PHYGITAL: HANDLE WITH CARE

EXPLORING THE RELATIONSHIP BETWEEN THE PHYSICAL AND DIGITAL FASHION DESIGN WORLDS

ALISON MURRAY

STUDENT: Alison Murray
STUDENT NO.: 500750463
NO. OF WORDS: 3418
SUPERVISOR: Stella Walker
INSTITUTION: Amsterdam Fashion Institute
COURSE: International Fashion Design
DATE: 06.05.2020

Figure 1: Authors own design and avatar with file size, render times, and image specs of the piece visible. From 'the only size that matters' series, exploring what digital aspects can be looked at to replace the physical garment care label (authors own image, 2020).

CONTENTS

TABLE OF FIGURES

TABLE OF TABLES

INTRODUCTION: THE CURRENT SITUATION

"It's like saying among airline pilots that the best flying team has three components: a pilot, a computer and a dog. The computer is there to fly the plane, the pilot is there to feed the dog. And the dog is there to bite the human if it tries to touch the computer."

- Hannah Fry, Hello World: Being human in the Age of Algorithms (Fry, 2018, p. 22)

Physical-Digital collaboration: 'phygital'. Humans' relationship with the digital world has boomed, a relationship which now surrounds our everyday life. Above, Fry (2018) highlights our relationship of trust with technology. When should the technology run its course and algorithmic language, and how much should humans get involved; this collaboration is an interesting one, especially in the world of design. The Covid-19 pandemic has thrust the digital sphere into the spotlight as a tool for communication, collaboration and creativity in a locked-down world, a tool which may be crucial for the future of fashion (McDowell, 2020). As fashion companies pause and employees work from home, "the only certainty is that business as usual is impossible" (Kent, 2020). This paper explores the status of both digital and physical fashion in these changing times, investigating ideas of how to care for the ever phygital-ising fashion industry. Through literary analysis, interviews, and experiments, the implications of the rise of digital fashion will be teased out, and recommendations made for ensuring that its future evolution is both sustainable and responsible.

Digital fashion is a burgeoning realm of the fashion world (Nataliya.ai, 2019), with brands, designers and tailors now adapting their creative output from the seam, stitch and hem to the screen, RAM and render. Within this emergent sub-industry, there are different directions companies have taken. In post-product creation, designers are choosing between digital-exclusive creations - meaning no physical garments are involved; and exporting their digital designs to be created or manufactured in the physical world. The choice made

is critical: one approach implies a full transfer of the creative process to the digital realm (PixelPool, 2020); the other suggests an ongoing collaboration between the digital and the physical: the phygital.

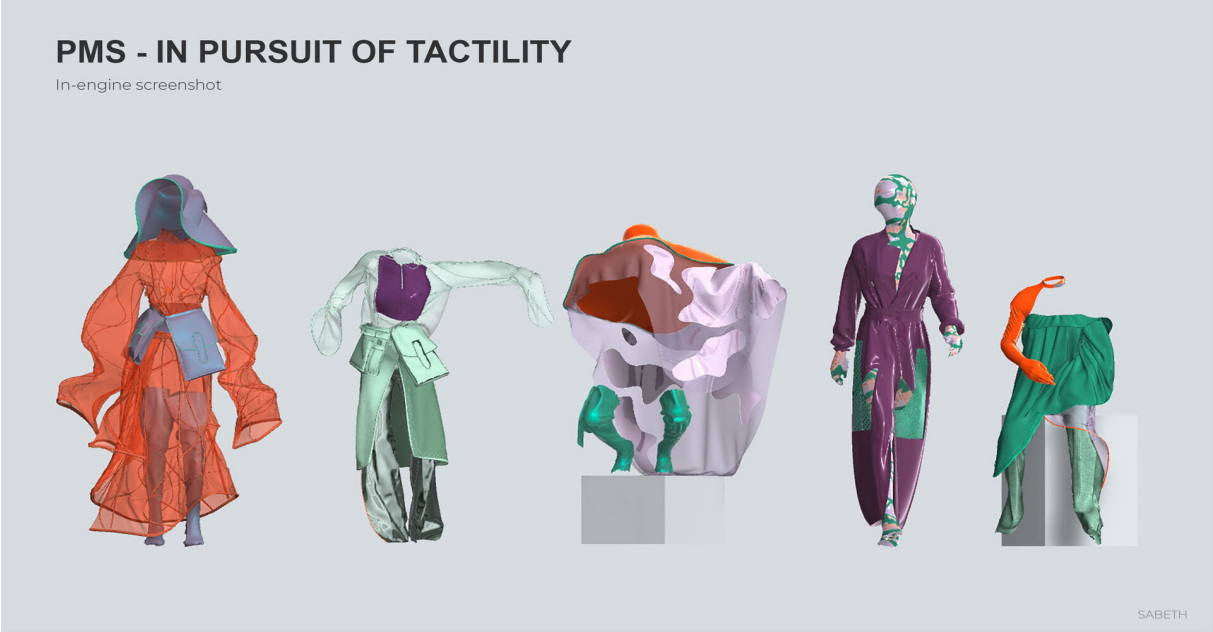

Figure 2: Studio PMS's digital collection 'In Pursuit of Tactility' (Sabeth v, 2019).

Digital-only brands include *Studio PMS,* whose work attempts to redefine tactility and "challenge and mitigate overproduction and overconsumption" (NOoF, 2020) (see Fig. 2). *A Hot Second* is "the world's first circular economy concept store" trading "physical products for digital experiences" (Insider Trends, 2020). *The Fabricant* is a leading digital-only brand who "waste nothing but data" (Zha, 2019). By fully-digitising their creative process, these brands are propelling a future vision of the fashion industry that is divorced from the realm of the physical as we know it, challenging standards.

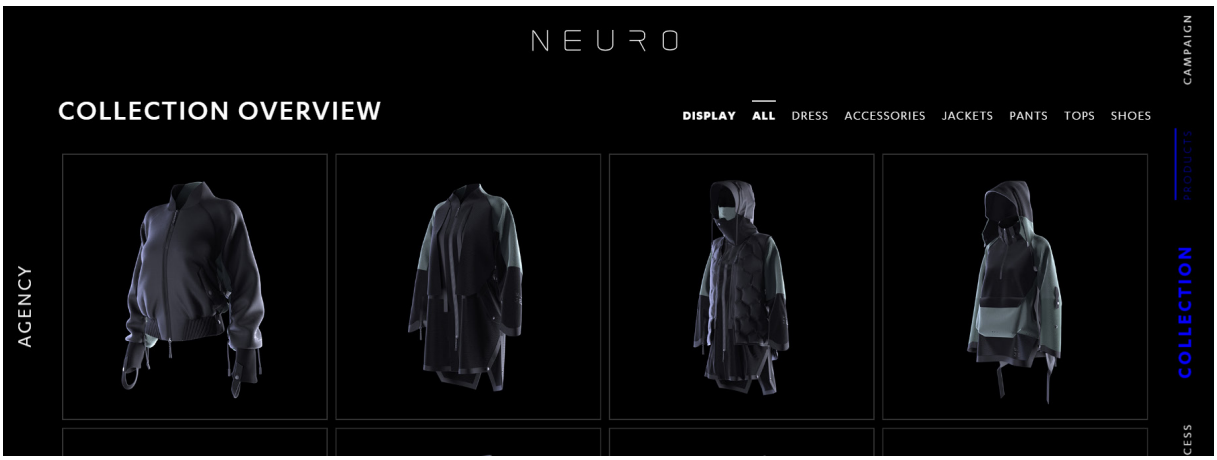

Figure 3: Neuro Studio 'Solventus' collection overview (Neuro Studio, 2019).

Phygital brands promote a collaborative intertwining of the physical and the digital. *Neuro Studios* create made-to-order digital samples for physical products, claiming that their vision is “less about selling products, and is more invested in proving that a sustainable, tech-driven supply chain works” (Lieber, 2019) (see Fig. 3). *Carlings* recently released both an augmented reality technology onto their ‘Last Statement T-Shirt’, and a digital-only collection that they render onto an image provided by the customer. The product was a success, and ““sold out” within a month” (Godwin, 2019) (see Fig. 4). This raises interesting questions relating to the interplay between physical fashion practices and the digital. The concept of the sell-out is rooted in the physical world - it relates to the depletion of stocks. How then does it apply to a digital product? In declaring a sell-out, *Carlings* manufactured a form of scarcity for their product, a method all too familiar in the luxury fashion world (Fowler, 2018). This points to a central question concerning the collaboration between the physical and digital - should ‘phygital’ brands mirror the fashion industry, or stand separately from it? Mirroring may lead to the recreation between the two spheres embedding pre-existing biases and fault lines in the industry. This is a wider problem with technological progress, as Hannah Fry has observed: “using algorithms as a mirror to reflect the real world isn’t always helpful, especially when the mirror is reflecting a present reality that only exists because of centuries of bias” (Fry, 2018, p. 70).

Figure 4: Carlings augmented ‘Last Statement T-Shirt’ (Snowden, 2019).

As technological progress digitises ever-more aspects of the fashion industry, it is important to understand how this relates to the source, that is, physical fashion. The physical fashion industry is not a stranger to controversy. A wealth of research has uncovered its problems, most pointedly regarding people and planet. The garment industry is the “second most predominant sector driving modern slavery” as of 2018 (Fashion Revolution, 2020).

Consumers are buying “60% more items of clothing than they did 15 years ago” of which they are keeping for “only half as long as they used to” (BOF, McKinsey & Company, 2019, p. 30). After the garment’s short life with the consumer, 11 million items of clothing are sent to landfill every week in the UK alone (Oxfam, 2019). Physical clothing production is ‘projected to rise by 63% by 2040” (The Guardian, 2020). Numbers like these are regrettably common to the fashion industry, pointing to the friction between people and planet embedded in current linear supply chain models and capitalist surplus economies designed to maintain limitless consumption. However, hope can be found around all corners. Digital fashion has helped to rethink the possibilities of production from start, to use, and afterlife. Sampling, or prototyping specifically used in the experimentation for fittings and design check, can be implemented digitally to reduce these large numbers. *EFI/Optitex* reported that “Adidas was able to eliminate close to 1.5 million physical samples between 2010 and 2013”, and Target “has reduced physical sampling by approximately 65% by implementing 3D digital design” (Roberts-Islam, 2019) Research by *The Waste and Resources Action Programme* has found that extending the active life of a garment by 9 months would reduce its carbon, water, and waste footprints by 20-30% per tonne (WRAP, 2017, p. 47). The rise of digital fashion thus presents an opportunity to reorient the industry in a more sustainable direction. The future presented by the advocates of digital fashion may be a world of opportunity and progress, yet it too ought to be analysed carefully.

The focus of this research paper is therefore: what is our phygital fashion relationship?

The answer to this question will be structured as follows. It will begin by analysing the multiplicity of phygital identities, specifying my personal lens on this subject. It will then address the industry’s digitization focusing on materials, and analyse the effect of the current COVID-19 pandemic on fashion. Then recommendations for phygital design guidelines through material experimentation will be outlined, before ending with an outlook on the phygital creative process.

MULTIPLICITIES

Figure 5: The Fabricant's Leela beta platform (The Fabricant, 2020).

This chapter explores our physical relationship with our digital extension of selves, highlighting my personal bias towards the rise of digital design, ending with how we should take care when defining what is the reality of self. Online platforms have enabled us to create multiple versions of ourselves and store them in multiple places. Organisations such as *The Fabricant* are already suggesting what this can look like, with their new digital fashion playground Leela (see Fig. 5), released in April 2020. Leela allows you to "express your digidentity. Introducing the first digital collectables for you to purchase and experience", with the aim to reduce physical fashion consumption (The Fabricant, 2020). Upon participating in a trial run of the platform in December 2019 - which included a 3D body scan digitally dressed and placed onto a prototype platform - their most common question for feedback participants was the physical-digital relationship between human and scanned avatar. Or their 'digital twin', meaning a "virtual copy of a physical system", this term has been around some time, coined back in 2002 by Dr. Michael Grieves and first used in NASA space missions (Kienzler, 2019). As an identical myself and digital user, I find myself more open to the idea of multiple and digital identities, and research shows that "twins equally recognize their own face and their twin's face" (Martini, Bufalari, Stazi and Aglioti, 2015). Deducing that one can relate to another, if it is similar enough, as The Fabricant's 3D body scan was.

'I' being a young graduating fashion designer based in Amsterdam, traversing the physical-digital affinity through my projects, and therefore coming into virtual contact with digital-selves often. It's as if my 'self' is multiplied. Moreover, many people are using a digital-self, any digital creative or social media presence is evidence of this. This digital use mixed with twin nature has heightened my multiplied identity, and as shown in Rosendahl's experimentation, "twins switch between dual identities, the first identity being that of a twin, and the other being that of a unique individual within the twin relationship" (Rohden, 2013). Myself and my twin can vouch for that feeling of switching between that of a pair and that of an individual, and now that of a digital triplet. Those open to the idea of multiple identities, are therefore potentially more accepting of the introduction of the first wave of digital fashion and digital selves. This is an underlying personal lens as to why the focus of this research explores two worlds. Additionally many people are multiple, changing what parts of ourselves are presented in different contexts. Digital identities provide opportunities to extend the development and exploration of ourselves.

The digital self has become important and hyper-realistic, as people "are continually seeking new ways to express their individuality" (Tamuly, 2020). However, "convincing customers that digital fashion can be just as covetable as their IRL [in real life] equivalents is the next step" (Lieber, 2019). Convincing people that their digital can be a reality, is something Cameron James-Wilson - creator of the world's first digital supermodel Shudu (see Fig. 6) - has had experience with. Cameron created a digital model so real that "when [he] realised that people were no longer questioning Shudu's existence and had almost

accepted that she was a real person, [he] decided to be very transparent" and expose the truth that Shudu was digitally created (Alti, 2018). The contradictory evidence shows that, firstly that the wider public still need convincing of the digital's realness, and secondly that they are simultaneously open to fully believing in Shudu's 'reality'. Cameron additionally raises "awareness that technology existed that could make 3D humans that looked so realistic […] we're at a place now where real people are so filtered, so photoshopped, that there is no actual differentiation between 3D art and a photo" (Alti, 2018). Touching upon the accuracy of technology, and the commonality of its phygital use. Physical and digital surrounds our daily lives, blurring, giving reality to both worlds; take care when judging reality.

Figure 6: Shudu, the world's first digital supermodel (MEFEATER, 2018).

MATERIALISATION

"We are desperate to create new life forms but we are rubbish at looking after the ones we have."

- Daisy Ginsberg (Dezeen, 2020)

This segment delves into physical fashions toxic issues, analysing how digitization can aid and care for its problems. 'Better' is a term repeatedly used in the industry. "Some are saying a better world will come out of this hardship" of lock-down (Adegeest, 2020). That we should "use this time to really think about ways to protect factory workers while doing better for the planet" and "get better at what we do" (Krentcil, 2020). In Ellen McArthur's report, "a new textiles economy - based on circular economy principles - would lead to better outcomes" (McArthur, 2017, p22). Above artist and biologist Ginsberg, talks on the topic of 'better' (Dezeen, 2020). Stating that, in the search for 'better', what is already present is overlooked. This relates to fashions hype with what is new and innovative, overshadowing that of traditional fashion; the innovative being digital design. It is therefore also important to maintain a focus on the status of physical fashion and its phygital relations. Especially since the value of unused clothing in wardrobes "has been estimated at around £30 billion", with "£140million worth of clothing going into landfill each year", in the UK (WRAP, 2020). Quantifying just how much "we are rubbish at looking after the ones we have" (Dezeen, 2020), especially when most garments contain toxic materials.

Currently, the worst fabrics for the environment are cotton, synthetics and animal-derived materials (J. Young, 2019). Extinction Rebellion states that "one billion animals are killed each year for leather", whilst "85% of the world's leather is tanned using chromium", an extremely toxic substance (J. Young, 2019). McArthur's report finds cotton contributes to water-scarcity, and synthetics (primarily polyester at 55%) "use large quantities of non-renewable feedstocks", are energy intensive, and shed non-biodegradable microfibres

(McArthur, 2017, p20, p119). However, there are many fabric developments occurring to reduce toxic impacts. A more substantive list of innovative material efforts can be found in Appendix A. One more successful example of a material that has made its way into the market, and is accessible to students, is Pinatex®: a leather-like material "made from waste pineapple leaf fibre" that "creates an additional income stream for farming communities" (Ananas Anam, 2020) (see Fig. 7). Focusing efforts on normalising responsible materials such as these, rather than toxic materials, is important for the sustaining of products and industry.

Figure 7: Pinatex® pineapple leather (Dan and Méz, 2019).

Figure 8: Own render of digital leather in CLO3D (authors own image, 2020).

Phygitalisation also provides the opportunity to heavily reduce physical production of toxic fabrics. Firstly, designers and producers can use what has already been produced, current times of lock-down further illuminate the importance of using-up what is around us instead of buying new (Fairs, 2020). Secondly, technology has advanced to realistically emulate the physical material in digital design (see Fig. 8). So much so that "in certain corners of the tech world, spending real cash on digital apparel is as routine as taking a trip to the mall", those who "can't afford Gucci in real life, can in the digital world" (Lieber, 2019). Showing that consumers place high economic value on digital twins, due to the superlative fabric and garment representation. The designs are distinctly recognised, further proving previous twin research that highlighted "twins equally recognize their own face and their twin's face" (Martini, Bufalari, Stazi and Aglioti, 2015). Moreover, the emulation of fabrics digitally can give space for even the most unsustainable and harmful fabrics to be moved to a digital place where they can be better sustained. Such fabrics originate from the same source (that being a computer code), unlike a range of sources like physical materials (plants, oil, animals). This could consequently free up time and effort in the physical world to instead focus on the development and implementation of responsible, less toxic materials. Digital design is a space to play with all materials in a safe way which, if embraced, could halt the new production of toxic fabrics.

THE CHANGING INDUSTRY

In this section, the changing nature of the physical fashion industry is explored, its interplay with the digital sphere, and the implications of the unprecedented response to the Covid-19 pandemic, whilst caring for our more common digital creative spaces. Researchers Duvfa and Dufva (2019), explore the future of involving the digital into our society. Dufva coined the term "digi-grasping" to denote an "active sense-making and existing in a world that consists of both a digital and a physical world". The researchers argue that digi-grasping can "empower people to understand and question the choices and motivations of current structures and create new […] thus an important approach to shaping futures" (Dufva and Dufva, 2019). An analysis of our structures has never been more important, of which the digital can aid. Arguably humans have already grasped much of digital life. Online communication is the fastest growing language globally (Criado-Perez, 2019, p. 8), and there has been a recent "spike in people looking to use digital services" (WGSN, 2020, p.7). With digital grasping increasing, there is space to seek effective change in the fashion industry's phygital transition as it is shaken by COVID-19.

Behaviours both physically and digitally are changing rapidly, as COVID-19 restricts the movements of millions globally into a lock-down, challenging the world of fashion. When "you're locked indoors, spending your days on Zoom, having the latest designer dress is no longer a capital investment" (Adegeest, 2020). However, "people are looking to technology to drive connection" (WGSN, 2020, p.15); digitally uniting whilst social distancing is enforced. Digital-selves are therefore more active, with our physical investments shifting. Furthermore, clinical protection has come important for physical material and design. The "application of fabrics will be changing in these times, with higher levels of mask and glove wearing" (Horowitz, 2020). Physically, protection is now a higher value than the latest dress. Digitally, a connection is underway.[1]

Moreover, consumption behaviours are wavering, as the environment shows signs of recovery. Futurist Li Edelkoort, writes “the true cost of shut down will lead to a global recession of a magnitude that has not been experienced before. This is not a financial crisis but a disruption crisis [...] A quarantine of consumption” (Fairs, 2020). However consumption behaviours are currently debated, with claims for universal credit surging, consumer spending is “likely to slump by an unprecedented amount” as stated by economist Paul Dales (Romei, 2020). While “fashion industries brace for turndown” (see Fig. 9), online shopping is becoming “more of a habit”, as “others turn to fast fashion for cheap thrills” (Indvik, 2020). This ‘thrill’ is now focused digitally, with some not able to afford thrills, whilst others spend on cheap fashion; which does not help fashion production problems as recently “more than $2.9 billion of exports have been cancelled or paused, displacing more than 2 million workers” (Kent and Nanda, 2020). On the other hand, environmental benefits are on the rise, with the Financial Times predicting “Fashion’s impact on the environment — the amount of carbon it produces, the millions of litres of dye that pollute the world’s waterways, its contributions to soil erosion and biodiversity loss — will drop sharply this year” (Indvik, 2020). The pandemic is allowing for reflection and analysis of the state of fashion and our way of living, caring for one another is essential.

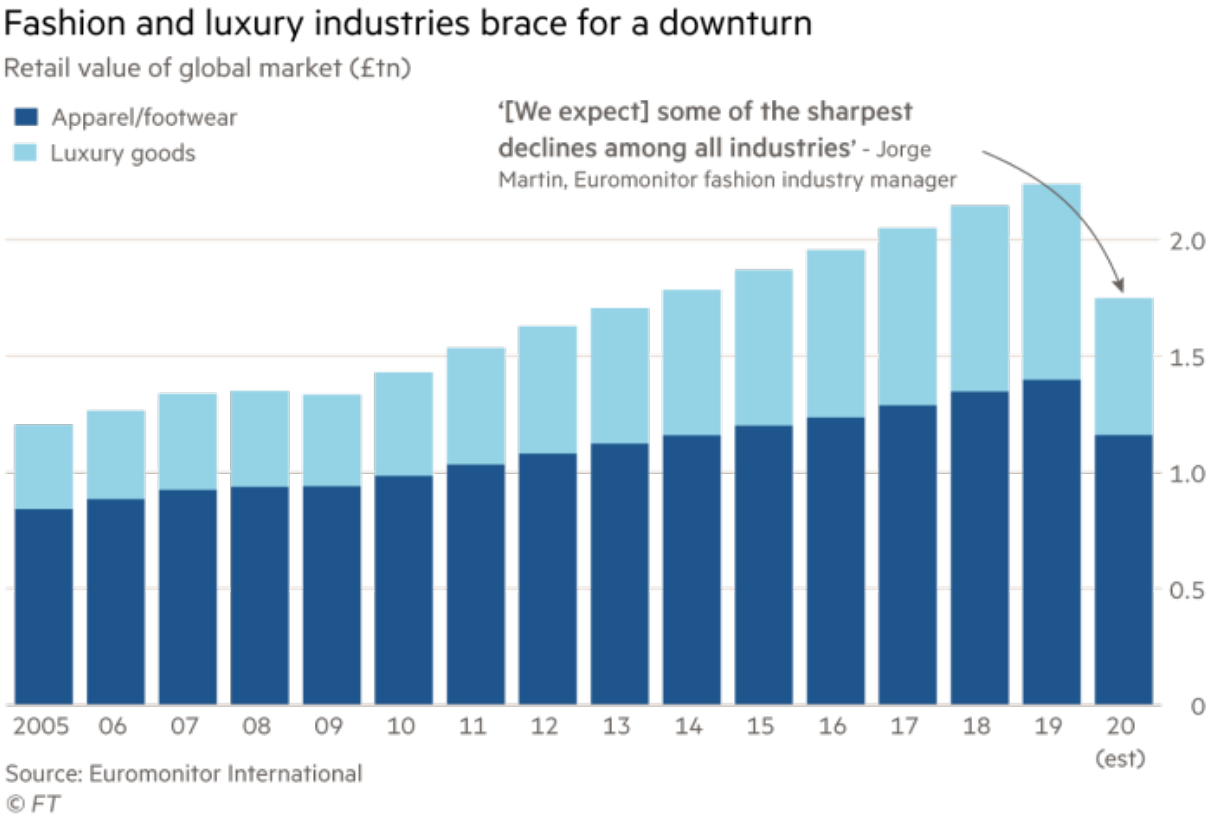

Figure 9: Fashion and luxuries industries brace for a turn down (Indvik, 2020).

[1] These current findings of behaviours are only current, with little knowing of their continuation post-COVID.

Previous ideas of what constitutes a fashion collection and show are being revamped, as brands are slowing down and producing less, as “seasonal trends will continue to disappear”, alongside “fashion shows called off” (Indvik, 2020). This can bring necessary heightened examination of the anatomy and relevancy of collections. New digital runways have accumulated mixed reviews. Video and streamed fashion shows can be seen to reduce the “rush from show-to-show” which “gave attendees more time to absorb them”, however others miss “the in-person “visceral” momentum” (McDowell, 2020). On one hand, it is providing a larger reflection time post-show, and in turn a more detailed judgement of the designs and the experience. As brands experiment with “digital presentations and live interactions”, another advantage is that “storytelling around brands and collections will improve” (Indvik, 2020). With time, experimentation, and creativity we can collaboratively explore digital methods of presenting to re-imagine and regain this “visceral momentum”.

Design and creativity are being recognised as an essential aspect of well-being during lock-down, valorising the place of creative spaces in society. Edelkoort mentions “rediscovering old favourites we own, reading a forgotten book and cooking up a storm to make life beautiful” as she boasts her future forecast of the “Age of the Amateur”, seemingly approaching faster than anticipated (Fairs, 2020). This, she describes, as an age in which people are empowered to be more creative. Lock-down is showing how valuable creativity is to well-being and societies. However, having to adjust to new creative spaces can be both mentally and physically challenging. To make-do with the other side of your bedroom, challenge that creative motivation. Staying motivated and inspired become more difficult activities during a pandemic (Berry, 2020). Care is needed internally and externally. Digital worlds can somewhat replace and re-create our lost creative spaces, if handled with care, providing another style of creativity.

RESPONSIBLE PHYGITALISATION

"Simply because it's digital does not by default make it sustainable."
- Morten Rosén, Head at Normative (Socha, 2020b)

Overlooked aspects in the rise in digital fashion are explored in this chapter, in order to handle the phygital design future (and present) with care for people and planet. Digital design is an exciting evolution, however, it is not perfect: it is relevant to investigate its mishaps and areas for improvement in order to use it in a responsible and sustained manner. Above Rosén touches upon overlooked sources of eco-damage, a major one being "the digital ecosystem itself", she is head at Normative, a tech company tasked with assessing the environmental and social impact of fully-digital *Helsinki Fashion Week*, in real time (Socha, 2020b). Shadowed digital elements such as file size, data, and e-waste are inspected, due to their negative environmental impacts

The digital is never fully separated from the physical. Hardware holds the software, and with many updates on tech, and companies "having deliberately built a short lifespan" for profit, we throw away more laptops and phones (Harris, 2020). Producing a computer and its monitor takes "at least 1.5 tons of water, 48 pounds of chemicals, and 530 pounds of fossil fuels" (Adeola, 2014, p. 99). As fashion embraces the digital, implementing systems to handle the waste build-up is crucial and it can have great effects. Recycling one million laptops "saves the energy equivalent to the electricity used by more than 3,500 US homes a year" (EPA, 2019). This is especially crucial as "the average global citizen uses their smartphone, laptop and Netflix account in a frequency unrivaled to their aviation habits" (Socha 2020b). Additionally, whilst creating digital fashion many files of multiple sizes are produced. This is possible due to giant data centres and servers which "house all our data,

serve all our entertainment, and power and cool the computing infrastructure, of which there are now more than 500 hyperscale data centers in the world" (Sverdlik, 2019) (see Fig. 10). Rosén ads, "did you know that data servers the size of multiple Walmarts coming up like mushrooms from the ground already have surpassed all global aviation in terms of carbon emissions? [...] That's only counting the direct energy the data servers consume and the sources of that energy often being fossil fuel-based" (Socha, 2020b). Moreover, these data centres have an extremely high energy consumption, reporting that globally they "used more than Britain's total electricity consumption" (Trueman, 2019). Contrarily, UK "electricity consumption plunged 10 per cent in the last week of March" (Romei, 2020) (see Fig. 11), when COVID-19 lock-down measures were enforced, suggesting that electricity use behaviours are collectively reducing. This physical-digital co-reliance is necessary to monitor its negative and overlooked environmental impacts. On a company and individual level, being aware of how tech is used and files are stored, can cause positive actions. Currently, with few guidelines for digital designing: investigating such phygital issues, like data, storage, and hardware elements, are important guideline research directions.

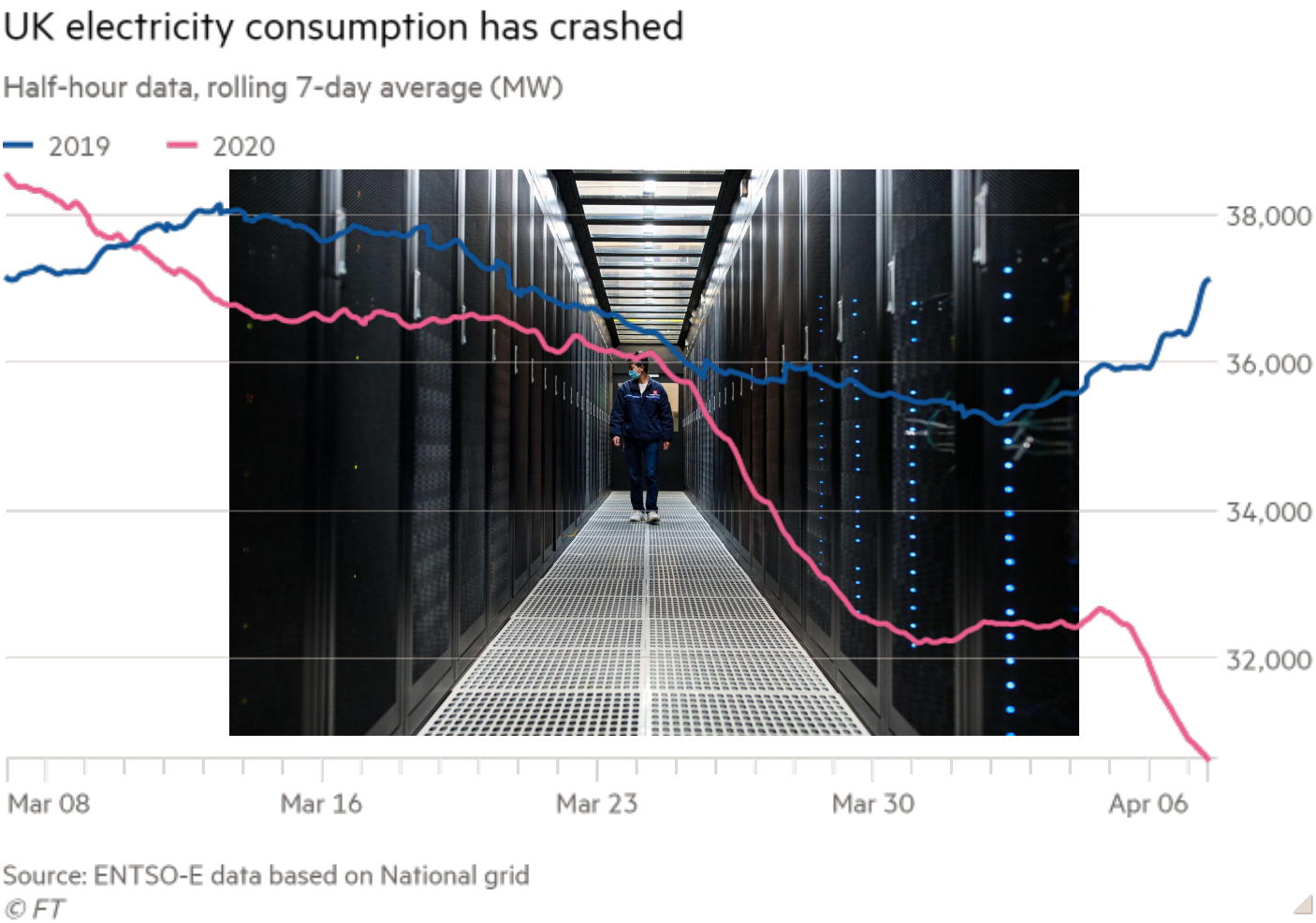

Figure 10: Checking servers at China Telecom Data Centre, the largest in the world at 10.7mn sq. ft (He and Ruiqi, 2020).

Figure 11: UK electricity consumption has crashed (Romei, 2020).

Stitch is a digital fashion company, based in Amsterdam, aiming to “make fashion seamless” (Stitch, 2020), who created a ‘render farm’ to solve render times. *Stitch* manager Joshua Dorland was interviewed regarding the company’s developments (See Appendix B for full transcript). A render farm, Dorland informs, is “nothing more than a big line of computers to do the calculations needed for rendering an image/video”. One can send a file via a hub and the “multiple computers take care of the rest”. It frees up “the computer for you to keep working on other projects” and speeds “up the process drastically […] with a simple t-shirt maybe taking 1-2 minutes on a render farm and up to 5 minutes locally”. This clearly improves work flow and efficiency. He highlights file size as an issue, but suggests that it is a thin line to “not compromise quality over speed”. E-waste is not something they “have a current priority for, although it is not something to forget” as they look into renewable energy sources. “The future of digital fashion is now on the radar more than ever” Dorland continues, it allows for “direct communication between Brands and Factories”. Yet, there needs to be “a lot more investment to […] make digital fashion design a success”, primarily in software, training, and common solutions for cross-application work in areas such as “file format and fabric physics”.

The next step is trust, “many people still have doubts about accuracy and good representation”. Trust you can practise, Dorland exclaims, “without requesting 10 samples, but only request 2”. He, too, highlights collaboration as the step forward, which is hard because “most brands want to keep their progress to them self and edge the competition”. Younger brands, such as themselves, have the opportunity to show how the industry should be, and what the guidelines are for a flourishing phygital future.

DIGI-CARE EXPERIMENT

In the search for phygital responsibility, one can explore: what are the digital fashion design sustainable guidelines?

To answer this question, an experiment was constructed. CLO3D is a leading software, due to its high quality representation of fabric properties helping "designers convert their prototypes to show how fabrics might move and how they can be stitched together" (Milner and Deeley, 2020), and its educational licences for students and businesses. The software hosts a large library of digitized fabrics, and upon designing it struck me: my peers and I do not know which fabric is the most 'sustainable' to use? Although this question is frequently asked by teachers regarding physical fabrics, it rarely is for digital fabrics. I assumed the digital fabrics to be more equalised; simply a different combination of 0's and 1's in its code. Therefore, an experiment was devised to test which CLO3D fabrics could be considered the most sustainable to use, in the search of digital design guidelines (see Fig. 12 - 18). The experiment further highlights the relevance of sharing digital design experiences, in order to collectively evolve responsibly.[2]

[2] Disclaimer: This experiment has not yet been officiated, further research can look to formally replicate it and have it peer-reviewed professionally for reliable results. However, this method looks to inspire others to look critically at their own creations, and push for research into digital sustainability.

Table 1: Digi-Care Experiment Method and Conditions.

EXPERIMENT	
METHOD	CONDITIONS [3]
• Design a basic 2 piece outfit in CLO3D. • Assign one fabric to the whole garment. • Render one whole front (no.2 angle) image as a png in the standard given settings. • Record the final render time, and file size of the png image. • Record information, and repeat for every fabric group.	• Carried out on a HP Pavilion 360 laptop. Specs. include: 10th Generation Intel® Core™ i3 processor. Intel® Core™ i3-10110U (2.1 GHz base frequency, up to 4.1 GHz base with Intel® Turbo Boost Technology, 4 MB cache, 2 cores). Intel® UHD Graphics. • Settings of CLO3D shown in Fig.12. Carried out on a CLO3D 5.1 • No other programme was open on the laptop at the time of carrying out the experiments. • Carried out midday to afternoon. • File size (FS) and render times (RT) were observed and chosen as measures due to their direct impact on storage space and electricity usage respectively.

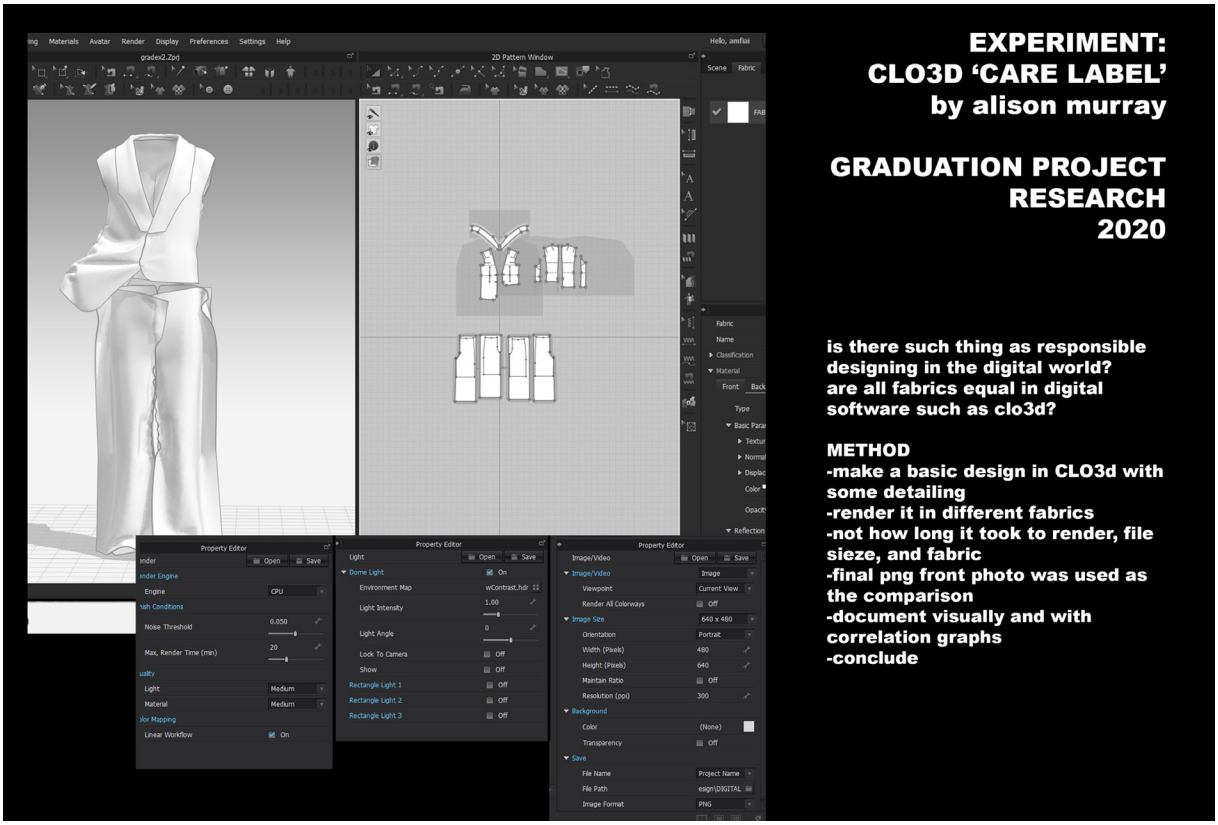

Figure 12: Digi-Care experiment instructions (authors own image, 2020).

[3] Power of laptop can cause large differences in results, this is why being transparent with the specs. is important. Finding that students (and others) creating on their own laptops will struggle to create larger files, and at a slower speed.

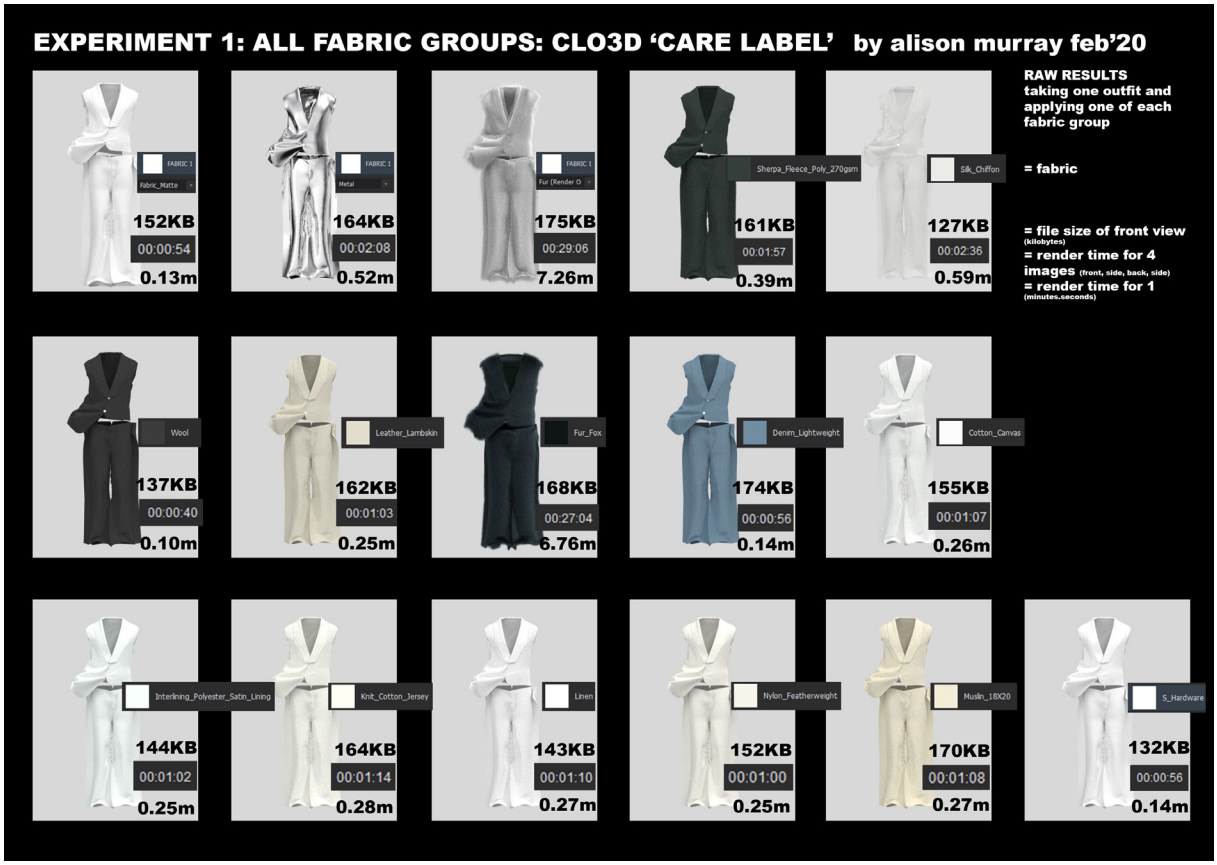

Figure 13: Experiment 1: All CLO3D fabric groups: raw data (authors own image, 2020).

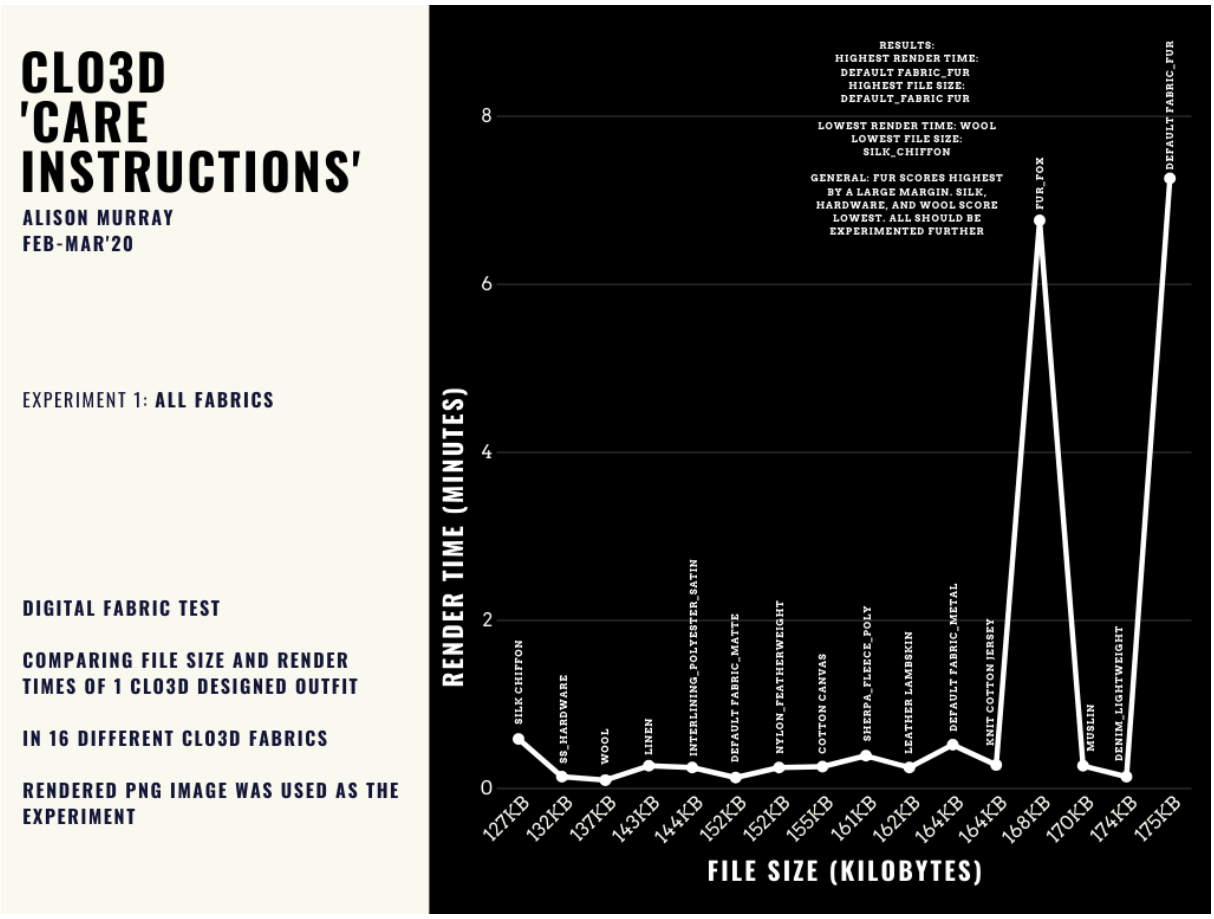

Figure 14: Experiment 1: All CLO3D fabric groups: graphed results (authors own image, 2020).

Figure 15: Experiment 2: Furs: raw data (authors own image, 2020).

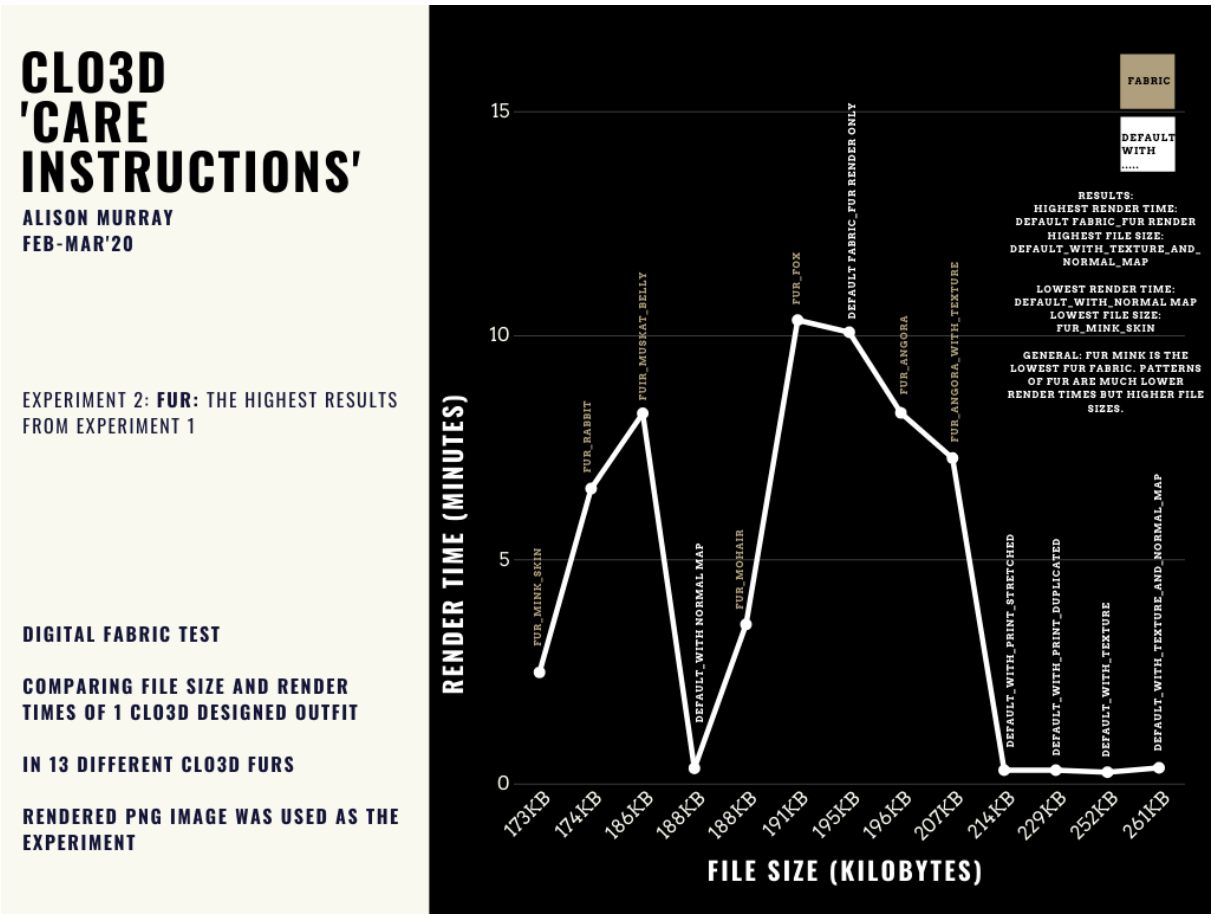

Figure 16: Experiment 2: Furs: graphed results (authors own image, 2020).

Figure 17: Experiment 3: Wool, Silk, and Hardware: raw data (authors own image, 2020).

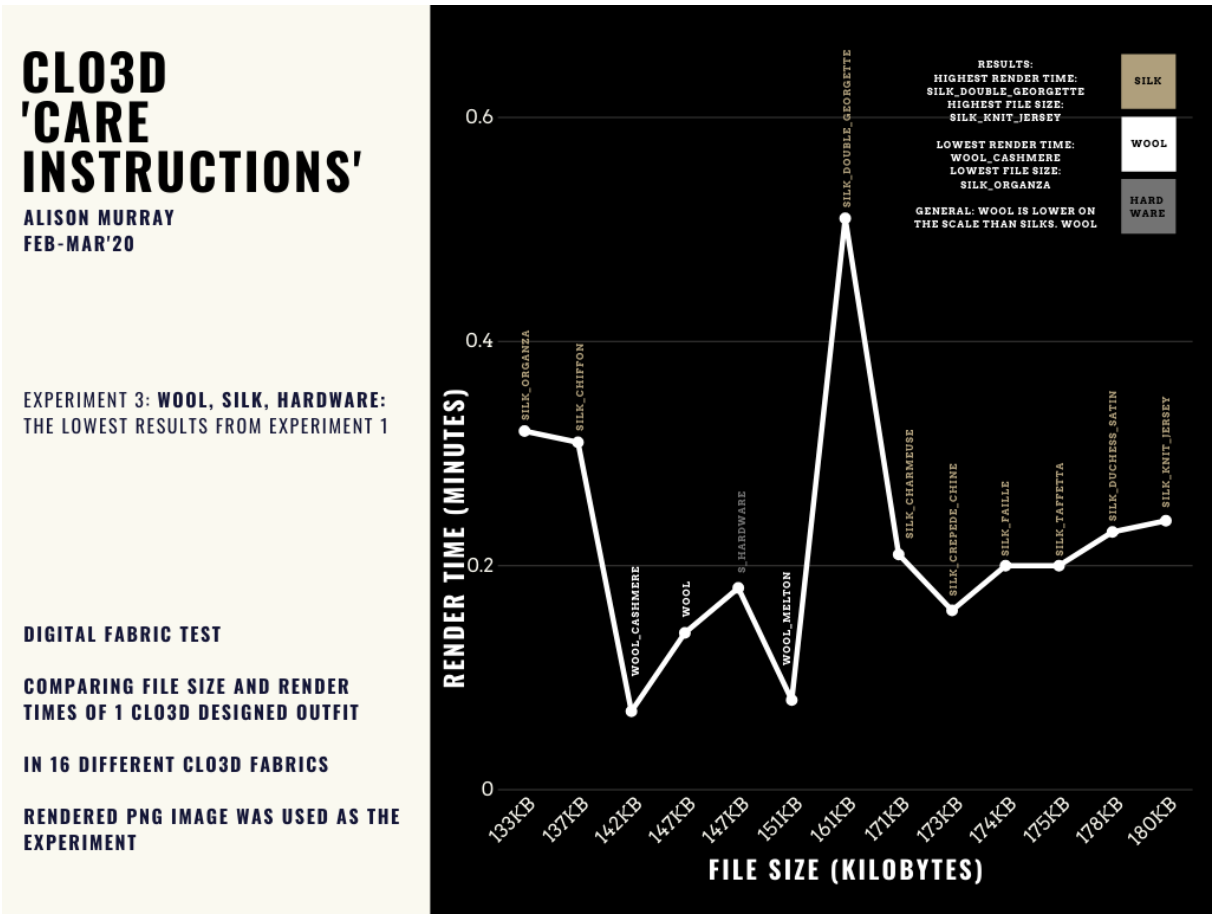

Figure 18: Experiment 3: Wool, Silk, and Hardware: graphed results (authors own image, 2020).

Table 2: Digi-Care Experiment Results. FS = File Size. RT = Render Times.

RESULTS			
Experiment	Highest Scoring	Lowest Scoring	Comments
1	Fur_Fox: FS: 168KB RT: 6.76m Default Fabric_Fur: FS: 175KB RT: 7.26	Wool FS: 137KB RT: 0.10m Silk: FS: 127KB RT: 0.59m Hardware: FS: 137KB RT: 0.14m	Fur had six times higher scores, leading to Experiment 2 into furs: finding 'the best of the worst'. The lowest scoring overall resulted in Experiment 3 into wool, silk, and hardware.
2	Fur_Fox: FS: 191KB RT: 10.35m Default_with_texture_ and_normal_map: FS: 261KB RT: 0.36m	Fur_Mink: FS: 173KB RT: 2.49m Fur_with_normal_map: FS: 252KB RT: 0.026m	Fur_mink can be deduced to be the most sustainable fur to use. Whilst the fur-like treatments of fabric had low file size, their render times were much higher. Fur_Fox and Fur_Angora were some of the highest scoring overall library furs, and therefore the most unsustainable.
3	Silk_Double_Georgette: FS: 161KB RT: 0.51m Silk_Knit_Jersey: FS: 180KB RT: 0.24m	Silk_Organza: FS: 133KB RT: 0.32m Wool_Cashmere: FS: 142KB RT: 0.07m	Silk_Ogranza and Wool_ Cashmere can be deduced to be the most sustainable fabrics in CLO3D because they score the lowest overall. Wool was the overall lowest scoring fabric group.

The results show that some digital fabrics are possibly more sustainable than others. Communication of this information could come in the form of a digital care label: something that digital fashion design still misses. Whereas a physical garment care label is a legality, and must include "fibre content, country of origin, care instructions, flammability" (UKFT, 2020). Care labels do have their own issues, with not providing enough information and leaving people confused (Hill, 2018), with many "mastering the techniques of how to remove the labels" (Cohen, 2020). However, they can provide relevant transparency and care of product, which can be revolutionised: file size replacing fibre content, render times can replace flammability, and 'made in' can replace made by abc, on the software xyz. Let's be inventive and effective about our digital garment transparency.

A MODERN ANALYSIS OF THE PHYGITAL CREATIVE PROCESS

The incorporation of the digital into fashion design is affecting the creative process itself, a development that will be analysed in this chapter. How the end product is represented online is of high value, through photography and video, especially when it 'goes-viral'. The question of the best angle of a garment is at the forefront, yet as imagery is 2D, do we even need to create the angle of the garment that is not seen by the lens? Online presence and attention "has become a strategy and currency of fashion" (Gallagher, 2019). In the "age of hyper signification", Parsons tutor, Marie Genevieve (2020), points out that a common thought is "how are we incorporating internet culture into design practice?". The digital is on our mind during creation, whether we know it or not, in the hope of going viral. Moreover, a good phygital relationship is shown to be linked to success; but also digital durability.

Our attention to the digital realm is often focussed on the issue of 'virality' - how often something on a screen is 'seen', 'shared' and passed on. There is another aspect of the digital that is overlooked by this focus: its potential durability. Durability is defined as something being "able to continue to exist for a long time" (Cambridge Dictionary, 2020). Digital images are not constrained to decay, degenerate or decompose in the same way as physical products, and therefore they represent the near-perfect durable product: continuously available at its original quality. Digital fashion promises products that do not degrade, or decompose, and transport around the world in just a click.

The replicated online image acquiring value is something of a paradigm shift, challenging the historical notion that mass production of art decreases its value. It contrasts to the early 20th century common belief, originating from Walter Benjamin, that the "aura", or value of a work of art "withers in the age of mechanical reproduction" (Benjamin, 2008, p.221). Fast-forward to the current day, Genevieve (2020) refers to today in art terms as "post-internet", which is described as practices "unlike those of previous generations,

[employ] the Web [as] just another medium, like painting or sculpture. Their artworks move fluidly between spaces, appearing sometimes on a screen, other times in a gallery" (Goldsmith, 2015). This post-internet art space has embraced digital fashion design. It uses the online space to create, share, present, explore software, learn from others', and venture to the offline world for feedback, updates, and experimentation; contributing to digital durability.

"The artistic use of the internet as a mass medium and the translation of its content into physical space is a constant game of experimentations between online and offline [...] It often engages in and comments on the fluctuating nature and saturation of the image, the circulation of cultural objects and of the self, the idea of hyperreality and the obsolescence of the physical."

- Marie Genevieve Cyr (2020)

TO CONCLUDE, WHAT IS OUR PHYGITAL FASHION RELATIONSHIP?

Digital extensions of the self are an increasingly essential part of our lives - particularly given the unprecedented constraints on our physical freedom imposed by the COVID-19 lock-down. Digital fashion design has its moment to prove itself. Multiplicities allow for an evolution of self into the digital sphere, interchanging between that of a digital-twin and that of an individual, taking care to not judge the reality of self. As digital fashion rises, analysis on the effect of digital design should match that of physical fashion, and subsequently grow together. There is the potential to re-shuffle production as the industry digitizes, by taking toxic materials out of the physical and into digital platforms, in the understanding that the digital is not a perfect solution without criticism. We can then focus our physical efforts on more responsible fabrics for the people and the planet. Additionally, the value placed on creativity is rising during lock-down, with the digital world replacing many creative spaces and connecting people. It is important to remember that digital is never without the physical, the software needs hardware, and this is causing negative environmental impacts. In the quest for digital design care, transparency in methods, file size, render times, and experiences are needed for a collaborative, sustainable phygital fashion future.

As brands slow down and reflect on the anatomy and relevance of collections and shows, I too will re-evaluate and present my own ‘collection’ in an alternative manner. My graduation project will look to address the digital with care by selecting materials based on their ‘digital sustainability’, by communicating its effects clearly, and educating the onlooker into a new way of seeing and decoding digital fashion. It will further investigate the current challenges of creative spaces physically and mentally, with the digital realm as a possible solution. Additionally, my project will explore the evolutions and multiplicities of the phygital self.

Digital fashion is a world of opportunity; however, it is how you use it that matters.

Digital: handle with care.

"The machine picks up on things I would have never, it learns with me, it offers new ways of looking at the world: a true collaboration."

- Refik Anadol, Machine Artist (Wired, 2020) (see Fig. 19)

Figure 19: Refik Anadol, Melting Memories, digital artwork (The Lumen Prize, 2020).

SOURCES

BOOKS

Adeola, F., 2014. Industrial Disasters, Toxic Waste, And Community Impacts. Lanham: Lexington Books, p.99.

Benjamin, W., 2008. The Work Of Art In The Age Of Mechanical Reproduction. London: Penguin UK, p.221.

Criado-Perez, C., 2019. Invisible Women: Exposing Data Bias In A World Designed For Men. 1st ed. London: Penguin Random House, p.8.

Fry, H., 2018. Hello World: Being Human In The Age Of Algorithms. 1st ed. New York: W.W. Norton & Company, p.22, 70.

JOURNALS

Dufva, T. and Dufva, M., 2019. Grasping the future of the digital society. Futures, [online] 107,pp.17-28. Available at: <https://www.sciencedirect.com/science/article/pii/S0016328717302252> [Accessed 26 February 2020].

Martini, M., Bufalari, I., Stazi, M. and Aglioti, S., 2015. Is That Me or My Twin? Lack of Self-FaceRecognition Advantage in Identical Twins. PLOS ONE, [online] 10(4), p.e0120900. Available at: <https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0120900> [Accessed 2 May 2020].

PODCASTS

The Guardian, 2020. Can The Fashion Industry Ever Be Sustainable? - Lucy Siegle And Laura Snapes.[podcast] The Guardian: Today in Focus. Available at: <https://open.spotify.com/episode/3vK2tSHvKap2w5RiA4lJRg> [Accessed 23 February 2020].

REPORTS

BOF, McKinsey & Company, 2019. The State Of Fashion 2019. [online] Business of Fashion, McKinsey & Company, p.30. Available at: <https://cdn.businessoffashion.com/reports/The_State_of_Fashion_2019.pdf> [Accessed 24 February 2020].

McArthur, E., 2017. A NEW TEXTILES ECONOMY: REDESIGNING FASHION'S FUTURE. [online] Ellen MacArthur Foundation, pp.20, 22, 119. Available at: <https://www.ellenmacarthurfoundation.org/assets/downloads/A-New-Textiles-Economy.pdf> [Accessed 3 May 2020].

WRAP, 2017. Valuing Our Clothes: The Cost Of UK Fashion. [online] The Waste and Resources Action Programme, p.47. Available at: <https://www.wrap.org.uk/sites/files/wrap/valuing-our-clothes-the-cost-of-uk-fashion_WRAP.pdf> [Accessed 27 March 2020].

WGSN, 2020. Coronavirus: Global Change Accelerators. Consumer Insight & Strategy. WGSN, pp.7, 15.

WEBSITES

Adegeest, D., 2020. Why The Fashion Industry Must Recalibrate. [online] Fashionunited.uk. Available at: <https://fashionunited.uk/news/fashion/why-the-fashion-industry-must-recalibrate/2020040948402> [Accessed 3 May 2020].

Alti, A., 2018. Interview With Cameron-James Wilson, Creator Of Shudu, 'The World'S First Digital Supermodel'. [online] WeRSM - We are Social Media. Available at: <https://wersm.com/interview-with-cameron-james-wilson-creator-of-shudu-the-worlds-first-digital-supermodel/> [Accessed 28 March 2020].

Ananas Anam, 2020. About Us - Piñatex. [online] Piñatex. Available at: <https://www.ananas-anam.com/about-us/> [Accessed 4 May 2020].

Berry, L., 2020. Why We Are Losing Motivation During Lockdown – And What We Can Do About It | Interact Software. [online] Interact software. Available at: <https://www.interact-intranet.com/blog/losing-motivation-during-lockdown/> [Accessed 3 May 2020].

Cambridge Dictionary, 2020. DURABLE | Meaning In The Cambridge English Dictionary. [online] Dictionary.cambridge.org. Available at: <https://dictionary.cambridge.org/dictionary/english/durable> [Accessed 28 April 2020].

Cohen, M., 2020. I Went Down A Rabbit Hole To Find Out Why We Still Have To Deal With Itchy Clothing Tags In 2020. [online] Good Housekeeping. Available at: <https://www.goodhousekeeping.com/clothing/a30260125/itchy-tags-labels-sweaters-shirts/> [Accessed 28 March 2020].

Dezeen, 2020. Artist And Designer Alexandra Daisy Ginsberg Discusses The Nuances Of What It Means To Design "A Better World". [image] Available at: <https://www.youtube.com/watch?v=e5ZwmfiRXR8> [Accessed 20 February 2020].

EPA, 2019. Electronics Donation And Recycling | US EPA. [online] United States Environmental Protection Agency. Available at: <https://www.epa.gov/recycle/electronics-donation-and-recycling> [Accessed 18 March 2020].

Fairs, M., 2020. Coronavirus Offers "A Blank Page For A New Beginning" Says Li Edelkoort. [online] Dezeen. Available at: <https://www.dezeen.com/2020/03/09/li-edelkoort-coronavirus-reset/> [Accessed 15 March 2020].

Fashion Revolution, 2020. WHY DO WE NEED A FASHION REVOLUTION?. [online] Fashion Revolution. Available at: <https://www.fashionrevolution.org/about/why-do-we-need-a-fashion-revolution/> [Accessed 27 March 2020].

Fowler, D., 2018. The Hype Machine: Streetwear And The Business Of Scarcity. [online] BBC.com. Available at: <https://www.bbc.com/worklife/article/20180205-the-hype-machine-streetwear-and-the-business-of-scarcity> [Accessed 3 May 2020].

Gallagher, J., 2019. Fashion'S New Strategy: Weird People Out And Watch Your Clothes Go Viral. [online] WSJ. Available at: <https://www.wsj.com/articles/how-oddball-clothing-goes-viral-11560178027> [Accessed 28 April 2020].

Genevieve Cyr, M., 2020. On The Relationship Between Post-Internet Art And Fashion Design Practice : Hek. [online] HeK - Share - the blog. Available at: <https://share.hek.ch/en/e-appropriation-and-recontextualization/> [Accessed 9 April 2020].

Godwin, C., 2019. The £7,500 Dress That Does Not Exist. [online] BBC News. Available at: <https://www.bbc.co.uk/news/business-49794403> [Accessed 9 February 2020].

Goldsmith, K., 2015. Post-Internet Poetry Comes Of Age. [online] The New Yorker. Available at: <https://www.newyorker.com/books/page-turner/post-internet-poetry-comes-of-age> [Accessed 8 April 2020].

Harris, J., 2020. Planned Obsolescence: The Outrage Of Our Electronic Waste Mountain. [online] The Guardian. Available at: <https://www.theguardian.com/technology/2020/apr/15/the-right-to-repair-planned-obsolescence-electronic-waste-mountain> [Accessed 3 May 2020].

Hill, A., 2018. Issues With Clothing Care Labels, Just How Clear Are They?. [online] Myfashionlife.com. Available at: <http://www.myfashionlife.com/archives/2018/02/20/issues-clothing-care-labels-just-clear/> [Accessed 3 April 2020].

Horowitz, J., 2020. My Life On Italy'S Coronavirus Frontlines, And In Quarantine. [online] The New York Times. Available at: <https://www.nytimes.com/2020/03/19/world/europe/italy-coronavirus-frontlines-quarantine.html> [Accessed 6 April 2020].

Indvik, L., 2020. Light After The Lockdown — The Future Of Fashion. [online] Financial Times. Available at: <https://www.ft.com/content/1b03efec-8895-11ea-a01c-a28a3e3fbd33> [Accessed 3 May 2020].

Insider Trends, 2020. How HOT:SECOND Brought Digital Fashion Into Physical Retail - Insider Trends. [online] Insider Trends. Available at: <https://www.insider-trends.com/how-hotsecond-brought-digital-fashion-into-physical-retail/> [Accessed 4 May 2020].

J. Young, S., 2019. The Real Cost Of Your Clothes: These Are The Fabrics With The Best And Worst Environmental Impact. [online] The Independent. Available at: <https://www.independent.co.uk/life-style/fashion/fabrics-environment-fast-fashion-eco-friendly-pollution-waste-polyester-cotton-fur-recycle-a8963921.html> [Accessed 27 March 2020].

Kent, S., 2020. Global Stories From A Month That Changed Fashion Forever. [online] The Business of Fashion. Available at: <https://www.businessoffashion.com/articles/professional/global-stories-from-a-month-that-changed-fashion-forever?utm_source=daily-digest-newsletter&utm_campaign=1661677622022904&utm_term=11&utm_medium=email> [Accessed 4 April 2020].

Kent, S. and Nanda, M., 2020. Fashion's Humanitarian Crisis. [online] The Business of Fashion. Available at: <https://www.businessoffashion.com/articles/professional/fashions-humanitarian-crisis?utm_source=daily-digest-newsletter&utm_campaign=1662939176758861&utm_term=11&utm_medium=email> [Accessed 2 April 2020].

Kienzler, R., 2019. Digital Twins And The Internet Of Things. [online] IBM Developer. Available at: <https://developer.ibm.com/technologies/iot/articles/digital-twins-and-the-internet-of-things/> [Accessed 2 May 2020].
Krentcil, F., 2020. Ok, Fashion. What Happens Now In The Coronavirus Pandemic?. [online] Harper's BAZAAR. Available at: <https://www.harpersbazaar.com/fashion/designers/a31955168/fashion-industry-coronavirus/> [Accessed 3 May 2020].
Larosse, M., 2020. IN A TIME OF CRISIS, FASHION HAS CHOSEN TO IGNORE THE DIGITAL SOLUTION — The Fabricant. [online] The Fabricant. Available at: <https://www.thefabricant.com/blog/2020/3/9/in-a-time-of-crisis-fashion-has-chosen-to-ignore-the-digital-solution> [Accessed 10 March 2020].
Lieber, C., 2019. Would You Buy A Virtual Pair Of Nikes?. [online] The Business of Fashion.Available at: <https://www.businessoffashion.com/articles/fashion-tech/virtual-fashion-digital-products> [Accessed 17 February 2020].
McDowell, M., 2020. Forced Cancellations Jumpstart Virtual Fashion Technology. [online] Vogue Business. Available at: <https://www.voguebusiness.com/technology/forced-cancellations-remote-working-jumpstart-virtual-vr-ar-fashion-technology> [Accessed 24 March 2020].
Milner, D. and Deeley, R., 2020. Fashion's Work-From-Home Gameplan. [online] The Business of Fashion. Available at: <https://www.businessoffashion.com/articles/professional/fashions-work-from-home-gameplan> [Accessed 18 March 2020].
Nataliya.ai, 2019. The Rise Of Digital Fashion.. [online] Medium. Available at: <https://nataliyamakulova.com/the-rise-of-digital-fashion-691f92126f90> [Accessed 5 March 2020].
NOoF, 2020. Designers Studio PMS. [online] Neworderoffashion.com. Available at: <https://neworderoffashion.com/designers/studio-pms-puck-martens-merle-kroezen-suzanne-mulder/> [Accessed 14 March 2020].
Oxfam, 2019. Second Hand September | Oxfam GB. [online] Oxfam Apps. Available at: <https://oxfamapps.org/secondhandseptember/> [Accessed 22 March 2020].
PixelPool, 2020. Physical To Digital: Future Disruption In The Fashion Industry - Pixelpool.[online] PixelPool. Available at: <https://pixelpool.com/physical-to-digital-future-disruption-in-the-fashion-industry/> [Accessed 2 May 2020].
Roberts-Islam, B., 2019. How 3D Digital Design And Augmented Reality Can Slash Textile Waste In Fashion. [online] Eco-Age. Available at: <https://eco-age.com/news/how-3d-digital-design-and-augmented-reality-can-slash-textile-waste-fashion> [Accessed 15 March 2020].
Rohden, H., 2013. Twins' Relationships Strongly Associated With Identity | Swedish National Data Service. [online] Swedish National Data Service. Available at: <https://snd.gu.se/en/find-and-order-data/data-focus/twins-relationships-strongly-associated-identity> [Accessed 29 February 2020].
Romei, V., 2020. The UK Economic Fallout From Coronavirus In Numbers. [online] Financial Times. Available at: <https://www.ft.com/content/33c03dc6-ceab-40e5-b61f-66829c5b9b2c> [Accessed 3 May 2020].
Santi, A., 2019. The True Cost Of Unpaid Fashion Internships. [online] Raconteur.

Available at: <https://www.raconteur.net/hr/unpaid-internships-fashion> [Accessed 28 April 2020].

Socha, M., 2020a. Helsinki Fashion Week — Already Green — Will Be Purely Digital, Too. [online] WWD. Available at: <https://wwd.com/fashion-news/designer-luxury/helsinki-fashion-week-goes-digital-only-coronavirus-1203553689/> [Accessed 4 April 2020].

Socha, M., 2020b. Purely Digital Events Are Not As Green As You Might Think. [online] WWD. Available at: <https://wwd.com/business-news/business-features/digital-fashion-week-to-be-audited-environmental-impact-1203563059/> [Accessed 2 May 2020].

Stitch, 2020. We Make Fashion Design Seamless.. [online] Stitchdesignlab.com. Available at: <https://www.stitchdesignlab.com/> [Accessed 4 May 2020].

Sverdlik, Y., 2019. Analysts: There Are Now More Than 500 Hyperscale Data Centers In The World. [online] Data Center Knowledge. Available at: <https://www.datacenterknowledge.com/cloud/analysts-there-are-now-more-500-hyperscale-data-centers-world> [Accessed 12 March 2020].

Tamuly, N., 2020. State Of Digital Fashion. [online] Medium. Available at: <https://medium.com/your-majesty-co/state-of-digital-fashion-aa37b079eb9e> [Accessed 22 March 2020].

The Fabricant, 2020. Leela. [online] Leela. Available at: <https://digital.fashion/> [Accessed 10 April 2020].

Trueman, C., 2019. What Impact Are Data Centres Having On Climate Change?. [online] Computerworld. Available at: <https://www.computerworld.com/article/3431148/why-data-centres-are-the-new-frontier-in-the-fight-against-climate-change.html> [Accessed 20 March 2020].

UKFT, 2020. Labelling Overview. [online] UK Fashion and Textile Association. Available at: <https://www.ukft.org/business-advice/labelling/> [Accessed 3 April 2020].

Wired, 2020. How This Guy Uses A.I. To Create Art | Obsessed | WIRED. [video] Available at: <https://www.youtube.com/watch?v=I-EIVlHvHRM> [Accessed 28 April 2020].

WRAP, 2020. Clothing Waste Prevention. [online] The Waste and Resources Action Programme. Available at: <http://www.wrap.org.uk/content/clothing-waste-prevention> [Accessed 28 March 2020].

Zha, W., 2019. Digital Fashion: 'The World Doesn'T Need More Physical Clothing'. [online] Fashionunited.uk. Available at: <https://fashionunited.uk/news/fashion/digital-fashion-the-world-doesn-t-need-more-physical-clothing/2019061943770> [Accessed 4 May 2020].

FIGURES

Figure 17: authors own image, 2020. Experiment 3: Wool, Silk, and Hardware: raw data. [Digitally created with CLO3D and Adobe Photoshop].
Figure 18: authors own image, 2020. Experiment 3: Wool, Silk, and Hardware: graphed results. [Digitally created with CLO3D and Adobe Photoshop].
Figure 19: The Lumen Prize, 2020. Refik Anadol, Melting Memories, A Series Of Digital Artworks. [image] Available at: <https://lumenprize.com/artwork/melting-memories/> [Accessed 3 May 2020].

APPENDIX

APPENDIX A

Suggestion of materials by most harmful product groups, cotton, synthetics, and animal derived (J. Young, 2019):

C.L.A.S.S (Creative Lifestyle and Sustainable Synergy), is a newer platform which gathers smart innovative materials globally that infuse technology, performance and sustainable credentials that take steps towards a circular economy. It sells fabrics, and has full transparency and communication of products from all fabric groups. https://www.classecohub.org/

Cotton Alternatives:
- Flocus - Form the kapok Tree, needs no pesticides, no fertilisers, no irrigation, grows in a biodiverse environment, 5 times lighter, waterproof and hypoallergenic props, natural insulation. GOTS, BCI, GRS. https://www.flocus.pro/
- Tencel - rayon/lyocell. Made from cellulose from renewable eucalyptus trees, reduced pesticides and water use. Closed loop process. Loose fibers are recycled back. Higher cost, but highly durable. https://www.tencel.com/
- Hemp: higher efficiency, smaller footprint, no synthetic fertilizers/pesticides or gmo seeds, produced 250% more fibers than cotton. Strong, absorbent, light weight.
- Flax, linen: durable, strong, stronger wet, less water.
- Ramie: silk luster, more absorbent, however, gummy resin, but resistant to bacteria.
- Nanollose: world's first process that creates microbial cellulose from agricultural and industrial organic waste, no felling or arable land. https://nanollose.com/
- Spinnova: cellulosic material from renewable sources, fsc certified wood. Little water or tending. No harmful chemicals. 99%less water than cotton. https://spinnova.com/our-method/sustainability/

Synthetics Alternatives:
- Econyl ®: nylon waste from landfills and oceans. Can be recycled, recreated, and

remolde again and agun. Closed-loop recycling. www.econyl.com
- PrimaLoft: world's first ever recycled biodegradable synthetic insulation and fabric. 86.1% biodegradation in 499 days under conditions. Attractive to the microbes. http://primaloft.com/primaloftbio
- DuPont Apexa ®: biodegradable polyester through industrial composting, no harm. Breaks down into carbon dioxide and water. Blended with different fibres, cotton, cellulose, or wool, to make stronger and softer.http://biosciences.dupont.com/solutions/biomaterials/
- Sorona ®: 37%plant-based materials, using less energy and greenhouse gases. Smooth, soft, stretch, wrinkle resistant, quick drying. Replace polyester.http://sorona.com/
- SeaCell ™: skin friendly, zinc oxide soothing and anti-inflammatory, against UVA and UVB radiation.provide up to spf50. https://www.smartfiber.de/en/fibers/smartceltm-sensitive/
- Repreve: recycled bottles into fiber. Wicking, adaptive, cooling, water repellency, durable.https://repreve.com/discover
- Mango Materials: naturally occurring biopolymer from waste biogas (methane), competitive with conventional oil-based plastics. http://mangomaterials.com/our-team/

Animal Alternatives:
- Deterra ®: bio based on castor beans, wool, corn, tencel, and coronas nuts. https://tierra.com/materials/deterra-bio-based-jacket/
- Vaude QMilk: 20% cows discarded milk and 80% wool. https://www.vaude.com/en-INT/Products/Eco-Fair-Collection/Sustainable-Materials/QMILK-felt/
- Orange fiber: made from by-products from the citrus industry, manufactured from silk-like cellulose and blended with silk, cotton and elastane. http://orangefiber.it/en/
- Pintatex ®: pineapple leaves, by-product, farming cooperatives and additional income, biomass left over after fibre has been extracted is used as natural fertiliser or further processed to biogas. Leather-like.
- Fruit Leather Rotterdam: left over mango fruits into durable leather-like materials. https://fruitleather.nl/
- MuSkin: Italian, mushroom leather, 100% vegetable layer, phellinus ellipsoids=wild fungus that attacks trees. Limits Bacteria proliferation. https://lifematerials.eu/en/shop/muskin/
- Frumat, Italy: apple skins. No chemically intense dying, durable, biodegradable.http://www.technofashionworld.com/frumat-the-leather-alternative-made-from-apples/
- Fur is a highly ethically debated fabric, and current alternatives (faux-fur) are oil-derived, therefore this category is yet to find a good alternative.

APPENDIX B

Interview with Joshua Dorland from Stitch, conducted by Alison Murray over email. Permission has been granted to use name and brand in the essay. UK, NL, 2020.

Transcript:

What is digital fashion design and how are current responses to it?
Specifically 3D fashion design is about creating your design intent in a 3D form as early as possible in the season using 3D apparel software. (Browzwear or CLO are the most common ones)
Most apparel designers still start with a hand or illustrator sketch but converting this into a 3D model from the start serves many benefits in the long run.
But the most immediate are less interpretation issues, what your see is what you get, and of course sample reduction.
Responses are mostly positive but there are of course some challenges to overcome.
Learning curve is one of them but also, what I do now works, why should I change…

Under the current situations (covid-19) how do you see the future of digital fashion design?
The future of digital fashion design is now more on the radar than ever.
The digital space allows for a much more direct communication between Brands and Factories.
The benefits are clearly coming to the surface but not everyone is set up to join the change.
There still needs to be a lot more investments from brands and factories to make digital fashion design a success.
This means investment in software, training people but also collaboration between brands and vendors to come to common solutions, for example file format and fabric physics.

To help with render issues you have a render farm, what is a render farm and how does it work, what problems does it fix?
A render farm is nothing more than a big line of computers to do the calculations needed for rendering an image/video.
You send your file via a Hub to the render farm and multiple computers take care of the rest.
The biggest advantage is that rendering does not have to be done locally on your own computer thus freeing up the computer for you to keep working on other projects.
As soon as the render is finished you can download the end result to us in communication or presentation.

What is a typical render time before and after the render farm?
There is no specific render time as this depends heavily on what you are trying to render.
But compared to local rendering the render farm speeds up the process drastically plus you can keep working on other projects locally.
A simple 1 color T-shirt would maybe take 1-2 minutes on a render farm and up to 5 minutes locally.
But a complex outerwear jacket with multiple color ways could take up to 10 minutes on a render farm and maybe 20 minutes locally.
(Speeds also depend on the type of computer your use locally)

What are the next challenges to consider in terms of product outcome/sustainability/ efficiency?
I believe the next challenges in digital design is trusting the software to give you a good representation of product outcome.
Most people still have doubts about accuracy.
This ties directly into sustainability, trust you can do without requesting 10 sample but only request 2.
Efficiency will only really benefit if we have enough people trained to use the tools effectively and collaborate between brands and factories.
This last point is the most challenging because most brands want to keep their progress to them self to keep the edge on the competition.

Do you consider file size, electricity use, and e-waste when creating?
Yes, file size is definitely an issue and needs to be checked all the time.
Taking minutes to just open a file because of the file size is not efficient.
But it is a thin line to not compromise quality over speed.
Electricity use is a difficult one, we obviously depend on software and hardware developers to always get better in this area.
And as a company we should always look into renewable energy sources.
E-waste is not something we currently have as priority although it is not something to forget.
However, due to using more and more digital assets and reducing sampling this contributes to reducing a lot of other waste product coming out of the fashion industry.