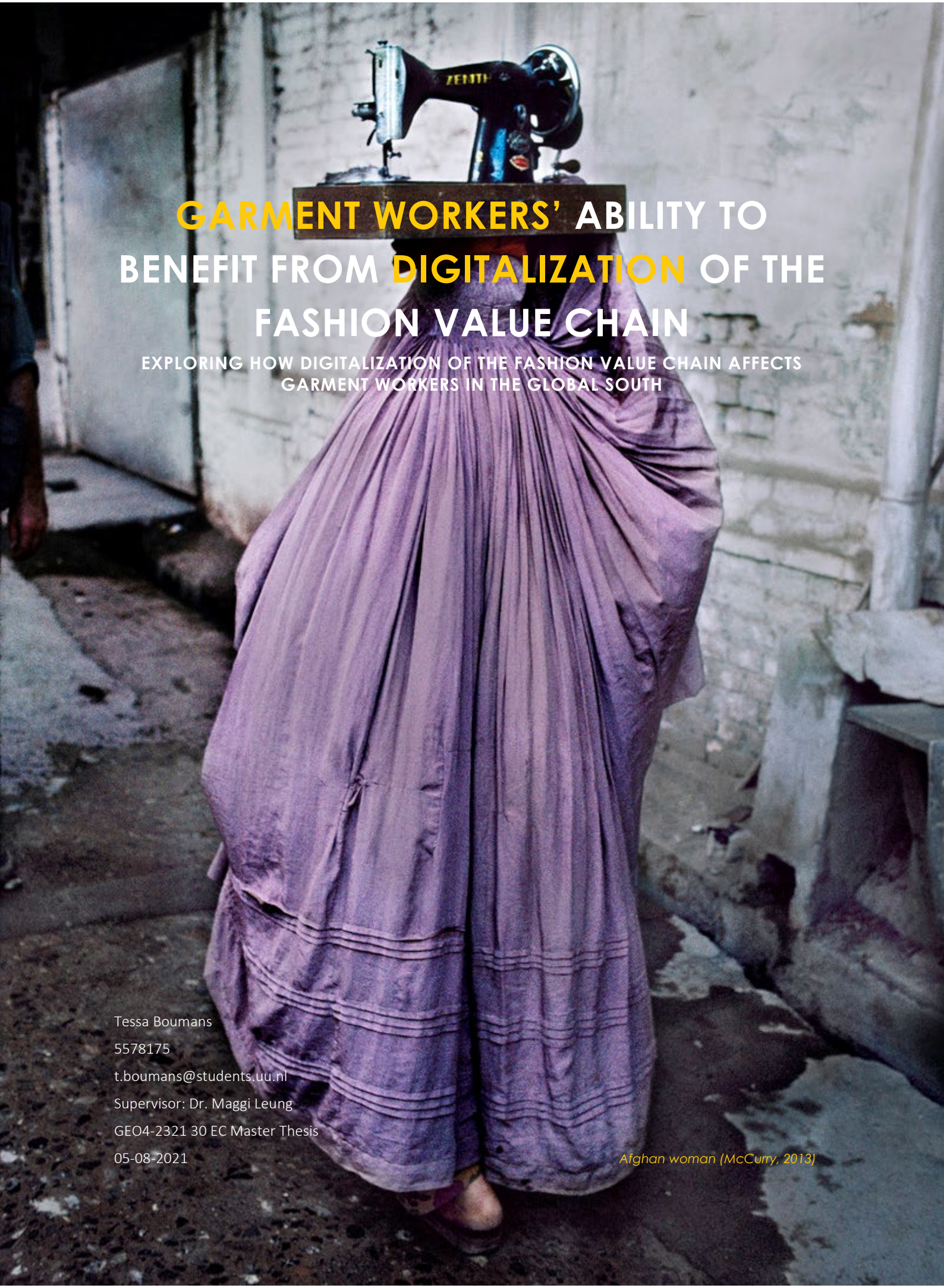

GARMENT WORKERS' ABILITY TO BENEFIT FROM DIGITALIZATION OF THE FASHION VALUE CHAIN

EXPLORING HOW DIGITALIZATION OF THE FASHION VALUE CHAIN AFFECTS GARMENT WORKERS IN THE GLOBAL SOUTH

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Afghan woman (McCurry, 2013)

"My God, we can do better than this."

- Prof. Richard Wolff (2015)

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SUMMARY

Whilst sustainability challenges are becoming increasingly urgent matters on global development agendas, societies have entered the 'digital age'. Unsurprisingly, along the lines of the current zeitgeist technologies are often put forward as a solution to development issues. Nevertheless, in many cases it remains unclear to what extent digitalization can actually *solve societies' problems. Especially when it comes to the social consequences of technological interventions, a significant academic knowledge gap prevails.*

In this research, the relationship between digitalization and social sustainability outcomes is explored by zooming in on the global fashion value chain. In recent years, technologies like 3D software, RFID tags, AVR, blockchain, and AI are changing the processes of the global fashion value chain. At the same time, the sector is notorious for its persistent substandard working conditions, especially for garment workers in the global south. Whilst social sustainability issues are a clear challenge for the sector, thus far there is little insight into how digitalization processes are affecting garment workers in the global south.

Based on theories of access, the main concern of this research is how digitalization affects the ability of garment workers in the global south to access their international workers' rights. To understand this effect, first the modus operandi of the fashion value chain is set out. Second, the status-quo context of garment workers is elaborated on. Additionally, the main digitalization activities in the fashion value chain are outlined. Ultimately, through an analysis of existing data and supplementary in-depth interviews with industry actors, this research formulates four constructs through which digitalization of the fashion value chain affects garment workers: making fast fashion faster, transparency and traceability, automation and reshoring, and data privacy and ownership.

Although the results show that these constructs allow room for both positive and harmful outcomes for garment workers, based on current exploitative system dynamics disadvantageous outcomes for garment workers are most likely to dominate. However, this can be circumvented. For one through additional knowledge creation, and subsequently through informed decision making from industry actors and governments that is respectful to the value of garment workers in the global south.

Key concepts: *digitalization, fashion value chain, social sustainability, garment workers in the global south, access to labor rights.*

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LIST OF ABBREVIATIONS

AI	Artificial Intelligence
AR	Augmented Reality
AVR	Augment virtual reality
BD	Big Data
CAD	Computer-aided design
CSR	Corporate Social Responsibility
CWRC	Centre for Workers' Rights Consortium
GLWC	Global Living Wage Coalition
ILO	International Labor Organization
RBV	Resource-based view
RFID	Radio-frequency ID
SCM	Supply chain management
SDGs	Sustainable Development Goals
TBL	Triple Bottom Line
VR	Virtual Reality

Threads - India (Kristine, n.d.-a)

1. INTRODUCTION

1.1. SOCIAL CHALLENGES IN THE FASHION VALUE CHAIN AND DIGITALIZATION AS A REMEDY

It was in 1966 when Alvin Weinberg, an engineer, asked himself the question: "Will technology solve all the problems of modern society?", after which he coined the term *technofix*. Decades later, there have been copious amounts of examples where technologies have indeed achieved prosperous outcomes for modern societies, and as a consequence new technologies are often commenced by a hopeful paradigm of expected positive outcomes (Jonhston, 2020). Unsurprisingly, in a world that faces unprecedented sustainability issues, the process of digitalization is fervently presented as a solution for society's problems. However, this devoted belief in technological advancements frequently leaves us blind to the (un)intended negative outcomes of a technofix (Jonhston, 2020). Especially the social consequences of technological interventions are often neglected (Corsi, Pagani, Kovaleski, & Luiz da Silva, 2020). As a result, the question of who *actually* benefits from a technology often remains unanswered.

All the while, global value chains are becoming increasingly digitalized (Brun, Gereffi, & Zhan, 2019; Fu, 2020; Görlich, 2021; Lund et al., 2019; OECD, 2017). One of such global value chains is that of the garment industry. In the past couple of decades, the garment industry has been subjected to rapid value chain changes and has become increasingly globalized and complex (Denuwara, Maijala, & Hakovirta, 2019; Kumar, Ekwall, & Wang, 2016; Kumar, Hallqvist, & Ekwall, 2017; Schenimann, 2018; Thomassey & Zeng, 2018). During this time, the industry has embraced a so-called *fast fashion* business model that requires brands to offer new trends to their customers as quickly as possible and for the lowest possible price (Thomassey & Zeng, 2018). However, the costs for cheap and fast clothing are paid elsewhere, and over time ethical, environmental, and labor issues in the garment industry have been vigorously neglected, leaving the sector's system in an unsustainable state (Bernhardt et al., 2009; Denuwara et al., 2019; Turker & Altuntas, 2014). Due to outsourcing, the production system has been especially detrimental for the working conditions of low-wage laborers in the global south, who are employed at the very foundation of the value chain. Since the fashion industry employs over 75 million people worldwide, of whom mostly women (UNECE, 2018), the garment sector has a big role to play in achieving the Sustainable Development Goals.

To develop a more sustainable value chain, fashion companies have set their sights on digitalization, and in light of the COVID-19 pandemic this digitalization process is being accelerated (BSR, 2021; Gonzalo, Harreis, Sanchez Altable, & Villepelet, 2020; Norna, 2020; UNCTAD, 2021). In particular, five types of technologies - 1) 3D software, 2) radio-frequency ID (RFID) tags, 3) augmented virtual reality (AVR), 4) blockchains, and 5) artificial intelligence (AI) - are invested in with hopes to

transform the value chain for the better (ILO, 2019c), promising environmental benefits such as less waste from samples, and social benefits such as much needed transparency into working conditions along the value chain. This digitalization process is often framed by governments, businesses and corporations, academia, and even trade unions as an "unstoppable accelerating process, which can and should be shaped in favor of workers." (Mahnkopf, 2019: 1). At the same time, these technologies offer brands more efficiency and opportunities to control the value chain.

Despite this optimism about the sustainability benefits of digitalization in the fashion value chain, it remains largely unclear how digitalization of the fashion value chain contributes to societal goals and whether it has actual potential to contribute to global sustainability transformations (Denuwara et al., 2019; Gill, 2015; ILO, 2019c; Mahnkopf, 2019). Especially for emerging countries in the global south, it is of particular importance to develop a better understanding of the social impacts of digitalization as the provision of decent jobs and securing well-being for vulnerable workers is a critical transformational development strategy (De Mattos, Kucera, & Rossi, 2020). Hence, for the sector to become more sustainable through digitalization efforts, it is of pivotal importance that these technologies improve the ability of garment workers to access their workers' rights.

In light of this importance, there is a need for a critical social analysis of who *actually* has access to the benefits that are generated with these technologies, and consequently who does not. By exploring a more holistic understanding of the digitalization process in the apparel industry, this study contributes to a knowledge foundation upon which transformative recommendations for policy makers and development institutions can be based. Additionally, it provides insight for the private sector to make informed choices about the technological pathways they choose to invest in. Finally, the research helps worker organizations and union networks to identify bottlenecks or opportunities for sustainable development of workers' well-being.

Overall, the key findings of this research indicate that digitalization affects garment workers in several ways, as technologies and garment workers are interlinked throughout the fabric of the apparel value chain. In their nature, technologies are not 'good' or 'bad' per se. Rather, the eventual impact of technologies on garment workers depends on two main factors. First of all: deliberate action from powerful industry actors, such as brands and retailers, and to an extent also NGOs, labor unions, and governments. Currently, the results of this research indicate that there is insufficient knowledge on, and attention for, the social effects of digitalization in the garment industry, hence explaining the overlooked risks that the current digitalization process poses for garment workers, such as the phenomena of ultra-fast fashion, automation and reshoring, and surveillance capitalism. Secondly, (historical) system dynamics steer the impact of these technologies in a direction that supports an exploitative economic logic. It is in this context that economic profits are valued above the labor rights

of garment workers, resulting in an inability of technologies to address the social challenges that garment workers face, which means that these technologies are unlikely to provide improved access to international workers' rights. Rather, in the present environment technologies can even be expected to deepen these challenges. However, I conclude that through the power of agency these ramifications are not predestined. Therefore, the discussion in chapter eight provides recommendations for industry actors to redirect the digitalization process towards a pathway that benefits garment workers in the global south.

1.2. RESEARCH FRAMEWORK

The research aim is to contribute to a better understanding of the overall social sustainability impact of digitalization. The specific knowledge gap this research focuses on is the currently unexplored field of how digitalization processes in the fashion industry are affecting the access of low-wage garment workers in the global south to international workers' rights. The main research question that follows is:

"How does the digitalization process of the fashion value chain affect the access to international workers' rights of low-wage garment workers in the global south?"

The main research question is subdivided into four sub-questions. First of all, I identify what the global fast fashion value chain looks like. Who are the main actors, how do resources move through the chain, what are the main processes, and what are the main sustainability issues? Secondly, I explore the context of garment workers in the global south. What are their main challenges and what mechanisms are preventing them to benefit from international workers' rights? Thirdly, I aim to get a better understanding of how the digitalization process has affected the fashion value chain in the past decades. Finally, through an iterative process and supported by insights and experiences from industry stakeholders, the risks and benefits of digitalization for workers' rights can be set out. Based on these steps, the following four sub-questions can be formulated:

SQ 1: "What does the global fashion value chain look like?

SQ 2: "To what extent do garment workers in the global south benefit from international workers' rights?"

SQ 3: "How has the digitalization of the fashion value chain developed in recent years?"

SQ 4: "What main consequences of the digitalization process for low-wage factory workers in the global south can be identified?"

Before presenting the results, I first set out my theoretical framework (chapter two). Here, I discuss academic debates on the process of digitalization and especially how digitalization can be used

to achieve sustainability goals. Subsequently, I explain how the fashion value chain is in need of a re-evaluation of what constitutes 'value' in order to bring about sustainable transformations. Secondly, I explain why answering the main research question requires a qualitative approach and elaborate on my methods of data collection and analysis (chapter three). Afterward, I present my data in order of the beforementioned sub-questions (chapter four, five, six, and seven) followed by a discussion of these results (chapter eight). The conclusion (chapter nine) presents a brief summary of the results, recommendations, and suggestions for further research.

Silk dyers hands - India (Kristine, n.d.-a)

2. THEORETICAL FRAMEWORK

The following chapter elaborates on two academic debates that are relevant to this study. These two debates help to understand and explain the research problem at hand and give guidance on how to interpret the results. The first part of this framework highlights the academic debate on digitalization. Most academic literature tends to overstate the benefits of new technologies, even though there is little comprehensive research in the area of social sustainability that supports this claim. This gap in the literature is problematized by post-colonial scholars, who illuminate the need for a broader understanding of the effects of digitalization. They call for a framework that looks beyond the functioning of a technology *an sich,* and instead has more attention for power relations and focuses on who has the ability to benefit from digitalization. Based on this argumentation, questions about who gets what, when, and how become important to understand the effects of digitalization on garment workers in the global south.

Secondly, in this theoretical framework I set out to define what social sustainability means for the fashion value chain. To define what social sustainability means for this study, I make a translation from the 'who gets what, when and how' framework to a 'who *should* get what, when and how' framework. By describing how risks and benefits are currently divided along actors in the global fashion value chain, I argue for a framework that re-evaluates the concept of 'value', one that is more respectful of garment workers and the value they add to the chain. This foundation gives guidance to how the data of this study is interpreted, as well as an indication of how the social risks and benefits of technologies can be understood in a more critical fashion.

2.1. THE ACADEMIC DEBATE ON 'DIGITALIZATION'

2.1.1. DIGITALIZATION MEETS THE SUSTAINABLE DEVELOPMENT GOALS

In the past few decades, the global interest in the Sustainable Development Goals (SDGs) has developed parallel to the digitalization of our societies. While 193 UN member states affirmed global social, environmental, and economic sustainability targets for the year 2030 (UN, 2015), humanity has entered the digital age (Schmidt & Cohen, 2013). 'Digitalization' (see table 2.1. for a variety of definitions) has changed how we interact with our environment, and most fundamentally it has changed the way humans interact with each other (Seele & Lock, 2017). In line with these two developments, in recent years governments, NGOs, companies, and academics have been trying to find possibilities and pathways to utilize digitalization to achieve global sustainability goals (Del Río Castro, González Fernández, & Uruburu Colsa, 2021; Mahnkopf, 2019; Seele & Lock, 2017; Shah, Cappella Ramesh, & Neuman, 2015).

Famously, the field of sustainability is divided into three main pillars: economic, environmental, and social. For a development to be 'sustainable', all three areas should be accounted for (Purvis, Mao, & Robinson, 2019). For two reasons, this research places particular weight on the social pillar of sustainability. First of all, within the fashion industry social sustainability challenges such as exploitation and labor conditions are pressing issues on the global sustainability agenda (UN, 2021). Secondly, in assessing the sustainability outcomes of digitalization processes, economic and ecological studies are thus far overrepresented in the grand scheme of available academic studies (see: Corsi et al., 2020; Thöni & Tjoa, 2017; Woodcraft, 2015; Young, 2019). Therefore, there is an urgent need to highlight the social impact of digitalization of the fashion value chain.

The (social) outcomes of digitalization are often positively framed by governments, businesses and corporations, academia, and trade unions (Jonhston, 2020; Mahnkopf, 2019). This is remarkable, because so far there is little concrete academic evidence of whether current digitalization efforts actually contribute to achieving societal goals (Del Río Castro et al., 2021; Mahnkopf, 2019; Seele & Lock, 2017). Alternatively, available literature focuses mostly on the benefits of technologies from an economic perspective, and generally deploys an optimistic discourse about the effects of digitalization. In order to create insight into the context in which technologies are developed and evaluated, section 2.1.2. elaborates on the effects of digitalization from the (dominant) business perspective. Subsequently, section 2.1.3. is more critical of this perspective and offers an alternative narrative for this research.

Table 2.1. Definitions of digitalization (based on: Parida, Sjödin, & Reim, 2019)

Reference	Definition
(Gardner Glossary, 2018)	**Digitalization** is the use of digital technologies to change a business model and provide new revenue and value-producing opportunities; it is the process of moving to a digital business.
(Gobble, 2018)	**Digitalization** is the straightforward process of converting analog information to digital. Digitalization refers to the use of digital technology, and probably digitized information, to create and harvest value in new ways.
(i-scoop, 2018)	**Digitalization** means turning interactions, communications, business functions and business models into (more) digital ones which often boils down to a mix of digital and physical as in omnichannel customer service, integrated marketing or smart manufacturing with a mix of autonomous, semi-autonomous, and manual operations.
(Luz Martín-Peña, Díaz-Garrido, & Sánchez-López, 2018)	**Industry 4.0** is being encouraged by the introduction of digital technologies that push the specialization of the value chain and also connectivity between actors. Industry

	4.0 heralds greater operational efficiency and the development of new products, services, and business models.
(Rachinger, Rauter, Müller, Vorraber, & Schirgi, 2019)	**Digitalization** (i.e., the process of converting analogue data into digital data sets) is the framework for digitalization, which is defined as the exploitation of digital opportunities. Digitalization by means of combining different technologies (e.g., cloud technologies, sensors, big data, 3D printing) opens unforeseen possibilities and offers the potential to create radically new products, services, and BM.

2.1.2. THE DOMINANT ECONOMIC PERSPECTIVE ON DIGITALIZATION

In their 2019 paper, Parida et al. (2019) summarize and synthesize 106 recently published works on how businesses (across all sectors) can utilize technologies for sustainability benefits. Their findings (table 2.2.) give an emblematic image of the state of current literature, which is very economic-oriented. Parida et al. note that most of the studies' theoretical focus lies on what they call a 'resource-based view' (RBV). This RBV emphasizes the need for a company to sustain a competitive market advantage, utilizing whatever technologies are at hand.

They state that fewer studies from their sample are based on transition theory, even though from a sustainability perspective it would be better to develop "a transformative business model innovation approach that favors more radical, structural changes in the business model instead of continual adaptation to suboptimal solutions. While other researchers propose concrete and workable action plans, transitioning to economic and social systems that can accommodate innovative changes is of particular importance." (2019: 5). In short, available literature mostly plays into status-quo economic system dynamics rather than contributing to much needed transformative strategies.

Parida et al. state that in order to derive economic, environmental, and social benefits from digitalization, business models need to be adapted by committing to the Triple Bottom Live (TBL) principle, which means that apart from a focus on financial profits, companies should also develop their business with an *equal* focus on social and environmental sustainability. By applying a business model lens, they identify how current studies perceive what business model innovations need to be developed in order to leverage digitalization for sustainability.

Although I am critical of the social sustainability benefits of these findings (table 2.2) which seem largely based on trickle-down effects, this research does provide insightful information about how companies perceive the benefits of digitalization and also gives an indication of what industry leaders tend to leave out of consideration when developing and implementing technologies. Moreover, it shows how digitalization is generally perceived in a positive frame, as substantial downsides of

digitalization are not touched upon, especially with regard to the impact for developing countries in the global south.

According to Parida et al., more research is necessary to determine the risks and benefits of digitalization. One of their questions for future research is: "how to ensure the sharing of risk and revenue among multiple actors in the ecosystems? […] Companies would need to ensure that 'opportunistic behaviors' do not become prevalent and that each actor is placed to earn a fair share of revenue." (2019: 14). The overall question of how risk and revenue is divided along the value chain is an important question to take into account for this research. Consequently, in section 2.2. I elaborate on what a 'fair share of revenue' means for businesses in the fashion industry.

Table 2.2. The benefits of digitalization from an industry perspective (based on: Parida et al., 2019)

Sustainability dimension	Benefits
Economic	- Radical and incremental digitalization will improve a companies economic performance (Parida, Sjödin, Wincent, & Kohtamäki, 2014). - Processes become more efficient through the continuous analysis of operational data and identification of operational bottlenecks (Cenamor, Rönnberg Sjödin, & Parida, 2017). - Process efficiency leads to optimized capacity, less errors, and among other things less equipment downtime (Sjödin, Parida, Leksell, & Petrovic, 2018). - Process optimization leads to lower production costs, cost-efficient resource utilization, and lower lead times (Grubic & Jennions, 2018; Porter & Heppelmann, 2014).
Environmental	- Reduced environmental footprint of the manufacturing process due to more efficient organizational methods, facilitated by digitalization (Gorissen, Vrancken, & Manshoven, 2016; Heiskala, Jokinen, & Tinnilä, 2016; Sjödin et al., 2018). - Technologies can facilitate eco-friendly product design, predictive maintenance, and product tracking (Bressanelli, Adrodegari, Perona, & Saccani, 2018).
Social	- Process automation and technologies like sensors can lead to increased safety and reduce incidences of human error that cause accidents (Sjödin et al., 2018). - Dangerous jobs can be eliminated by using remotely operated or autonomous machines. - Repetitive, unrewarding jobs can become more knowledge-intensive, rewarding tasks (Sjödin et al., 2018). - Economic benefits can lead to improved potential for regional development, especially for remote regions (Loebbecke & Picot, 2015; Vendrell-Herrero, Myrthianos, Parry, & Bustinza, 2017).

2.1.3. FACTORING IN THE SOCIAL EFFECTS OF DIGITALIZATION

In previous paragraphs I presented how most available academic literature on (sustainable) digitalization does not put social sustainability at its core, rather it is often presented as a by-product of technologies that are primarily developed to promote economic (and in some cases environmental)

benefits. This raises questions about the importance of social sustainability. Is the lack of academic attention an indication that it is indeed not an important factor, and is the problematizing of attention for social sustainability trumped up? According to critical literature, the answer is: no.

As the work of Johntson (2020) taught us earlier, the (un)intended negative outcomes of digitalization are often overlooked due to the hopeful paradigm that has historically surrounded the process of developing new technologies. At the same time, the social benefits of digitalization for developing countries are hardly discussed in current literature, let alone the possible risks. Corsi et al. (2020: 5) confirm this perception: "Studies have shown that the pillars are weighed unevenly. In general, the economic aspect receives more significance than the environmental and the social, with the latter often downright ignored". According to Seuring (2013), this oversight has to do with the difficulty of modeling and measuring social impacts.

However, the work of El Bilali and Allahyari (2018) shows that factoring in social aspects is not only possible, it also reveals a less optimistic outlook on the effects of digitalization. They have researched the sustainability outcomes of digitalization in global food systems, and particularly what that means for smallholder farmers in the global south. Table A in the appendix presents an overview of their main findings. Overall, they conclude that digitalization has far-reaching impact on individuals and communities, and poses both risks and benefits for sustainability. Their work shows how virtual relations disconnect consumers and farmers from each other, how farmers become more constrained by the power of globalization, how technology excludes vulnerable farmers, and how privacy and data ownership issues expand the power of big corporations. Although these risks might not be true for the fashion industry and garment workers, they are possible indicators to look out for in this study.

2.1.4. DIGITAL COLONIALISM AND THE ABILTIY TO BENEFIT

The work of Parida et al. (2019) reveals an overall lack of critical distrust against the process of digitalization and who actually benefits from it. Most studies highlight the impressive potential benefits of digitalization for businesses and workers alike, yet often times these benefits are focused on material resources and trickle-down mechanisms. However, social sustainability comprises of more than monetary value. The consequences - both in its positive and negative potential - of technological developments should be considered a holistic issue. In order to comprehend the sustainable impact of a technology, one needs to look beyond the functionalities of the technology as such and the problems it is meant to solve, and develop a better understanding of who has the ability to reap benefits from a technology, and consequently: who does not.

The social sustainability of a technology can be seen as a matter of 'accessibility', or rather: "the ability to benefit from things." (Ribot & Peluso, 2003: 153). This perception of access, borrowed from

the field of rural sociology, does not only take into account material objects, but also takes into account persons, institutions, and symbols (Ribot & Peluso, 2003). Ribot & Peluso's theory of access states that in order to actually benefit from a technology, a person should not only have the right to this benefit but also the ability to actually claim this right. The latter has everything to do with power.

This critical assessment of who has access plays into the relatively new debate on digital colonialism. With the increasing role of data in how societies are managed, some authors raise attention to the issue of a new, digital colonialism (see: Coleman, 2019; Kwet, 2019; Pinto, 2018; Young, 2019). In the absence of comprehensive data protection laws in global south countries, western tech companies can freely exploit data of individuals and communities as a resource for profit and predictive analysis (Coleman, 2019). In his research, Kwet (2019) presents clear examples of digital colonialism, where foreign multinationals undermine local development, dominate the market, and extract revenue from the global south based on their dominance over the digital infrastructure.

Current studies on the effects of digitalization remain focused on the global north, which is unsurprising as most of digital technologies are developed by and for (urban) global north people. However, when it comes to applying this discussion to the global south research tends to focus on a one-dimensional, instrumental perspective, looking only at economic advantages and benefits (Young, 2019). According to Pinto (2018), current analyses have been too simplistic and more research is needed on the complexity of the power of surveillance and the concentration of data collection from a small number of public and private actors. Hence, this research is attentive to power dynamics that originate in the field of digital colonialism.

2.2. RE-DEFINING VALUE

2.2.1. SOCIAL SUSTAINABILITY IN VALUE CHAINS

Defining and measuring social sustainability in value chains can be difficult (Seuring, 2013). As a result, most papers written about sustainable value chain management do not even touch upon the social domain of sustainability, but rather define overall sustainability in terms of environmental and economic indicators (Corsi et al., 2020). Leaving out the social dimension in value chain management negates efforts to establish overall sustainability transitions in value chains, as Seuring (2013: 1515) describes: "This would basically leave all assumptions of supply chain management unquestioned and rather support a marginally changed business as usual, where sustainability is still subordinate to economic issues." In order to understand sustainable transitions for the fashion value chain, social sustainability parameters need to be determined.

Social sustainability can be determined based on many parameters, for example health, wages, social justice, equity, and so on (Thöni & Tjoa, 2017; Woodcraft, 2015). Ultimately however, the meaning of social sustainability "remains both context specific and ontologically open, and thus any rigorous operationalisation requires explicit description of how it is understood." (Purvis, Mao, & Robinson, 2019: 692). Hence, the following paragraphs are dedicated to set out a framework of how social sustainability can be understood for the fashion value chain. The basic assumptions of this definition are rooted in the beforementioned theory of access from Ribot and Peluso (2003). This means that I first set out the *rights* that garment workers have to benefit from production processes, and subsequently whether they have the *ability* to benefit from production processes.

2.2.2. INTERNATIONAL WORKERS' RIGHTS

'International workers' rights' are concrete yet universal parameters, developed to ensure the well-being of all workers. The following quote from the International Labor Organization (ILO) (2019a: 13) clearly describes how laborers should be regarded as more than just an economic production factor: "Labour is not an inanimate product, like an apple or a television set, that can be negotiated for the highest profit or the lowest price. Work is part of everyone's daily life and is crucial to a person's dignity, well-being and development as a human being. Economic development should include the creation of jobs and working conditions in which people can work in freedom, safety and dignity. In short, economic development is not undertaken for its own sake, but to improve the lives of human beings." According to the ILO, not only should work on a global scale adhere to standards of freedom, equity, security and dignity (ILO, 2019b), economic growth should also provide benefits for all (ILO, 1998, 2021). These principles are translated into eight fundamental workers' rights, which are depicted in table B in the appendix.

However, these ILO conventions are still very general and not necessarily tailored to the fashion value chain. Although they serve as a useful basis, a more explicit albeit still internationally oriented framework is needed to define accurate workers' rights for this study. Hence, table 2.3. shows the most fundamental workers' rights for this research, based on a collection of academic studies, as well as parameters as defined by NGO's and industry watchdogs. In order to be regarded as sustainable, technologies should not harm and, considering the state of the value chain (see: Denuwara et al., 2019), even promote the workers' rights as described in table 2.3.

However, as Ribot and Peluso state in their theory of access: "The right to access does not automatically lead to someone having the ability to access." (2003: 160). This is especially true for garment workers, as the fashion value chain is characterized by large inequalities of the division of both resources and power. Table 2.3. already presents a first indication of the ability of workers to seize their

rights, but these challenges are properly expanded on in chapter five. Looking at international workers' rights alone is not enough to fathom the social dimension of the apparel value chain, since the ability to claim these rights requires power. Hence, the following section discusses prevalent issues of equity and social justice in the fashion value chain, by discussing who currently 'gets what, when, and how' and who '*should* get what, when and how'.

Table 2.3. Most important workers' rights for low-wage garment workers in the global south

1) Right to a living wage
Based on the hours of a standard working week, the wages and benefits should be enough in order for workers to meet the basic needs of themselves and their families. A living wage also means that some discretionary income is provided. The garment industry is notorious for not providing a living wage to a large share of its workers (Ford & Gillan, 2017), which has only worsened since the COVID-19 pandemic (see: Meyer, Hardy, Witte, Kagy, & Demeke, 2021).
2) No forced labor
Employment should be freely chosen. Workers should give informed consent for their labor and be able to leave their job at any time. Any forms of modern day slavery should be abolished, which includes human trafficking (Marcketti & Karpova, 2020). It is estimated that worldwide, there are around 40.3 million people who are living under some form of modern day slavery (Landman & Silverman, 2019). Fashion industry actors are notorious for not reporting on the state of modern day slavery in their supply chain (Voss et al., 2019).
3) No child labor
Countries should set a minimum age for work (although no younger than fifteen and preferably eighteen when a person is fully physically and mentally developed. Children between 15-18 should not work under circumstances that are likely to harm their health, safety or morals. Due to the low-skilled production process of garments, children are frequently deployed in the fashion value chain. Sometimes even for instrumental reasons, as their small fingers make it easier to assemble finer pieces (e.g., beading, sequins and assembling jewelry) (Dimitrova, 2020).
4) Right to reasonable hours of work and limited overtime
On a regular basis, workers should not be required to work more than 48 hours per week and should be provided with at least one day off every seven days. Working overtime is only on a voluntary basis, should be rewarded with a premium compensation, should not be requested on a regular basis, and should not exceed 12 hours per week. In the garment industry, working overtime is not only a common practice it is also often forced and required for an individual to generate a basic income (Prentice, De Neve, Mezzadri, & Ruwanpura, 2018).
5) Right to safe and healthy working conditions
Workspaces should be safe and hygienic. Regulations should ensure that occupational hazards are minimized as much as possible. Additionally, any types of (threats of) physical abuse, sexual or other harassment, and intimidation is prohibited. In the fashion industry, violence and harassment – especially against women – is still commonplace (ILO, 2019c). Although still not always up to par, the industry has taken major steps regarding

the safety of buildings after the Rana Plaza building collapse in 2013, which killed 1132 people and injured more than 2500 (Xavier, 2019).

6) Right to organize and bargain collectively

Workers have the right to organize and bargain for better working conditions as a collective and in peace. Employees and governments have the responsibility to protect workers from anti-union discrimination. However, so far realization of these rights remains a struggle in the industry (Ashraf & Prentice, 2019; Kuruvilla & Li, 2021; Rahim & Islam, 2020).

7) No discrimination

All sorts of employment relationships are to be based on equal opportunities, regardless of race, nationality, skin color, gender, religion, political preference, membership of a union or handicaps. Basically, all people have the right to freedom, dignity, economic security, equal opportunity, and to develop both material and spiritual well-being. Currently, many cases of discrimination are still being reported in the garment industry, especially against migrants and gender-based discrimination (see: Beresford, Cucco, & Prota, 2017; Li & Dickson, 2019; Srivastava, 2019).

8) Right to legally binding employment relationship

Through certain ambiguous labor contracting arrangements, people can be stripped from their national social security laws and regulations. Workers should be better protected against these types of constructions, and additionally younger workers should be given opportunities to participate in training and education programs. These rights are not yet dominantly manifested in the fashion industry. For example, with clothing sales dropping due to the COVID-19 pandemic, brands have frequently exploited the fragility of legal constructions and it is estimated that this has left over one million garment workers suddenly unemployed (J. Vogt, Saage-Maaß, Vanpeperstraete, & Hensler, 2020).

2.2.3. WHO GETS WHAT, WHEN AND HOW

As was stated before, economic growth should provide "benefits for all" (ILO, 1998, 2021). First of all, it is important to acknowledge that the outsourcing of garment manufacturing has without a doubt provided global south countries access to new markets and opportunities for economic growth. Especially for Asian countries like Bangladesh, Pakistan and Cambodia, the export of garments makes up a significant share of their national economy (see figure 2.1.). With a global workforce of over 75 million people, the fashion industry provides jobs for an incredible amount of workers (Solidarity Center, 2019). Be that as it may, "the distribution of value added across global apparel value chain continues to be skewed towards OECD economies, with pre and post manufacturing services capturing more gain than actual manufacturing" (Miller & Hohenegger, 2017: 1). In practice, trickle down effects seem to be absent, as 97% of the economic profits for the whole value chain are earned by just twenty - what McKinsey & Company (2020) call "value creating" - companies (see figure c in the appendix).

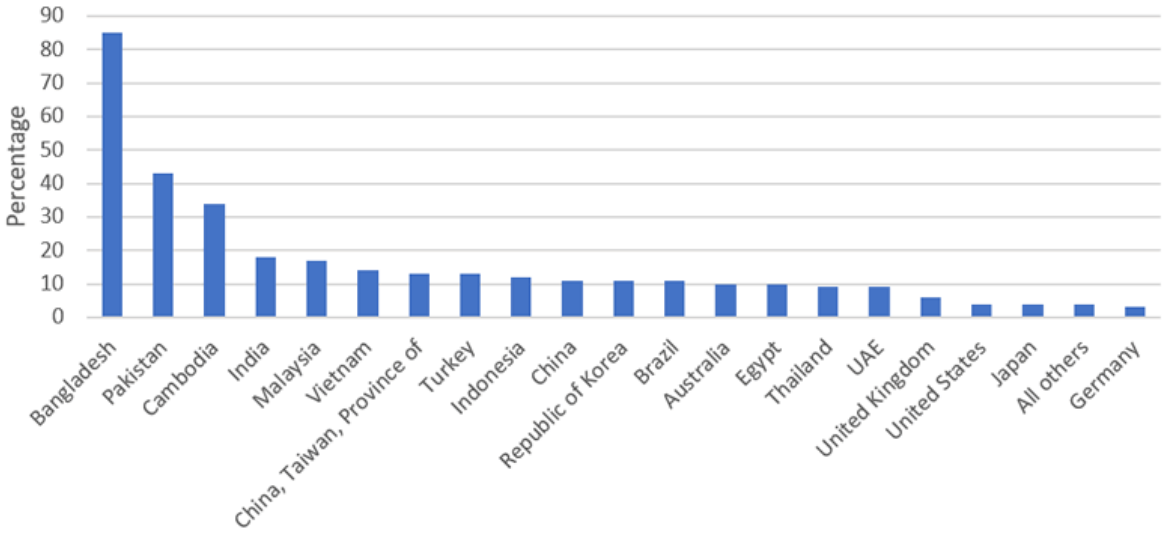


Figure 2.1. Top 20 exporting countries for fashion goods and the share fashion goods take on in their total country exports (in %) (UNCTAD, 2020)

Additionally, the industry is characterized by large inequalities of power along the value chain. According to Agrawal et al. (2021), the fashion brands (retailers) are seen as the focal actors. They are usually the ones who contract upstream partners, and determine the main structure of the chain, meaning that the apparel brands are often times the ones who decide the (low-cost) manufacturing location and the supplier (often this outsourcing is placed in the global south) (Kumar et al., 2016, 2017). Overall, brands make large profit margins (Adegeest, 2020; Skeldon, 2020; Statista, 2021b; Sweney & Butler, 2021) and are thus capable of seizing material benefits of the value chain.

However, the fashion value chain is complex and comprises a variety of actors (which is elaborated on in chapter four). Thus, there is no black-and-white division of power. For example, although brands and retailers are notably the most powerful actors in the value chain, the low transparency throughout the value chain can make it difficult for brands and retailers to rule out ethical misconducts in the production process (Agrawal et al., 2021). Also, consumer demands create a strong incentive (some might even say obligation) for companies to be highly competitive (see: Mckinsey & Company, 2020). At the same time, government regulations in the global south are generally failing to adequately effectuate garment workers' rights (Denuwara et al., 2019; Kumar et al., 2016, 2017; Schenimann, 2018). For this research framework, it is important to acknowledge the multitude of power-dynamics at play, whilst also addressing the dominant position of brands and retailers in the overall chain.

The complexity of power dynamics makes it difficult to argue why the current division of risks and rewards in the fashion value chain are 'unfair' and 'socially unsustainable'. However, through a discussion of the concept 'value' a framework can be set up that enables an interpretation of the results

which links digitalization to social sustainability outcomes for garment workers. What constitutes as 'valuable' is undeniably in the eye of the beholder, however in the following paragraphs I will argue why the way value is dominantly perceived in the fashion sector can be regarded as unfair, and forms a breeding ground for unsustainable practices that value the accumulation of wealth for individuals over social benefits and the well-being of workers. Since the subject of 'values' is inherently formed by normative indicators, it is important to acknowledge that in all probability my personal beliefs and background play a role in the arguments that I choose to set out in the following paragraphs, on which I further reflect in the method chapter (section 3.1.).

2.2.4. WHO SHOULD GET WHAT, WHEN AND HOW

In the production process of - let's say - a T-shirt, there are more activities that add 'value' to the T-shirt than just the natural resources and labor costs necessary for its manufacturing. Activities like design and marketing, transport, and storage also add a certain value to the T-shirt. They are considered as production costs and included in the eventual cost price. Most commonly in the fashion sector, the rationale behind the eventual price structure is top down rather than bottom up (see figure 2.2.), meaning that the eventual selling price of the T-shirt is determined by taking the intended *profit* as a starting point, rather that the *costs of labor*. Contrary to this, bottom-up price structures would be more attentive to providing decent wages for workers, but for top-down price structures wages are subordinate to profits for retailers.

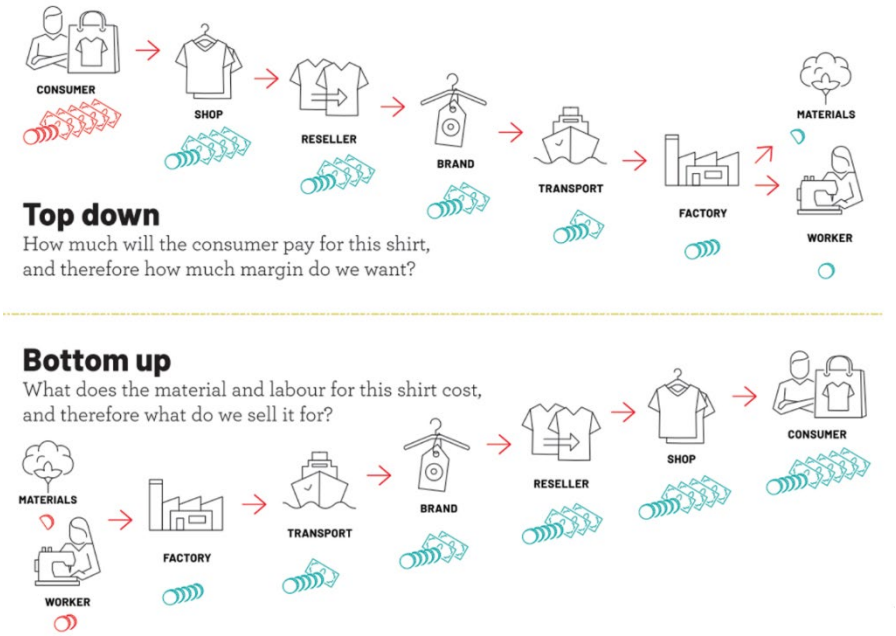


Figure 2.2. Top down and bottom up pricing (Fair Wear, 2019)

In sustainability literature, 'value' should also include non-monetary factors such as ecological circularity. For example, contrary to more contemporary depiction of the fashion value chain, the value

chain designed by Runnel, Raihan, Castle, Oja, & Bhuiya (2017) (figure 2.3.) depicts the fast fashion value chain including the waste that is generated at each step of the chain, thus factoring in environmental values. However, determining social value in a similar rectilinear fashion is more ambiguous and therefore, as already became clear in section 2.1., often overlooked. So how can social value be better included in value chain analyses? Palmer (2003) states that when discussing 'value' in an ethical sustainability context, an important question to raise is: who counts morally and why? Niinimäki (2015) applies this philosophical discussion to the fashion industry. She states that in order for the industry to become more sustainable, brands need to bring an ethical consideration into their business model. However, "this aspect seems to be problematic for some manufacturers and companies, they do not want to make moral claims about what is right and what is wrong." (2015: 3).

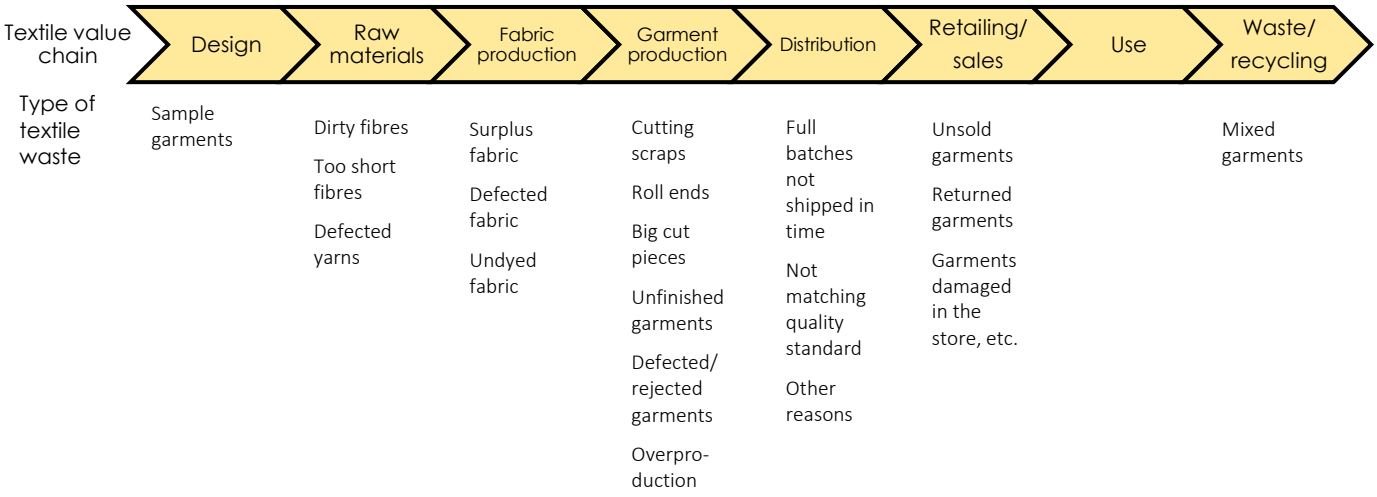


Figure 2.3.: Global textile value chain and the type of waste it produces (based on: Runnel et al., 2017)

But this seemingly neutral stance of large retailers is a barrier for transformative change. Is not wanting to dedicate to a moral stance not inherently the same as taking a stance in support of the status quo? This 'non-stance' of large retailers shapes how value continues to be interpreted in the fast fashion business model and consequently how value is rewarded. In many cases garment workers are not being paid a living wage and lack empowerment, while retailers have been profiting from large profit margins for years and exert vast control over the value chain (see table D in the appendix) (Fair Wear, 2019; Oxfam, 2017; Theuws & Overeem, 2020). It is my perspective that this division of wealth and power is not socially just and therefore unsustainable. Anyone who works a full hour work week should at least be able to make a living wage, especially when there are bounteous profits being made at the other end of the value chain.

To invigorate this statement, I want to share two cases. First, in 2020 the Clean Clothes Campaign broke down how the costs of a T-shirt are typically assembled along the supply chain (see figure 2.4.). Along the lines of this dissection, the mere profit for a brand is rated twenty times more valuable than the labor of a garment worker in the global south. To be clear, profit has little to do with production factors like sowing, marketing, transport, etcetera. Profit is a self-proclaimed reward for the brand in order to keep growing. In a capitalist system, this growth is necessary for a company to survive. So, does that justify not paying workers a living wage?

Even if you were to believe in the inherent fairness of the capitalist system, I would argue that the answer to that question is: no. To illustrate this argument, I zoom in on a second case, the one of Zara. Zara is a famous Spanish retail chain that stands at the forefront of the global (fast) fashion industry, and which has been very influential in forming the structure of the global value chain as we know it today (Aftab, Yuanjian, Kabir, & Barua, 2018; Crofton & Dopico, 2007). According to Forbes (2021), the founder of Zara and pioneer of the fast fashion business model has a net worth of $82.9 billion and is considered one of the top twenty richest people on earth. Ostensibly, in the overall system a single entrepreneur is valued a great deal more than millions of women in the global south who struggle to provide for their families. Let me be clear that my argument does not lead to a call for a Marxist revolution. However, this example strikingly shows that when it comes to social sustainability there is a dire need for a system that promotes social justice, and in order to transform this system there is a need to re-evaluate who *deserves* to get what, when and how.

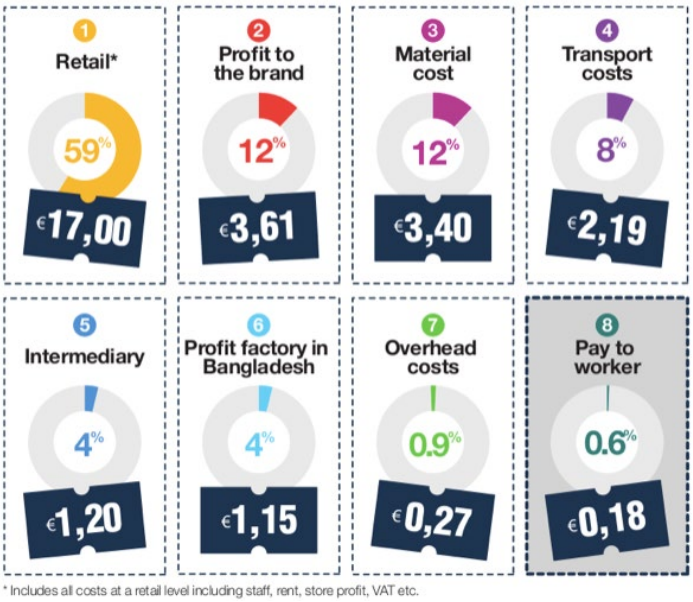


Figure 2.4.: Breaking down the costs of a T-shirt (Clean Clothes Campaign, 2020b)

As a practical step to combat this inequality, NGOs and watchdogs have increasingly called for a redistribution of profit margins along the value chain that are more respectful of the value of labor. This would benefit the working conditions of garment laborers in the global south while having a

negligible effect on the retail price (Miller & Williams, 2009; Nova & Kline, 2013; Pollin, Burns, & Heintz, 2004). Brands and retailers counter this by stating that wage increases ultimately result in a multiplier effect, as actors on each level of the chain will insist on a percentage mark-up (Miller & Hohenegger, 2017). However, empirical evidence shows that paying a living wage through a redistribution of profit margins is a feasible option that is not detrimental for the overall competitive market position of a brand (Egels-Zandén, 2017). The argument against a more equal distribution of wealth along the value chain suggests that, again, profit margins and competitiveness of a brand are regarded to be more valuable than worker well-being.

Based on these arguments, I draw the conclusion that the way value is currently dominantly interpreted in the fashion value chain is unfair and unsustainable. To refer back to the work of Palmer (2003), when determining what value means brands should take responsibility and start raising the question: who counts morally and why? If you ask this question, the inequality of monetary rewards becomes a symptom of a deeper, structural negligence to be critical of the responsibility companies have to care for the well-being of workers in their value chain. The outcomes of this question are in the eye of the beholder, but asking it is a first step in moving towards a more socially sustainable industry. The valuation mechanisms companies and people uphold are important to take into account when analyzing the risks and benefits of digitalization, as it says a lot about whose interests are valued most and who holds power to seize their interests. In turn, it means that for a more socially sustainable transformation of the value chain, technologies need to be set up in a manner that promotes social justice for garment workers.

Sewing - Côte D'Ivoire (Ethical Fashion Initiative, 2018)

3. METHODS

3.1. METHODOLOGICAL APPROACH

The research aim is to contribute to a better understanding of the overall social sustainability impact of digitalization. The specific knowledge gap this research focuses on is the currently unexplored field of how digitalization processes in the fashion industry are affecting the access of low-wage garment workers in the global south to international workers' rights. The main research question that follows is:

"How does the digitalization process of the fashion value chain affect the access to international workers' rights of low-wage garment workers in the global south?"

For several reasons, answering this research question requires predominantly qualitative data. Perceptions of concepts such as 'value', 'power', and 'access' are best captured through words, rather than numbers. Value chain dynamics and social relations are key components of this study, and these are best measured via qualitative methods. Moreover, the explorative nature of this study requires methods that help to develop a better understanding of underlying mechanisms between the concepts and possibly discover new relevant concepts that were previously not on the radar. To answer the main research question, primary as well as secondary data is used.

Since qualitative methods are less controlled and more interpretative in nature than quantitative methods, the results of this study are sensitive to my position as researcher. Because this research includes concepts like digital colonialism and focuses on workers in the global south, I feel it is necessary to mention that my roots lie in a global north country, and I have a background in political and sustainability science. My observations and interpretations are undoubtedly colored by these lenses, as well as by my many other personal experiences. At the same time, I am critical of status-quo mechanisms and consider myself open to alternative perceptions. Furthermore, throughout this study I have tried to include both data from a business perspective as well as data from worker perspectives, although the latter has, for reasons I will get into, been more difficult to find. To fill this gap and considering the inequalities of power and wealth in the fashion value chain, I have been especially critical of some industry data, however in my opinion always within reasonable boundaries and preferably based on multiple sources.

3.2. METHODS OF DATA COLLECTION AND ANALYSIS

3.2.1. EXISTING DATA

Most of the results of this study are based on existing data, both in the form of written documents (such as reports, conference proceedings, website pages, news articles, industry forecasts, blogs, etc.) and non-written documents (such as documentaries, recorded roundtable discussions, and short information videos). These sources are scattered, but brought together provide very useful information and form the foundation of the data collection for this study. The sources for the main narrative of each sub question were selected and analyzed based on a literature review, and in some cases supported with examples from a more empirical nature to make concepts more comprehensible. This method of making sense of an existing body of literature through aggregation, interpretation, explanation, or integration is referred to as a 'stand-alone' review (Levy & Ellis, 2006; Rousseau, Manning, & Denyer, 2008; Templier & Paré, 2015).

According to Xiao & Watson (2019) stand-alone literature reviews can be divided into four categories depending on the purpose of the review, which can be either to describe, test, extend, or critique. Since the knowledge gap at hand requires this study to translate overarching hypotheses to the field of the garment industry and to explore new concepts, the type of review for this study falls under the category 'extend'. In order to preserve the integrity of the narrative for this type of review it is important to remain critical about which data to synthesize and whether it remains applicable to the current research question and concepts (Mays, Pope, & Popay, 2005).

The eventual selection and analysis method is based on what Xiao & Watson (2019) call a 'thematic synthesis'. For this method, data is subdivided into several themes which are then clustered and synthesized for the analysis (J. Thomas & Harden, 2008). This is reflected in the separation of garment workers context (chapter 5) and the digitalization process of the fashion value chain (chapter 6). In these two chapters, concepts and second-order constructs are extracted from the available literature, which are then brought together in the analysis of chapter 7, transforming them into third-order constructs. Through this process, with this extending review I attempt to build on the existing literature in order to get a better understanding of the link between digitalization and garment workers.

Especially sources (both academic and non-academic) that gave insight in the digitalization process of the last decades were widely available, both from a retailer/brand perspective (e.g., McKinsey reports) and from a worker-oriented perspective (e.g., ILO reports). So too were documents about the context of workers' rights and power dynamics in the fashion value chain (e.g., reports the ILO, industry watchdogs, and sources from international and sometimes local labor organizations). What was more difficult to find were documents that connect digitalization directly to garment workers

(which speaks to the research gap at hand). However, based on the theoretical framework and the preliminary data gathered for sub question one and two, some main areas of concern are derived and data was collected for these topics. For example, themes like transparency of the value chain, data ownership, and reshoring are identified as consequences of digitalization that impact garment workers. Based on these indications, I was able to look for critical research and other documents such as reports from industry 4.0 watchdogs and the ILO that focus on these particular themes and subtract the information that I consider applicable to the fashion value chain.

Existing data was derived in multiple ways. The non-academic sources are found through mere Google searches. Additionally, sometimes reports from retailers, branch organizations and NGOs were forwarded by respondents. Academic sources were found via direct searches in Google Scholar (preferably filtered on works published from 2017 onward) and through snowball searches in Scopus and Elsevier. Admittedly and in line with what the theoretical framework would suggest, data that highlights the benefits of technology was abundant and critical data more difficult to find. However, as a result from thorough searches based on holistic and interdisciplinary search terms, alternative critical data also surfaced.

3.2.2. IN-DEPTH INTERVIEWS WITH INDUSTRY ACTORS

As this research focuses on the fashion value chain, the knowledge and experiences of industry actors give access to important insights about value chain (digitalization) processes and underlying (power and social) dynamics. Additionally, this type of data complements the existing data as it provides more opportunities to tie concepts together. Also, respondents can give surprising insight in concepts and mechanisms that otherwise could have been overlooked. Seeing as this research is remote in nature and the global fashion value chain involves millions of people, collecting data via interviews has been a process of narrowing down and deciding between an overwhelming number of possible respondents, but has also been a process of disappointing responses, time restrictions, and ethical limitations.

Let me begin with my selection method. In order to answer my sub questions, I wanted to interview people who could tell me about digitalization of the value chain and the context of workers. My ultimate selection is based on several different criteria. For one, I contacted people who I found online when searching for companies that specialize in developing technologies for the fashion value chain, as well as organizations that host congresses and other events to promote technological developments in the fashion value chain, and branch organizations. Compared to other selected respondents, these contacts were quite responsive, although also limited in their time.

Secondly, to get insight into the perspective of garment workers and their connection to digitalization of the value chain, I contacted local labor organizations in Cambodia, Bangladesh, and

India (this selection is partly based on their share in the global garment export, but also on coincidental findings of their contact details in reports and via contacts at CNV International), as well as industry watchdogs and international labor organizations. This selection was based on my own network as well as a search online for the contact details of local labor organizations. In all fairness, contacting these organizations has been very difficult, unresponsive, and time-consuming. Although the curse of non-response is only natural in the process of data collection, whenever I got at least some response there seemed to be one culprit that actively tried to sabotage my data collection: COVID-19.

The impact of the pandemic has been palpable for my data collection, hence the need to dedicate a paragraph of reflection to these circumstances. First of all, the COVID-19 pandemic has disrupted the fashion sector awfully and enormously (see: CARE, 2021; Clean Clothes Campaign, 2021c; Fair Wear, 2020; Fashion Revolution, 2021; WRC, 2020, 2021a). Consequently, industry actors, be it watchdogs, labor organizations or retailers, are under huge pressure and extremely busy with monitoring and dealing with the effects of the pandemic. For one, this meant that requests for interviews were very often declined for the reason that people were too busy because of COVID-19. Unfortunately, selecting and contacting these respondents has been very time consuming and yet futile.

Secondly and on a more personal note, at one point it did not feel ethical anymore to push for interviews with local labor organizations who were located in global south countries. People in, for example, India and Bangladesh were in lock-down and concerned with their own health as well as the safety of their families, communities and garment workers. I decided that I was not comfortable with pushing my research when there are obviously more important things that required people's attention. Denying that issue would be stepping on my own theoretical framework about what constitutes as valuable. All in all, I have to admit that the data collection would have been more complete with the direct input of local labor organization, but under the current circumstances I am grateful of the people who did make the time to meet with me, as well as understanding for the people who did not have that opportunity.

The respondents are depicted in table 3.1. All interviews were conducted via Zoom and recorded with the permission of the respondents. Although sometimes there were some connection problems, overall the online interviews did not pose any problems. All interviews were transcribed. In these transcriptions, I highlighted parts that supported or supplemented the existing data. Respondents agreed that the anonymized interview could be used for this research. Respondents were informed about the nature of this research and that it will be shared with others, among which themselves if they were interested in reading the results. I also informed them that the recordings of the interviews are to be deleted after the completion of this research, and that in the meantime data is stored in a secured

cloud location. For each interview, an interview guide was set up, however during the interviews this guide was sometimes diverted from depending on the input of the respondent. The interviews varied from half an hour to an hour, depending on the time the respondent could spare.

Table 3.1. List of respondents

Respondent #	Affiliation	Topic of interview
1	Works as Foresight Technology Manager and researches the legal and ethical challenges and opportunities of digital transformations for societies.	Expected/ongoing outcomes of technologies for global value chains.
2	Head of a supplier of fashion clothing elements and services in manufacturing with production in Asia and Europe, which sells its products to brands & retailers throughout Northern America, Europe and the UK.	Process of digitalization and the impact of technologies on the fashion value chain from a retail perspective.
3	Buying and production consultant at a network organization of producers, importers, agents, and large traders in fashion and textiles.	Process of digitalization (with a focus on 3D technologies) and the impact of technologies on the fashion value chain.
4	Director of Transnational Strategies at an organization that develops and promotes a governing model to protect the most vulnerable and lowest-wage workers in global supply chains.	Power dynamics and workers rights in the fashion value chain.
5	Advisor at a non-profit organization that helps to develop digital solutions for social sustainability impact.	How (big) data can be used for development.

Yarn - Burkina Faso (Mimault, 2018)

4. THE GLOBAL FASHION VALUE CHAIN

This chapter sets out the basic principles of the global fashion value chain. How do materials flow through the (supply) chain, who are the main actors, and what does the dominant business model look like? This sets the context in which technologies are being developed and implemented. Additionally, it is important to understand the main sustainability issues of the fashion value chain, as technologies are in part developed to tackle these issues.

4.1. A GLOBALIZED SUPPLY CHAIN

Unlike the value chain, the supply chain does not necessarily show were value is added but rather how resources are moved throughout the production process (CISL, 2020). Figure 4.1. demonstrates the material flow in a typical fashion supply chain (see figure E in the appendix for an alternative representation that includes additional value chain actors & processes). It goes without saying that the reality of the supply chain is more complex than what is captured in this picture. Although this is of course commonly the case when modeling a real-life system, it is especially true for the fast fashion supply chain, as the sector is notorious for its complex production networks involving multiple partners (Agrawal et al., 2021).

For what are primarily financial reasons, in the past few decades the production process of garments that are produced for the global north has been outsourced to the global south. Most brands and retailers contract suppliers are based in countries where labor is relatively cheap and environmental regulations are loose (Denuwara et al., 2019; Kumar et al., 2016, 2017; Schenimann, 2018). As a result, the labor-intensive manufacturing activities are moved developing countries, especially to Asia but also to countries in Africa and South America (see figure 2.1.). Unfortunately, the outsourcing of the production process goes hand in hand with a pervasive violation of international worker's rights in garment factories in the global south (Anner, 2019), and in the wake of the COVID-19 pandemic, these violations have only worsened (Khambay, 2020; Mehta, 2020).

'The global south' is a term which is most commonly used to represent the countries of Africa, Central and Latin America, the Pacific and Caribbean islands, and most of Asia (Mahali et al., 2018). Geographically speaking, countries of the global south are not exclusively located in the southern hemisphere, but are classified based on common structures of inequalities. These common denominators refer to social, political, and economic challenges (Wolvers, Tappe, Salverda, & Schwarz, 2015). Comaroff & Comaroff (2012: 113) state that " 'The Global South' has become a shorthand for the world of non-European, postcolonial peoples. Synonymous with uncertain development, unorthodox economies, failed states, and nations fraught with corruption, poverty, and strife." It should

be noted that based on these qualifications, distinctions between the global north and global south are not always as clear-cut (Comaroff & Comaroff, 2012). Nevertheless, with regard to the geographical production activities of the fashion value chain, the term global south is a useful focus for this study.

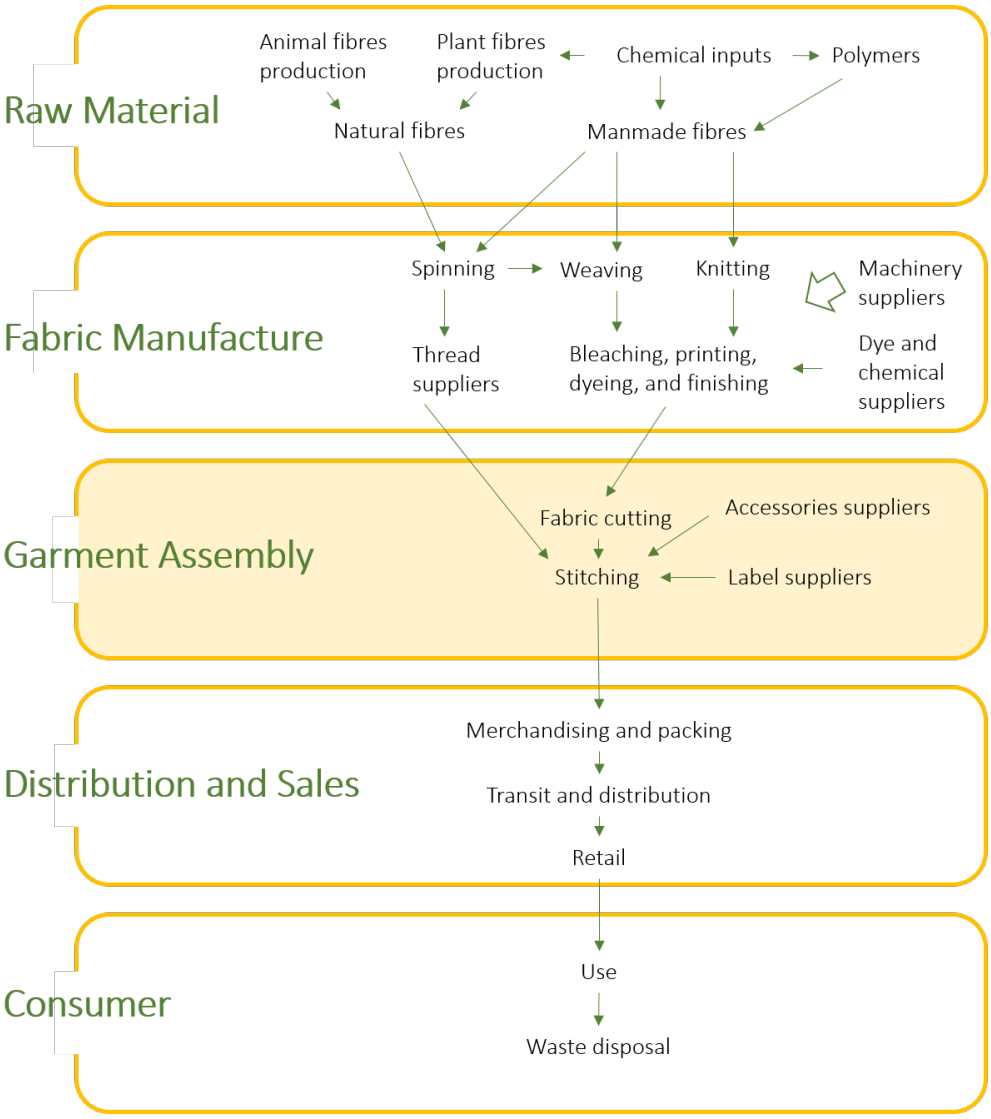


Figure 4.1. Simplified typical fashion supply chain (based on: Pérez, Queiruga-Dios, Martínez, & del Rey, 2020)

4.2. THE DEMOCRATIZATION OF FASHION

The production process of a piece of clothing has not always been this global and complex. The transformation of the garment production process started in the 1970s with a Spanish retailer called Zara (Crofton & Dopico, 2007). The Zara philosophy compares selling clothes to selling fish: it sells fast and for a higher price when its fresh, but the older it becomes the more difficult it is sold and often requires discounting (Aftab et al., 2018; The Economist, 2012). This principle is what lies at the core of

the global (fast) fashion business model and is an expression of the economic principles that prevail in the sector (Denuwara et al., 2019).

Often times, people mistake the 'fast' in 'fast fashion' as referring to the speed at which clothing is consumed and disposed of (Demkes, 2020). Although this is indeed one of its symptoms, more accurately the term 'fast fashion' encapsulates the business model where brands try to accommodate the latest trends as fast as possible (Ahnsmann, Janssen, Vaart, Bos, & Bakker, 2020; Demkes, 2020). With the rise of social media, these trends have become even more dynamic and in order to keep up companies have had to develop quick-response production systems (Cachon & Swinney, 2011; Michaela & Orna, 2015). In their efforts to do so, over the years brands have significantly shortened the lead time of the overall production process of clothing (e.g., design, production, distribution) (Ahnsmann et al., 2020; Demkes, 2020), and brands have abandoned the traditional production agenda of seasonal collections (Crofton & Dopico, 2007).

Generally, the fast fashion value chain has the following characteristics: it is labor intensive, capital investments are relatively low, there is a wide range of product designs, production volumes can vary widely, and the sector is highly competitive (Nayak & Padhye, 2018). Additionally, due to the labor-intensive nature of garment manufacturing, production processes are often outsourced to global south countries where wages are relatively low, and social and environmental regulations are less strict compared to the EU and U.S. (Denuwara et al., 2019; Kumar et al., 2016, 2017).

Proving to be profitable, over time other brands have copied the Zara business model – in some cases even brands that normally identify as exclusive, luxury brands (see: Rosa, 2013). Zara describes this as the "democratization of fashion" (Crofton & Dopico, 2007). And indeed, this model has made fashion more affordable and accessible to the masses (Rosa, 2013). But, as discussed in the theoretical framework, the price for this business model is paid elsewhere in the value chain.

4.3. AN UNSUSTAINABLE VALUE CHAIN

The fast fashion value chain feeds into a culture that is inherently unsustainable (Ahnsmann et al., 2020). On a large scale, there is a high level of clothing consumption, garments have a short lifespan, and people are quick to discard their 'disposable clothes'. Business models of large apparel brands facilitate and reinforce this behavior. All in all, this leads to an increased pressure on the cost price, the quality of the clothes, and the overall value chain (Ahnsmann et al., 2020). These types of sustainability issues of the current system have been well researched. Denuwara, Maijala, & Hakovirta (2019) have summarized several of these studies to identify the main environmental, social, and economic sustainability issues, related to specific parts of the value chain (see table 4.1.). For this research,

especially the social consequences of the current fashion business model are important to take into account and therefore elaborated on in chapter five.

According to Niinimäki & AAkko (2014), the responsibility for taking up these sustainability challenges lies mainly with large, multinational retailers, who can make a big impact with their scale of production and available resources. The influence of small entrepreneurs is limited. In line with this necessity, companies are increasingly focusing on promoting sustainability activities, such as setting sustainability criteria for their suppliers and monitoring and auditing production activities in their supply chain (Turker & Altuntas, 2014).

In more recent years, the process of digitalization has been argued to serve as a new leverage point in the industry's quest for sustainability. However, as Vezzoli (2007) argues, the benefits of technological developments are ultimately dependent on new interactions between different stakeholders in the value chain, as well as a more sustainable relationship between consumers and the clothing that they buy. Hence, sustainable technologies should not just fuel the current production systems, but challenge them and help redefine current system processes.

Table 4.1. Main sustainability issues within the apparel value chain (based on: Denuwara et al., 2019)

Value chain	Environmental impact	Social impact	Economic impact
Processing natural fibers	High water use, high fertilizer use, ecosystem degradation, waste	Child labor, health and safety, forced labor, role of women in cultivation, financial dependence on chemical companies, instability of cotton prices	In 2007, US cotton industry revenue was $27 billion
Processing synthetic fibers	High water use, high energy yse, air emissions, nonbiodegradable toxic air pollutants	Health and safety	The global synthetic fibers market size for 2025 was $88.5 billion (revenue) in 2016
Fabric network	High water use, high energy use, water pollution, waste, toxic chemical use, air pollution, emissions	Forced labor, child labor, low wages, exposure to high amounts of pollution	US textile and apparel shipments totaled $76.8 billion in 2018
Garment network	Waste, air pollution, toxic chemical use, water pollution, air emmissions	Child labor, health and safety, forced labor, role of women	Efficient collection, transportation, stock management, asset tracking
Export network	Air pollution and emissions, waste	Wages, working conditions	Estimated environmental consulting total revenue in 2023: $12.4 billion
Retail network	Waste (plastics, packaging)	Customer service, wages, working conditions	Asset tracking, stock management, payments handling, theft issues, brand issues

Secondhand use network	Positive impact: keeps products from landfill, reuse, benefits of circular economy	Wages, new business owners (logistics, laundry, retail)	Creates small businesses, consumer savings

Child labor in the textile industry - India (Kristine, n.d.-b)

5. GARMENT WORKERS' RIGHTS AND THEIR ABILITY TO BENEFIT FROM THEM

Due to the globalized nature of the apparel value chain, universal and international workers' rights are an important safeguard to protect garment workers. Yet, in practice these rights are frequently violated. The following chapter gives an overview of the main challenges faced by the garment manufacturing workforce in the global south, which are all direct violations of their workers' rights as defined in table 2.3. In order to understand why these violations happen and continue to occur, the second part of this chapter explores the underlying mechanisms that perpetuate the violation of the rights of garment workers in the global south. Ultimately, understanding how the violation of workers' rights are structurally undermined helps to indicate the risks and opportunities for digitalization transformations to either reinforce or break with these mechanisms.

5.1. CHALLENGES FOR GARMENT WORKERS IN THE GLOBAL SOUTH

5.1.1. LIVING WAGES

The garment industry provides millions of people with jobs worldwide (Solidarity Center, 2019). At the same time, garment workers in the global south usually do not make enough money to sustain decent livelihoods for themselves and their family or in other words: make a living wage (Clean Clothes Campaign, 2020b; Ford & Gillan, 2017; GLWC, 2018a). Based on sixty living wage definitions found in different sources, the Global Living Wage Coalition (GLWC, 2018b) defines a living wage as: "The remuneration received for a standard workweek by a worker in a particular place sufficient to afford a decent standard of living for the worker and her or his family. Elements of a decent standard of living include food, water, housing, education, health care, transportation, clothing, and other essential needs including provision for unexpected events."

A living wage is not the same as the legal minimum wage. In many global south countries, the legal minimum wage is not up to par with the necessary living wage (Clean Clothes Campaign, 2020b) (for example see figure G in the appendix). Hence, under national law employers in the global south are usually not legally bound to pay workers a living wage (Miller & Hohenegger, 2017). And so this is unlikely to happen, because ultimately "attempts to pay living wages will be resisted by dominant actors that benefit from the current status quo." (Egels-Zandén, 2017: 101). This is reflected in figure 5.1., which shows how some of the largest apparel brands, with suppliers located in many different global south countries, fail to provide any evidence that living wage standards are upheld in their production systems.

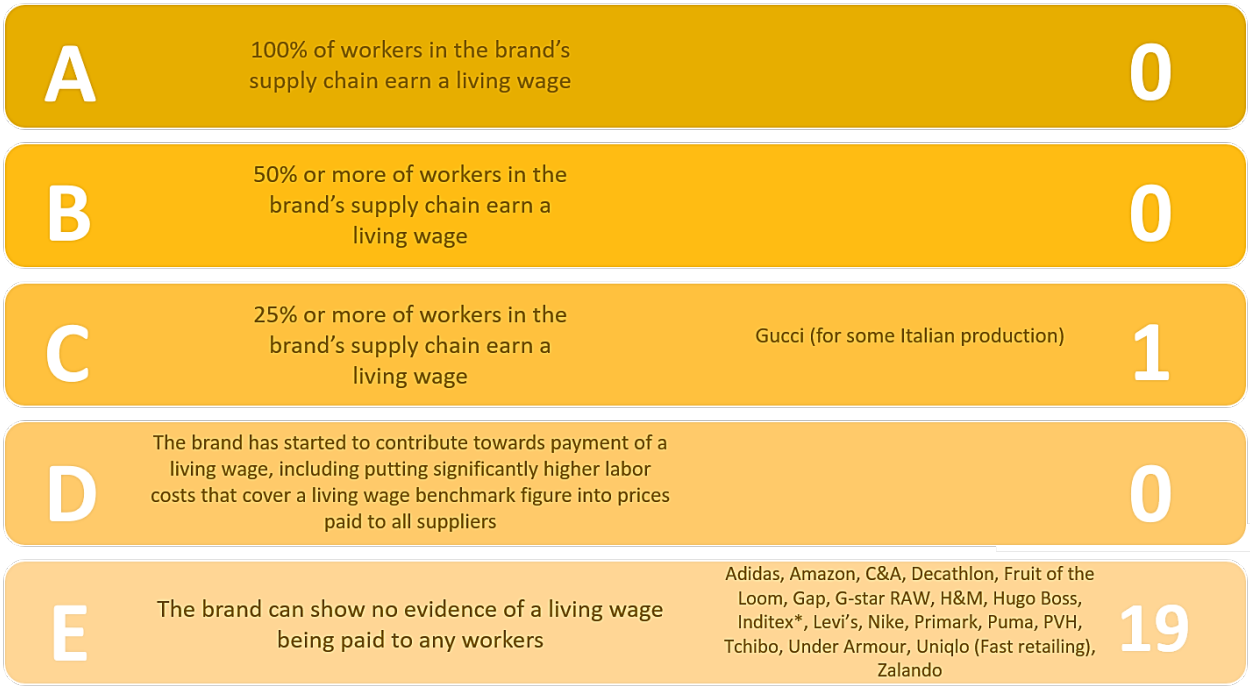


Figure 5.1. The state of pay in the global garment value chain (based on: Bryher, 2019)
**(note that Inditex is the overarching company of the brands Zara, Pull&Bear, Massimo Dutti, Bershka, Stradivarius, Oysho, Zara Home and Uterqüe)*

5.1.2. MODERN SLAVERY AND CHILD LABOR

Since modern slavery and child labor are forbidden by law in most countries, it often occurs in the shadows and is therefore difficult to measure. In spite of that, industry actors are well aware of the scale at which violations of these laws occur throughout the chain. For example, countries like India, Uzbekistan, China, Bangladesh, Egypt, Thailand, and Pakistan are notorious for child labor in the garment value chain (SOMO, 2014). Moreover, figure F in the appendix shows and overview of countries prone to modern slavery. The Walk Free Foundation (2018) estimates that in 2016 there were about 40.3 million people subjected to modern slavery. After the tech-sector (manufacturing of laptops, computers and mobile phones), the apparel sector is the biggest sector that uses modern slaves for the production process of garments. Modern slavery and child labor are deployed through the most basic stages of the fashion value chain: from the production of cotton through the garment manufacturing process (Melville, 2020).

5.1.3. UNREASONABLE WORKING HOURS

Garment workers are often pressured or forced by factory managers to work overtime, especially when order deadlines from brands come closer. On a regular basis, workers are forced to work more than the ILO's recommended 48-hour work week (Clean Clothes Campaign, 2021d; Hult, 2016) (see figure 5.2.). In many cases, workers who do not comply often risk being fired. These strenuous hours lead to increased health risks, especially for women who are usually also responsible for the household.

Because of their low wages, garment workers usually have to work overtime to generate more income. However, many factories do not actually pay for overtime. Instead, practices like setting unrealistic daily targets or manipulate working time sheets are not uncommon in garment factories (Clean Clothes Campaign, 2021d).

Figure 5.2. Unreasonable working hours for garment workers (SustainYourStyle, 2020)

5.1.4. HEALTH AND SAFETY ISSUES

Although most pressing health issues are a consequence of long working hours, other health and safety issues revolve around hazards of working with chemicals and machines without proper protection, and unsafe buildings that increase the risk fire hazards and collapse, while lacking emergency exits. This is especially true for factories in South-East Asia (Clean Clothes Campaign, 2021b; Kabir, Maple, Usher, & Islam, 2019; WRC, 2021c). When tragedy strikes, garment workers are often not compensated (Clean Clothes Campaign, 2021b; WRC, 2021c). As one can imagine, the introduction of COVID-19 in crowded factories is a new major health threat (WRC, 2021c).

5.1.5. BARRIERS TO FORM LABOR UNIONS

In many factories, is it difficult for workers to speak up and unionize to seize their rights. This has become especially apparent in the wake of the pandemic, now that brands are cancelling orders and workers are not being paid. News sites and industry reports state that there are many cases of people being fired if they protest (Centre, 2020; Grant & Carroll, 2020; Kelly, 2020; Paton, 2021; Sainato, 2020b). However, this is not just something that happens because of the pandemic but has been a prevalent issue. Apart from being fired other reprimands are sometimes also issued, such as: "physical abuse as well as verbal abuse which is sometimes of a sexual nature, forced overtime, denial of paid maternity leave, failure to pay wages and bonuses on time or in full, pressures on workers not to use the toilet, and provision of dirty drinking water" (Human Rights Watch, 2015).

5.1.6. GENDER DISCRIMINATION AND GENDER-BASED VIOLENCE

More than 80% of the garment factory workers are women (ILO, 2019a; WRC, 2021b). The fact that the large majority of garment workers are women is not a coincidence, but often the result of discriminatory selection practices (Clean Clothes Campaign, 2021a). Women structurally receive a lower wage than men, on average 18% as estimated by the ILO (Huynh, 2016; ILO, 2019a), and due to household obligations have less opportunities to organize themselves than men (Clean Clothes Campaign, 2021a). Consequently, women working in garment factories also often get less opportunities to climb up the ladder in their organization than men (Menzel & Woodruff, 2021). On top of that, women regularly face gender-based violence, such as sexual harassment both on the factory floor as well as when they walk home after late night shifts (Clean Clothes Campaign, 2021a; Human Rights Watch, 2019; Labour Behind the Label, 2021). Additionally, women often do not receive maternity leave, child care support, and safe travel to work (Clean Clothes Campaign, 2021a).

5.1.7. UNCERTAIN CONTRACTS

Most garment laborers in the global south work under temporary, insecure or informal contracts (Clean Clothes Campaign, 2020a). This is especially the case for workers who are working under (unauthorized) subcontracting arrangements. Hidden subcontracting often occurs when manufacturing factories experience pressure to deliver fast and at the cheapest possible prices (SOMO, 2015). In practice, volatile contract constructions deprives workers' of job security, and can leave workers suddenly unpaid for work already done, which has happened on a large scale in the wake of the pandemic when many large brands canceled their orders for clothes that were already made (BBC World Service, 2020; Gatty, 2020; ILO, 2020; WIEGO, 2020).

5.2. MECHANISMS THAT UNDERMINE GARMENT WORKERS' RIGHTS

The beforementioned violations of garment workers' rights are not stand-alone phenomena, but outcomes of, and maintained by, certain system dynamics. Undoubtedly, these mechanisms are widespread and context dependent. However, based on the available data data for this research some main mechanisms are identified that give insight into the context in which technologies are being developed and implemented. Because brands and retailers are the main driving actors for digitalization and exert most power over the value chain, I mainly focus on the position that they hold in these mechanisms, but for the sake of integrality I also reflect on the role of other actors such as consumers, suppliers, and governments.

5.2.1. COMPETITION AND PRICE SQUEEZE

Brands and retailers demand a continuous price squeeze from their suppliers. As a consequence, garment factories in the global south are forced to bid against one another to offer the lowest possible manufacturing price (Jiang, 2009; R. Locke, Amengual, & Mangla, 2009; Miller & Hohenegger, 2017). Respondent 4 explains this mechanism quite strikingly: "Brands really push prices down in their supply chain by forcing factories to compete against one another on the basis of price, and by returning to suppliers year after year and asking for lower and lower prices. And what that means is that factories have less and less money to afford to comply with labor rights, because it costs money to implement labor rights protection. It costs money to pay overtime […]. It costs money to keep hygienic environment in the bathrooms. It costs money to have a fire exit. And so, because brands and retailers push prices down so low, suppliers have to cut corners in any way they can, in order to save business, and the way that that manifests is by violating the rights of their workers."

Suppliers and consumers also play a role of importance in this race to the bottom. First of all, the buying practices of brands and retailers create a relationship between suppliers and brands that is becoming increasingly unstable and temporary (Clean Clothes Campaign, 2020a). Hence, it difficult for brands and retailers to build trust and settle on long-term agreements. Additionally, some supplier factory managers are undermining workers' rights to skim extra profit for their personal gains via mechanisms of ambiguous bookkeeping, falsifying time cards, and instructing workers what to say when audited (Jiang, 2009; Khurana & Ricchetti, 2016).

Secondly, consumer demands play a role in the behavior of brands and retailers (Camargo, Pereira, & Scarpin, 2020; Gupta & Gentry, 2018). According to Gabrielli, Baghi, & Codeluppi (2013: 207) "Fast fashion is not merely a matter of time-to-market, quick response or variety of choice but rather a highly involved meaning-attribution process accomplished by post-modern consumers aiming to express their personal lifestyle through consumption and possession." In spite of that, some brands have proven that it is possible to develop more conscious production mechanisms in spite of these fast fashion consumer demands (Miller & Hohenegger, 2017; Remy, Speelman, & Swartz, 2016), which is exemplary for the agency that some value chain actors have within the sector's system.

In recent years however, this post-modern mindset has been subjected to critical reflection. Consumers are becoming increasingly aware about the sustainability issues of the fashion value chain and the demand for sustainable fashion is increasing (Khandual & Pradhan, 2019; B. Zhang, Zhang, & Zhou, 2021). At the same time, sustainability concerns and consumption behavior are often a case of cognitive dissonance. When it comes to buying fast fashion, there is often a discrepancy between what consumers think they *should* be doing and what they *actually* do (B. Zhang et al., 2021). According to

Remy, Speelman, & Swartz (2016) "Sales increases suggest that most shoppers either overlook or tolerate the social and environmental costs of fast fashion." For example, a study from Reczek, Irwin, Zane, & Ehrich (2017) shows that consumers are indeed inclined to conveniently forget about unethical labor practices as a coping mechanism for their buying behavior.

At the same time, it is difficult for consumers to ice out unethical brands, for one because of the convenience and availability of these cheap clothes (Jagannathan, 2018), as well as the allure of wanting to follow trends that are constantly imposed via (online) marketing strategies and social media (T. Nguyen, 2020). Studies show that brands and (digital) marketing strategies influence the purchasing decisions of consumers (Horváth & van Birgelen, 2015; Janathanan & Nizar, 2018; Purwar, 2019; Stephen, 2016). Although the objective of these marketing activities is in part to share information and bind consumers to their brand, the ultimate aim is to generate sales (Purwar, 2019). Simultaneously, over the years apparel brands have increasingly tricked their consumers through greenwashing, making it even more difficult for consumers to choose for more sustainable brands (Dahl, 2010; Ro, 2021; Shin & Lim, 2021; Slater, 2019; H. Vogt, 2020). Overall, these practices show how a profit-driven economic logic is persistently reproduced via activities in the value chain as a whole.

From previous paraphs it becomes clear that brands and retailers are the linchpin when it comes to setting a more bottom-up price structure (see figure 2.2.), since they influence both consumer demands as well as competition between garment factories. Nevertheless, it should be acknowledged that both consumers and factory owners and managers also play a role in undermining garment workers' rights. In spite of that, the conclusion remains that the most power to establish transformative change lies with brands and retailers, as described by respondent 4: "The way that global supply chains are structured, the way that power works in global supply chains, is that it is the companies at the top, the brands and retailers, who exert the most power over the rest of their supply chain. They are also the ones that are best able to deal with it because they are the ones who have been reaping the profits for years and years and years, by depressing prices and wages and extracting all of this work from workers at an exploitative rate."

Due to its destructive impact on the fashion industry as a whole, the COVID-19 pandemic paves the way to construct new mechanisms. However, according to a report from the Centre for Workers' Rights Consortium (CWRC) on a large-scale brands and retailers are now demanding even more price discounts than they did prior to the pandemic and in some cases, suppliers are even forced to accept prices that are below the cost of production. Additionally, in their latest orders brands and retailers demand payment schedules that allow them to delay payment for additional weeks or months. "In sum, the survey results indicated that many brands and retailers are treating their suppliers' increasing

desperation as a source of bargaining leverage. The survey also showed that these financial pressures threaten the viability of many apparel suppliers and are likely to cause, or have already caused, large-scale dismissals of workers." (Anner, 2020: 1)

5.2.2. VIOLATIONS ARE UNMONITORED AND UNREGULATED

Two other factors that prevent garment workers from seizing their rights relate to the visibility of the value chain (or rather lack thereof) and lack of regulations. First of all, cases where workers' rights are violated are not always visible, which can make it difficult for buyers to know if any misconducts have occurred during the production process. The transparency of the fashion value chain becomes clouded due to its complexity, as well as due to the competitive climate in which companies are incentivized to keep their production process a secret (Kumar et al., 2017; Respondent 2, 2021). A study from Fashion Revolution (2020) into 62 well-known retailers (see the list in table G in the appendix) reveals to what extent brands have insight in their value chain. The general results are depicted in figure 5.3. and show that most brands do not know where their product is coming from other than their tier 1 suppliers. This is problematic, because this means brands cannot check which factories are violating workers' rights and to what extent. Also, a lack of transparency makes it difficult for governments to enforce labor laws and for NGOs and labor unions to lobby for better working conditions (Respondent 5, 2021).

Figure 5.3. Insight of brands into their value chain (based on: Fashion Revolution, 2020b)

At the same time, a lack of monitoring of workers' rights violations in the value chain is only part of the problem. A lack of government regulation and enforcement of labor laws is a second. First of all, local labor laws are not always in compliance with international labor rights. This is problematic, because the effectiveness of transnational regulations are highly dependent on local institutions (Distelhorst, Locke, Pal, & Samel, 2015; R. M. Locke, Rissing, & Pal, 2013; Lupo & Verma, 2020; Schuessler, Frenkel, & Wright, 2019; Toffel, Short, & Ouellet, 2015). Second of all, local labor laws in global south countries are not always enforced (Coslovsky, 2014; Fine & Gordon, 2010; Zhuang & Ngok, 2014). So even when violations of workers' rights are well-known and local institutions are in place,

local authorities might not actually act on the standards that they have in place to protect garment workers' rights.

There are several, context specific reasons why global south governments fail to implement and enforce labor laws, which are too extensive to elaborate on for this thesis. However, two global value chain dynamics that undermine government action are interesting to point out. First of all, due to the imbalance in market power between global north and global south countries, government and market institutions in the global south tend to compete amongst each other for a competitive advantage. As a result, there is a race to the bottom to offer the cheapest labor on the international market (Chan, 2010). Consecutively, this race is supported by brands and retailers, who according to respondent 5 "have directly and indirectly exerted pressure to keep legal standards as lacks as possible."

5.2.3. LACK OF ALTERNATIVES AND (FEMALE) EMPOWERMENT

'I feel tired, but I have no choice. I have to work.'

This quote from a Cambodian garment worker was published in The New York Times for a portrait article called "Who made my clothes?" (Yar, 2019). It speaks to the position of garment workers, as they are limited in their freedom to choose a different job and have no alternative but to return to the factory. In their current position they cannot afford to risk being fired or simply quitting when working conditions are bad, especially since they often have family members depending on their salary (Barenblat, 2016; Nikdam, 2021; Oakes, 2020). Overall, in the apparel value chain garment workers, especially the predominant female workforce, often lack empowerment to freely take control over their own working life.

Although the fashion value chain is fueled by labor of mostly female garment workers, the overall value chain is run by men (Danziger, 2019; V. Friedman, 2018; Oakes, 2020; Pike, 2016; Spellings, 2018). For example, in Vietnam men are three times more likely to become a factory supervisor (T. L. H. Nguyen, 2017), and in Bangladesh the fast majority of senior union leaders are men and only 3.1% of female workers are members of a union (Habib, 2016). It is in this context that industry watchdogs and NGOs call to address this issue of gender inequality and disproportionate representation of women empowerment in the value chain in order to establish sustainable transformations of the industry (Hoang, 2020; Oakes, 2020).

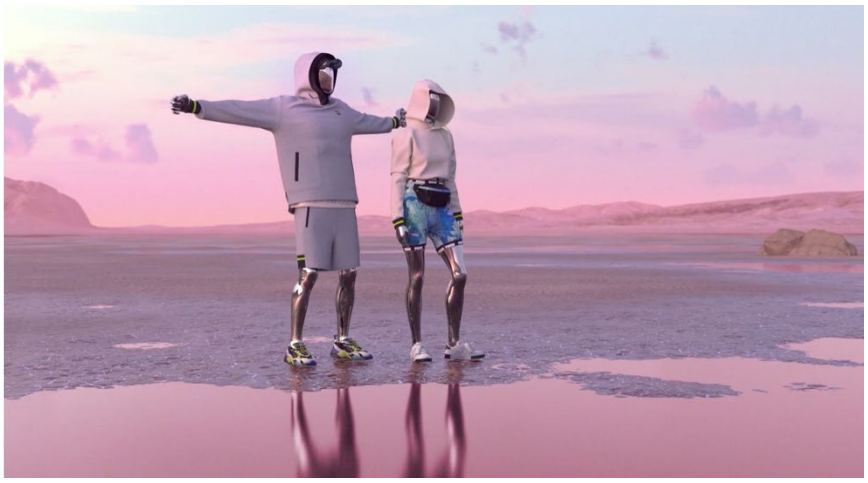
3D design (The Fabricant, 2020)

6. DIGITALIZATION OF THE FASHION VALUE CHAIN

The previous chapters set the context in which the digitalization process of the fashion value chain is taking place. The chapters show how social unsustainable practices are rooted in the fashion system, and what mechanisms are in place that maintain these social challenges for garment workers. The current chapter takes a step away from the social sustainability problems and elaborates on the main digitalization processes that are currently happening in the fashion value chain, and explores the main drivers behind these developments. According to the International Labor Organization (ILO), "Digitalization will shape how products are designed, how supply chains are managed, how and where production takes place, how logistics systems are automated and run, and how products are marketed, sold and delivered to the consumer." (2019c: 3). In that sense, digitalization has significant potential to transform the current textile value chain.

To make the process of digitalization more feasible, in this research five technologies are highlighted: 3D software, radio-frequency ID (RFID) tags, augmented virtual reality (AVR), blockchain and artificial intelligence (AI). These technologies are the main digitalization activities that are currently happening in the value chain (ILO, 2019c). The following paragraphs explore the basic functioning's of these technologies, and summarize how and why they have been developed over the past decades. These insights form a stepping stone for the next chapter to make a link between workers' well-being and these technologies.

6.1. 3D APPAREL SOFTWARE – FROM PHYSICAL SAMPLES TO DIGITAL DESIGNS



3D design (The Fabricant, 2021)

3D or 'CAD' (computer aided design) technologies can virtually simulate fabrics, which makes it easier for designers and manufacturers to design and fit garments before they go into bulk production (Alam, Rahman, Alam, & Ireen, 2020). 3D software can greatly reduce the need for samples in the design and

production process of a garment. Sarkar (2020: 77) describes samples as "a representation of the garment made as per the specifications provided by the buyer to foresee the finished product appearance, fit, production capability when produced in bulk by the manufacturer." As table J in the appendix shows, there are many different types of samples. Additionally, figure K in the appendix shows how these samples are continuously shipped back-and-forth throughout the design and production process. With the help of 3D software, these costly and time-consuming processes become much more efficient. Although not yet widely adopted throughout the chain, 3D apparel software is on the rise among high-skilled actors in the industry (Alam et al., 2020).

3D design technology did not originate in the fashion sector, but over time 3D technology became more accessible to fashion designers. At present, two well-known frontrunners that have introduced 3D software in their value chains are Nike and Hugo Boss (Lier, 2019). Staying true to its pioneering reputation, in 2017 Hugo Boss fully digitalized its product development for shirts, ties, and knitwear (Hugo Boss, 2017). The company claims to invest in this technology to reduce its environmental footprint as "The use of 3D virtualization in the design phase permits a substantial reduction in prototypes." (Hugo Boss, 2017: 63). However, at the same time advantages of 3D technology are described as "shortening development times" (Hugo Boss, 2017: 55). The same motivation is true for Nike, as they are using 3D technology to cut costs and increase the overall development speed of their products (Lier, 2019). Apart from Nike and Hugo Boss, many other high street brands are producing their collections with the help of 3D designs (McQuillan, 2020; Respondent 2).

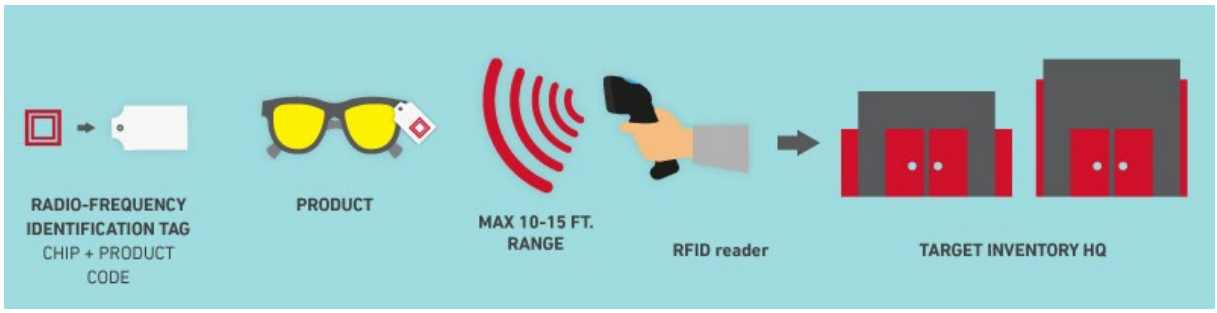
Based on sources derived from software developing companies, online fashion industry platforms, and academic literature, table 6.1. depicts the industry's main reasons for the development of 3D software, as well as the value chain alteration that follows. From an economic perspective the increased efficiency of design and production processes are an important factor. The main sustainability incentive to develop 3D software boils down to environmental benefits. In the scope of my search range, I have not found documents or other sources of evidence that demonstrate concern with the effects of these value chain changes for the labor conditions of garment workers.

Table 6.1. Incentives behind 3D software development and how it changes the value chain

Industry incentive	Value chain changes	Sources
Efficiency	- Digital samples *vis a vis* physical samples significantly increases the efficiency of the design process and reduces the amount of labor necessary for the design process.	(Lier, 2019; McQuillan, 2020; Öğülmüş, Arslan, & Üreyen, 2015; Papahristou & Bilalis, 2016; Penn-Slater, 2020; PI Apparel, 2021; Sculpteo, 2021)

Economic	- Working with physical samples costs the industry billions each year. Moreover, money is saved on real-life fotoshoots and showrooms. - Additionally, digital fit session for consumers can greatly reduce the return rate and improve overall sales.	(Lier, 2019; Penn-Slater, 2020; PI Apparel, 2021; Sculpteo, 2021)
Environment	- "3D design wasn't created to solve environmental issues in the fashion industry. But it can help to minimise the impact […]." (Penn-Slater, 2020). - Reducing samples means less waste and less transport. - Also, 3D software helps designing clothes that fit consumer demands more accurately, hence reducing residual, superfluous garment production which ends up as waste.	(McQuillan, 2020; Papahristou & Bilalis, 2016; Penn-Slater, 2020; PI Apparel, 2021)

6.2. RFID-TAGS – TRACKING THE VALUE CHAIN



RFID technology (Softcon, 2020)

RFID tags are small, wireless chips that transmit a digital code by sending out radio waves. Basically, they function like invisible barcodes. RFID tags have infiltrated the fast fashion value chain from start to finish, being used in manufacturing, inventory control, warehousing, distribution, logistics, automatic object tracking and overall supply chain management (Nayak, Singh, Padhye, & Wang, 2015). The tracking abilities of RFID technology are useful for apparel companies, because it helps them to control the complex processes of their supply chain (Nayak et al., 2015).

In the 1990s, RFID tags became widely implemented in many sectors. Technological breakthroughs caused for the tags to be massively applied for supply chain management and article tracking throughout the value chain (Landt, 2005). Most significantly, RFID has stimulated better coordination between all partners of the value chain (Nayak et al., 2015), and has helped companies to shorten production cycles (Lee, Choy, Ho, & Law, 2013). Consequently, companies that took advantage of RFID technology (e.g., Zara, H&M, and Benetton) have generated a large market share (Nayak et al., 2015). Their business strategy of frequent inventory turns and wide range of product variety is strongly connected to and dependent on the deployment of RFID technology (Christopher, Lowson, & Peck, 2004; Legnani, Cavalieri, Pinto, & Dotti, 2010; Moon & Ngai, 2008).

Table 6.2. depicts the main incentives behind the development of RFID and its impact on the value chain. Although incentives for RFID seem largely aimed at increasing efficiency and profits, environmental and social sustainability incentives also play a role. Nevertheless, there are also warning signs that raise concern about the social impact of this technology. For example, on the one hand more transparency of the value chain can bring to light issues such as child labor, and consequently large apparel companies can be held accountable through Corporate Social Responsibility (CSR) contentions. At the same time, RFID technology poses risks for local labor opportunities (Denuwara et al., 2019) and potentially creates robot-like working conditions for people in factories who are already in scrutinized working conditions. With examples such as Amazon where warehouse workers are meticulously monitored (see: Sainato, 2020; Yeginsu, 2018), these types of consequences should be properly explored.

Table 6.2. Incentives behind RFID development and how it changes the value chain

Industry incentive	Value chain changes	Sources
Efficiency	- RFID helps with efficient inventory management because retailers are able to track their products more accurately and in real-time. - In turn, warehousing can be optimized and wasted space can be reduced.	(Denuwara et al., 2019; Jet Marking, 2017)
Economic	- More control over the value chain gives competitive advantage. - More efficient processes can reduce production costs. - RFID tags can help compbat counterfeiting. - RFID can improve customer experience by shortening the checkout time and product tracking services.	(Christopher et al., 2004; Huanyuan, 2021; Jet Marking, 2017; Legnani et al., 2010; Moon & Ngai, 2008; Nayak et al., 2015)
Environment	- Through the optimization of systems and production processes, waste can be reduced. - However, the materials needed to make RFID tags negatively impact the environment.	(Denuwara et al., 2019; Jet Marking, 2017)
Social	- More transparancy of the value chain can bring to light issues such as child labor, and consequently large apparel companies can be held accountable through Corporate Social Responsibility (CSR) contentions. - However, RFID also poses risks for local labor opportunities.	(Denuwara et al., 2019)

6.3. AVR – ENHANCING SHOPPING EXPERIENCES

AVR smart mirror enhances consumer experience (FXGear, 2021)

Augmented Reality (AR) and Virtual Reality (VR) are two types of technologies that have emerged in both the physical and online retail part of the value chain. AR is defined by Olsson, Lagerstam, Kärkkäinen, & Väänänen-Vainio-Mattila (2013: 288) as a technique "to combine real and computer-generated digital information into the user's view of the physical world in such a way they appear as one environment." Basically, AR provides opportunities for consumers to interact with virtual products (McCormick et al., 2014; Reitmayr & Drummond, 2006). In turn, VR techniques require a headset which blocks real world vision and sound, and emerges the user in a virtual world (Bonetti, Warnaby, & Quinn, 2018).

Especially in the past decade, AVR technologies have been increasingly used in the fashion sector to enhance customer experiences (Boardman, Henninger, & Zhu, 2019). For instance, in 2011 Topshop introduced the world's first virtual fitting room (AVR Spot, 2018). Other examples of more recent AR implementations is the use of Snapchat, both by high street as well as high end brands. To illustrate, the UK high street retailer River Island created several Snapchat filters for London Fashion Week (Arthur, 2017), and a special filter was designed to promote the high end Karl Lagerfeld x Kaia collection (Newbold, 2018). As for VR, the American Macy's was one of the first retailers who created a digital shopping environment for their customers. By using VR glasses, customers could virtually walk through the store and buy products (Alibaba Group, 2016; Boardman et al., 2019). Especially with the COVID-19 epidemic and its related limitations for physical shopping experiences, investments and implementations of AVR are expected to take flight (GlobeNewswire, 2020; Walk-Morris, 2020).

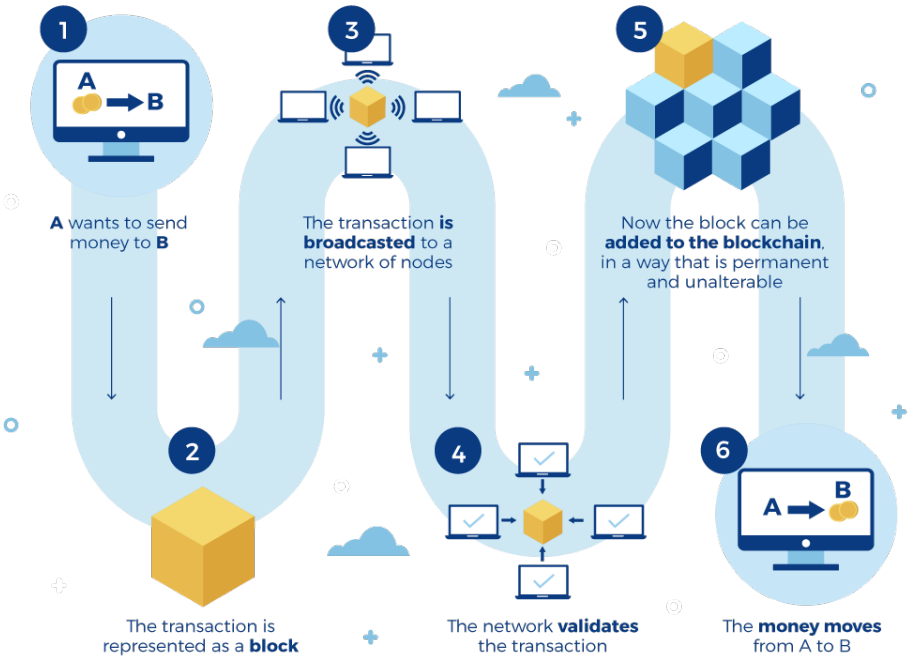
However, AVR technology is more than just a trivial sales gimmick, and the main incentives for retailers to implement AVR technologies and its impact on the value chain are summarized in table 6.3. Available literature on AVR suggests that this technology can have a significant impact on conventional shopping patterns and customers' attitudes towards how they consume clothes (Carmigniani & Furht,

2011; Javornik, 2016; Moorhouse, tom Dieck, & Jung, 2017). Currently, literature focuses mainly on how AVR technologies can help brands increase customer loyalty and attract new markets (see: Dacko, 2017; Javornik, 2016; Moorhouse et al., 2017; Yarrow, 2014). Overall, based on the search range of this research there is little convincing evidence that AVR development in the fashion industry is driven by environmental or social sustainability goals. Instead, the development and implementation goals of AVR is generally for the purpose of increasing sales for brands and retailers.

Table 6.3. Incentives behind AVR development and how it changes the value chain

Industry incentive	Value chain changes	Sources
Efficiency	- AVR can help with better communication through the value chain and lower lead times.	(De Silva, Rupasinghe, & Apeagyei, 2018)
Economic	- AVR can be used to enhance consumer experiences and speed up the pruchase decision making of consumers. This contributes to a companies competitiveness. - However, investments in AVR technologies are quite costly (e.g., floor space, technological equipment, training staff and hiring high-skilled engineers).	(Bonetti et al., 2018; Huang & Liao, 2014; Piotrowicz & Cuthbertson, 2014)
Environment	- Linked to 3D software, AVR technology can help in the digital design/fitting process as well as setting up digital showrooms. - Try-before-you-buy technologies can help reduce returns. Also, less samples and transport reduce waste and carbon footprint of the industry.	(IFD, 2019; Roberts-Islam, 2019)(Dixit, 2020)
Social	- AVR can be used to connect consumers to the value chain and provide an emersive narrative about working conditions of garment workers.	(A. Nguyen, 2020)

6.4. BLOCKCHAIN – INVESTING IN TRACEABILITY



An example of blockchain (SARA, 2021)

Basically, blockchain is a technology that is able to record and track data (CIGI, 2018). Although it has many applications, within the fashion value chain its biggest promises are traceability and transparency (ElMessiry & ElMessiry, 2018). In the current system, the trade-off between traceability and low production costs are causing buyers to commonly choose for the latter, which has resulted in the ethical and environmental challenges the industry is famous for (Rusinek, Zhang, & Radziwill, 2018). Moreover, due to the complexity of the value chain it difficult for brand owners, retailers, and NGOs to monitor and control the social sustainability problems that occur throughout the chain (Klassen & Vereecke, 2012; Parmigiani & Rivera-Santos, 2011). With the arrival of blockchain, this could change for the better (Mandolla, Petruzzelli, Percoco, & Urbinati, 2019; Wang, Singgih, Wang, & Rit, 2019).

Since consumers increasingly ask for a more transparent value chain, brands try to accommodate (A. Friedman, 2020). Nevertheless, blockchain technology applications in the fashion industry are still in their infancy, and there are no real examples yet where the technology has been fully integrated in the value chain. However, there are some first efforts to do so. Powered by TextileGenesis (a traceability platform), the Austrian textile company Lenzing Group has recently started a 12-month program that implements blockchain technology in the value chains of four large apparel brands: H&M, ArmedAngels, Mara Hoffman, and Chicks (A. Friedman, 2020). This opens up the potential for a more traceable and transparent value chain, which is heralded as a key element for a

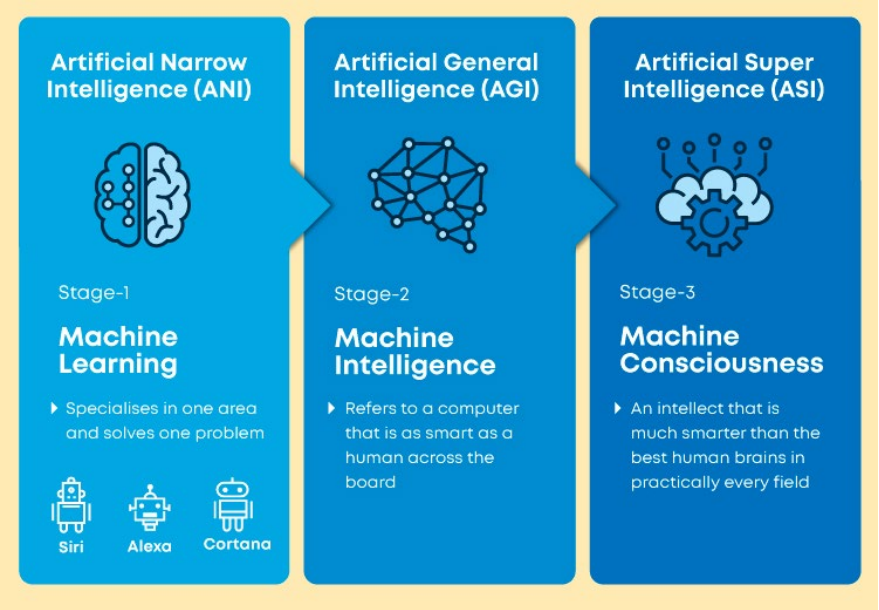
sustainable value chain, both in an environmental and social sense (see: Fashion Revolution, 2016; Gerretsen, 2021).

However, there are more reasons for brands to implement blockchain technology in their value chain (see table 6.4.). First of all, the digital footprint created by blockchain can help brands protect the intellectual property of their products. Although, according to some, "Theft of original ideas is the worst form of robbery in the fashion industry" (Vithlani, 1998: 12), on top of that counterfeiting is costing (luxury) apparel brands billions of euro's each year (Hilton, Choi, & Chen, 2004; OECD/EUIPO, 2019). Blockchain would be a promising solution for securing this intellectual property, which for example Louis Vuitton is already investing in (Abeyratne & Monfared, 2016; Allison, 2019). Secondly and more drastically, blockchain affects the efficiency of the value chain (Wang et al., 2019). By accelerating the speed at which data moves between parties (Bedell, 2016; MH&L, 2016), blockchain improves inventory management and reduces the amount of time that products are stuck in the transit process (Barnard, 2017; Loop, 2017). Additionally, by getting rid of the middle man (financial institutions), blockchain significantly reduces transaction costs of money transfers (Pérez et al., 2020; Wang et al., 2019). Thus, economic objectives are also important drivers of blockchain development.

Table 6.4. Incentives behind blockchain development and how it can change the value chain

Industry incentive	Value chain changes	Sources
Efficiency	- Blockchain enhances communcation between value chain actors and improves inventory management. - Speeds end-to-end supply chain execution, provides opportunities to spot issues before they occur. - Allows the automation of data analysis activities (e.g., demand forecasting, asset monitoring, optimization and lean improvements).	(Barnard, 2017; Bedell, 2016; Loop, 2017; MH&L, 2016; Wang et al., 2019)
Economic	- Blockchain reduces transaction costs and helps secure intellectual property, thus reducing counterfeiting.	(Abeyratne & Monfared, 2016; Allison, 2019; Pérez et al., 2020; Wang et al., 2019)
Environment	- Better traceability through blockchain can help retailers source more environmentally friendly materials.	(Fashion Revolution, 2016; Gerretsen, 2021)
Social	- The securiyty mechanisms of blockchain helps to create trust between industry actors. - Blockchain allows the development of services such as track-and-trace hence making the chain more transparent.	(Wang et al., 2019)

6.5. AI – MACHINE TAKE-OVER



Three types of AI (Advani, 2021)

"AI is the field of study that deals with the synthesis and analysis of computational agents that act intelligently" (Nayak & Padhye, 2018: 109). In other terms, Artificial Intelligence is technology that is designed to make computational decisions that were formerly made by human actors. This type of technology can be used to automate processes that are currently labor-intensive. For example, industry actors are required to make decisions about apparel design, cut order planning, production scheduling, sales forecasting, and supply chain management (SCM), which can be intractable processes. With the help of AI, these decisions could be digitalized (Guo, Wong, Leung, & Li, 2011). Over the years, the successes of AI have been strongly dependent on the power of computers and the availability of data (Anyoha, 2017; Luce, 2019). Unsurprisingly, in the current 'age of big data' AI is now able to provide meaningful machine learning, which has affected business models in numerous sectors (Bean, 2017).

In the fashion industry, AI development has infiltrated nearly every step of the value chain (Giri, Jain, Zeng, & Bruniaux, 2019; Luce, 2019), although newest uses are still in early stages (Bharadwaj, 2019). Yet, large high street retailers such as ASOS, Uniqlo, Tommy Hilfiger and Levi's are already actively using AI in, for example, their contact with consumers (Spijkers, 2021). In the case of manufacturing, machines were previously not refined enough to take over human labor, but now there are examples of companies who are accelerating automation developments through AI and machine learning (e.g., Yuho Sewing Machine Co. LTD or Softwear). This potentially decreases labor availabilities in developing countries because it takes over manual jobs, and at the same time the production process of garments is transferred back to developed countries due to the high investment costs in AI

automation technologies (Wall Street Journal, 2018). In table 6.5. these main incentives behind AI development and its consequences for the value chain are summarized.

Table 6.5. Incentives behind AI development and how it can change the value chain

Industry incentive	Value chain changes	Sources
Efficiency	- AI controlled robots can replace manual laborers and perform higher accuracy and faster speed (e.g., sowing, quality inspections). - AI SCM systems can optimize logistics.	(Bharadwaj, 2019; Singh Bisen, 2020; Veal, 2020)
Economic	- AI can help give insight into what does and does not sell. Gives retailers more opportunities to spot and develop new trends. - AI can improve the effectiveness of strategic business decisions that directly increase revenue. - AI can provide consumers with a more personalized shopping experience, which makes them more likely to buy.	(Intelistyle, 2021; Singh Bisen, 2020; R. Thomas, 2020)
Environment	- "Analysing complex factors that contribute to carbon footprint, AI can identify the most sustainable supply partners and modes of transport for a business that still makes financial and operational sense." (Intelistyle, 2021).	(Intelistyle, 2021)
Social	- The outmation incentives of AI development poses risks for the workforce in developing countries.	(Abeyratne & Monfared, 2016; Gangoda, Cobb, & Krasley, 2020; Infosys, 2017; Nayak & Padhye, 2018; Parschau & Hauge, 2020)

6.6. CHANGING PROCESSES OF THE FASHION VALUE CHAIN

Even though these technologies have yet to reach their full potential, their impact on the value chain is already visible. In figure 6.1. the main findings of this analysis are summarized in a practical overview. It shows for each of the five technologies how they are impacting, or expected to impact, each step of the value chain. The previous paragraphs show that although environmental and social sustainability goals are also on the agenda of retailers who are adopting these technologies, for the most part they seem to be a by-product of a dominant profit-driven focus. What becomes clear from the available data is that industry documents dominantly focus on economic benefits for retailers, and even in academic literature thorough critical analyses of the social effects for garment workers remain largely absent.

	Overarching	Design	Raw materials	Fabric production	Garment production	Distribution	Retailing/ sales
3D		Digital samples can speed up the design process.	Reduces the need for physical materials in the design process.	Reduces the need for physical samples.			Helps design clothes that fit consumer demands more accurately.
RFID	(Real time) tracking of value chain processes.				Shortens lead times.	Optimization of warehouse space.	Helps combat counterfeiting.
AVR	Better communication through the value chain.	Linked to 3D technology it can help digitalize the design process.		Shortens lead times.	Shortens lead times.		Speeds up purchasing decision making of consumers, reduces returns.
Blockchain	Increased traceability and communication throughout the chain. Also, opportunities for automation of data analysis through the chain.		Can help source more environmentally friendly materials.				Increases control over inventory management, helps combat counterfeiting.
AI	Optimize logistics and business strategies through the chain.	Some design decisions can be digitalized.		Manual labor can be replaced with AI controlled robots. Shortens lead times.	Manual labor can be replaced with AI controlled robots. Shortens lead times.	Logistical processes in transport and warehouses can be optimized.	More personalized shopping experience increases sales.

Figure 6.1. Where and how technologies intervene in the fashion value chain

EthicEra, Milan Design Week (ITC Ethical Fashion Initiative, 2019)

7. GARMENT WORKERS' ABILITY TO BENEFIT FROM DIGITALIZATION

Chapter four shows how over the years the fashion value chain has become more globalized, complex, and is driven by fast production mechanisms and profit. The consequential challenges for garment workers in the global south are elaborated on in chapter five, including the mechanisms at play that undermine garment workers' rights. Chapter six takes a step into the direction of digitalization and shows which concrete developments are currently happening and how these affect the value chain. In order to bring these findings together, this chapter links the digitalization processes to the ability of garment workers to benefit from their rights.

7.1. MAKING FAST FASHION EVEN FASTER

All of the technologies mentioned in chapter six have the ability to speed up the production process. This raises the question what happens to the well-being of garment workers if fast fashion becomes even faster. A recent study from Camargo et al. (2020) explores how technologies can be used by brands and retailers to achieve the business strategy of what they refer to as 'ultra-fast fashion'. As opposed to 'regular' fast fashion, ultra-fast fashion can shorten lead times from weeks to mere days. Other characteristics of ultra-fast fashion *vis a vis* fast fashion can be found in table H in the appendix.

A main characteristic of companies that adhere to an ultra-fast fashion business model, such as ASOS, Boohoo, Missguided, Choosy, Fashion Nova, Zara, and H&M (Hendriksz, 2017), is that they are *technology-focused* (Camargo et al., 2020). Speeding up their production process through technological developments enables them to launch more weekly collections and achieve possible profit gains (Camargo et al., 2020; Wu, Ma, & Liu, 2019; Zheng Zhou & Wu, 2010). According to non-business actors, there is no doubt that ultra-fast fashion only deepens the social problems of garment workers as depicted in section 5.1. (Crawford, 2020; Demkes, 2019; Hendriksz, 2017; Khambay, 2019; Laville, 2019; Monroe, 2021). As respondent 4 states: "The garment industry is already a massively efficient industry in many ways, and yet none of that has been shared or benefitted workers."

However, from a business perspective this does not necessarily have to be the case. Both respondent 2 and 3 reflect on the concept of 'shorter time to market' and respondent 2 explains how this will get rid of what they call the "low costs syndrome". They explain this as follows. It can be difficult for brands and retailers to predict how much they are going to sell of a certain item, and thus they often place the largest possible orders for the lowest possible price. As a consequence, there are regularly large garment surpluses, which do not sell and therefore result in lost revenue. With the help of technologies, brands and retailers can develop more accurate predictions of how many garments they will sell. Additionally, the shorter lead times from weeks to mere days will reduce the risks of having to

predict trends on the long-term, and thus brands and retailers can more accurately deliver what consumers demand. In turn, brands can place smaller orders for similar prices, which creates more room for higher wages of garment workers. In a nutshell: more efficiency can increase opportunities to provide workers with a living wage. However, according to respondent 4 there would also have to be concrete mechanisms in place to ensure that this margin actually ends up in workers' pockets, instead of "simply hoping that that will happen."

7.2. TRANSPARENCY & TRACEABILITY

Technologies such as RFID, AI, and Blockchain generate information that can enhance the traceability and transparency of the value chain. In recent years, the interest in traceability and transparency has grown for consumers, retailers and brands, and NGOs alike, although the value that is assigned of this type of information (sharing) differs among actors (Kumar et al., 2017). First of all, traceability and transparency are heralded by industry actors – from NGOs to governments to brands and retailers – as vital for the improvement of working conditions and well-being of garment workers in the global south, simply because knowing what the working conditions are in the value chain is a first step towards addressing related problems (see section 5.2.2.) (Amed et al., 2019; Chaffo, 2021; Fashion Revolution, 2020b, 2020a; Nikdam, 2021; Romero, 2020).

However, respondent 4 explains that more transparency does not automatically lead to better compliance with workers' rights: "Having more transparency, knowing more about your supply chain, is not a bad thing. It can be positive thing, but unless you have a system in place to address the problems that you find when you trace your supply chain, tracing your supply chain alone does not fix the problem. There are already many cases where supply chains are very traceable, […] most brands and retailers publish lists of their suppliers, at least their tier 1 suppliers, on their websites. Those factories are by no means exemplary factories when it comes to labor rights. There are massive amounts of exploitation and abuses in those factories." Transparency might be a stepping stone, but in order to establish better working conditions for garment workers other mechanisms need to be in place that enforce workers' rights and hold brands, retailers, and suppliers legally accountable to binding agreements (Chaffo, 2021; Hogervorst, 2020; Well Made Clothes, 2020). Without these binding agreements, "brands have tended to do what they think is best for their brand and what their consumers want. There are certain cultural barriers that remain and some of that comes down to a lack of wanting to give any competitive advantages away in hyper-competitive industries such as fashion." (Chaffo, 2021).

In light of that background, it is important to note that brands and retailers foster other benefits of transparency as well, for example traceability information can yield more control over the fashion value chain and is useful for brands and retailers to maximize profits (Cheng, Xiao, Xie, & Huang, 2013; Gobbi & Massa, 2015; Guercini & Runfola, 2009; Kumar et al., 2017). In other words, complying to workers' rights is probably not the only incentive for retailers and brands to invest in technologies that facilitate transparency. All in all, transparency has the potential to be used as a tool to benefit garment workers' access to working rights, yet benefits for garment workers are unlikely to be achieved unless this is actively pursued through purposeful actions of (powerful) industry actors and governments. For example, whenever labor violations are discovered "brands […] should use their leverage with the employer to press the employer to make the necessary changes." (Respondent 4).

7.3. AUTOMATION AND RESHORING

7.3.1. AUTOMATION OF THE GARMENT PRODUCTION PROCESS

The garment industry is labor-intensive for a reason. For a long time, it has been a challenge to develop machines that are able to work with such a frail material as fabric. At the same time, the abundance of cheap labor in countries like Bangladesh, China, Cambodia, and India has limited the incentive for brands and retailers to automate (Emont, 2018). However, this context is changing. For one, wages in global south countries are slowly increasing and so too are the production costs (Emont, 2018; Kearney, 2014). Secondly, new technological innovations such as AI and 3D software are finally opening up possibilities for automation of garment production (Gangoda et al., 2020; Hasan, 2018; Infosys, 2017; Parschau & Hauge, 2020).

Evidently, automation has an effect on workers. Some sources describe automation in a positive frame. For example, a report from Infosys, an international technology consultancy company, (2017: 9) states that: "It is inevitable that AI will reshape the composition of the human workforce, freeing individuals from the repetitive, uncreative roles and allowing them to work on activities that add greater value." However, as one can imagine this creates problems in environments when workers lack alternatives, such as is often the case for garment workers in the global south (see section 5.2.3.). According to Parschau & Hauge (2020) there are strong indications that automation through AI will lead to a loss in job opportunities for low-skilled workers, especially in developing countries, which is especially true for women workers (Chang & Hunynh, 2016). At the same time, clothing producers in developing countries say they have no other options but to automate to cope with intensifying cost pressures (see section 5.2.1.) (Emont, 2018).

Gangoda et al. (2020: 2) state that the current automation process is all but benefitting garment workers: "With the apparel industry mindset focused on achieving the next best technological developments at a blurring speed, ethical and sustainable best practices are not priorities, resulting in negative impacts to apparel workers. Optimistically, the implementation of Automation and AI solutions should provide solutions to industry issues, as opposed to creating new problems." A report from the ILO predicts that as automation poses a threat for the majority of garment workers in some top-producing Asian countries (see figure I in the appendix), with their governments not taking the necessary measures to protect garment workers from automation (Chang & Hunynh, 2016). On top of that, there are examples where automation has been used by factory owners to undermine worker demands, threatening to 'automate their jobs away' (Emont, 2018). As described by Zahid Hussain, the World Bank's lead Bangladesh economist, automation and the lack of alternatives for garment workers in the global south is a "social time bomb." (Emont, 2018).

However, this threat can be averted. According to Leila Jana, CEO of the company SamaSource which aims to provide low-income communities with jobs in more high-skilled sectors, there is no point in fighting the automation process. "If we can automate those unfulfilling types of work, all the better." However, she emphasizes the need for systemic changes in order to actually achieve outcomes of automation that benefit workers: "This doesn't work without systemic changes. Companies without human workers […] should be paying higher taxes that support more human social goals, such as safety nets, job retraining, and universal basic income. And people should be rerouted to work that could be done with dignity." (Rao, 2017). This systemic change requires to be initiated and supported by both governments and powerful industry actors (Apparel Resources, 2019; Hertveldt, 2020; Ong & Klotz, 2018).

7.3.2. RESHORING

Reshoring (or 'backshoring') is the process of bringing back the previously outsourced production process from what are usually global south countries to the global north. For a time, reshoring in the labor-intensive garment production was not economically profitable due to the wage difference between global north and south countries. However, with opportunities for automation increasing due to digitalization, the option of reshoring becomes more viable. In the past decade, retailers, brands and governments form the US, UK, and EU have become increasingly interested in the topic of reshoring (De Backer, Menon, Desnoyers-James, & Moussiegt, 2016; Kearney, 2014).

Shortening value chains through reshoring has some benefits for brands and retailers. For example: reduced costs of production (via automation and reduced transport costs), improved quality

and consistency, improved waste control, more flexibility to react to customer demand, reduces risks with regard to intellectual property and regulatory compliance of manufacturers, and can facilitate innovation by bringing together R&D and production activities (Bárcia De Mattos, Dasgupta, Jiang, Kucera, & Schiavone, 2020; EY, 2015; Leicestershire Textiles Hub, 2018; Pegoraro, De Propris, & Chidlow, 2020). Especially since the COVID-19 pandemic there is a new awareness for the risks and vulnerabilities of globalized supply chains. Therefore, more than ever before companies and governments are considering new possibilities for producing closer to home (Barbieri et al., 2020; Cherney, 2020; Karlson & Solli Sæther, 2020; Raza, Grumiller, Grohs, Essletzbichler, & Pintar, 2021; Shih, 2020; G. Zhang, 2020).

In terms of workers' rights, like automation reshoring poses a threat for garment workers as it takes away job opportunities in a labor-scarce environment. According to an ILO report (Chang & Hunynh, 2016: 2) "ASEAN Member States are lagging in their responses to this trend [reshoring]. As aforementioned, the costs of these technologies are rapidly falling and their application is becoming more commonplace. Consequently, ASEAN could experience huge setbacks in development and growth if increased reshoring is not countered." Although according to some it is too early to speak of an overall *trend* of reshoring (Kucera & Barcia de Mattos, 2019), some empirical studies show how cases of reshoring lead to considerable job losses in some global south countries (Bárcia De Mattos et al., 2020; Chang & Hunynh, 2016; Dachs, Kinkel, & Jäger, 2017; Faber, 2018; Petersen, 2019; Uma & Singh, 2019). Although the effects of reshoring are detrimental for garment workers in global south countries, the extent to which reshoring will expand remains unclear. While some sources expect it to be the newest trend in the development of the global market (Ashby, 2016; Chang & Hunynh, 2016; De Backer et al., 2016; Petersen, 2019; Respondent 1), other sources state that it is unlikely to happen on a large scale (Brown, 2020; Cosgrove, 2020; Hasan, 2018; Stenta, 2016; Respondent 2; Respondent 4).

7.4. DATA PRIVACY AND OWNERSHIP

The digitalization of the fashion value chain is built on technologies, but in turn these technologies are dependent on the availability and analysis of enormous amounts of data, or in other words: Big Data (BD) (Jain, Bruniaux, Zeng, & Bruniaux, 2017). In the wake of the digital age, the saying 'data is power' is used perpetually to describe the current zeitgeist (Gavin, 2020; Hasseier, 2019; Popular Science, 2011; Slaughter & McCormick, 2021; Véliz, 2020). However, who actually controls this newfound type of power and what development purpose does this type of data ownership serve in the fashion value chain? And, most importantly when talking about social transformations: how does BD serve garment workers and their ability to benefit from workers' rights?

The debate around how BD affects societies is ongoing, and many questions, especially around ethics, remain unanswered. One of the risks of operations that depend on BD, is that they are often programmed in a way that is in support of the current system (Hulme, 2015). Although this is not a problem in itself, in case of the fashion industry relying on status-quo mechanisms (see section 5.2.) risks standing in the way of transformative change for garment workers in the global south.

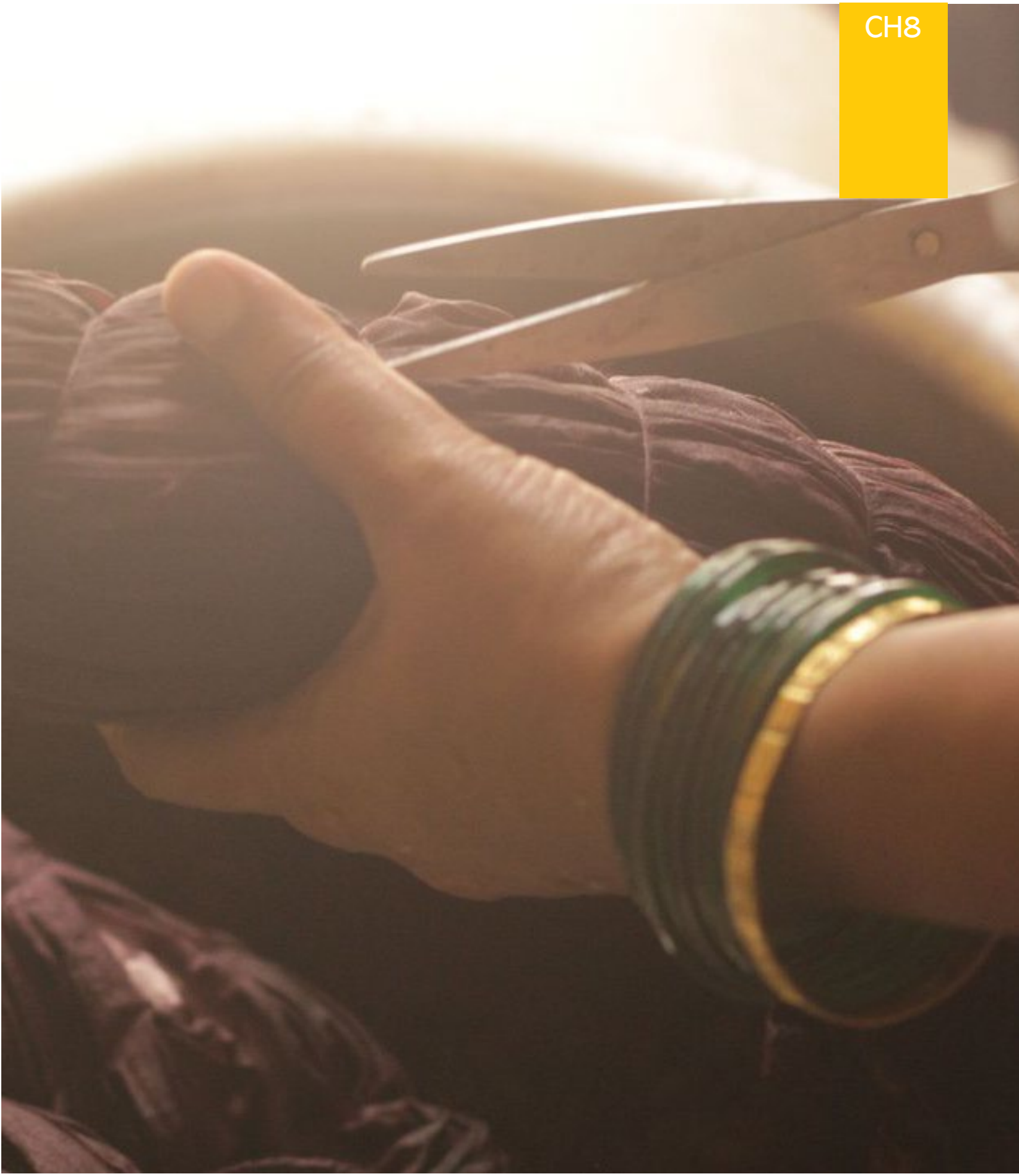
In the fashion industry, the actors that are most actively using services of data collection and analytics are brands and retailers, which is unsurprising due to its potential for commercial benefits (Madsen & Stenheim, 2016; Respondent 5). In the past decade, brands and retailers are increasingly using data in: "trend forecasting, supply chain management, analysing customer behaviour, preferences and emotions." (Jain et al., 2017: 2). Although some sources promote BD as a means to create more transparency, other sources are critical about the real-life implications of meticulous monitoring and surveillance of workers, which Harvard Professor Shoshana Zuboff (2019) refers to as the phenomenon of *surveillance capitalism*.

In the absence of available data from the garment industry in the global south, I illustrate the possible implications of BD on the factory work floor with the infamous case of Amazon. Amazon is very advanced in applying BD and technologies such as AI to monitor the labor activities in their warehouses and transport (Fierro, 2020; Hanley & Hubbard, 2020; Higgins, 2021; Lecher, 2019; Morse, 2020; Palmer, 2020; Saner, 2018; Williams, 2021). Combined with zero hour contracts and strict productivity regimes, Amazon workers have described their working conditions as "horrendous" and "exhausting" (Channel 4 News, 2013). Journalist James Bloodworth, who went undercover in a UK Amazon factory describes the working conditions as "a level of exploitation I had never seen before" (2020).

Although the case of Amazon takes place in the UK and is not specifically related to the garment industry (although apparel is one of their product categories), it is nonetheless an emblematic example that could very well translate to the garment industry, now or in the future. As respondent 1 explains: "Look, this is not only Amazon, right? So, this is common practice in China for example […] or other countries like Indonesia, for example, or Mexico. […] But I think the recent experience shows that these trends are bigger forces in one way or another. The world follows." According to Zuboff the concentration of knowledge at companies leads to profound inequality and power, and she states that "the risks of corporate surveillance outweigh the benefits." (Fortune Magazine, 2019).

BD is widely used for the development of businesses, but using data for social development is still in its early days (Coulton, Goerge, Putnam-Hornstein, & de Haan, 2015; Cull, Foster, Joliffe, & Veerappan, 2021). But in spite of BD being dominated by brands and retailers, NGOs and labor unions are slowly starting to dip their toes in the BD waters. For example, respondent 5 explains how their

organization works together with NGOs and labor organizations to collect data from garment workers, and use this at an aggregate level to create a stronger negotiation position for garment workers.



Textile dye studio in Mumbai, India (Zazi Vintage, 2021)

8. DISCUSSION OF THE RESULTS

The data presented in previous paragraphs touches upon many factors and system dynamics that affect the access of workers to international workers' rights. The aim of the following chapter is to link this data to the theoretical debates presented in chapter two and to discuss how these results are interpreted. Additionally, this chapter discusses the implications of these results, or in other words why they matter. Finally, the limitations of this study are recognized and practical recommendations are formulated for those industry actors who are interested or actively involved with the (social implications of) digitalization of the fashion value chain.

8.1. INTEPRETATION OF THE RESULTS

8.1.1. REVISITING THE THEORY

So, what do these results mean for the main research question, which was: "How does the digitalization process of the fashion value chain affect the access to international workers' rights of low-wage garment workers in the global south?" In order to formulate an answer, I first shortly revisit the main take-aways from the theoretical framework.

First of all, the debate on 'digitalization' showed that although technologies are often perceived in a positive frame with regard to opportunities for sustainable development, there is an overall lack of empirical evidence to support this perception. Additionally, in current studies an economic (and to a lesser extent environmental) focus on the effects of digitalization is overrepresented, whilst social impacts are near to neglected. In accordance with the data that I found for this research, the theory states that there is no reason to assume that researchers, governments, NGOs, companies, labor unions, or any other industry actors are deliberately or malevolently undermining a social focus on digitalization. Rather, this focus is largely determined by system dynamics, which have historically developed to perceive economics as a dominant field of interest. Hence, critical literature warns for the gradual shift towards digital colonialism; a digitalized economic system in which garment workers in the global south are refrained from having access to their international workers' rights.

Secondly, the theoretical framework discusses why social sustainability is an important area of development in the fashion value chain, and how transformative change is needed to establish improved access for garment workers in the global south to international workers' rights. In principle, the theory explains that the rights of garment workers in the global south are institutionalized on an international level, but in practice garment workers in the global south are on a large scale rarely able to benefit from these rights, which is supported by the data as presented in chapter 5.1 on challenges

for garment workers. As explained in section 5.2., the same economically oriented system dynamics are driving this discrepancy. Hence, in the theoretical chapter the concept of 'value' is debated in order to set a framework that explores how economic prioritization can be re-evaluated and to invigorate a more equal focus on the social pillar of sustainability.

8.1.2. DIGITALIZATION: THE GOOD, THE BAD AND THE POTENTIAL FOR TRANSFORMATIVE CHANGE

Chapters four, five, and six help to build an understanding of the context and relations between the variables 'fashion value chain', 'garment workers in the global south', and 'digitalization'. Based on this thematic analysis, in chapter seven these constructs are brought together to define four main areas of impact: making fast fashion faster, transparency and traceability, automation and reshoring, and data privacy and ownership. The common denominator of these four constructs is the dualistic role of the digitalization process: on the one hand technologies have the potential to benefit workers' access to labor rights, on the other hand technologies can deepen the challenges that garment workers are already facing.

In spite of this dichotomic potential, the data gives reason to believe that generally digitalization processes in the fashion value chain are moving towards harmful paths rather than improving the access of garment workers to their labor rights. This conclusion is based on four main observations. First of all, historically the system dynamics of the fashion value chain haven proven unfavorable for garment workers in the global south, and since technologies are prone to be developed in accordance with the existing system I deem it likely that this trend will continue. And – secondly - this is in fact what you already see happening in the value chain. As chapter six showed, the main intentions for technological developments in the garment value chain are based on either economic or environmental goals. Social goals are rarely set as one of the main drivers, if at all. Thirdly, even if there is a clear intention to develop technologies for the direct benefit of garment workers, the lack of research and attention for social consequences of digitalization in the fashion sector means there are limited handles for industry actors to deliberately plan and implement holistic social pathways for digitalization. Take for example the effort to establish transparency through digitalization: an endeavor to directly improve the working conditions of garment workers, but without supporting political and economic mechanisms transparency in itself is not a driver of transformative change. As long as the digitalization process is fueled by the same economic logic that has historically created large scale inequality and disempowerment of garment workers, there is reason to be skeptical of the benefits of digitalization for garment workers in the global south.

8.2. IMPLICATIONS OF THE RESULTS

Contrary to what existing literature has focused on, this analysis brings attention to the potential for far-reaching social impact of digitalization in globalized value chains. In this analysis both the potential for positive as well as negative social outcomes (in terms of workers' ability to benefit from their labor rights) are discussed. In line with what was stated in the theory (see section 2.1.), this analysis has made clear that the technologies as described in chapter six are not having a negative or positive impact on garment workers *an sich*. Rather, from a global perspective the effect digitalization has on garment workers seems to be largely determined by both system dynamics that follow a certain economic logic, and by what powerful actors in the chain consider to be most valuable factors to prioritize in their development strategies. Historically, the activities in the garment value chain follow an exploitative economic logic, which favors brands and retailers and deprives garment workers in the global south from their access to international workers' rights. Considering this context, the available data suggests that the current digitalization process is not likely to increase garment workers' access to labor rights, and in fact might even marginalize the position of garment workers in the global value chain even more.

Since profit-driven system dynamics are an important mechanism behind the deteriorating access of garment workers to their labor rights, there is a need to discuss how this system is fueled and by whom. Although the results showed that there are many different actors involved in the garment value chain, there is a particular group of actors with a notable dominant power over the chain: brands and retailers. Although brands and retailers are subjected to mechanisms of competition and consumer demands - whilst at the same time governments fail to protect garment workers' rights (see 5.2.2.) - the theoretical framework and data presented in chapter four shows that brands and retailers are also the ones that over the years have benefitted the most from the current economic system. Based on this analysis, anyone who believes that actors have agency and influence on a system would recognize that brands and retailers can be significant drivers of social transformative change in the fashion value chain and should thus take their social responsibility to garment workers into account when investing in digitalization.

However, other actors in the system have a meaningful, albeit less direct role to play as well. As chapter 5.2. showed, there are other actors who influence the (outcomes of the) production system. For example, governments need to regulate and effectuate in favor of garment workers, consumers can vote with their purchases for a system that prioritizes fair compensation for labor and the safety of garment workers, labor organizations can invest in becoming more knowledgeable about the impact of digitalization on garment workers and include this process as one of their pillars of attention. However, this is of course easier said than done. In a value chain that can/does not provide basic needs for the

majority of its workforce of millions, digitalization is not the obvious choice to place on top of the development agenda.

8.3. LIMITATIONS OF THIS STUDY

There are some limitations to the results presented in this study, because as much as they indicate a probable effect, there is not enough empirical evidence of how 3D software, RFID tags, AVR, blockchain and AI to be able to make hard claims about the direct relation between these technologies and the ability of workers to benefit from international labor rights. Additionally, due to the explorative and thematic nature of the used methods the results of this study are very generalized, whilst the global fashion value chain and its workers are complex, diverse, widespread and context bound. Hence, I would state that, when the world has recovered from the pandemic, there are many opportunities for future empirical research, both on international, local, aggregate or individual levels, that test and expand on the theoretical hypotheses developed in this research.

Originally, I had intended interviews with industry actors to be the main data source for this research. Although relying primarily on existing data has been an adequate alternative for my research aim, it would be insightful if additional research includes the direct input of industry actors. This could help in strengthening or checking the claims made in this study, or expand on other, thus far undiscussed phenomena. Unfortunately, due to people's busy schedules (which was argued to be mainly caused by the pandemic) respondents were very difficult to reach. In the timespan of circa a month I was almost full-time trying to plan interviews, albeit with unfruitful outcomes. To overcome this, I also tried sending open-question survey or questions through email, however the non-response was again all-abundant. Hence, I decided to change my course of action and adjust my methods to a more extensive literature study. Although this was of course not the original plan, it is in my view that, together with the few weeks of extension that I was given to deal with this complication, the adjusted methods are comprehensive and can effectively contribute to the research gap at hand.

Finally, it is important to acknowledge that the four constructs in chapter seven are not exhaustive, and that there are likely many more interesting relationships to explore. These particular constructs are elaborated on because based on the available data I judged these topics to be the most relevant and logical to include in my research. However, I think that further research could not only deepen the understanding of the relationships already mentioned in this research, but also provide new insights into thus far unexplored areas of interest. For example, it would be interesting to learn more about how governments can steer the digitalization process more actively towards the benefits of their citizens rather than brands and retailers, or in a more offbeat direction it would for example

even be interesting to learn about the effects that digitalization (e.g., AVR) can have on something like consumer behavior in terms of awareness for social challenges of garment workers.

8.4. RECOMMENDATIONS

To refer back to an earlier mentioned quote from the ILO (2019a: 13) "economic development is not undertaken for its own sake, but to improve the lives of human beings." Based on these ILO principles, on a global scale labor should adhere to standards of freedom, equity, security, and dignity. It is with these principles in the back of my mind that I formulate the following recommendations for private industry actors, policy makers, and development institutions.

8.4.1. THE SOCIAL RESPONSIBILITY OF BRANDS AND RETAILERS

First of all, brands and retailers can start investing in more holistic knowledge creation on the digitalization process of the fashion value chain. This means moving away from a RBV (Resource Based View), and dedicating to TBL (Triple Bottom Line) business strategies that account for social, environmental, and economic developments *equally*. Considering their powerful position in the value chain and their active role in the digitalization process, brands and retailers have a social responsibility to make informed investments in digitalization pathways that support garment workers to access their labor rights.

In practice, brands and retailers can use newfound transparency and improved communication mechanisms to actively build closer relationships with their suppliers, and to discuss and invest in improvements of the working environment. To pose another example, private actors can focus on minimizing the risk of technological developments leading to robot like working conditions or deprive communities of labor opportunities, and rather focus on actively seeking ways in which technological developments can help built communities and empower workers. Depending on the context, many other strategies for a more socially sustainable digitalization process can be formulated. However, the core recommendation for brands and retailers is that it would be helpful if they vigorously re-evaluate their current priorities in the digitalization process and start by asking themselves Palmer's neglected question: who counts morally and why?

8.4.2. GOVERNMENT REGULATIONS

Unfortunately, historically the business strategies deployed by brands and retailers in the fashion value chain have generally proven to harm garment workers in the global south rather than adhere to standards of freedom, equity, security, and dignity. Thus, addressing only the responsibility of private actors is probably not sufficient to achieve a more sustainable digitalization process. Hence, I would recommend that governments facilitate mechanisms and regulations that protect garment workers

against the risks of digitalization processes. Again, this means first investing in research that establishes a more comprehensive understanding of the consequences of digitalization for garment workers and consequently by actively intervening rather than just letting the digitalization process run its course.

As discussed earlier, the absence of comprehensive data protection laws in global south countries allows western companies to freely exploit data of individuals and communities. In order to protect garment workers from this digital colonialism, governments in the global south are recommended to develop regulations that prevent foreign multinationals from undermining local development and dominating the market and digital infrastructure. I would add to that the responsibility of governments in the global north to hold brands and retailers accountable for their value chain as a whole and for the digital activities through which they exert revenue from the global south. Ultimately, the globalized nature of the value chain requires governments in both the global north and south to robustly protect garment workers' access to international labor rights from the risks of digitalization. It would be interesting for further research to delve into the strategies that governments can equip to safeguard international workers' rights in the context of garment workers in the global south.

8.4.3. NON-PROFIT AGENDA SETTING

Understandably but worryingly, the discussion on the potential risks and benefits of digitalization in the fashion value chain seems currently not to be on the agenda of non-profit value chain actors. The problem with that is that it allows private actors to remain focused on an RBV perspective, as long as - for example labor unions - are not pressuring them to factor in a more socially oriented perspective in their digitalization activities. It also means government lobbying opportunities for digitalization regulations are not taken advantage of. The difficulty is that non-profit actors are logically less occupied with digitalization because their time and energy is usually focused on more pressing issues such as health, safety and provision of a living wage, matters which have become even more urgent in times of COVID-19. Nevertheless, it would be constructive for garment workers if their representatives and defending institutions are more actively involved in the debate around digitalization in the apparel value chain, especially considering that digitalization can deepen the social challenges garment workers are already facing. Non-profit organizations could thus become a more critical participant in the debate on the power of digitalization, and could also explore more opportunities to utilize technologies for the promotion of the labor rights of garment workers. After all, in the right hands the power of data can be utilized to benefit garment workers.

Profile of a woman who works in a sweatshop in India (Conway, 2019)

9. CONCLUSION

The aim of this research is to create more insight into the effects of digitalization of the fashion value chain on garment workers in the global south, and particularly their access to international labor rights. In order to achieve that goal, the following research question is posed: "How does the digitalization process of the fashion value chain affect the access to international workers' rights of low-wage garment workers in the global south?" This knowledge gap has been addressed via a structuration of thematic analyses based on existing literature and in-depth interviews, through which concepts such as 'fashion value chain', 'garment workers' rights', and 'digitalization' have been explored and linked to each other in order to explain their relationship.

In order to understand the context in which digitalization is taking place, I have first set out the main characteristics, actors and processes of the global fashion value chain in chapter four. This showed not only the complexity of the chain, but also indicated the sustainability issues that arise from the current fast fashion production processes and power imbalances between value chain actors. In order to elaborate on the social sustainability challenges faced by garment workers, chapter five elaborates on the status-quo context of garment workers in the global south. This chapter showed how garment workers in the global south are generally not able to access their international labor rights. Additionally, chapter six sets out the main digitalization processes that are currently happening in the value chain, which are developments in the field of 3D software, RFID tags, AVR, Blockchain, and AI. The importance of this chapter is to derive the most significant value chain changes that these technologies cause and to understand the reasons behind their development and by whom they are being implemented.

Finally, these concepts all come together in chapter seven, where the impact digitalization processes have on the value chain are translated to the context of garment workers. This resulted in an analysis of four main constructs: making fast fashion faster, transparency and traceability, automation and reshoring, and data privacy and ownership. In all four cases, digitalization is argued to both possibly benefit *or* harm the ability of garment workers to access their international labor rights. However, due to system dynamics and based on historical outcomes where garment workers have been structurally exploited and undervalued, I conclude that it can be expected that, in general, current digitalization activities are unlikely to provide garment workers in the global south with better access to their international labor rights.

So, why do these results matter? First of all, as was depicted in chapter four the current working conditions of garment workers in the global south are far from being up to par with SDG standards. It is thus important to keep exploring opportunities to improve workers' access to labor rights. At the same time, in the wake of the digital age it seems inevitable that global value chains become more

digitalized, and so too the fashion value chain. However, in order to establish pathways that benefit garment workers, the effects of these technologies should not be taken for granted and analyzed critically. And although the results of this thesis conclude on a more grim relationship between digitalization and garment workers' rights at this point in time, so too does it reveal opportunities for improvement. With the support of additional research, this could be the starting point of a body of works that create better understanding of the social effects of the digitalization of global value chains. In turn, this can lead to the formulating of better informed solutions for industry actors in order to promote garment workers' access to standards of freedom, equity, security, and dignity. Because without a doubt, *we can do better than this* (Wolff, 2015).

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APPENDIX

TABLE A

Risks and benefits of digitalization for smallholder farmers in the global south
(based on: El Bilali & Allahyari, 2018)

Sustainability dimension	Potential benefits	Potential risks
Environmental	- More efficient resource use (e.g., water and energy) and more productive inut use (e.g., fertilizers and pesticides) reduce (local) pollution of the environment. - Less GHG emissions. - Reducing food losses.	- When local contexts are not taken into account, the environment can actually be harmed. E.g., when E-waste ends up in the environment due to a lack of physical infrastructure for its disposal (Davies, 2014).
Economic	- Linking smallholders to markets (McLaren et al., 2009; Sylvester, 2015). - Reduce costs for production, transport and distribution. - Increase productivity and profitability. - Reduce transaction costs in the value chain. - Increase food security (FAO, 2015; UN-ESCAP, 2008; World Bank, 2017).	- When ICT services are not tailored to individual contexts or when they are based on high quality information sources (e.g., blockchain) farmers can be excluded from the rural economy. Especially when a farmer does not have the capital to pay for the initial investment costs (Aker, Ghosh, & Burrell, 2016). - Multinationals could gain even more market dominance, decreasing the economic power of smallholder farmers even further. For developing agro-ict services these power imbalances should be taken into account (Svenfelt & Lamela, 2016).
Social	- Can help increase social justice and equity for marginalized rural groups in the global south (Lokeswari, 2016). - Farmers can get better access to information and become more empowered to take on a leading role in innovation (UNCTAD, 2007; Uphoff, 2012). - Increasing transparency of food supply chains. - Improving food practices. - Fostering networking among food chains actors.	- Disconnecting farmers and consumers through virtual relations. - Increasing dependency on technology and the power of globalisation. - Risk of increasing exclusion of small-scale and computer illiterate producers. - Privacy issues and problemens with ownership of data. Big corporations can collect large datasets on farms and use this data to expand their market share (Mulligan & Berti, 2015).

TABLE B

Eight fundamental workers' rights conventions defined by the ILO

1) The Freedom of Association and Protection of the Right to Organize Convention, 1948 (No. 87)
Convention 87 recognizes that workers should have the principal freedom of association, which serves as a tool to improve labor conditions and establish peace. Having the freedom of expression and association are vital for progress (ILO, 2017b).
2) The Right to Organize and Collective Bargaining Convention, 1949 (No. 98)
Convention 98 recognizes that workers have the right organize and to bargain as a collective. They shall be adequately protected against anti-union discrimination (ILO, 2017c).
3) The Forced Labor Convention, 1930 (No. 29) (and its 2014 Protocol)
Convention 29 binds countries to suppress all forms of compulsory labor in the quickest possible time. The term 'forced labor' includes all work or services that are performed by a person, usually under the threat of a penalty, for which they have not voluntary applied. There are some exceptions such as military service or work under conviction in a court of law (ILO, 2017a). The added 2014 Protocol recognizes that Convention 29 needs additional measures and denounces compulsory labor more explicitly. Additionally, the Protocol states that it violates the dignity of millions of men, women and children, and recognizes that forced labor perpetuates poverty. Moreover, it recalls the exceptions made in the definition of Convention 29 and states that forced labor is applicable to all human beings without distinction. Members are obligated to penalize compulsory labor and to ensure that these laws are strictly enforced. Additionally, the Protocol draws special attention to the risks of human trafficking and increased forced labor in the private economy, especially imposed on migrants (ILO, 2017i).
4) The Abolition of Forced Labor Convention, 1957 (No. 105)
Convention 105 expands on the Slavery Convention of 1926, and states that all measures should be taken to prevent forced labor from showing any likeness to slavery, meaning the abolition of debt bondage, serfdom and ensuring that wages are paid regularly. Also, workers should have a palpable possibility to terminate their employment (ILO, 2017e).
5) The Minimum Age Convention, 1973 (No. 138)
Convention 138 states that each member should design a national policy that ensures effective abolishment of child labor. Although states are allowed to set their own minimum age, they should progressively make efforts to raise the minimum age for employment to a level when young persons are fully physically and mentally developed (ILO, 2017g).
6) The Worst Forms of Child Labor Convention, 1999 (No. 182)
Convention 182 states that the elimination of the worst forms of child labor requires immediate national and international action. All concerns of work should be removed and instead children should be offered free basic education. The term 'child' applies to all persons under eighteen. The term 'worst forms of child labor' refers

to all forms of slavery (such as child trafficking), offering children for prostitution or pornography, using children for illicit activities (such as drug trafficking), or work that is likely to harm the health, safety or morals of a child (ILO, 2017h).

7) The Equal Remuneration Convention, 1951 (No. 100)

Convention 100 states that work of equal value should be equally rewarded regardless of sex. The term remuneration refers to salary and any emoluments that arise out of a person's employment (ILO, 2017d).

8) The Discrimination (Employment and Occupation) Convention, 1958 (No. 111)

Convention 111 states that all human beings, irrespective of race, creed or sex, have the right to develop both material and spiritual well-being and have a right to freedom, dignity, economic security and equal opportunity. The term discrimination includes any distinction, exclusion of preference based on race, color, gender, religion, political preference, and national or social origin. When someone is selected for or excluded from a job based on inherent requirements for that job this does not count as discrimination (ILO, 2017f).

FIGURE C

The 'super winners' of the fashion value chain (McKinsey & Company, 2020)

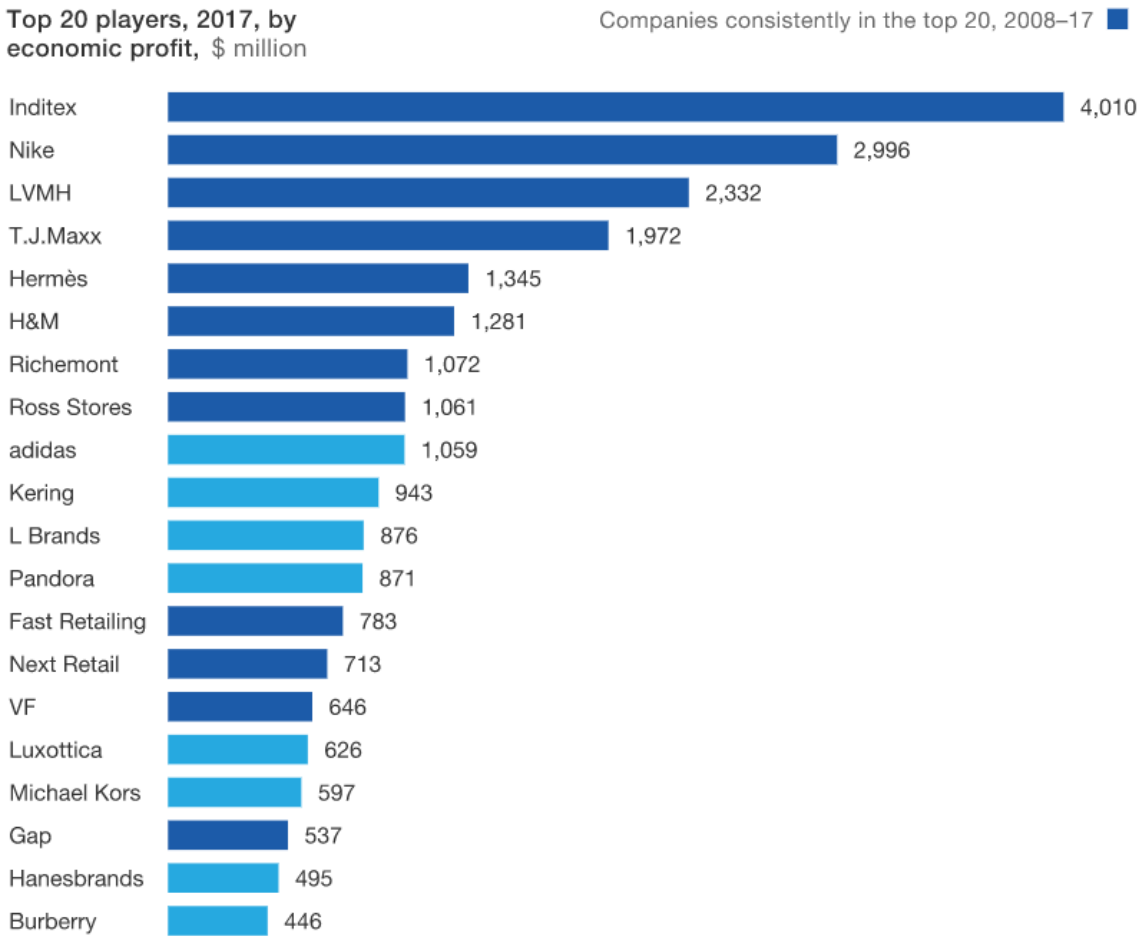


TABLE D

Value of the leading 10 apparel brands worldwide in 2020 (in million U.S. dollars) (Statista, 2021a)

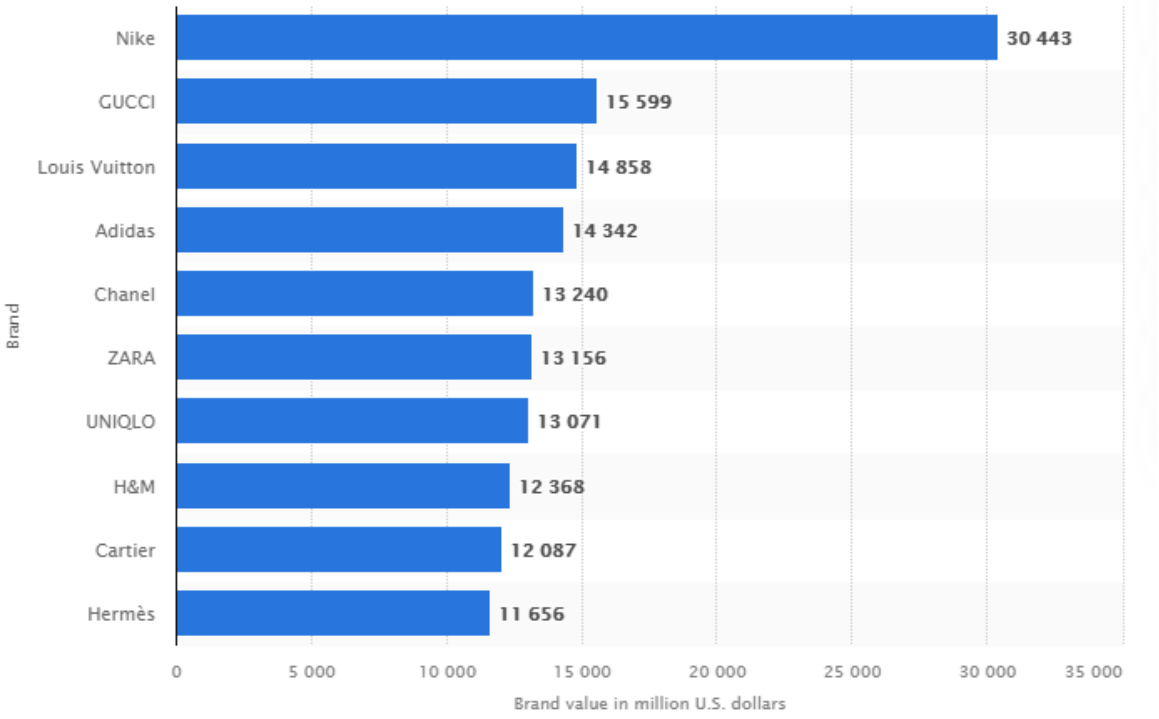
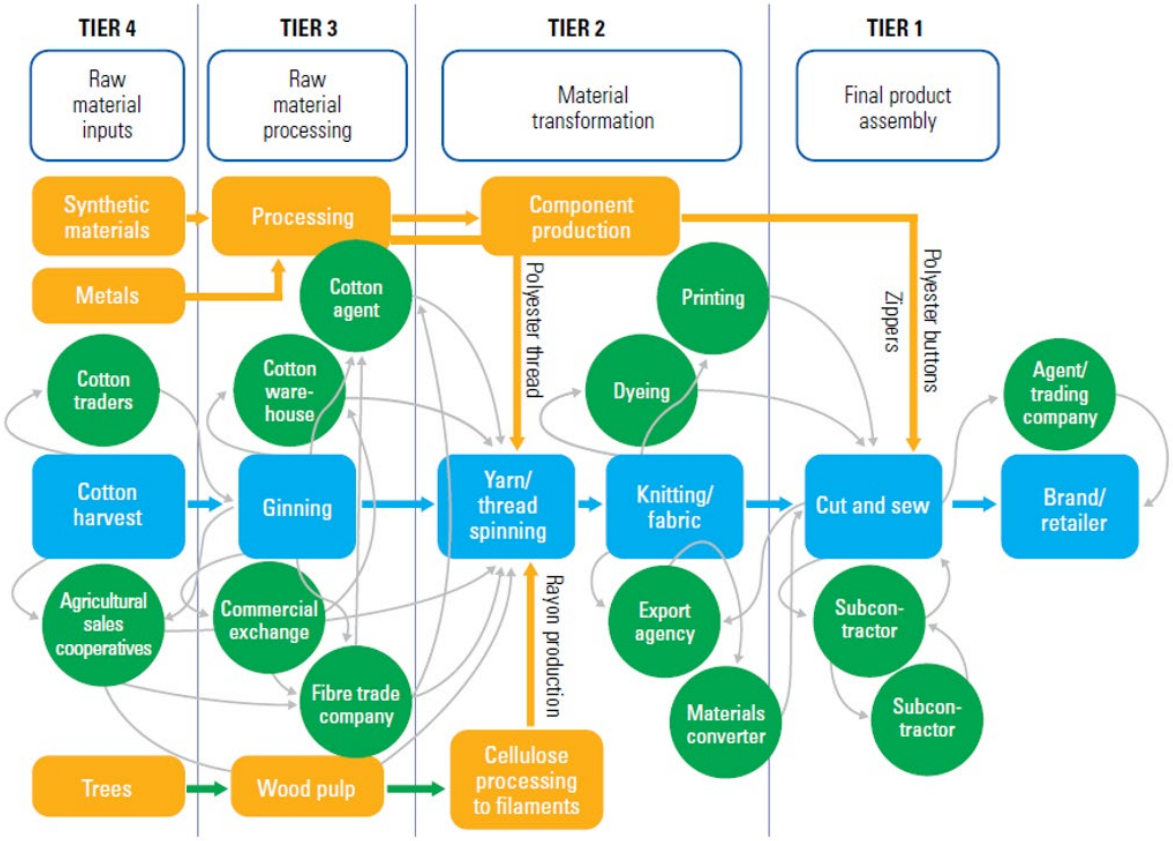


FIGURE E



Apparel supply chain (Jackson, 2019)

FIGURE F

Estimated prevalence of modern slavery by country (noting 10 countries with highest prevalence, estimated victims per 1,000 population) (Walk Free Foundation, 2018)

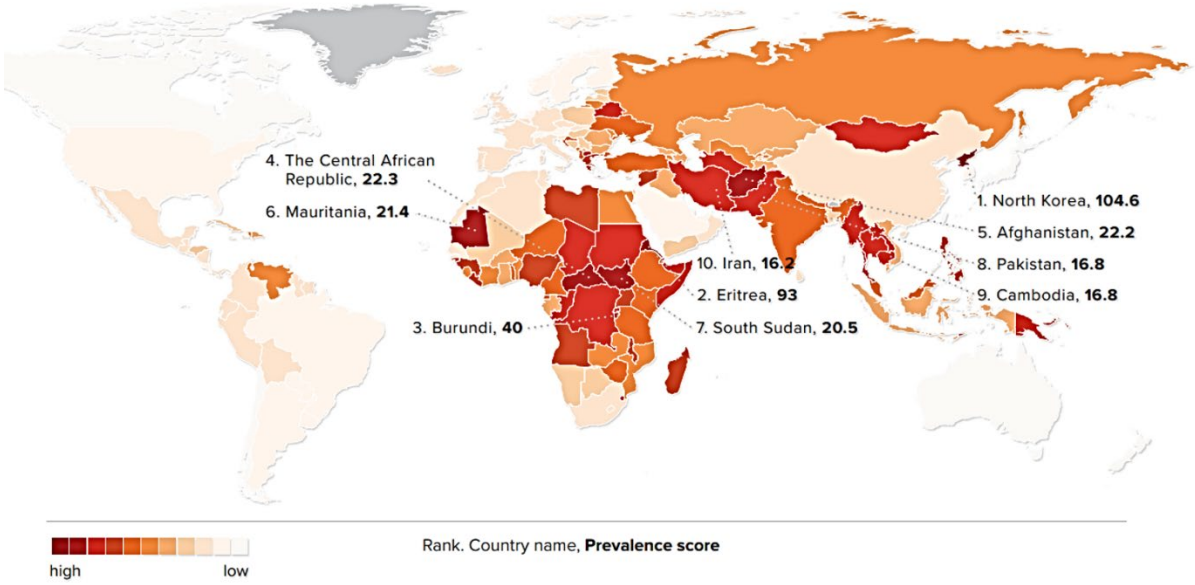


TABLE G

List of retailers included in a study by Fashion Revolution (2020)

Brand	
Abercrombie & Fitch	Levi Strauss & Co.
Aldi SOUTH	Li&Fung
Aldi Nord	Lidl
Amazon	LLP
American Eagle	Marks & Spencer
Arcadia (Topshop)	Matalan
Asda	Missguided
ASOS	New Balance
United Colors of Benetton	New Look
BESTSELLER	Next
Bon Prix (Otto Group)	Nike Inc.
Boohoo	Nudie Jeans
C&A	Otto Group
Carrefour	OVS
Celio	Pentland (Berghaus, Speedo…)
Columbia Sportswear Co.	Primark
Cortefiel	PUMA
Decathlon	PVH (Tommy Hilfiger, Calvin Klein…)
El Corte Ingles	Ralph Lauren
Esprit	Sainsbury's
Fashion Nova	Target
G-Star Raw	Tchibo
Gap Inc. (inluding Banana Republic and Old Navy)	Tesco
H&M	The Children's Place
HanesBrands	Uniqlo
Hugo Boss	Varner
Inditex (Bershka, Pull&Bear…)	VF Corp (Timberland, Dickies)
Jack Wolfskin	Walmart (excluding Asda)
JD Sports	Zalando
John Lewis	Zeeman
KiK	

TABLE H

Characteristics of ultra-fast fashion (Camargo et al., 2020)

Fast fashion	Ultra-fast fashion
A direct-to-consumer business model with a focus on mass production of clothes	A direct-to-consumer business model with a focus on producing clothes on an on-demand basis
Focuses on achieving economies of scale, producing large batches of the same garments	On-demand production; less quantity and more exclusive pieces produced, maintaining high product rotation
About 2,000–11,000 pieces introduced annually	The volume of exclusive pieces introduced annually is 11,000 to 200,000
Forecast-driven to predict future trends and understand what consumers want in the near future	Higher data-reliance to predict trends and understand what consumers want right now
Focuses on scaling the number of brick-and-mortar stores. E-commerce is important, but not a major income source	Vertically-integrated e-commerce mainly used to connect with consumers and collect data to understand consumer purchase habits and behaviour
Physical fashion brands with social media extension	Digital fashion brands. High social media reliance on identifying trends and connect with consumers. Technology-focused, mainly using artificial intelligence, social tagging and trend-watching by style scouts
The goal is to provide the products as cheaply as possible, at a fast pace, with a lead time of 5–6 weeks	Does not necessarily have to offer ultra-cheap clothes, but its focus is on providing trendy clothes at an even faster pace with a lead time from a few days to four weeks
Leagile supply chain strategy	Leagile + responsive supply chain strategy
More focused on offshoring production due to cost savings (outsourcing production and a high number of suppliers)	Onshoring and/or nearshoring production maintaining a strong connection with suppliers
Reasonable minimum stock; still carries some excess stock due to mass production	No excess stock or a reasonable minimum inventory
Due to its high focus on achieving economies of scale, fast fashion has been outsourcing its production to countries where the labour cost is low. Therefore, this segment has been pointed out as having one of the most unethical and unsustainable practices	Ultra meets consumer demands at a quick pace without having to overproduce items. This impacts the amount of waste produced, which is significantly reduced, possibly turning this segment into a more ethical sustainable business model. With onshoring production, jobs are brought back to developed countries where labour cost is higher

Table 4. Differences found between fast fashion and ultra-fast fashion

FIGURE I

Share of wage and salaried employment in key manufacturing and services subsectors at high risk of automation (per cent) (Chang & Hunynh, 2016)

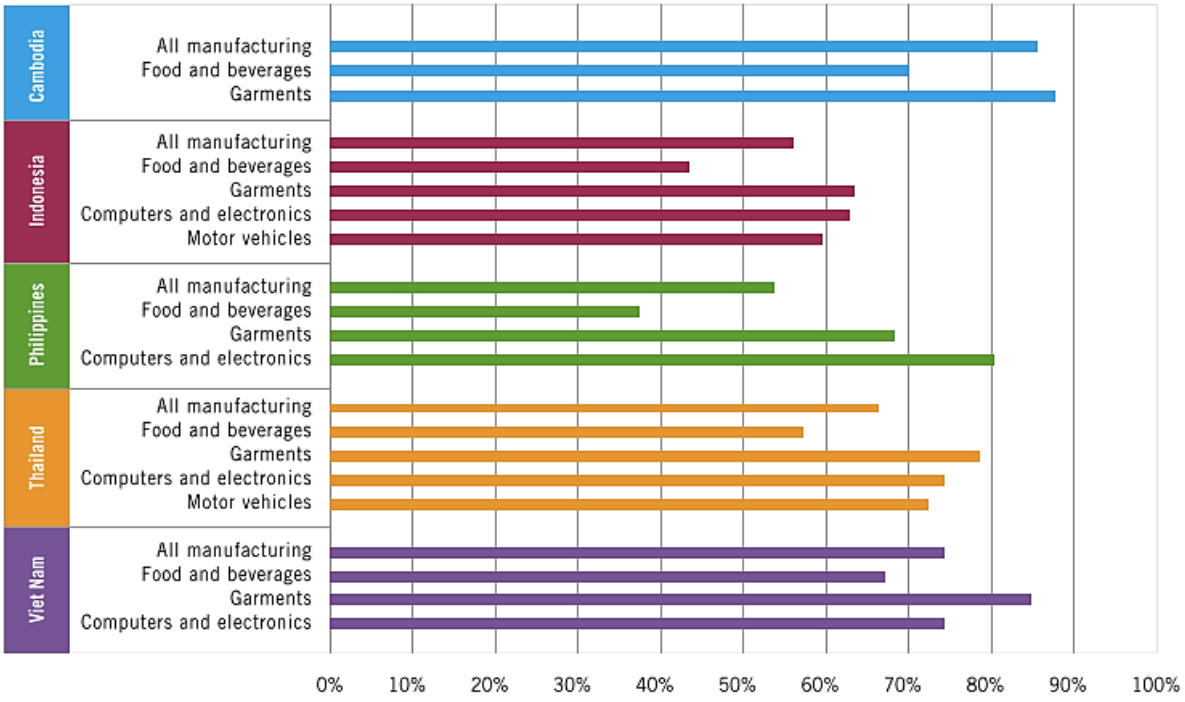


TABLE J

Types of garment samples (Sarkar, 2018)

Type of sample	Definition
Proto sample/First sample	The first sample that is made based on the design sketch, one-size, and made of fabrics that are similar to what the end product should look like, but is not yet made of the actual fabric that is available in the factory. Proto sample is send to the manufacturer.
Fit sample	The fit of a garment is determined through the fit sample, usually fitted on a middle-size dress form or human model. The FIT sample and measurement is corrected until it meets the fit requirements.
Size set sample	The objective of the size set sample is checking the garment fit of multiple sizes.
Salesman sample (SMS)	Salesman samples, known as SMS, are developed for displaying the design in the retail stores. The purpose of displaying samples in the store is forecasting the order volume. Salesman samples are also known as the marketing sample.
Photo shoot sample	For capturing a photo for the catalogue and e-commerce sites photo shoot samples are made, and the photo is taken on model or dress form.
Preproduction sample PP	The PP sample is made with actual fabric. The PP sample is made by the factory in the production line. All the development samples are made in the sampling room.
Gold seal sample	An approved sample for bulk production.
TOP sample/Production sample	Factory starts bulk production after the PP sample approval. After the bulk production start, few garments are picked randomly from the production output of the first production run for quality checking by the buyer's QA. These samples are known as Top of Production sample.
Counter sample	When a factory makes samples for different sample approvals from the buyer, the factory makes 2-3 additional samples for their internal reference. Counter samples are a copy of the original samples. In case, approved samples are not available when needed or the sample required by the different teams at the same time, the factory can refer the counter sample by giving internal merchandising or quality team.
Shipment sample	Shipment sample is kept by the buyer as well as by the factory for future reference if any complaint raised by a customer regarding deviation of the product design and product detailing in the sold garment.
Show sample/showroom sample	The apparel manufacturers and suppliers prepare a sample for the displaying on the in-house design room or in the exhibition.
Garment performance test (GPT) sample	The sample that is collected from the bulk production and send to a testing lab for garment performance test.
Development sample	The development samples are those sample which made until the final factory gets bulk production approval.
Red tag sample/sealed sample	A red tag sample is the same as the gold seal sample and sealed sample.
Digital garment sample	A garment sample that is made on the software and shows the 3D form of the garment, is called a digital garment sample.

FIGURE K

The continuous back-and-forth shipping of samples in the fashion value chain (McQuillan, 2020)