: Not only are leading apparel brands experimenting with Web3 technologies, but small and medium-sized enterprises (SMEs) have also implemented such projects.**

In H5.1, it was claimed that the percentage of the companies planning to integrate NFTs into their business is less than 40%. Based on the conducted one-sample z-test, I could conclude that H5.1 can be accepted, and I formulated the following thesis:

**T5.1: The percentage of the companies planning to integrate NFTs into their business is less than 40%.**

H5.2 stated that the percentage of the companies planning to integrate blockchain technology into their business is less than 35%. Based on the conducted one-sample z-test, I could conclude that H5.2 can be accepted, and I formulated the following thesis:

**T5.2: The percentage of the companies planning to integrate blockchain technology into their business is less than 35%.**

In H5.3, it was claimed that the percentage of the companies planning to integrate metaverse into their business is less than 30%. Based on the conducted one-sample z-test, I could conclude that H5.3 can be accepted, and I formulated the following thesis:

**T5.3: The percentage of the companies planning to integrate metaverse into their business is less than 30%.**

At the beginning of the research, the H6 hypothesis got defined that claimed that the most notable partnerships and deals presented by Lil Miquela on her Instagram are predominantly associated with renowned brands in the fashion, music, and technology sectors. During in-depth analysis of her Instagram content, it was found that the collaborations indeed revolved prominently around these sectors. It could be concluded that H6 can be accepted, and thus the following thesis could be formulated:

**T6: The most significant deals or partnerships showcased by Lil Miquela on her Instagram are likely associated with high-profile brands in the fashion, music, and technology sectors, which align with her digital persona's key areas of influence and engagement.**

## **12.2. The new and novel scientific results of the research**

### **12.2.1. Identifying opportunities in key blockchain sub-domains**

In delving into the expansive field of blockchain applications, current research elucidated intriguing findings that extended across five pivotal domains. Presenting these fields furnished businesses and researchers with a foresight into the evolving landscape of digital technologies, particularly blockchain, and its multifarious applications across diverse industries. Therefore, the gained knowledge can guide strategic planning and decision-making processes thus enabling entities to remain agile and adaptive in a dynamically changing digital economy. The five explored fields were the followings:

1. **Metaverse:** The metaverse consists of multiple virtual realities, augmented reality, and the Internet thus providing a transcendent digital universe where users can interact in a seemingly physical way. This research shed light on its potential to create alternative socio-economic ecosystems, nurture virtual communities, and proffer a distinctive platform for interpersonal and business interactions that defy geographical and physical constraints.
2. **NFTs (i.e., Non-Fungible Tokens):** Within the realm of NFTs, the emphasis revolves around redefining digital ownership and establishing tangible value for digital assets. Not merely do NFTs confer verifiable ownership and provenance of digital items through blockchain, but they pave the way for artists and creators to monetise their works in a decentralised manner further reconfiguring the relationship dynamics between creators, investors, and consumers.
3. **Digital Fashion:** Venturing into digital fashion, the emergence of a novel intersectionality between technology and fashion is discerned, where virtual garments and accessories are not bound by physical limitations. This domain introduces a fascinating dynamic that challenges conventional fashion economics, sustainability, and production thus presenting an avant-garde perspective on aesthetics and utility in the digital realm.
4. **Traceability:** The findings in traceability illuminated a path towards enhanced ethical consumption and substantiated sustainability claims. It advocates for a transparent product journey from the origin to the end-user thus ensuring accountability within the production and supply chain processes and concurrently empowering consumers to make informed, ethical purchasing decisions.
5. **Crypto Payments:** Upon exploring crypto payments, it became evident that this sector disrupts traditional financial frameworks by offering an alternative, decentralised

mechanism for transactions. Crypto payments have the potential to dismantle financial barriers providing a more inclusive economic landscape that can accommodate diverse financial participants including those marginalised by traditional banking systems.

### **12.2.2. Web3 Pattern Cards**

The development of Web3 pattern cards, inspired by the St. Galler Business Model Innovation Pattern Cards, offered a possibility of marrying Web3 technologies with innovative project ideation within the fashion industry. Current research successfully collated 38 innovative ideas through a meticulous combination of secondary research works, in-depth qualitative interviews, and brainstorming thus forming a comprehensive set of Web3 pattern cards. These cards, deeply rooted in industrial needs and capabilities, open doors to a wide array of practically implementable Web3-based projects while providing textile brands with a clear and understandable guide through the often complicated technological landscape of Web3 projects.

The dual-pronged approach of involving insights from potential customers and blockchain developers ensures a balanced analysis of each Web3 project by incorporating perspectives of interest and economic viability from varied stakeholders. The involvement of three blockchain developer companies in evaluating the economic feasibility of each project underscores the empirical robustness of the findings. Customer interests were meticulously recorded and incorporated into the evaluation process allowing for a balanced and insightful analysis.

By implementing a comprehensive colour-coded evaluation scheme, the outcomes of current study offer straightforward, intuitive insights into the analysis of budget and consumer demand considerations. The findings, while easily interpretable, offer a substantive analytical depth thus providing fashion brands with immediate, intelligible insights into the feasibility and consumer interest of each project. Moreover, a categorised overview covering various aspects of projects like partnerships, utility, customer loyalty, and payments offers a broad spectrum of insights empowering fashion brands to opt for Web3 projects that align with both financial viability and consumer demographic interests.

Concluding with empirically derived implementation recommendations informed with data on consumer interest and development cost considerations, the research forwards the practical integration of Web3 technologies in the fashion industry. Vital projects, such as "unlimited physical replacement of products," "early access to new collections and

discounts," and "lifetime discount," are highlighted due to their high demand among customers and low anticipated budgetary implications. Thus, these findings provide a concrete bridge from theoretical propositions to actionable pathways granting textile companies a clear path towards innovative practices that are not merely in sync with the consumers' desires but logistically and financially plausible, as well. This research propels the Web3 project integration in the fashion industry while ensuring that the recommendations are not merely innovative but practically, logistically, and financially validated, too.

### **12.2.3. Insights from the phenomenon of virtual influencer Lil Miquela**

From the meticulous exploration of the phenomenon surrounding Lil Miquela and her digital existence, several noteworthy learnings that intertwine technology, economy, and ethics in a digitalised context emerged:

1. **Digital influence:** The compelling economic and social influence wielded by virtual entities substantiated by Lil Miquela's collaborations and social engagement signals a digital transformation where artificial entities can drive tangible impacts in real-world scenarios. It demonstrates that digital personas can indeed sway consumers' behaviour, influence social dialogues, and participate in cultural discourses thereby becoming a legitimate focus of both the business and social sectors.
2. **Marketing paradigms:** Virtual influencers reshape marketing strategies, where the influencers' authenticity is redefined, and traditional influencer marketing paradigms are disrupted. Lil Miquela's successful campaigns and large follower base indicate that virtual influencers may provide novel and potentially more controllable avenues for brand promotions and product placements.
3. **Social advocacy:** The potential for CGI influencers to act as the agents of social change is manifested in Lil Miquela's engagement with various social and ethical issues. Her interactions and positions in social campaigns showcase a nuanced way of message dissemination reaching and influencing a demographic that might be primarily digital-native. It brings forth a model where digital influencers can be potent vehicles for driving social movements and advocacy campaigns.
4. **Ethical considerations:** The phenomenon introduces multifaceted ethical quandaries. While the economic implications are substantial, the ethical aspects related to transparency, authenticity, and accountability in the actions of virtual entities necessitate rigorous scrutiny.

5. Narrative and identity: Virtual entities, beyond being marketing tools, establish narratives and identities that interact with audiences in a unique manner. Lil Miquela's interactions, stories, and developed persona show a unique capability of digital entities to craft narratives and cultivate identities that resonate with and engage audiences.
6. Regulatory framework: The absence of a regulatory framework governing the actions, endorsements, and representations of virtual influencers like Lil Miquela underscores a gap in the legislative and ethical structures of this study. It emphasises an emergent need to explore, develop, and establish guidelines and regulations that account for the novel challenges and implications introduced by virtual entities in current digital and physical realms.
7. Interdisciplinary impact: Finally, Lil Miquela underscores the convergence of technology with various disciplines: marketing, sociology, ethics, and more. It underlines the necessity for interdisciplinary research and approaches to fully comprehend and navigate the impacts and implications of virtual entities across varied domains of societies and economies.

### **12.3. The achievement of the objectives**

The aim of the empirical research was to observe the integration of Web3 technologies in the textile companies from different angles and to determine their potential. On the one hand, it was aimed to collect projects that could be realised by textile companies. On the other hand, I wanted to evaluate if there was a demand for these technologies from the customers' side and what the attitude of the textile companies towards these technologies is. The final goal of the research was to create an overview on which projects would be possible, and their realisation was connected with what effort, and how high their potential for success was.

To reach this purpose, both primary and secondary research was conducted. The secondary research provided already existing Web3-based projects, which could get added to the Web3 pattern cards. Additionally, the qualitative interviews helped in better understanding the potential customers' desires and attitude thus optimising the list of Web3 pattern cards.

After creating the list of potential projects, the focus was on the evaluation of these ideas in form of a quantitative research among potential customers. Thus, the survey participants' desires and preferences could be collected and analysed. Parallel to that, quantitative research was conducted among Swiss and Hungarian textile companies to detect their plans

regarding the projects that were built on Web3-based technologies. As last part of the research, a case study about Lil Miquela was conducted.

The desired goals of the research were achieved, and the results were explained extensively in the dissertation. For the continuation of the research, I have already planned two possible directions, which are explained in the following chapter in depth.

#### **12.4. Recommendations for the continuation of the research**

The research provides comprehensive knowledge in the field of Web3 projects, while the customers' needs and the costs of realisation are analysed, as well. This information is helpful for textile companies as it supports them in finding ideas and creating concepts. However, they do not provide guidance on how to realise these projects. Current PhD dissertation does not offer practical advice on which technologies and developers are needed to realise each project. Therefore, I have already started working on a solution with a blockchain developer, where the best rated projects from *Table 9* are analysed, the project plans for them are created, and the applied technologies are described. In addition, alternatives that can be implemented without programming skills are collected, as well. This should provide assistance for the textile companies to be able to implement more cost-effective alternatives and to gain overview of the whole development process, too. Since these suggestions are still in the elaboration phase, they are not included in this work. They will be published later and made available to textile companies.

As it has already been mentioned in *Chapter 8.5*, the research analyses the customers' needs based on theoretical information from the survey participants. No realised project has taken place; therefore, it has not been analysed by practical examples how well such projects are accepted by the customers. After preparing the project plans and technology stack with the blockchain developer, the next part of the research could focus on implementing some of these projects in practice and analysing them afterwards. Thus, it will be possible to determine exactly how well each project is accepted by the customers and whether there is a real demand for them.





## SUMMARY

Current research addresses the question of how Web3 technologies can be integrated into textile companies.

For this purpose, first an extensive literature research is conducted, where the theoretical background of the innovation management, the textile industry, and the Web3 technologies is investigated. Subsequently, innovations in the textile industry are studied and analysed. During this analysis, a research gap is discovered.

Afterwards, based on secondary research, it is investigated which projects have already been realised in the textile industry. The fashion industry is known for being innovative; thus, it is no surprise that the companies in this area have already been experimenting with concepts based on Web3 technologies. It can be concluded that apparel companies have various projects in the field of metaverse, NFTs, digital fashion, traceability, authenticity, and crypto payments. These projects include both short-, medium-, and long-term actions and offer a mixture of solutions for fashion companies. Additionally, it can be recognised that there is a trend towards a more collaborative way of working through partnerships<sup>6</sup>. These existing projects with a short description are included in the list of Web3 pattern cards.

After the secondary research, qualitative interviews are conducted to gain insights into the customers' potential needs and desires as well as their level of knowledge of Web3 and related technologies. Subsequently, during these interviews, the list of Web3 pattern cards is completed; thus, a collection of 38 ideas from the categories partnerships, utility, product, metaverse, PFPs, gaming, digital fashion, verification, arts, sustainability, customer loyalty, play-to-earn, community building, and payments is made available.

The complete list is then evaluated by potential customers during quantitative research. This makes it possible to identify that the greatest interest from the customers' side is for the following projects in order of interest: unlimited physical replacement of products, train-to-earn: earning money by doing sports, visibility of the life cycle of the product, and early access to new collections and to discounts.

Furthermore, three blockchain developers are asked to analyse the ideas regarding the necessary costs for implementation. After receiving all three ratings, the average of the awarded points is calculated. This information helps textile brands to estimate at the beginning how high the budget for their desired project could be. These experts have labelled the projects lifetime discount, early access to new collections and to discounts, and unlimited

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<sup>6</sup> The research presented in this paragraph will be published in (Paulovics, 2022)

physical replacement of products all equal in terms of budget friendliness and being of the lowest costs.

On average, for both factors, the projects unlimited physical replacement of products, early access to new collections and to discounts, lifetime discount, visibility of the lifecycle of the product, and exclusive drops and products exclusively for token holders performed best in the provided order. Therefore, these projects are recommended for realisation for textile companies.

The next part of the empirical research consists of a quantitative survey among textile companies investigating the use of Web3 technologies by these companies. The participating companies, primarily from Hungary and Switzerland, show limited interests in integrating the new technologies. In particular, they lack resources for implementation and a supervisor who could support them when questions arise. Furthermore, they state that they lack ideas on what kind of projects could be implemented and they do not have sufficient knowledge in this area.

In the last chapter, AI-generated virtual celebrities are examined to provide a comprehensive analysis of Lil Miquela. This analysis involves a year-by-year breakdown, highlighting pivotal events, brand affiliations, musical ventures, and other significant endeavors. Analysing Lil Miquela's trajectory offers insights into the real-world implications, challenges, and opportunities of synthetic media entities in the evolving digital milieu.

The dissertation provides a comprehensive insight into the field of Web3 technologies in the textile industry. The research findings are significant for textile companies because they provide them a basic understanding of the space and offer a wide range of projects that could be integrated into their practice, as well. The research will be continued in the future, and practical examples that can be used for project realisation will be developed.

## ÖSSZEGZÉS

A kutatás azzal a kérdéssel foglalkozott, hogy a Web3 technológiákat hogyan lehet integrálni a textilipari vállalatokba.

Ennek érdekében először széleskörű irodalomkutatást végeztem, ahol az innovációmenedzsment, a textilipar és a Web3 technológiák elméleti háttérét vizsgáltam. Ezt követően a textilipari innovációkat tanulmányoztam és elemeztem. Az elemzés során feltártam a kutatási hiányosságokat, mely a kutatás további részét nagy mértékben meghatározták.

Ezután szekunder kutatómunka keretében megvizsgáltam, hogy milyen projektek léteznek már a textiliparban. A divatipar közismerten innovatív, így nem meglepő, hogy az ezen a területen működő vállalatok már kísérleteznek a Web3 technológiákon alapuló koncepciókkal. Megállapítható, hogy a divatcégek részéről már léteznek különböző projektek a metaverse, a nem fungibilis tokenek (NFT-k), a digitális divat, a nyomon követhetőség, a hitelesség és a kriptofizetések területén. Ezek a projektek rövid-, közép- és hosszú távú intézkedéseket egyaránt tartalmaznak, és a divatcégek számára számos megoldást kínálnak. Ezen túlmenően felismerhető, hogy a partneri kapcsolatokon keresztül az együttműködésen alapuló munkamódszer irányába mutató tendencia tapasztalható. A fent említett kategóriákba tartozó, már létező projektek rövid leírással bekerültek a Web3 Pattern Cards listájára.

A szekunder kutatást követően kvalitatív interjúkat készítettem, hogy betekintést nyerjek az ügyfelek potenciális igényeibe és vágyaiba, valamint a Web3-mal és a kapcsolódó technológiákkal kapcsolatos ismereteik szintjébe. Ezt követően az interjúk során kiegészült a Web3 Pattern Cards listája, így egy 38 ötletből álló gyűjtemény jött létre, amely a partnerség, a szolgáltatás, a termék, a metaverse, a PFP, a játék, a digitális divat, az ellenőrizhetőség, a művészet, a fenntarthatóság, a vásárlói hűség, a play-to-earn, a közösségépítés és a fizetés kategóriáiból állított össze ötleteket.

A teljes listát ezután a kvantitatív kutatás során a potenciális ügyfelek értékelték. Ez lehetővé tette annak megállapítását, hogy a vásárlói oldalról a legnagyobb érdeklődés a következő sorrendben szereplő projektek iránt mutatkozik: a termékek korlátlan fizikai cseréje, train-to-earn: pénzkeresés sportolással, a termék életciklusának láthatósága, korai hozzáférés az új kollekciókhoz és a kedvezményekhez.

Három blokkláncfejlesztőt is felkértem, hogy elemezzék az elképzeléseket a megvalósításhoz szükséges költségekkel kapcsolatban. Mindhárom értékelés beérkezése után kiszámoltam a megítélt pontok átlagát. Ez az információ segít a textilmárkáknak abban,

hogy már kezdetben megbecsüljék, mekkora lehet a kívánt projekt költségvetése. Ezek a szakértők az élethosszig tartó kedvezményt, az új kollekciókhoz és kedvezményekhez való korai hozzáférést és a termékek korlátlan fizikai cseréjét minősítették a legalacsonyabb költségű projekteknek.

Mindkét tényező átlagában a termékek korlátlan fizikai cseréje, az új kollekciókhoz és kedvezményekhez való korai hozzáférés, az élethosszig tartó kedvezmény, a termék életciklusának láthatósága, valamint az exkluzív, csak a token-tulajdonosoknak szóló limitált kollekciók teljesítettek a legjobban, ebben a sorrendben. Ezeket a projekteket tehát javasoltak a textilipari vállalatok által történő megvalósításra.

Az empirikus kutatás következő része a textilipari vállalatok körében végzett kvantitatív felmérésből állt, amely a Web3 technológiák e vállalatok általi használatát vizsgálta. A résztvevők, főként magyarországi és svájci vállalatok, csak korlátozott érdeklődést mutattak a technológiák integrálása iránt. Különösen hiányzott a megvalósításhoz szükséges erőforrás és egy olyan tanácsadó, aki támogatna volna őket, amikor kérdések felmerülnek. Azt is kijelentették, hogy nincsenek ötleteik arra vonatkozóan, hogy milyen projekteket lehetne megvalósítani, és hogy nem rendelkeznek elegendő ismerettel ezen a területen.

Az utolsó fejezetben a mesterséges intelligencia által generált virtuális hírességek vizsgálatára kerül sor, hogy Lil Miqueláról átfogó elemzés készüljön. Ez az elemzés évenkénti bontást tartalmaz, kiemelve a sarkalatos eseményeket, márkakapcsolatokat, zenei projekteket és egyéb jelentős törekvéseket. Lil Miquela pályájának elemzése betekintést nyújt a szintetikus médiaszemélyiségek valós hatásaiba, kihívásaiba és lehetőségeibe a fejlődő digitális közegben.

A disszertáció átfogó betekintést nyújt a Web3 textilipari felhasználásának területére. A kutatási eredmények jelentősek a textilipari vállalatok számára, mert alapvető ismereteket nyújtanak számukra erről a területről, és számos olyan projektet kínálnak, amelyeket be lehetne építeni a gyakorlatukba. A kutatás a jövőben folytatásra kerül, és olyan gyakorlati példák kerülnek kidolgozásra, amelyek felhasználhatók a projektek megvalósításához.

## ZUSAMMENFASSUNG

Die vorliegende Forschungsarbeit beschäftigte sich mit der Frage, wie Web3-Technologien in Textilunternehmen integriert werden können.

Zu diesem Zweck wurde zunächst eine umfangreiche Literaturrecherche durchgeführt, in der der theoretische Hintergrund des Innovationsmanagements, der Textilindustrie und der Web3-Technologien untersucht wurde. Im Anschluss daran wurden Innovationen in der Textilindustrie betrachtet und analysiert. Bei dieser Analyse wurde die Forschungslücke aufgedeckt.

Anschließend wurde anhand von Sekundärforschung untersucht, welche Projekte in der Textilindustrie bereits existieren. Die Modeindustrie ist bekannt dafür, innovativ zu sein, und so ist es nicht verwunderlich, dass Unternehmen in diesem Bereich bereits mit Konzepten experimentiert haben, die auf Web3-Technologien basieren. Daraus lässt sich schließen, dass es bereits verschiedene Projekte von Modeunternehmen in den Bereichen Metaverse, nicht-fungible Token (NFTs), digitale Mode, Rückverfolgbarkeit, Authentizität und Kryptozahlungen gibt. Diese Projekte umfassen sowohl kurz-, mittel- als auch langfristige Maßnahmen und bieten einen Mix aus Lösungen für Modeunternehmen. Darüber hinaus ist ein Trend zu einer stärker kooperativen Arbeitsweise durch Partnerschaften zu erkennen. Diese bestehenden Projekte wurden mit einer kurzen Beschreibung in die Liste der Web3 Pattern Cards aufgenommen.

Nach der Sekundärforschung führte ich qualitative Interviews durch, um Einblicke in die potenziellen Bedürfnisse und Wünsche der Kunden und ihren Kenntnisstand über Web3 und verwandte Technologien zu gewinnen. Während dieser Interviews wurde die Liste der Web3 Pattern Cards vervollständigt, so dass eine Sammlung von 38 Ideen entstand, die Ideen aus den Kategorien Partnerschaften, Dienstleistungen, Produkte, Metaverse, PFPs, Spiele, digitale Mode, Verifizierung, Kunst, Nachhaltigkeit, Kundenbindung, Play-to-Earn, Gemeinschaftsbildung und Zahlungen enthielt.

Die vollständige Liste wurde dann im Rahmen einer quantitativen Untersuchung von potenziellen Kunden bewertet. Dabei konnte festgestellt werden, dass das größte Interesse von Kundenseite für die Projekte in folgender Reihenfolge besteht: unbegrenzter physischer Austausch von Produkten, Train-to-Earn: Geld verdienen durch Sport, Einblick in den Lebenszyklus des Produkts, früher Zugang zu neuen Kollektionen und zu Rabatten.

Drei Blockchain-Entwickler wurden außerdem gebeten, die Ideen hinsichtlich der notwendigen Kosten für die Umsetzung zu analysieren. Nachdem alle drei Bewertungen vorliegen, wurde der Durchschnitt der vergebenen Punkte berechnet. Diese Information hilft

Textilmarken, im Vorfeld abzuschätzen, wie hoch das Budget für ihr Wunschprojekt sein könnte. Die Experten haben die Projekte Lifetime-Rabatt, frühzeitiger Zugang zu neuen Kollektionen und zu Rabatten sowie unbegrenzter physischer Austausch von Produkten als gleichwertig in Bezug auf Budgetfreundlichkeit und geringste Kosten eingestuft.

Im Durchschnitt schnitten bei beiden Faktoren die Projekte unbegrenzter physischer Austausch von Produkten, frühzeitiger Zugang zu neuen Kollektionen und zu Rabatten, lebenslanger Rabatt, Einblick in den Lebenszyklus des Produkts und exklusive Angebote und Produkte nur für Token-Inhaber am besten ab, und zwar in dieser Reihenfolge. Diese Projekte werden daher für die Umsetzung durch Textilunternehmen empfohlen.

Der nächste Teil der empirischen Forschung bestand aus einer quantitativen Umfrage unter Textilunternehmen, in der der Einsatz von Web3-Technologien durch diese Unternehmen untersucht wurde. Die teilnehmenden Unternehmen, hauptsächlich aus Ungarn und der Schweiz, zeigten wenig Interesse an der Integration der Technologien. Insbesondere fehlte es ihnen an Ressourcen für die Umsetzung und an einem Betreuer, der sie bei auftretenden Fragen unterstützen könnte. Sie gaben auch an, dass es ihnen an Ideen fehlt, welche Art von Projekten durchgeführt werden könnten, und dass sie nicht über ausreichende Kenntnisse in diesem Bereich verfügen.

Im letzten Kapitel werden KI-generierte virtuelle Persönlichkeiten untersucht, um eine umfassende Analyse von Lil Miquela zu erstellen. Diese Analyse umfasst eine Aufschlüsselung nach Jahren und hebt zentrale Ereignisse, Markenpartnerschaften, Musikprojekte und andere wichtige Aktivitäten hervor. Die Analyse von Lil Miquelas Werdegang bietet Einblicke in die realen Auswirkungen, Herausforderungen und Möglichkeiten synthetischer Medienentitäten im sich entwickelnden digitalen Milieu.

Die Dissertation hat einen umfassenden Einblick in den Bereich Web3 in der Textilindustrie gegeben. Die Forschungsergebnisse sind für Textilunternehmen von besonderer Bedeutung, da sie ein Grundverständnis für diesen Bereich vermitteln und ein breites Spektrum an Projekten bieten, die in die Praxis integriert werden können. Die Forschung wird in der Zukunft fortgesetzt und es werden praktische Beispiele entwickelt, die für die Projektrealisierung genutzt werden können.

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## APPENDIX

### Appendix 1: Interview guideline Fashion

1. Where did you hear about Web3 based projects?
2. Can you tell me what you know about it?
3. Is there a project you have heard of and liked the idea?
4. Which statements are true for you?
  - I own cryptocurrencies
  - I own NFT(s)
  - I already attended a metaverse event
  - I made in-game purchases of skins or accessories
  - I own digital fashion pieces
5. What's the reason behind your decision, not to own or get involved into blockchain based products?
  - Fear of potential government regulations
  - I don't feel confident that my knowledge is enough in this area
  - There is nobody who could explain it to me
  - Cybersecurity/theft risks
  - Price volatility of cryptocurrencies
  - Negative environmental impact
  - I don't know how to buy it
  - I don't see the advantages of it
6. Do you know people who own Web3 based products or have attended a Web3-related event?
7. If more of your friends would have it, would you be interested?
8. When buying clothing, beauty, and fashion products, what is important to you? Quality? Novelty? Uniqueness?
9. What would be the conditions or projects or ideas that would make you interested in buying or using Web3-related products?
10. Would the following conditions make you curious to learn more and eventually join blockchain based services?
  - You could verify the authenticity of the purchased products and art pieces.
  - You could verify the entire life cycle of a product.

- You can earn money by playing games.
- You can earn money by doing sports.
- You can get access to limited edition products.
- You can get access to exclusive events.
- You can pay in cryptocurrency at some shops.
- A dedicated person leads you through the process and explains the steps.
- The application leads you through the process of registration.
- There is always somebody who can help you if you have any question.
- The software is built on an easier to understand way, similar to apps that you already know and use.

11. How important is it for you to support local brands and businesses? Why? Which types of business would you like to support the most?

- any local business
- any international business
- micro enterprises with up to 9 employees
- small enterprises with up to 49 employees
- medium-sized enterprises with up to 249 employees
- large enterprises with more than 249 employees

12. Would you be interested if a clothing brand that you like introduces the following products:

- Payment with cryptocurrencies in the local store
- Payment with cryptocurrencies in the online store
- NFTs
- NFTs that give additional rights, like attendance to VIP events
- Organizing a metaverse event
- Selling in-game skins or accessories
- Offering their clothing as digital fashion



## Appendix 2: Interview guideline Crypto

1. Where and when did you first hear about Crypto based projects?
2. When did you become an active trader?
3. What are your activities focused on in the Web3 space?
4. Which statements are true for you?
  - I own cryptocurrencies
  - I own NFT(s)
  - I already attended a metaverse event
  - I made in-game purchases of skins or accessories
  - I own digital fashion pieces
5. How do you decide what to buy?
6. Which NFT projects do you really like? Even if you don't have one.
7. Where do you get your information about what's newest on the market?
8. Do you have friends that own Web3 based products or services?
9. Are you interested in Play-to-earn model?
10. How interested are you in clothing and fashion brands?
11. Are there any brand that you think have an interesting NFT project?
12. When buying clothing, beauty, and fashion products, what is important to you?  
Quality? Novelty? Uniqueness?
13. Would you be interested if a clothing brand that you like introduces the following products:
  - Payment with cryptocurrencies in the local store
  - Payment with cryptocurrencies in the online store
  - NFTs
  - NFTs that give additional rights, like attendance to VIP events
  - Organizing a metaverse event
  - Selling in-game skins or accessories
  - Offering their clothing as digital fashion

### **Appendix 3: Survey for primary research 2: Quantitative research among potential fashion customers**

1. Who recommended you the participation? Please add the email address below or write agnesp@gmail.com

2. What's your gender?

- woman
- man
- other

3. How old are you?

- 10-25
- 26-41
- 42-57
- 58+

4. Where are you located?

- Hungary
- Switzerland
- Austria
- Germany
- other European country

5. How much do you monthly spend on the following products on average? Prices are in EUR.

List of products:

- Investing in cryptocurrencies
- Buying NFTs
- Attending metaverse events
- Doing in-game purchases
- Buying digital fashion

Answers:

- 0
- 1-50
- 51-100
- 101-200

- 201-500
- 501-1000
- 1001-2000
- 2001+

6. Which statements are true for you? Choose as many as you like.

- I own cryptocurrencies
- I own NFT(s)
- I already attended a metaverse event
- I made in-game purchases of skins or accessories
- I own digital fashion pieces
- I own a smartwatch/wearable
- None of above

7. Do you spend on anything else regularly, related to blockchain technologies that hasn't been stated yet?

- Open question

8. How do you get informed about latest drops and news?

- Open question

9. How do you decide which project to invest in?

- Open question

10. Do you agree with the following reasons why you don't yet own any blockchain-based products (e.g. NFTs, cryptocurrencies, Bitcoin, etc.)=

Statements:

- Fear of potential government regulations
- I have missing knowledge in this area
- I would need somebody who can explain it to me how to start
- Cybersecurity/theft risks
- Price volatility of cryptocurrencies
- Negative environmental impact
- I have lack of knowledge how to buy it
- Advantages are unclear to me
- I never heard about these technologies
- I would need a contact person who I can ask anytime if I have questions or I'm unsure how to proceed

- The blockchain based apps and processes are too complicated

Answers:

- don't agree
- partly agree
- totally agree
- I don't know

11. Would you be interested in the following services in the fashion industry offered through blockchain based technologies?

Statements:

- You can verify the authenticity of the purchased fashion items.
- You can verify the entire life cycle of a product: where it was produced, when, since when on the shelves, etc.
- Please select “Maybe..” to prove you pay attention
- You can earn money by playing games.
- You can earn money by doing sports.
- You can earn money by creating unique fashion looks online.
- You can get access to exclusive events, style coaching, make-up consulting.
- You can get access to exclusive content like blog posts, interviews, online course.
- You can get access to limited edition products that nobody else can buy.
- You can get early access to discounts, new collections
- You can vote which products of the new collection you like. Thus, you define which products should be produced.
- You can get a guarantee that if your fashion item breaks, it will be replaced or repaired for free for your lifetime.
- You can spend a day with one of your favourite designers or at the headquarters of the brand.
- You can become part of the community and have conversation on topics that you find important.
- When you bought a product in the store, you get access as well to exclusive digital experiences.
- You can try on fashion items digitally and post the pictures on social media.
- You can design fashion items that will be produced by the brand and offered for sales.

- Readyplayer.me or other avatars dressed in your clothes
- Please select “Yes!” to prove you pay attention
- Skins and NFTs for gaming
- NFTs as profile pictures from one of your favourite brands
- You can pay in cryptocurrency in the web shop.
- You can pay in cryptocurrency at local shops.

Answers:

- Definitely not
- Maybe..
- Yes!

12.How important is it for you to support local brands and businesses?

Rate between 0 (not important) and 10 (very important)

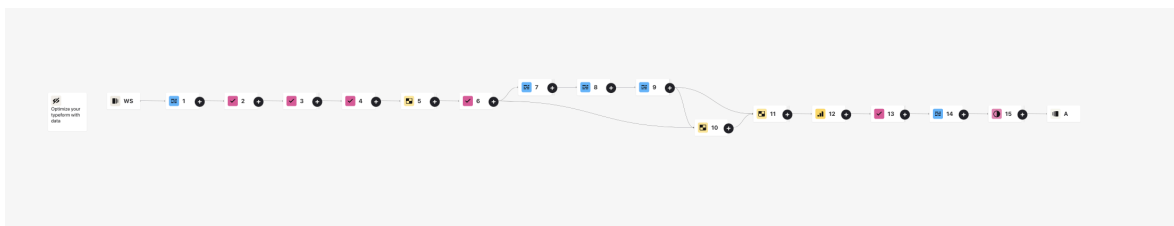
13.Which clothing enterprises do you prefer to support and feel connected the most with?

- any local business
- any international business
- micro enterprises with up to 9 employees
- small enterprises with up to 49 employees
- medium-sized enterprises with up to 249 employees
- large enterprises with more than 249 employees

14.Would you like to participate in the raffle?

If so, please leave us your e-mail here. If not, please write no.

### Logic of the survey:



#### Appendix 4: Critical and calculated values

H0: The possession of a cryptocurrency and/or NFT and the interest that one can verify the authenticity of the purchased fashion items are independent of each other.

H1: The two are not independent.

<b>n<sub>ij</sub></b>	<b>Definitely not</b>	<b>Maybe..</b>	<b>Yes!</b>	<b>Sum</b>
NO CR/NFT	23	54	32	109
YES CR/NFT	6	13	10	29
<b>Sum</b>	<b>29</b>	<b>67</b>	<b>42</b>	<b>138</b>

<b>n<sub>ij</sub>*</b>	<b>Definitely not</b>	<b>Maybe..</b>	<b>Yes!</b>	<b>Sum</b>
NO CR/NFT	22.9057971	52.92	33.2	109
YES CR/NFT	6.094202899	14.08	8.83	29
<b>Sum</b>	<b>29</b>	<b>67</b>	<b>42</b>	<b>138</b>

<b>CHI<sup>2</sup><sub>ij</sub></b>	<b>Definitely not</b>	<b>Maybe..</b>	<b>Yes!</b>	<b>Sum</b>
NO CR/NFT	0.000387421	0.022	0.04	0.063957116
YES CR/NFT	0.001456168	0.0828	0.16	0.240390539
<b>Sum</b>	<b>0.001843589</b>	<b>0.1048</b>	<b>0.2</b>	<b>0.304347655</b>

$$CHI^2_{\text{calc}}=0.304348$$

$$CHI^2_{\text{crit}}=5.9915$$

The calculated value is not greater than the critical value, so I cannot reject H0, so there is no significant correlation between the two criteria.

H0: The possession of a cryptocurrency and/or NFT and the interest that one can verify the entire life cycle of a product: where it was produced, when, since when on the shelves, etc. are independent of each other.

H1: The two are not independent.

<b>n<sub>ij</sub></b>	<b>Definitely not</b>	<b>Maybe..</b>	<b>Yes!</b>	<b>Sum</b>
NO CR/NFT	21	42	46	109
YES CR/NFT	3	9	17	29
<b>Sum</b>	<b>24</b>	<b>51</b>	<b>63</b>	<b>138</b>

<b>n<sub>ij</sub>*</b>	<b>Definitely not</b>	<b>Maybe..</b>	<b>Yes!</b>	<b>Sum</b>
NO CR/NFT	18.95652174	40.283	49.8	109
YES CR/NFT	5.043478261	10.717	13.2	29
<b>Sum</b>	<b>24</b>	<b>51</b>	<b>63</b>	<b>138</b>

<b>CHI2_ij</b>	<b>Definitely not</b>	<b>Maybe..</b>	<b>Yes!</b>	<b>Sum</b>
NO CR/NFT	0.220283207	0.0732	0.28	0.577743942
YES CR/NFT	0.827961019	0.2752	1.07	2.171520332
<b>Sum</b>	<b>1.048244227</b>	<b>0.3484</b>	<b>1.35</b>	<b>2.749264274</b>

$$\text{CHI}^2_{\text{calc}}=2.7493$$

$$\text{CHI}^2_{\text{crit}}=5.9915$$

The calculated value is not greater than the critical value, so I cannot reject H0, so there is no significant correlation between the two criteria.

H0: The possession of a cryptocurrency and/or NFT and the interest that one can earn money by playing games are independent of each other.

H1: The two are not independent.

<b>nij</b>	<b>Definitely not</b>	<b>Maybe..</b>	<b>Yes!</b>	<b>Sum</b>
NO CR/NFT	32	27	50	109
YES CR/NFT	7	9	13	29
<b>Sum</b>	<b>39</b>	<b>36</b>	<b>63</b>	<b>138</b>

<b>nij*</b>	<b>Definitely not</b>	<b>Maybe..</b>	<b>Yes!</b>	<b>Sum</b>
NO CR/NFT	30.80434783	28.435	49.8	109
YES CR/NFT	8.195652174	7.5652	13.2	29
<b>Sum</b>	<b>39</b>	<b>36</b>	<b>63</b>	<b>138</b>

<b>CHI2_ij</b>	<b>Definitely not</b>	<b>Maybe..</b>	<b>Yes!</b>	<b>Sum</b>
NO CR/NFT	0.046408518	0.0724	0	0.119954969
YES CR/NFT	0.174432015	0.2721	0	0.450865227
<b>Sum</b>	<b>0.220840532</b>	<b>0.3445</b>	<b>0.01</b>	<b>0.570820195</b>

$$\text{CHI}^2_{\text{calc}}=0.5708$$

$$\text{CHI}^2_{\text{crit}}=5.9915$$

The calculated value is not greater than the critical value, so I cannot reject H0, so there is no significant correlation between the two criteria.

H0: The possession of a cryptocurrency and/or NFT and the interest that one can earn money by doing sports are independent of each other.

H1: The two are not independent.

<b>nij</b>	<b>Definitely not</b>	<b>Maybe..</b>	<b>Yes!</b>	<b>Sum</b>
NO CR/NFT	18	33	58	109
YES CR/NFT	5	5	19	29
<b>Sum</b>	<b>23</b>	<b>38</b>	<b>77</b>	<b>138</b>

<b>nij*</b>	<b>Definitely not</b>	<b>Maybe..</b>	<b>Yes!</b>	<b>Sum</b>
NO CR/NFT	18.16666667	30.014	60.8	109
YES CR/NFT	4.833333333	7.9855	16.2	29
<b>Sum</b>	<b>23</b>	<b>38</b>	<b>77</b>	<b>138</b>

<b>CHI^2_ij</b>	<b>Definitely not</b>	<b>Maybe..</b>	<b>Yes!</b>	<b>Sum</b>
NO CR/NFT	0.001529052	0.297	0.13	0.42914208
YES CR/NFT	0.005747126	1.1162	0.49	1.612982299
<b>Sum</b>	<b>0.007276178</b>	<b>1.4131</b>	<b>0.62</b>	<b>2.042124379</b>

$$CHI^2_{\text{calc}}=2.0421$$

$$CHI^2_{\text{crit}}=5.9915$$

The calculated value is not greater than the critical value, so I cannot reject H0, so there is no significant correlation between the two criteria.

H0: The possession of a cryptocurrency and/or NFT and the interest that one can earn money creating unique fashion looks online are independent of each other.

H1: The two are not independent.

<b>nij</b>	<b>Definitely not</b>	<b>Maybe..</b>	<b>Yes!</b>	<b>Sum</b>
NO CR/NFT	29	36	44	109
YES CR/NFT	11	8	10	29
<b>Sum</b>	<b>40</b>	<b>44</b>	<b>54</b>	<b>138</b>

<b>nij*</b>	<b>Definitely not</b>	<b>Maybe..</b>	<b>Yes!</b>	<b>Sum</b>
NO CR/NFT	31.5942029	34.754	42.7	109
YES CR/NFT	8.405797101	9.2464	11.3	29
<b>Sum</b>	<b>40</b>	<b>44</b>	<b>54</b>	<b>138</b>

<b>CHI^2_ij</b>	<b>Definitely not</b>	<b>Maybe..</b>	<b>Yes!</b>	<b>Sum</b>
NO CR/NFT	0.213010238	0.0447	0.04	0.300301177
YES CR/NFT	0.800624688	0.168	0.16	1.128718217
<b>Sum</b>	<b>1.013634926</b>	<b>0.2127</b>	<b>0.2</b>	<b>1.429019394</b>

$$CHI^2_{\text{calc}}=1.4290$$



$$\text{CHI}^2_{\text{crit}}=5.9915$$

The calculated value is not greater than the critical value, so I cannot reject  $H_0$ , so there is no significant correlation between the two criteria.

$H_0$ : The possession of a cryptocurrency and/or NFT and the interest that one can get access to exclusive events, style coaching, make-up consulting are independent of each other.

$H_1$ : The two are not independent.

<b>nij</b>	<b>Definitely not</b>	<b>Maybe..</b>	<b>Yes!</b>	<b>Sum</b>
NO CR/NFT	34	34	41	109
YES CR/NFT	9	12	8	29
<b>Sum</b>	<b>43</b>	<b>46</b>	<b>49</b>	<b>138</b>

<b>nij*</b>	<b>Definitely not</b>	<b>Maybe..</b>	<b>Yes!</b>	<b>Sum</b>
NO CR/NFT	33.96376812	36.333	38.7	109
YES CR/NFT	9.036231884	9.6667	10.3	29
<b>Sum</b>	<b>43</b>	<b>46</b>	<b>49</b>	<b>138</b>

<b>CHI^2_ij</b>	<b>Definitely not</b>	<b>Maybe..</b>	<b>Yes!</b>	<b>Sum</b>
NO CR/NFT	3.86515E-05	0.1498	0.14	0.286223728
YES CR/NFT	0.000145276	0.5632	0.51	1.075806425
<b>Sum</b>	<b>0.000183928</b>	<b>0.7131</b>	<b>0.65</b>	<b>1.362030153</b>

$$\text{CHI}^2_{\text{calc}}=1.3620$$

$$\text{CHI}^2_{\text{crit}}=5.9915$$

The calculated value is not greater than the critical value, so I cannot reject  $H_0$ , so there is no significant correlation between the two criteria.

$H_0$ : The possession of a cryptocurrency and/or NFT and the interest that one can get access to exclusive content like blog posts, interviews, online course are independent of each other.

$H_1$ : The two are not independent.

<b>nij</b>	<b>Definitely not</b>	<b>Maybe..</b>	<b>Yes!</b>	<b>Sum</b>
NO CR/NFT	29	50	30	109
YES CR/NFT	6	10	13	29
<b>Sum</b>	<b>35</b>	<b>60</b>	<b>43</b>	<b>138</b>

<b>nij*</b>	<b>Definitely not</b>	<b>Maybe..</b>	<b>Yes!</b>	<b>Sum</b>
NO CR/NFT	27.64492754	47.391	34	109
YES CR/NFT	7.355072464	12.609	9.04	29

<b>Sum</b>	<b>35</b>	<b>60</b>	<b>43</b>	<b>138</b>
<b>CHI<sup>2</sup>_ij</b>	<b>Definitely not</b>	<b>Maybe..</b>	<b>Yes!</b>	<b>Sum</b>
NO CR/NFT	0.066421638	0.1436	0.46	0.672614222
YES CR/NFT	0.249653745	0.5397	1.74	2.52810173
<b>Sum</b>	<b>0.316075383</b>	<b>0.6833</b>	<b>2.2</b>	<b>3.200715952</b>

$$\text{CHI}_{\text{calc}}^2=3.2000$$

$$\text{CHI}_{\text{crit}}^2=5.9915$$

The calculated value is not greater than the critical value, so I cannot reject H0, so there is no significant correlation between the two criteria.

H0: The possession of a cryptocurrency and/or NFT and the interest that one can get access to limited edition products that nobody else can buy are independent of each other.

H1: The two are not independent.

<b>nij</b>	<b>Definitely not</b>	<b>Maybe..</b>	<b>Yes!</b>	<b>Sum</b>
NO CR/NFT	25	39	45	109
YES CR/NFT	5	10	14	29
<b>Sum</b>	<b>30</b>	<b>49</b>	<b>59</b>	<b>138</b>

<b>nij*</b>	<b>Definitely not</b>	<b>Maybe..</b>	<b>Yes!</b>	<b>Sum</b>
NO CR/NFT	23.69565217	38.703	46.6	109
YES CR/NFT	6.304347826	10.297	12.4	29
<b>Sum</b>	<b>30</b>	<b>49</b>	<b>59</b>	<b>138</b>

<b>CHI<sup>2</sup>_ij</b>	<b>Definitely not</b>	<b>Maybe..</b>	<b>Yes!</b>	<b>Sum</b>
NO CR/NFT	0.071798963	0.0023	0.06	0.129113129
YES CR/NFT	0.269865067	0.0086	0.21	0.485287277
<b>Sum</b>	<b>0.34166403</b>	<b>0.0109</b>	<b>0.26</b>	<b>0.614400405</b>

$$\text{CHI}_{\text{calc}}^2=0.6144$$

$$\text{CHI}_{\text{crit}}^2=5.9915$$

The calculated value is not greater than the critical value, so I cannot reject H0, so there is no significant correlation between the two criteria.

H0: The possession of a cryptocurrency and/or NFT and the interest that one can get early access to discounts and new collections are independent of each other.

H1: The two are not independent.

<b>n<sub>ij</sub></b>	<b>Definitely not</b>	<b>Maybe..</b>	<b>Yes!</b>	<b>Sum</b>
NO CR/NFT	21	32	56	109
YES CR/NFT	3	11	15	29
<b>Sum</b>	<b>24</b>	<b>43</b>	<b>71</b>	<b>138</b>

<b>n<sub>ij</sub>*</b>	<b>Definitely not</b>	<b>Maybe..</b>	<b>Yes!</b>	<b>Sum</b>
NO CR/NFT	18.95652174	33.964	56.1	109
YES CR/NFT	5.043478261	9.0362	14.9	29
<b>Sum</b>	<b>24</b>	<b>43</b>	<b>71</b>	<b>138</b>

<b>CHI<sup>2</sup><sub>ij</sub></b>	<b>Definitely not</b>	<b>Maybe..</b>	<b>Yes!</b>	<b>Sum</b>
NO CR/NFT	0.220283207	0.1135	0	0.333940597
YES CR/NFT	0.827961019	0.4268	0	1.255156036
<b>Sum</b>	<b>1.048244227</b>	<b>0.5403</b>	<b>0</b>	<b>1.589096633</b>

$$\text{CHI}^2_{\text{calc}}=1.5890$$

$$\text{CHI}^2_{\text{crit}}=5.9915$$

The calculated value is not greater than the critical value, so I cannot reject H<sub>0</sub>, so there is no significant correlation between the two criteria.

H<sub>0</sub>: The possession of a cryptocurrency and/or NFT and the interest that one can vote which products of the new collection one likes; thus, one can define which products should be produced are independent of each other.

H<sub>1</sub>: The two are not independent.

<b>n<sub>ij</sub></b>	<b>Definitely not</b>	<b>Maybe..</b>	<b>Yes!</b>	<b>Sum</b>
NO CR/NFT	23	38	48	109
YES CR/NFT	6	11	12	29
<b>Sum</b>	<b>29</b>	<b>49</b>	<b>60</b>	<b>138</b>

<b>n<sub>ij</sub>*</b>	<b>Definitely not</b>	<b>Maybe..</b>	<b>Yes!</b>	<b>Sum</b>
NO CR/NFT	22.9057971	38.703	47.4	109
YES CR/NFT	6.094202899	10.297	12.6	29
<b>Sum</b>	<b>29</b>	<b>49</b>	<b>60</b>	<b>138</b>

<b>CHI<sup>2</sup><sub>ij</sub></b>	<b>Definitely not</b>	<b>Maybe..</b>	<b>Yes!</b>	<b>Sum</b>
NO CR/NFT	0.000387421	0.0128	0.01	0.020971147
YES CR/NFT	0.001456168	0.048	0.03	0.078822587
<b>Sum</b>	<b>0.001843589</b>	<b>0.0607</b>	<b>0.04</b>	<b>0.099793734</b>

$$\text{CHI}^2_{\text{calc}}=0.0998$$

$$CHI^2_{crit}=5.9915$$

The calculated value is not greater than the critical value, so I cannot reject H0, so there is no significant correlation between the two criteria.

H0: The possession of a cryptocurrency and/or NFT and the interest that one can get a guarantee that if one's fashion item breaks, it will be replaced or repaired for free for one's lifetime are independent of each other.

H1: The two are not independent.

<b>nij</b>	<b>Definitely not</b>	<b>Maybe..</b>	<b>Yes!</b>	<b>Sum</b>
NO CR/NFT	11	27	71	109
YES CR/NFT	1	7	21	29
<b>Sum</b>	<b>12</b>	<b>34</b>	<b>92</b>	<b>138</b>

<b>nij*</b>	<b>Definitely not</b>	<b>Maybe..</b>	<b>Yes!</b>	<b>Sum</b>
NO CR/NFT	9.47826087	26.855	72.7	109
YES CR/NFT	2.52173913	7.1449	19.3	29
<b>Sum</b>	<b>12</b>	<b>34</b>	<b>92</b>	<b>138</b>

<b>CHI^2_ij</b>	<b>Definitely not</b>	<b>Maybe..</b>	<b>Yes!</b>	<b>Sum</b>
NO CR/NFT	0.244315915	0.0008	0.04	0.283324339
YES CR/NFT	0.918290855	0.0029	0.14	1.064908722
<b>Sum</b>	<b>1.16260677</b>	<b>0.0037</b>	<b>0.18</b>	<b>1.348233061</b>

$$CHI^2_{calc}=1.3482$$

$$CHI^2_{crit}=5.9915$$

The calculated value is not greater than the critical value, so I cannot reject H0, so there is no significant correlation between the two criteria.

H0: The possession of a cryptocurrency and/or NFT and the interest that one can spend a day with one of one's favourite designers or at the headquarters of the brand are independent of each other.

H1: The two are not independent.

<b>nij</b>	<b>Definitely not</b>	<b>Maybe..</b>	<b>Yes!</b>	<b>Sum</b>
NO CR/NFT	48	30	31	109
YES CR/NFT	14	7	8	29
<b>Sum</b>	<b>62</b>	<b>37</b>	<b>39</b>	<b>138</b>

<b>nij*</b>	<b>Definitely not</b>	<b>Maybe..</b>	<b>Yes!</b>	<b>Sum</b>
NO CR/NFT	48.97101449	29.225	30.8	109
YES CR/NFT	13.02898551	7.7754	8.2	29
<b>Sum</b>	<b>62</b>	<b>37</b>	<b>39</b>	<b>138</b>

<b>CHI^2_ij</b>	<b>Definitely not</b>	<b>Maybe..</b>	<b>Yes!</b>	<b>Sum</b>
NO CR/NFT	0.019253617	0.0206	0	0.04106752
YES CR/NFT	0.072367042	0.0773	0	0.154357232
<b>Sum</b>	<b>0.091620659</b>	<b>0.0979</b>	<b>0.01</b>	<b>0.195424753</b>

$$CHI^2_{\text{calc}}=0.1954$$

$$CHI^2_{\text{crit}}=5.9915$$

The calculated value is not greater than the critical value, so I cannot reject H0, so there is no significant correlation between the two criteria.

H0: The possession of a cryptocurrency and/or NFT and the interest that one can become part of the community and have conversation on topics that one finds important are independent of each other.

H1: The two are not independent.

<b>nij</b>	<b>Definitely not</b>	<b>Maybe..</b>	<b>Yes!</b>	<b>Sum</b>
NO CR/NFT	29	48	32	109
YES CR/NFT	7	10	12	29
<b>Sum</b>	<b>36</b>	<b>58</b>	<b>44</b>	<b>138</b>

<b>nij*</b>	<b>Definitely not</b>	<b>Maybe..</b>	<b>Yes!</b>	<b>Sum</b>
NO CR/NFT	28.43478261	45.812	34.8	109
YES CR/NFT	7.565217391	12.188	9.25	29
<b>Sum</b>	<b>36</b>	<b>58</b>	<b>44</b>	<b>138</b>

<b>CHI^2_ij</b>	<b>Definitely not</b>	<b>Maybe..</b>	<b>Yes!</b>	<b>Sum</b>
NO CR/NFT	0.011235208	0.1045	0.22	0.333951665
YES CR/NFT	0.042228886	0.3929	0.82	1.255197636
<b>Sum</b>	<b>0.053464094</b>	<b>0.4975</b>	<b>1.04</b>	<b>1.589149301</b>

$$CHI^2_{\text{calc}}=1.5891$$

$$CHI^2_{\text{crit}}=5.9915$$

The calculated value is not greater than the critical value, so I cannot reject H0, so there is no significant correlation between the two criteria.

H0: The possession of a cryptocurrency and/or NFT and the interest that if one bought a product in the store, one gets access as well to exclusive digital experiences are independent of each other.

H1: The two are not independent.

<b>n<sub>ij</sub></b>	<b>Definitely not</b>	<b>Maybe..</b>	<b>Yes!</b>	<b>Sum</b>
NO CR/NFT	27	53	29	109
YES CR/NFT	7	9	13	29
<b>Sum</b>	<b>34</b>	<b>62</b>	<b>42</b>	<b>138</b>

<b>n<sub>ij</sub>*</b>	<b>Definitely not</b>	<b>Maybe..</b>	<b>Yes!</b>	<b>Sum</b>
NO CR/NFT	26.85507246	48.971	33.2	109
YES CR/NFT	7.144927536	13.029	8.83	29
<b>Sum</b>	<b>34</b>	<b>62</b>	<b>42</b>	<b>138</b>

<b>CHI<sup>2</sup><sub>ij</sub></b>	<b>Definitely not</b>	<b>Maybe..</b>	<b>Yes!</b>	<b>Sum</b>
NO CR/NFT	0.000782124	0.3315	0.53	0.85741642
YES CR/NFT	0.002939707	1.2459	1.97	3.222703097
<b>Sum</b>	<b>0.00372183</b>	<b>1.5774</b>	<b>2.5</b>	<b>4.080119517</b>

$$CHI^2_{\text{calc}}=4.0801$$

$$CHI^2_{\text{crit}}=5.9915$$

The calculated value is not greater than the critical value, so I cannot reject H0, so there is no significant correlation between the two criteria.

H0: The possession of a cryptocurrency and/or NFT and the interest that one can try on fashion items digitally and post the pictures on social media are independent of each other.

H1: The two are not independent.

<b>n<sub>ij</sub></b>	<b>Definitely not</b>	<b>Maybe..</b>	<b>Yes!</b>	<b>Sum</b>
NO CR/NFT	51	40	18	109
YES CR/NFT	12	6	11	29
<b>Sum</b>	<b>63</b>	<b>46</b>	<b>29</b>	<b>138</b>

<b>n<sub>ij</sub>*</b>	<b>Definitely not</b>	<b>Maybe..</b>	<b>Yes!</b>	<b>Sum</b>
NO CR/NFT	49.76086957	36.333	22.9	109
YES CR/NFT	13.23913043	9.6667	6.09	29
<b>Sum</b>	<b>63</b>	<b>46</b>	<b>29</b>	<b>138</b>

<b>CHI<sup>2</sup>_ij</b>	<b>Definitely not</b>	<b>Maybe..</b>	<b>Yes!</b>	<b>Sum</b>
NO CR/NFT	0.030856459	0.37	1.05	1.451574999
YES CR/NFT	0.115977725	1.3908	3.95	5.455919823
<b>Sum</b>	<b>0.146834184</b>	<b>1.7608</b>	<b>5</b>	<b>6.907494822</b>

$$\text{CHI}^2_{\text{calc}}=6.9075$$

$$\text{CHI}^2_{\text{crit}}=5.9915$$

The calculated value is greater than the critical value, so I can reject H<sub>0</sub>, so there is a significant correlation between the two criteria.

H<sub>0</sub>: The possession of a cryptocurrency and/or NFT and the interest that one can design fashion items that will be produced by the brand and offered for sales are independent of each other.

H<sub>1</sub>: The two are not independent.

<b>n<sub>ij</sub></b>	<b>Definitely not</b>	<b>Maybe..</b>	<b>Yes!</b>	<b>Sum</b>
NO CR/NFT	35	43	31	109
YES CR/NFT	13	9	7	29
<b>Sum</b>	<b>48</b>	<b>52</b>	<b>38</b>	<b>138</b>

<b>n<sub>ij</sub>*</b>	<b>Definitely not</b>	<b>Maybe..</b>	<b>Yes!</b>	<b>Sum</b>
NO CR/NFT	37.91304348	41.072	30	109
YES CR/NFT	10.08695652	10.928	7.99	29
<b>Sum</b>	<b>48</b>	<b>52</b>	<b>38</b>	<b>138</b>

<b>CHI<sup>2</sup>_ij</b>	<b>Definitely not</b>	<b>Maybe..</b>	<b>Yes!</b>	<b>Sum</b>
NO CR/NFT	0.223823295	0.0905	0.03	0.346641348
YES CR/NFT	0.841266867	0.34	0.12	1.302893341
<b>Sum</b>	<b>1.065090161</b>	<b>0.4305</b>	<b>0.15</b>	<b>1.649534688</b>

$$\text{CHI}^2_{\text{calc}}=1.6495$$

$$\text{CHI}^2_{\text{crit}}=5.9915$$

The calculated value is not greater than the critical value, so I cannot reject H<sub>0</sub>, so there is no significant correlation between the two criteria.

H<sub>0</sub>: The possession of a cryptocurrency and/or NFT and the interest that Readyplayer.me or other avatars can be dressed in one's clothes are independent of each other.

H1: The two are not independent.

<b>nij</b>	<b>Definitely not</b>	<b>Maybe..</b>	<b>Yes!</b>	<b>Sum</b>
NO CR/NFT	58	33	18	109
YES CR/NFT	13	12	4	29
<b>Sum</b>	<b>71</b>	<b>45</b>	<b>22</b>	<b>138</b>

<b>nij*</b>	<b>Definitely not</b>	<b>Maybe..</b>	<b>Yes!</b>	<b>Sum</b>
NO CR/NFT	56.07971014	35.543	17.4	109
YES CR/NFT	14.92028986	9.4565	4.62	29
<b>Sum</b>	<b>71</b>	<b>45</b>	<b>22</b>	<b>138</b>

<b>CHI^2_ij</b>	<b>Definitely not</b>	<b>Maybe..</b>	<b>Yes!</b>	<b>Sum</b>
NO CR/NFT	0.065754854	0.182	0.02	0.270114767
YES CR/NFT	0.247147553	0.6841	0.08	1.015258952
<b>Sum</b>	<b>0.312902407</b>	<b>0.8661</b>	<b>0.11</b>	<b>1.285373719</b>

$$CHI^2_{\text{calc}}=1.2853$$

$$CHI^2_{\text{crit}}=5.9915$$

The calculated value is not greater than the critical value, so I cannot reject H0, so there is no significant correlation between the two criteria.

H0: The possession of a cryptocurrency and/or NFT and the interest in skins and NFTs for gaming are independent of each other.

H1: The two are not independent.

<b>nij</b>	<b>Definitely not</b>	<b>Maybe..</b>	<b>Yes!</b>	<b>Sum</b>
NO CR/NFT	63	33	13	109
YES CR/NFT	14	6	9	29
<b>Sum</b>	<b>77</b>	<b>39</b>	<b>22</b>	<b>138</b>

<b>nij*</b>	<b>Definitely not</b>	<b>Maybe..</b>	<b>Yes!</b>	<b>Sum</b>
NO CR/NFT	60.81884058	30.804	17.4	109
YES CR/NFT	16.18115942	8.1957	4.62	29
<b>Sum</b>	<b>77</b>	<b>39</b>	<b>22</b>	<b>138</b>

<b>CHI^2_ij</b>	<b>Definitely not</b>	<b>Maybe..</b>	<b>Yes!</b>	<b>Sum</b>
NO CR/NFT	0.078223399	0.1565	1.1	1.337139924
YES CR/NFT	0.294012085	0.5882	4.14	5.025801784
<b>Sum</b>	<b>0.372235484</b>	<b>0.7447</b>	<b>5.25</b>	<b>6.362941709</b>

$$CHI^2_{\text{calc}}=6.3629$$



$$CHI^2_{crit}=5.9915$$

The calculated value is greater than the critical value, so I can reject  $H_0$ , so there is a significant correlation between the two criteria.

$H_0$ : The possession of a cryptocurrency and/or NFT and the interest for NFTs as profile pictures from one's favourite brands are independent of each other.

$H_1$ : The two are not independent.

<b>n<sub>ij</sub></b>	<b>Definitely not</b>	<b>Maybe..</b>	<b>Yes!</b>	<b>Sum</b>
NO CR/NFT	70	30	9	109
YES CR/NFT	12	7	10	29
<b>Sum</b>	<b>82</b>	<b>37</b>	<b>19</b>	<b>138</b>

<b>n<sub>ij</sub>*</b>	<b>Definitely not</b>	<b>Maybe..</b>	<b>Yes!</b>	<b>Sum</b>
NO CR/NFT	64.76811594	29.225	15	109
YES CR/NFT	17.23188406	7.7754	3.99	29
<b>Sum</b>	<b>82</b>	<b>37</b>	<b>19</b>	<b>138</b>

<b>CHI<sup>2</sup><sub>ij</sub></b>	<b>Definitely not</b>	<b>Maybe..</b>	<b>Yes!</b>	<b>Sum</b>
NO CR/NFT	0.422624781	0.0206	2.4	2.847834951
YES CR/NFT	1.588486245	0.0773	9.04	10.70393137
<b>Sum</b>	<b>2.011111025</b>	<b>0.0979</b>	<b>11.4</b>	<b>13.55176632</b>

$$CHI^2_{calc}=13.5518$$

$$CHI^2_{crit}=5.9915$$

The calculated value is greater than the critical value, so I can reject  $H_0$ , so there is a significant correlation between the two criteria.

$H_0$ : The possession of a cryptocurrency and/or NFT and the interest that one can pay in the cryptocurrency in the web shop are independent of each other.

$H_1$ : The two are not independent.

<b>n<sub>ij</sub></b>	<b>Definitely not</b>	<b>Maybe..</b>	<b>Yes!</b>	<b>Sum</b>
NO CR/NFT	56	35	18	109
YES CR/NFT	4	13	12	29
<b>Sum</b>	<b>60</b>	<b>48</b>	<b>30</b>	<b>138</b>

<b>n<sub>ij</sub>*</b>	<b>Definitely not</b>	<b>Maybe..</b>	<b>Yes!</b>	<b>Sum</b>
NO CR/NFT	47.39130435	37.913	23.7	109

YES CR/NFT	12.60869565	10.087	6.3	29
<b>Sum</b>	<b>60</b>	<b>48</b>	<b>30</b>	<b>138</b>

<b>CHI<sup>2</sup>_ij</b>	<b>Definitely not</b>	<b>Maybe..</b>	<b>Yes!</b>	<b>Sum</b>
NO CR/NFT	1.563781412	0.2238	1.37	3.156651376
YES CR/NFT	5.877661169	0.8413	5.15	11.86465517
<b>Sum</b>	<b>7.441442581</b>	<b>1.0651</b>	<b>6.51</b>	<b>15.02130655</b>

$$\text{CHI}^2_{\text{calc}}=15.0213$$

$$\text{CHI}^2_{\text{crit}}=5.9915$$

The calculated value is greater than the critical value, so I can reject H<sub>0</sub>, so there is a significant correlation between the two criteria.

H<sub>0</sub>: The possession of a cryptocurrency and/or NFT and the interest that one can pay in the cryptocurrency at local shops are independent of each other.

H<sub>1</sub>: The two are not independent.

<b>n<sub>ij</sub></b>	<b>Definitely not</b>	<b>Maybe..</b>	<b>Yes!</b>	<b>Sum</b>
NO CR/NFT	56	36	17	109
YES CR/NFT	7	13	9	29
<b>Sum</b>	<b>63</b>	<b>49</b>	<b>26</b>	<b>138</b>

<b>n<sub>ij</sub>*</b>	<b>Definitely not</b>	<b>Maybe..</b>	<b>Yes!</b>	<b>Sum</b>
NO CR/NFT	49.76086957	38.703	20.5	109
YES CR/NFT	13.23913043	10.297	5.46	29
<b>Sum</b>	<b>63</b>	<b>49</b>	<b>26</b>	<b>138</b>

<b>CHI<sup>2</sup>_ij</b>	<b>Definitely not</b>	<b>Maybe..</b>	<b>Yes!</b>	<b>Sum</b>
NO CR/NFT	0.782276293	0.1888	0.61	1.579959577
YES CR/NFT	2.94027986	0.7095	2.29	5.938468756
<b>Sum</b>	<b>3.722556153</b>	<b>0.8982</b>	<b>2.9</b>	<b>7.518428334</b>

$$\text{CHI}^2_{\text{calc}}=7.5184$$

$$\text{CHI}^2_{\text{crit}}=5.9915$$

The calculated value is greater than the critical value, so I can reject H<sub>0</sub>, so there is a significant correlation between the two criteria.

**Appendix 5: The range of the correlation coefficient**

<b>Correlation coefficient</b>	<b>Scale used in current empirical research</b>	<b>The strength of the correlation</b>
$r=1$	$r=1$	Perfect positive correlation
$0.7 \leq r < 1$	$0.7 \leq r < 1$	Strong positive correlation
$0.2 \leq r < 0.7$	$0.3 \leq r < 0.7$	Medium strength positive correlation
$0 < r < 0.2$	$0 < r < 0.3$	Weak positive correlation
$r=0$	$r=0$	No linear relationship

Source: own visualisation adapted from Sajtos and Mitev (2007)

**Appendix 6: The correlation between the possession of a cryptocurrency and/or NFT and the listed factors**

<b>Offer</b>	<b>Value of r</b>	<b>Strength</b>
you can try on apparel items digitally and post the pictures on social media	0.22	Weak positive correlation
you can use skins and NFTs for gaming	0.21	Weak positive correlation
you can use NFTs from your favourite brands as profile pictures	0.31	Medium strength positive correlation
you can pay in cryptocurrency in web shops	0.33	Medium strength positive correlation
you can pay in cryptocurrency at local shops	0.23	Weak positive correlation

Source: own visualisation based on the surveyed data

**Appendix 7 The recalculation from percentage to points**

<b>From %</b>	<b>To %</b>	<b>Points</b>
98.4375	100.00	5.00
95.3125	98.4375	4.88
92.1875	95.3125	4.75
89.0625	92.1875	4.63
85.9375	89.0625	4.50
82.8125	85.9375	4.38
79.6875	82.8125	4.25
76.5625	79.6875	4.13
73.4375	76.5625	4.00
70.3125	73.4375	3.88
67.1875	70.3125	3.75
64.0625	67.1875	3.63
60.9375	64.0625	3.50
57.8125	60.9375	3.38
54.6875	57.8125	3.25
51.5625	54.6875	3.13
48.4375	51.5625	3.00
45.3125	48.4375	2.88
42.1875	45.3125	2.75
39.0625	42.1875	2.63
35.9375	39.0625	2.50
32.8125	35.9375	2.38
29.6875	32.8125	2.25
26.5625	29.6875	2.13
23.4375	26.5625	2.00
20.3125	23.4375	1.88
17.1875	20.3125	1.75
14.0625	17.1875	1.63
10.9375	14.0625	1.50
7.8125	10.9375	1.38
4.6875	7.8125	1.25
1.5625	4.6875	1.125
0	1.5625	1.00

Source: own visualisation

## **Appendix 8: Questionnaire for primary research 3: Quantitative research among Swiss and Hungarian clothing companies**

1. In which year was your company founded?

- Open question

2. Where is your headquarters located?

- Hungary
- Switzerland
- Germany
- Austria
- Other

3. What is the approximate total number of your employees?

- 1 – 19
- 20 – 49
- 50 – 99
- 100 – 249
- 250 – 499

4. Has your company implemented projects that use the following technologies?

- VR (Virtual Reality)
  - Yes, one project, we do not plan any further projects
  - Yes, several projects, we are not planning any further projects
  - Yes, and we are planning more projects
  - Not yet, but we plan to
  - Not and is not planned
  - I do not know the term
- AR (Augmented Reality)
  - Yes, one project, we do not plan any further projects
  - Yes, several projects, we are not planning any further projects
  - Yes, and we are planning more projects
  - Not yet, but we plan to
  - Not and is not planned
  - I do not know the term
- AI (Artificial Intelligence)

- Yes, one project, we do not plan any further projects
  - Yes, several projects, we are not planning any further projects
  - Yes, and we are planning more projects
  - Not yet, but we plan to
  - Not and is not planned
  - I do not know the term
- Metaverse
  - Yes, one project, we do not plan any further projects
  - Yes, several projects, we are not planning any further projects
  - Yes, and we are planning more projects
  - Not yet, but we plan to
  - Not and is not planned
  - I do not know the term
- Blockchain
  - Yes, one project, we do not plan any further projects
  - Yes, several projects, we are not planning any further projects
  - Yes, and we are planning more projects
  - Not yet, but we plan to
  - Not and is not planned
  - I do not know the term
- NFTs (non-fungible tokens)
  - Yes, one project, we do not plan any further projects
  - Yes, several projects, we are not planning any further projects
  - Yes, and we are planning more projects
  - Not yet, but we plan to
  - Not and is not planned
  - I do not know the term
- 3D Printing
  - Yes, one project, we do not plan any further projects
  - Yes, several projects, we are not planning any further projects
  - Yes, and we are planning more projects
  - Not yet, but we plan to
  - Not and is not planned

- I do not know the term
- IoT (Internet of Things)
  - Yes, one project, we do not plan any further projects
  - Yes, several projects, we are not planning any further projects
  - Yes, and we are planning more projects
  - Not yet, but we plan to
  - Not and is not planned
  - I do not know the term
- Robotics
  - Yes, one project, we do not plan any further projects
  - Yes, several projects, we are not planning any further projects
  - Yes, and we are planning more projects
  - Not yet, but we plan to
  - Not and is not planned
  - I do not know the term
- Drones
  - Yes, one project, we do not plan any further projects
  - Yes, several projects, we are not planning any further projects
  - Yes, and we are planning more projects
  - Not yet, but we plan to
  - Not and is not planned
  - I do not know the term

5. Please briefly describe your project: What was the goal of the project? How was the project realised? Are you satisfied with the result?

- Open question

6. To what extent do the following reasons keep you from implementing blockchain-based projects?

- Fear of possible government regulation
  - Not at all
  - Partly
  - To a large extent
  - I cannot judge
- Lack of knowledge in this area



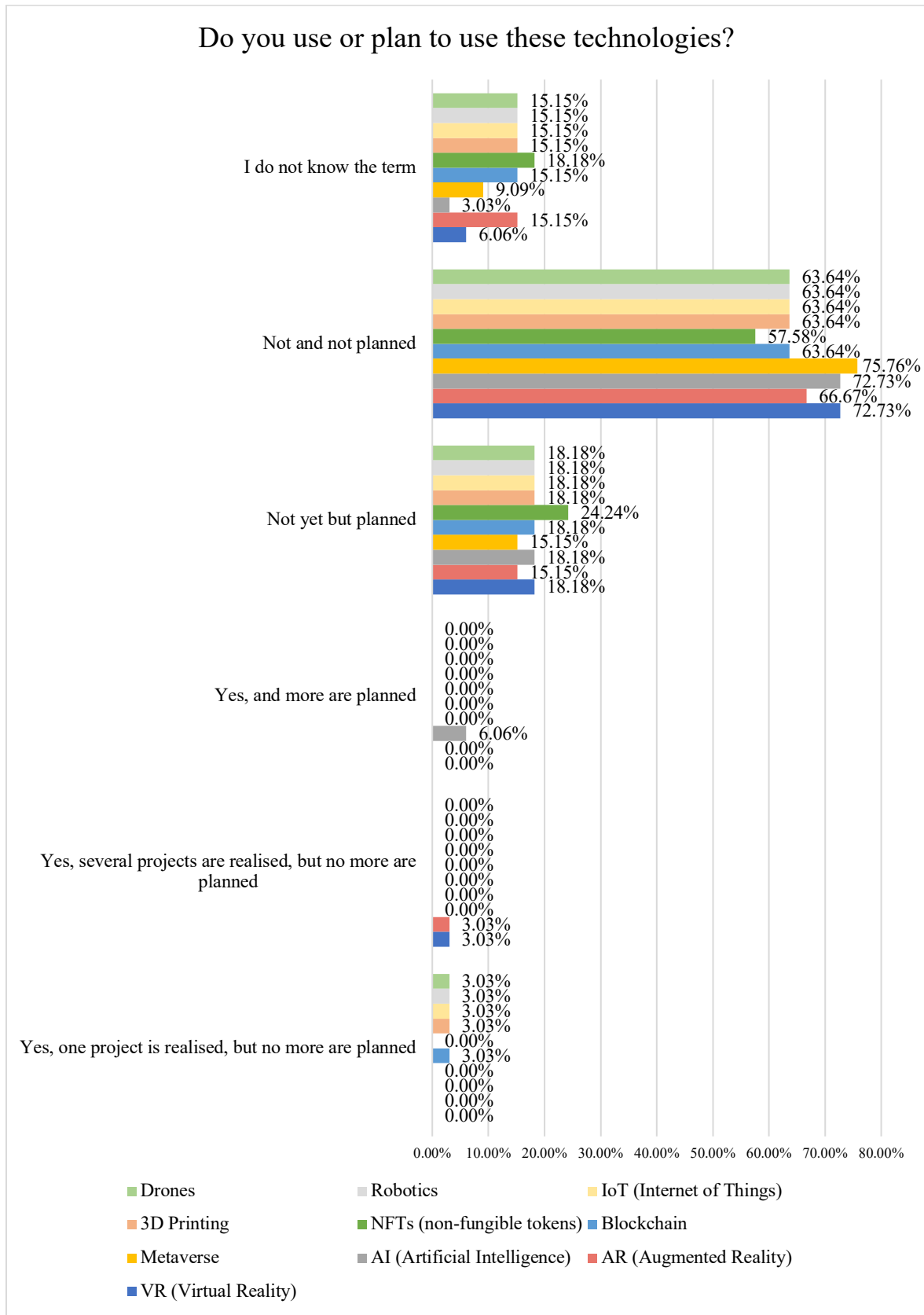
- Not at all
  - Partly
  - To a large extent
  - I cannot judge
- Lack of ideas for such projects
  - Not at all
  - Partly
  - To a large extent
  - I cannot judge
- Lack of resources for implementation
  - Not at all
  - Partly
  - To a large extent
  - I cannot judge
- Lack of supervisor to answer questions
  - Not at all
  - Partly
  - To a large extent
  - I cannot judge
- Cybersecurity/theft risks
  - Not at all
  - Partly
  - To a large extent
  - I cannot judge
- Price volatility of cryptocurrencies
  - Not at all
  - Partly
  - To a large extent
  - I cannot judge
- Negative impact on the environment
  - Not at all
  - Partly
  - To a large extent

- I cannot judge
- Unclear advantages of the technology
  - Not at all
  - Partly
  - To a large extent
  - I cannot judge
- I have never heard of these technologies
  - Not at all
  - Partly
  - To a large extent
  - I cannot judge
- The blockchain-based applications and processes are too complicated
  - Not at all
  - Partly
  - To a large extent
  - I cannot judge

7. If you would like to realise a Web3 based project, what would be your motivation behind it? What return and what benefits would you expect from a Web3 based project?

- Open question

### Appendix 9: The usage and planned implementation of the listed Web3-based projects by textile companies



Source: own compilation, 2022, n=33

## KÖSZÖNETNYILVÁNÍTÁS

Ezúton szeretném megköszönni mindazoknak, akik szakmai tudásukkal, tapasztalataikkal, hozzáértésükkel és emberségükkel segítették munkámat.

Első sorban köszönöm konzulenseimnek, Dr. Keresztes Gábornak és Dr. habil Koloszár Lászlónak, hogy nem mondtak le rólam, habár bizonyára nem volt könnyű a nagyon váltakozó fokozatú motivációm és teljesítményem tolerálni.

Ezúton szeretném megköszönni munkájukat, Dr. Keller Veronikának és Dr. habil. Szabó Zoltánnak, akik opponensi értékelésükben és a disszertáció munkahelyi vitáján építő jellegű javaslatokat, kritikákat fogalmaztak meg, amik felhasználásával készíthettem el a disszertációm végső változatát.

Prof. Dr. Obádovics Csillának a Széchenyi István Gazdálkodás- és Szervezéstudományok Doktori Iskola vezetőjének szeretném megköszönni, hogy a komplex vizsga előtt motivált, hogy meglegyen a kötelező publikációm a vizsgára bocsátáshoz. Emellett köszönöm, hogy lehetővé tette, hogy bár levelező képzésben vettem részt, mégis megtapasztalhattam oktatási feladatokat is. Nagyon élveztem.

Dr. habil. Tóth Balázs Istvánnak köszönöm a 2022/23/1 félév kezdete előtti beszélgetést, ami lelket öntött belém, hogy ne adjam fel a tanulmányaimat és segített meglátnom a fényt az alagút végén.

Prof. (FH) Dr. habil. Czeglédy Tamásnak köszönöm az inspiráló beszélgetéseket, s a példaképet, amit állít, hogy az ember ilyen elhivatottan szeretheti a munkáját és megtalálhatja azt a területet, ami tényleg tökéletesen illik a jelleméhez.

Evan Tomlin volt munkatársamnak köszönöm a rengeteg tudást, amit megosztott velem a Web3 & Blockchain témakörben. Bár a technológiai háttérrel nem sikerült elsajátítanom, a lelkesedését a téma iránt szerencsére sikerült átvennem.

Tóth Eszternek nagyon hálás vagyok a segítségéért az angol nyelvű szövegek stilizálásában, a szöveg érthetőbbé tételében és a források formázásában.

Kovács Noéminak köszönöm a segítséget a hangfelvételek legépelésénél. Rengeteg időt spórolt meg nekem ezzel.

Minden primer kutatásom alanyának, interjúm résztvevőjének és a kérdőíveim kitöltőinek is hálás köszönet az idejükért és a tapasztalataik megosztásáért.

És végül, de nem utolsó sorban szeretném megköszönni a férjemnek, hogy mellettem állt és támogatott, s minden lehetőséget megadott, hogy az szabadidőmet a kutatásnak szenteljem, s megpróbáljam “megtalálni önmagam” és az utam.

## NYILATKOZAT

Alulírott *Paulovics Ágnes*, jelen nyilatkozat aláírásával kijelentem, hogy a(z) *Innovation Management in the Textile Industry: Potential of Web3 Technologies in the Fashion Industry* című PhD értekezésem önálló munkám, az értekezés készítése során betartottam a szerzői jogról szóló 1999. évi LXXVI. törvény szabályait, valamint a *Soproni Egyetem, Széchenyi István Doktori Iskola* által előírt, a doktori értekezés készítésére vonatkozó szabályokat, különösen a hivatkozások és idézések tekintetében.<sup>1</sup>

Kijelentem továbbá, hogy az értekezés készítése során az önálló kutatómunka kitétel tekintetében témavezető(i)met, illetve a programvezetőt nem tévesztettem meg.

Jelen nyilatkozat aláírásával tudomásul veszem, hogy amennyiben bizonyítható, hogy az értekezést nem magam készítettem, vagy az értekezéssel kapcsolatban szerzői jogsértés ténye merül fel, a Soproni Egyetem megtagadja az értekezés befogadását.

Az értekezés befogadásának megtagadása nem érinti a szerzői jogsértés miatti egyéb (polgári jogi, szabálysértési jogi, büntetőjogi) jogkövetkezményeket.

Kelt: Freienbach (Svájc), 2023.11.28.

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doktorjelölt

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<sup>1</sup> 1999. évi LXXVI. tv. 34. § (1) A mű részletét – az átvevő mű jellege és célja által indokolt terjedelemben és az eredetihez híven – a forrás, valamint az ott megjelölt szerző megnevezésével bárki idézheti. 36. § (1) Nyilvánosan tartott előadások és más hasonló művek részletei, valamint politikai beszédek tájékoztatás céljára – a cél által indokolt terjedelemben – szabadon felhasználhatók. Ilyen felhasználás esetén a forrást – a szerző nevével együtt – fel kell tüntetni, hacsak ez lehetetlennek nem bizonyul.