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“Digital fashion” on its way from niche to the new norm

Abstract

”Digital fashion” is a new, growing field in the field of fashion design, now becoming abruptly relevant due to its non-physical essence. “Digital fashion” is a processual tool to assist design but also a new fashion space, culture, and community. The term refers to a practice that produces three-dimensional *virtual clothing* as *prototypes/sample simulations* for possible physical garments, datafied *digital representations*, or *end-products* in themselves, worn only in virtual spaces where dressed avatars are fluidly enmeshed with our physical bodies and identities. “Digital fashion” converges fashion and gaming but also redefines the professional role of a fashion designer. The designer becomes a *digital artisan*, using the embodied technical fashion knowledge, yet, suddenly regaining the *artistic independence* with endless possibilities to test in 3D-form. Two ethnographically investigated case studies on “digital fashion” pioneers, Atacac and The Fabricant, are presented and analyzed.

Keywords: digital fashion, fashion designer, 3D-technology, digital-only, phygital

Introduction

At the end of 2018, New York Magazine reported that Fortnite-videogame – free-of-charge to play – made more profit with its virtual "fashion industry" than Amazon (Swearingen 2018). Having professional background in fashion design, this news inspired me to think whether the gaming world is a new arena for fashion designers, alongside the costume and character designers. Although digital garments have been part of entertainment industry for decades, a turning point in the *fashion world* happened around in 2019 when in collaboration with blockchain company Dapper Labs, the Dutch fashion start-up The Fabricant auctioned their *digital-only dress* at Ethereal Summit (New York) in cryptocurrency worth 9500 dollars (Roberts-Islam 2019, The Fabricant 2019). The purpose of this transaction was to promote the expanded possibilities of blockchain technology and to donate for charity. However, the "digital fashion house" The Fabricant and the area of "digital fashion" became suddenly a hyped topic, covered largely by fashion and mainstream media from BBC to Cosmopolitan. The phenomenon of "digital fashion" was then rather niche, a curiosity and a ground for experimentation. Since then, the amount of "digital fashion designers" has increased rapidly together with virtualization of the traditional fashion companies. Lately, due to COVID-19-restrictions, "digital fashion" has been regarded in a more serious tone by fashion media such as Vogue Business (McDowell 2020), included in fashion summits and embraced by designers who typically work with physical couture (Socha 2020; Ralph & Russo 2020; Diderich and Templeton 2020; Singh 2020).

The vaguely, yet, frequently used term "digital fashion" refers to a practice that produces three-dimensional virtual clothing as prototypes or sample simulations for possible physical garments, and/or for datafied virtual, digital-only garment representations. Thus, in professional and media discourse, "digital fashion" stands for two meanings: 1) a *processual tool* that is used to assist design and sales, as for example, in case of Tommy Hilfiger who is entirely digitizing their design processes and showrooms (McDowell 2019c). Such tool is entering also the fashion schools, for example, Parsons School of Design has included CLO3D-software courses in their fashion design curriculum, finding this educational solution highly practical during the COVID-19 lockdown in New York (Clo Marketing 2020). 2) "Digital fashion" also refers to an *end-product* in itself, worn only in virtual spaces, where dressed avatars are fluidly enmeshed with our physical bodies and identities (Makryonitis 2018). For example, in AR-experience, digital-only garments can be tailored on photographed bodies and in VR-experience worn by "digital twins" or avatars. Besides self-expression in virtual reality, 3D-garments can also be used in a virtual fitting service (Lee & Xu 2020). Furthermore, "digital fashion" is "skins" in videogames, worn by avatars that do or do not represent real bodies. For example, Animal Crossing for Nintendo Switch has become a bestseller of the COVID-19-spring 2020, operating in the intersection of the gaming and the fashion industry, and providing a platform for both the luxury brands, underground streetwear brands and fan-fashion (Renwick 2020).

The traditional fashion field is based on physical garment production – restricted or large-scale – and is hierarchical by its nature, with the most art-like, autonomous and designer-driven activities at the top (Bourdieu 1993a, 1993b; McRobbie 1998, Rocamora 2016, 237-238). In this *field*, the players are argued to compete with their symbolic "fashion capital", using different strategies: the "newcomers" rely on subversion strategies to overthrow the conservation strategies of the established, dominant players (Bourdieu 1993b, 133; Rocamora 2016, 234-235). The artistic, aesthetic, material and technical garment construction skills could be seen as the *jurisdiction* of fashion designers – the link between their occupation and the work itself (Abbott 1988); whereas their authorship, personifying role, social position and institutional recognition as professional *legitimization* (Kawamura 2018, 55-70). Lately, the fashion field has lost its centralized ivory tower structure to some extent in its search for merging the conventional practices with digitally mediated ones (Crewe 2012, 2017; Rocamora 2011). Jurisdiction and legitimization strategies of design practices should be reexamined in the transforming socio-technical circumstances. I argue that "digital fashion" is a *newcomer*, a growing subfield of the larger fashion field, challenging the mindset of fashion design and rethinking the very foundations of designers' work. Drawing from the collaborative and dynamic digital culture (Bollier and Racine 2005), "digital fashion" is now becoming abruptly relevant due to its non-physical essence, ethical aspirations and resourceful possibilities. Can this niche phenomenon become the new normal in the fashion industry? If yes, how and why "digital fashion" is practiced in the real-life settings?

This paper presents and analyzes two ethnographically investigated case studies on "digital fashion" vanguards, Atacac and The Fabricant, asking how these two different niche practices possibly transform the norms of fashion designers' work. This paper also conceptualizes "digital fashion," claiming that the COVID-19 reality might accelerate the digitalization of fashion design processes, virtualize fashion consumption, generate parallel fashion cultures and professional assemblages that force the fashion world to react.

"Digital fashion" as processual tool

Fashion design process is traditionally associated with designer-driven hands-on activities, such as sketching, draping, handling the materials and fitting on human models, requiring a combination of technical skills, aesthetic and temporal sensitivity, commercial understanding as well as creativity (Renfrew & Renfrew 2009; Bye & Sohn 2010; McKelvey & Munslow 2012; Nixon & Blakley 2012; Raebild 2015; Kawamura 2018). Computer-aided design (CAD) tools have entered the everyday work of fashion designers during the last decades and mastering CAD is typically a requirement in the contemporary job market (Bye & Sohn 2010, 200; McKelvey & Munslow 2012, 132; Sun, Li and Wang 2014, 1042). Computer technology in combination with professional tacit knowledge and manual processes are argued to facilitate the creativity in fashion design processes (Bye & Sohn 2010; Harris 2005; Arribas & Alfaro 2018). Patternmakers have already moved from drawing physical patterns to digital pattern-cutting and 3D-prototyping (Grice 2019, xvi). 3D-software such as Lectra Modaris 3D Fit, Browzwear VStitcher and Optitex 3D Runway import pattern models from

professional pattern design tools and are developed primarily for pattern-designers but also for fashion designers to save time and sampling expenses (Volino, Cordier & Magnenat-Thalmann 2004, 597; Sun et al. 2014; Mattila 2016, 1-2; Jhanji 2018).

An empirical case study on a virtual 3D-fashion design process, conducted by Arribas and Alfaro (2018), suggests that 3D-modeling enhances designers' creative freedom, helps to track the different phases of design, enables "3D virtual pre-prototyping," improves the communication between the designer and the manufacturer and enriches the retail user experience. However, the study also found several challenges in embracing 3D-software: usually fashion designers do not possess required software skills and their employers do not encourage such digital transformations. Therefore, Arribas and Alfaro (2018) propose that fashion design 3D-software should be targeted at specificities of *fashion design practice*. Enabled by computational power, the development of such software towards more sophisticated visual representation, efficient real-time interactivity between design and simulation, and focus on designer-oriented workflows – especially in case of the CLO3D-software – have tempted fashion designers to explore 3D-tools in their creative processes, bringing patternmaking and fashion design but also fashion imagery production and virtual worlds closer together (Stylios, Wan & Powell 1996; Volino et al. 2004, Braddock Clarke & Harris 2012; Spahiu et al 2014 & 2015; Mattila 2016; Makryonitis 2018; Black 2019; Greder et al. 2020).

"Digital fashion" as garment representations

The Western concept, culture and practice of fashion incorporates a non-physical symbolic and physical material dimension: fashion and clothing, image-making and garment industry, fashion as art and commercial fashion practices (Kawamura 2018; McRobbie 1998; Clark 2012; Black 2019). Today, the virtual dimensions of fashion are argued to be remediated and refashioned, and the new digitized practices to be relationally coexisting with the traditional and material ones (Crewe 2013; 2017). Acceleration and immediacy characterize the digital age, together with devaluation of material goods in the ever-changing, interconnected, post-industrial, informational network society (Bell 1973; Bauman 2000; Castells 2000; Rocamora 2013; Bertola & Teunissen 2018; Santos et al. 2020). The pace of fashion is turning from fast to instant (Rocamora 2013), and the authority beyond the professional fashion world (Rocamora 2011; Crewe 2017; Särmäkari 2020). As Louise Crewe (2017, 131) writes, "[e]mergent technologies are probing and perforating the boundaries between firms and consumers, production and consumption, object and image, the material and the virtual." E-commerce has rapidly grown resulting in normalization of virtual garment representations.

Digital 3D-design and virtual reality applications have been utilized by other industries in product development, marketing and e-commerce considerably earlier than in fashion due to the hard surfaces of the products. 3D-software makes possible to display, for example, cars before manufacturing them. In the early stages of digital dress, 3D-software restricted the

creative sartorial possibilities, forcing the cloth simulation to share the same surface as the body of the avatar, however, fashion-specific 3D-software have overcome this challenge (Makryonitis 2018, 101-2, Arribas and Alfaro 2018). Lately, the potential in reduced lead times, prototype errors and sample numbers have persuaded fashion companies to test digital 3D-representations prior physical production (Mattila 2016, 1; Arribas & Alfaro 2018). Certain sustainability aspects are identified in the use of 3D-software: when hyper-real imagery minimizes prototyping, sampling, photos and models, the orders are placed on-demand, turning the traditional Design/Make/Sell model into a less resource-depleting Design/Sell/Make – or design-present-sell-produce, as Atacac frames their model (Black 2019; Särmäkari & Vänskä 2020).

Makryonitis (2018, 103) argues that digital dress as a vehicle of identity, representation and commerce is potentially becoming a link between the electronic entertainment and the fashion worlds, bridging the gap between fashion and character design. Due to avatar design and significance of storytelling, the question of representation is central in digital-only fashion. Sport games, virtual multiplayer worlds and other contemporary settings resemble the physical and social dimensions of real-world dressing behavior (Makryonitis 2018, 108-9). Even non-realistic digital garments are treated as commodities rather than media surfaces and artificial scarcity makes such commodities desirable in the synthetic worlds of online games (Lehdonvirta, Wilska & Johnson 2009; Castronova 2005). As Lehdonvirta et al. (2009, 1075) observed in their study on Habbo Hotel -online game, the "lack of trendy sneakers at school could be compensated with virtual dragons and record players," pondering whether this phenomenon could have ecological implications. In the digital fashion paradigm, fashion companies might sell their designs in both physical form *and* in virtual spaces.

Methods

Previous research on digital 3D-fashion design calls for more empirical case studies in the area (Arribas and Alfaro 2018; Vanderploeg et al. 2017). Two forerunners and influencers of "digital fashion" – Atacac and The Fabricant - were investigated in-depth during 2019, in their physical locations. In order to delve into the complexity of the cases, the research material was collected and analyzed using case study strategy, qualitative methods and ethnographic approach (Flick 2014; Atkinson & Hammersley 1994). The cases were observed for several days in their physical studios, during their everyday activities: work, meetings, discussions and workshops. The people working in the companies were interviewed in a semi-structured manner. During the observation, notes and photographs were taken to capture the aspects that cannot be expressed explicitly and verbally. The field was experienced personally by the researcher (Lüders 2004; Moon 2016, 67). The interviews were sound-recorded and transcribed. Additionally, case-related media articles, talks, videos, podcasts, websites and social media content were collected and analyzed. Case study approach was chosen to understand the "how" and "why" behind the unexplored complexity

of two contemporary "digital fashion" practices and to construct new knowledge through personal interpretation of the data by the researcher (Yin 2018, 2-4; Stake 1995, 37). Reflexive thematic analysis method was utilized to generate themes using the creativity, subjectivity and activity of the researcher as a resource for positioned, context-bound and situated meaning-making (Braun & Clarke 2006, 2019). After an immersive familiarization with the data, an iterative coding process was executed in dialogue with evolving themes and theoretical assumptions (ibid.).

Vanguards of "digital fashion"

Atacac and The Fabricant are the pioneers and vanguards of "digital fashion" as well as influencers in fashion tech area. These two companies are similar in many ways, yet, very different in terms of their relation to the body, the object and the workflows. I first heard about the idea of "digital fashion" from the founder of Atacac, Rickard Lindqvist, who anticipated that digital garments will replace perfumes and bags as the main revenue of luxury brands, and become a new medium for designers to express their ideas without social limitations or economic boundaries.

Atacac is a Swedish, Gothenburg-based company, founded in 2016 by a fashion designer-researcher Rickard Lindqvist and a digital creative Jimmy Herdberg. At the time of my fieldwork, the company employed two fashion interns, a producer, a patternmaker, two tailors and a digital production employee. The other intern, Tom, was concentrating on the "communication" and garment representation side under Jimmy's guidance. The other, Wilma, was focusing more on the processual dimensions of digital fashion design. Christian, having fashion design background and tech-savviness, mostly transformed the physical fabrics into their digital twins. Anna was the project manager who "made sure that everything works;" Amandine prepared the patterns for production; and two micro-factory tailors, with origins from Syria, made the garments. Atacac builds on Lindqvist's "kinetic garment construction theory" that he developed during his experimental PhD research at University of Borås. The theory proposes an alternative pattern-cutting paradigm that defies the standardized and static 2D-pattern-cutting and bases its principles on the balance directions and biomechanical points of the moving body (Lindqvist 2015). When the founders encountered the CLO3D-software, they saw business and artistic possibilities in its combination with Lindqvist's theory. Atacac uses "digital fashion" as a tool for efficiency, creativity and their subversive design-present-sell-produce-model (cf. Black 2019) as well as sells their digital garments in a virtual reality platform Sansar[1]. Atacac uses a dynamic pricing model where the garments are considerably cheaper when pre-ordered. They are also testing CLO's beta version of a virtual fitting service which would ultimately enable a straightforward on-demand production. The starting point for their design is the human body and the pattern, therefore, the 3D-files contain very detailed data of the existing (or future) clothes. Atacac has built a traditionally equipped micro-factory at their studio after noticing

[1] https://store.sansar.com/store/atacac

that external manufacturing is not flexible enough for their needs, and that perishing Swedish sewing skills are now saved by the asylum seekers. They collaborate with other brands and offer production services for small scale needs. Atacac believes in overall transparency and open-source philosophy. In addition to displaying their design and production processes openly online, Atacac provides free 2D-patterns and 3D-models on their Sharewear-platform, inviting the customers to make their own versions of Atacac styles and through that building the community.

The Fabricant positions itself in the intersection of fashion and technology, as "the world's first digital fashion house" and is an Amsterdam-based fashion start-up of 5 people at the time of my fieldwork, and 11 people at the moment. The founder, Kerry Murphy, has professional background in film production, visual effects and advertising. Co-founder and creative director, Amber Jae Slooten, is a trained fashion designer, expanding her work to creating concepts and storyboards. Amber was the first fashion design student at AMFI to produce an entirely digital final fashion collection. After that she has taught at the same institution, establishing the study area of "digital fashion" and inspiring others to choose the digital 3D-space (including the two interns at Atacac). The Fabricant's creative producer, Marlous Custers, plays an essential role in company operations as she manages the practical side of everyone's work as well as the large network of clients and freelancers. Another co-founder, Andrea Hoppenbrouwer, has solid corporate experience and is responsible for commercial direction. Bram Siebers was employed as a 3D product expert with technical fashion production background. The later increase of their personnel shows that the company has grown fast since 2019. Their blog content and a range of slogans are produced by a freelance writer Mickey Larosse. The Fabricant highlights that they are a digital-*only* fashion house that *does not* produce physical garments, "makes the impossible possible, wastes nothing but data and exploits nothing but imagination." They design surreal bodies, imaginative clothes, environments and fashion films. The Fabricant's revenue comes primarily from collaboration with other brands; however, they wish to start selling their own designs and "create the digital-only fashion industry" (Murphy 2019). The starting point for their designs is the concept, storyboard and draping on the avatar. The digital garment, the story and the digital experience are the *end-products*, merging fashion design and animated film. For The Fabricant, digital fashion is a space for dreaming, free from the constraints of the physical reality and providing anyone "the entire fashion industry on their hard drive" (Larosse 2019).

New digital norms for fashion designers

The following five themes were developed to answer the question about the new norms that the two "digital fashion" cases are constructing for fashion designers. The analysis focuses on the two sides of professional jurisdiction (Abbott 1988): the content of work and the social position of the practice in a larger professional context. The work aspect includes the processes, technologies, essential skills, outcomes, organizational nature of operations and experience of work. The social dimension concerns the figure of fashion designer and the

status of a newcomer within the established field of fashion (Bourdieu 1993b, 133). This analysis aims at giving a glimpse into the possible development of the fashion design field in the (post-)COVID-19-era.

Building from scratch in unexplored terrain of endless possibilities (EXPERIENCE OF WORK)

Both companies are apparent "architects" of the new fashion world (Wilcox 2019), operating in unexplored and fuzzy terrain. Building everything from scratch is their privilege and challenge: there are endless operational possibilities and at the same time there are no existing blueprints, rules or frames. Therefore, the companies have to embrace the start-up mindset where failure is part of business. During the observation, I sensed a mix of an easygoingness and a stress at both studios due to the workload and uncertainty. As Black (2019) notes, although the communication and technology have changed significantly, the financial struggle of small businesses remains. Both companies and their designers are balancing between their independent artistic work and the more profitable client projects. As Atacac's intern Wilma Kuipers (2019) writes in her report: "Their business model is supported by three pillars; providing a fashion collection, consultancy and production facilities." The Fabricant, on its part, earns from digitalization and phygitalization of their clients' collections together with film production. The commercial growth does not seem to be the main driving force behind these two practices, rather, they have shifted from the traditional quantitative fashion business approach to a more qualitative one (Clark 2019, 316). Being subversive, the companies do not see others as competition, rather, they want to educate and transform the dominant fashion industry.

Atacac and the Fabricant are designing new workflows, managing a large number of different projects, collaborators and a network of freelancers as well as coping with suspicious, yet, curious reception by the fashion industry. The Fabricant's Amber feels more confident after drawing voluminous attention by the media and fashion companies. There are many questions in the air and both companies are consulting other professionals about technical possibilities such as automation of rendering and algorithmic tools to scale operations. Atacac talks about a new "digital fashion paradigm" while The Fabricant pursues a "digital-only fashion industry." In case of Atacac, the 3D-software enables agility and speed in the overall process from design to distribution, shortening the lead time from typical 1-1,5 years to 1-8 weeks. They developed a workflow where the 3D-file of a garments takes two directions from the designer's table: another in further physical product development and another to the communications team for imagery work, such as videos. Atacac built their micro-factory from scratch too, machine-by-machine together with diverse projects. Atacac is a pre-industrial and post-industrial fashion business where the designer can experiment virtually on a screen and physically at the micro-factory. The Fabricanters are particularly enthusiastic about the limitless creative possibilities beyond the physical ("even gravity!") and social

constraints that the virtual fashion space enables, providing evidence for Arribas's and Alfaro's (2018) argument that digital 3D-fashion design enhances designers' creativity.

Digital craftsmanship (TECHNOLOGY)

The cases are practicing refined *digital craftsmanship* where the designer becomes a *digital artisan*, a designer-*maker* who literally stitches garment pieces together on the screen. Both companies highlight the role of the CLO3D-software as an inspiration and a precondition behind their practices, due to the designer-friendly user experience of the software and the aesthetically appealing outcome that it enables. CLO3D could be seen to entail *sociotechnical affordances*, that take the existing fashion designer skillset and operational ecosystem into account, pushing and encouraging its users towards new actions, workflows and ultimately, culture of work (Davis and Chouinard 2017). The software is not the first and not the only of its kind, however, both cases of this study chose CLO3D because they found it most compatible with their traditionally learned fashion design processes, such as draping. For Atacac's Rickard, transition to digital 3D-software happened smoothly due to his background in patternmaking and academic research. The "artisans of the cyberworld" (Holmqvist Deacon 2019) Atacac merges tech innovation with physical craft, whereas The Fabricant focuses on translating and going beyond the physical skills.

As Atacac's fashion intern Wilma points out: "[…] when you start working, it's very easy to learn [to use CLO3D], but to work accurately needs practice." Although technical and fashion skills help to master CLO3D, the software also evokes appreciation towards and fosters the understanding of garment construction. Real-time virtual representation helps to test and communicate ideas quickly and without material investment ("I never run out of fabric"), creating *immediately* a realistic garment representation. The designer can go back and forth, returning to previous versions. Three-dimensional "sketching" shapes the workflow and mindset of designer who designs *for* and *on moving bodies*, and e.g. Amber believes that the current design interfaces are only a phase on their way to even more intuitive, hands-on VR-design tools, away from mouse, keyboard and a flat screen.

Digital garments are virtual simulations or/and representations of the physical garments. In addition to the CLO3D fabric library, Atacac uses an ordinary scanner and the "black box" i.e. the fabric kit provided by CLO3D to *digitize physical fabrics*. Digitized fabrics contain all the physical property data as the physical fabric, such as stretch, bending, density and buckling. The quantified fabric defines how the garment falls on (or from) the avatar, simulating the real experience, enhanced with animation and lightning. The work happens in dialogue between the 2D and the 3D-sides of the software. Amber designs primarily on 3D, whereas Rickard changes the 2D-pattern to change the 3D. Rickard uses a human-sized screen for a feel of realism while designing-prototyping. Digital fashion designers must possess skills to draw 2D-patterns and translate them in 3D, and ability to convert tech packs or physical garments into 3D assets. Though their primary software is CLO3D, both Atacac

and The Fabricant use flexibly numerous other programs, depending on the nature of the project. *Interoperability* between the different software is important in the smart digital environments of contemporary "fashion 4.0" practices (Bertola & Teunissen 2018).

Craftsmanship aspect is also evident in the service models. Both cases believe that personalized tailoring is becoming a new norm, either digital clothing tailored on personal avatars and customized for or by the customer, or physical clothing produced according to individual measures (or 3D-scans), needs and desires. Atacac's pre-sales model helps them to *immediately* identify garments that catch customers' attention and are worth evolution. In the presented cases, the new normal is not fast but immediate fashion with slow, local and reflexive processes (cf. Clark 2019). Luxury is not defined by the brand value, or the designer's name, but by the *process* i.e. the design and customization level of the garment.

Differentiation from the fashion world (SOCIAL POSITION)

Both companies have an ambivalent relationship to fashion: they appreciate the culture and simultaneously find the fashion world frustrating and unsustainable, acknowledging that the fashion industry is slow at transforming, digitizing and challenging internally their conventions (cf. Black 2019). The cases are primarily driven by creative and processual ambitions, however, also profoundly by *ethical* motivation, pursuing transparency, sustainability and inclusivity. Atacac wishes to improve the physical world with the help of technologies whereas The Fabricant wants to take distance from the physical realm whatsoever. The Fabricant aims at designing avatars that are non-binary and diverse in terms of body shapes and colors, whereas Atacac blurs the gender boundaries and focuses on the individual differences of the bodies. Some of The Fabricant's cyborg avatars play with posthuman aesthetics, not having faces and realistic human body shapes, and walking in dystopian environments that remind about the implications of human actions. "Sustainability" does not only refer to the social and environmental sustainability but also *sustainability of work*, contrasting the burnout culture of fashion and self-exploitation of fashion designers (cf. McRobbie 1998). The studios are decorated to be pleasant working environments, encouraging relaxed communication. Free-time activities as well as families are constantly brought up in conversations. Atacac arranges weekly a common (voluntary) sports activity during working hours.

Finding the traditional fashion designers' ideals of glamour and exclusivity outdated, the companies are applying elements of *open-source philosophy* by sharing their designs for modification or just for copying online free-of-charge (Särmäkari & Vänskä 2020). By doing so, they contest the secretive and protectionist culture of the fashion industry where copying is, paradoxically, normal, and invite people to build the alternative fashion world together with them. As Rickard said, "I'd rather see they make a good copy than a bad copy." The democratic tendency to flatten hierarchies of the fashion world (cf. Rocamora 2011; Crewe 2017) are also evident in The Fabricant's attitude (29 April 2019): "In the digital-only

fashion world we all get to walk the runway and sit in the front row." Both companies openly credit their sources of inspiration and endorse other companies in e.g. their social media channels. Instead of "adding to the piles of clothing" their practices favor the processes, concepts and the underlying value-intensive stories. If we look at occupations as a system where different occupations establish their jurisdictions and differentiate themselves from others by mastering particular skills and fulfilling a particular need (Abbott 1988), these two "digital fashion" practices differentiate themselves from the traditional fashion workflows, worldview, organizational culture and outcome, but aesthetically also from the "gamey" aesthetics. However, both companies believe that virtual fashion and gaming world will attract the young generations because the jobs are scarce in the traditional fashion industry.

Dividing the expression layer and the protection layer of fashion (PROCESSES -OUTCOME)

The Fabricanters envision, that the *expression layer* of fashion – already living in social media and media in general (McRobbie, 1998; Rocamora 2017) – could be increasingly detached from the *protection layer* of clothing. Digital-only fashion is performative, constructing the fluid identity from the assemblage of the dressed avatar and a semiotic extension of the wearers's body (Makryonitis 2018, 100; Biocca 1997). The "virtual" form of a product is a "real" commodity (Lehdonvirta et al. 2009). Digital clothing could become a novel medium for expression in a larger *fashion* context. As Atacac's Wilma envisions:

> *"[…] you can have several identities and try them out periodically. And it is also interesting from a sustainable point of view, because now you don't have to actually put on and buy something every two or three days, but you can just renew yourself there."*

In virtual realm, designers regain the *artistic independence* with endless possibilities to test in 3D-form, designing for "phygital" experiences where the virtual and the physical dimensions collide, blurring the distinction between the "real" and the "simulated" (Gaggioli 2017). Atacac is selling the digital versions of their garments as "digital skins" in virtual reality, while simultaneously producing physically innovative designer clothing. In their design processes, digital and physical live literally side-by-side, making the division of these two realities evident. They, however, believe that people will be spending more time in virtual realities and that Atacac might be selling mostly virtual garments in the future. While Atacac designs primarily for physical bodies, The Fabricant designs both the digital bodies and the digital clothing for the digital bodies that move only in virtual spaces. The Fabricant is developing a virtual fashion space Leela[2] where the avatar, the environment and the garment are customizable. Digital-only clothing is not only *mediatized* (Rocamora 2017) but *becomes the media space*, relying on the immersive capabilities of the embodied material human

[2] https://digital.fashion/

experience. Both cases design for the "virtual layer of expression" that does not presuppose the physical production of clothing, arguably producing "fashion without products" (Thiel 2017). Whether for pre-sales, immersive fashion experiences, or virtual fitting services, appealing and hyper-real data-intensive imagery is crucial. Rickard believes that inexpensive 3D-scanning using mobile devices will become mainstream, filling the online stores with realistic moving customer avatars.

Authorial, professional, organizational, operational and material fluidity

In both cases, the authorial, professional, organizational and material boundaries are rather fluid. They question whether there will be fashion brands as we know them, moving toward service-oriented business models. Both believe in legitimization by the *community* therefore they grow their communities through sharing and engaging. Especially "Gen Z" and growing generation are considered to adopt the virtual co-creation mindset. As Rickard notes, "[…] kids today start playing Minecraft when they're like five, and Minecraft is 3D modelling, so for that generation what we do in CLO now, will be so natural." 3D-software that aims at attracting large number of young creatives posts instructions in YouTube and encourages everyone to share knowledge about digital making. People who are not trained in fashion design can try their wings as designers, adding non-professional contribution to the virtual pool of fashion. This might lead to a similar situation as in the music industry: anyone can start their own label and publish their outcome online regardless where they live or who they know. Yet, it is hard to stand out in the crowded digital world. In addition to the digital fashion community, Atacac and The Fabricant have lately been legitimized also by the dominant fashion world through media visibility and collaborations with major companies. They collaborate mostly with sports and luxury brands, co-creating the concepts together with the companies and covertly educating them to become digi-able. Technologies not only remediate and refashion the distribution but also the designing and production of fashion (Crewe 2013; 2017).

Additionally, fluidity characterizes their physical workspaces that are open and shared with other companies. Transparency is literal in the studio of The Fabricant where the walls are made of glass. The studio of Atacac does not have walls at all and the company is located in the middle of the old, renovated industrial building. Atacac collaborates with other tenants of the building, such as a photographer and textile buyer. The Fabricant works very closely with the digital interface design company, Your Majesty. Collaboration is not limited to their neighbors as different assets (garment, avatar, environment, sound, motion) require a diverse expertise. The Fabricant manages and is in a daily dialogue with an international ever-growing network of freelancers. As their producer Marlous pointed out, "reading people" and communication skills are essential as well as capability of finding truly skillful freelancers that fit specific tasks and projects. Operational models of these two start-ups are based on flexible collaboration rather than being "one man's band" (Black 2019). The companies saw potential in professional synergies: Atacac's Rickard is technical expert in garment

construction and Jimmy in interactive digital experiences and programming; The Fabricant's Kerry is a technical expert in filmmaking, animation and visual effects whereas Amber a traditionally trained and conceptually creative fashion designer. Although the division between roles is clear, the creative processes are a blend of mutual input. Both companies are opening the designs for the public, collaborating with different parties and blurring the boundaries between the material and digital skills, a brand and a community, as well as fashion and other fields. Having that said, they apply fluidity in their everyday operational mindset.

Conclusions

This paper introduced and conceptualized "digital fashion" which refers to an apparel *design paradigm* that uses fashion-specific 3D-software in the design, prototyping, sampling and distribution processes, and an entire *virtual fashion culture* that exists adjacently with the traditional fashion industry. "Digital fashion" is a space and community that redefine the dressed body, the fashion object and subject. Wearing digital-only clothing might be a niche phenomenon but using the digital fashion paradigm in design and production processes is becoming normalized. "Digital fashion" converges fashion and technology, and brings together a plethora of professionals and amateurs, holding a fluid mindset of digital culture where the design processes are in a constant state of negotiation (Bollier and Racine 2005).

Both presented practices strongly differentiate themselves from the conventional fashion field in terms of ethics and workflows. Without pre-existing operational blueprints, the cases can be labeled as "architects" of a new, digital fashion world, practicing refined *digital craftsmanship* and designing for "phygital" experiences, digital bodies in motion, virtual spaces and the *virtual layer of expression*. As a tool for optimization, virtualization, and digitalization of the design process and production, "digital fashion" is still relying on the tacit knowledge and artistic vision of the designer, thus, the jurisdiction is only expanded to entail a wider range of technical digital skills, overlapping with other occupations. "Digital fashion" redefines the professional role of a fashion designer who becomes a *digital artisan*, a designer-*maker* with *artistic independence*. However, as collaboration, co-creation and personalization are their new normal, the professionalization is pursued with an emphasis on intelligent and ethical processes instead of designer's authority.

When looking at fashion primarily on the screens, it is sometimes hard to tell the difference between the physical and the virtual. Can we experience digital fashion as we experience the material, tactile, and the social fabric of fashion? Could "digital fashion" replace some of our fashion needs and desires, making the overproduction physical clothing obsolete? How the digital twins (or non-twins) affect experiences of our bodies? Will designers lose their tacit knowledge if they move to digital prototyping and sampling? There are many questions to be explored. As part of digital culture, "digital fashion" might not be as odd as it first sounds. We all, however, start experiencing a Zoom-fatigue. According to the media reports, the A/W

2020 fashion weeks that were forced to be largely digital, were far from successful (Mondalek 2020). Will the virtual overload of the COVID-19 times result in a desire for *physical-only* fashion experiences? And what kind of risks does "digital fashion" present, in terms of copying and other questionable activity? Will layperson participation degrade the fashion culture?

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