SSOAR

Open Access Repository
www.ssoar.info

Digital value chain restructuring and labour process transformations in the fast-fashion sector: Evidence from the value chains of Zara & H&M

López, Tatiana; Riedler, Tim; Köhnen, Heiner; Fütterer, Michael

Veröffentlichungsversion / Published Version
Zeitschriftenartikel / journal article

Zur Verfügung gestellt in Kooperation mit / provided in cooperation with:
Wissenschaftszentrum Berlin für Sozialforschung (WZB)

Empfohlene Zitierung / Suggested Citation:
López, T., Riedler, T., Köhnen, H., & Fütterer, M. (2021). Digital value chain restructuring and labour process transformations in the fast-fashion sector: Evidence from the value chains of Zara & H&M. *Global Networks*, *22*(4), 684-700. https://doi.org/10.1111/glob.12353

Nutzungsbedingungen:
Dieser Text wird unter einer CC BY Lizenz (Namensnennung) zur Verfügung gestellt. Nähere Auskünfte zu den CC-Lizenzen finden Sie hier:
https://creativecommons.org/licenses/by/4.0/deed.de

Terms of use:
This document is made available under a CC BY Licence (Attribution). For more Information see:
https://creativecommons.org/licenses/by/4.0

gesis Leibniz-Institut für Sozialwissenschaften

Mitglied der Leibniz-Gemeinschaft

Received: 28 October 2020 | Revised: 1 November 2021 | Accepted: 18 November 2021

DOI: 10.1111/glob.12353

ORIGINAL ARTICLE

Digital value chain restructuring and labour process transformations in the fast-fashion sector: Evidence from the value chains of Zara & H&M

Tatiana López[1] | **Tim Riedler**[2] | **Heiner Köhnen**[3] | **Michael Fütterer**[4]

[1] Berlin Social Science Centre, Berlin, Germany

[2] Department of Economic and Social Geography, Faculty of Management, Economics and Social Science, University of Cologne, Cologne, Germany

[3] TIE Global/'Ver.di verbindet'-Project, Frankfurt, Germany

[4] Department of Geography and Geology, University of Salzburg, Salzburg, Austria

Correspondence
Tatiana López, Berlin Social Science Centre, Reichpietschufer 50, 10785 Berlin, Germany.
Email: tatiana.lopez@wzb.eu

Funding information
Hans Böckler Stiftung, Grant/Award Number: 2019-671-3

Abstract

In this article, we combine a workplace-centred Labour Process Theory approach with a multi-level Global Value Chain perspective to link digital labour process transformations in the fast-fashion value chain to broader dynamics of digital value chain restructuring. Drawing on a case study of H&M and Zara, we show how these retailers' digital supply chain management strategies are linked to the de-skilling, standardization and rationalization of tasks and to the emergence of new digital forms of labour control in production, logistics and retail. At the same time, we find that the effects of these transformations on working conditions are mediated by workers' position in the value chain as well as by gender and capital-labour power relations. The article contributes to debates on value chains and digitalization by revealing how, under digital capitalism, the ability to control and digitally integrate labour processes in complex store, logistics and manufacturing networks represents a key source of power in buyer-driven value chains.

KEYWORDS
digital Taylorism, digitalization, fast-fashion, global value chains, labour process, value chain restructuring

This is an open access article under the terms of the Creative Commons Attribution License, which permits use, distribution and reproduction in any medium, provided the original work is properly cited.
© 2021 The Authors. *Global Networks* published by Global Networks Partnership and John Wiley & Sons Ltd.

1 | INTRODUCTION

Recently, an emerging corpus of studies has tackled restructuring of value chains and work, driven by new digital production technologies discussed under the labels of 'industry 4.0′ or 'smart factories' (e.g., Butollo, 2021; Fuchs, 2020; Pardi et al., 2020). Here, we seek to complement these studies by focussing on current value chain restructuring processes in the fast-fashion sector, which are not driven primarily by digitalization processes in manufacturing but in retail and logistics (Azevedo & Carvalho, 2012; Yip & Huang, 2016). We argue that fast-fashion retailers' digital value chain restructuring strategies represent attempts to secure and expand their market shares and value chain power in face of competition from new 'digital lead firms' (Staab & Nachtwey, 2016). These new digital lead firms rely on the Internet and/or new digital technologies, such as big data analytics, autonomous robots, the Internet of Things and cloud computing, to set up digitally integrated, highly demand-driven and cost-efficient e-retail value chains (Brun et al., 2019). In response, established fast-fashion retailers are seeking to enhance supply chain speed, responsiveness and cost-efficiency by introducing digital supply chain management (SCM) systems that enable real-time data exchange between online and offline sales operations, and between the different value chain stages (Nayak, 2019).

In this article, we evaluate the impact of fast-fashion retailers' digital supply chain integration strategies on labour processes and working conditions. Hitherto, the link between digitalization and labour process transformations has been studied predominantly at the workplace level (see Briken et al., 2017; Evans & Kitchin, 2018; Newsome et al., 2013). In this article, we combine a workplace-centred LPT approach with a multi-level Global Value Chain (GVC) perspective to link digital labour process transformations in the fast-fashion value chain to broader dynamics of digital value chain restructuring. Drawing on a case study of two major fast-fashion retailers, H&M and Zara, we show how these retailers' digital SCM strategies shape digital labour process transformations at the production, logistics and retail stages of the value chain. We use the term 'value chain' here to refer to the abstract, analytical concept of the interlinked stages of value-creating activities that are performed and coordinated by lead firms to create competitive advantages (Gereffi et al., 2005). In contrast, we use the term 'supply chain' to refer to the concrete, empirically existing configurations of different in-house and external services coordinated by fast-fashion retailers to create, transport, market and sell products to customers.

Our findings – based on data from 15 in-depth interviews and a series of workshops with managers, workers and unionists from Spain, Germany, Bangladesh and India – show how H&M's and Zara's strategies to enhance the speed and flexibility of their supply chains through digital SCM lead to similar labour process transformations along the value chain. These transformations are characterized by the de-skilling, standardization and rationalization of tasks, heightened work intensity and new digital forms of labour control. At the same time, we find that the effects of these transformations on working conditions are mediated by workers' position in the value chain as well as by gender and capital-labour power relations: On the one hand, we reveal how particularly in the highly feminized garment manufacturing and fashion retail sectors, women tend to be most adversely affected by the rationalization and flexibilization of labour processes. On the other hand, our analysis shows that in those segments of the value chain where strong collective worker representation exists, potential negative effects of digital labour process transformations on workers have been mitigated.

The article contributes to debates on value chains, digitalization and labour by revealing how under digital capitalism the ability to control and digitally integrate labour processes in complex store, logistics and manufacturing networks represents a key source of power in buyer-driven value chains. In this context, we provide three important empirical insights into the mechanisms through which established fast-fashion retailers consolidate their value chain and market power under digital capitalism: First, we show how established fast-fashion retailers' digital SCM strategies consolidate retailers' power position vis-à-vis suppliers by increasing transaction costs for buyer-switching, since suppliers have to invest into buyer-specific digital infrastructure. Hence, our findings attenuate claims from previous studies that digitalization processes may lead to more balanced power relations between lead firms and suppliers (c.f. Azmeh & Nadvi, 2014; Berg et al., 2017).

Second, we illustrate how established fast-fashion retailers seek to consolidate their market power in face of competitions from new 'ultra-fast' pure online retailers (Camargo et al., 2020) by making substantial investments into technologically advanced logistics centres and artificial intelligence solutions for optimizing transport flows as well as by establishing new partnerships with specialized e-commerce contract logistics providers. We, thereby, provide renewed evidence for the 'e-commerce/logistics nexus' underpinned by 'Logistics 4.0′ as new central field of value creation in retail value chains under digital capitalism (c.f. Bousonville, 2017; Butollo, 2021).

Third and last, we reveal how the standardization, rationalization and densification of labour processes is a key feature and pre-condition of retailers' digital SCM strategies: To synchronize and optimize labour processes at the different stages of the value chain, complex activities and workflows need to be broken down into smaller, standardized tasks that can then be tracked and managed with the help of digital devices and algorithms. By revealing this link, we, hence, re-embed digital labour process transformations associated with 'Digital Taylorism' into the broader context of value chain restructuring under digital capitalism (c.f. Brun et al., 2019; Staab & Nachtwey, 2016).

2 | GVC RESTRUCTURING UNDER DIGITAL CAPITALISM: IMPLICATIONS FOR VALUE CHAIN GOVERNANCE AND LABOUR PROCESSES

Literature at the intersection of GVC analysis and LPT has highlighted that market power and value chain power accrue to lead firms from them being able to control the organization and coordination of geographically fragmented labour processes (Hammer & Riisgaard, 2015; Taylor et al., 2015). A lead firm's power position can, however, be contested when new players enter the market, challenging the established modes of labour process coordination and organization. In this case, to secure their market position, lead firms are forced to re-structure the ways in which labour processes within their value chains are organized and coordinated (Flecker & Meil, 2010, 682 f.). Under digital capitalism, established lead firms experience pressure to restructure their value chains resulting from the competition of new 'digital lead firms', which rely on the Internet and/or new digital technologies to set up digitally integrated, highly demand-driven and cost-efficient supply chains (Brun et al., 2019).

Digital capitalism places established lead firms in producer and buyer-driven GVC under pressure to adapt their business models by integrating the digital technologies and coordination modes used by these digital lead firms into their own supply chains (Brun et al., 2019, 61f.). In response, established lead firms seek to enhance their supply chain speed, responsiveness, flexibility and cost-efficiency by developing new end-to-end digital SCM systems (Ageron et al., 2020). SCM as a strategic approach already emerged in the 1970s and 1980s with the introduction of barcode technology allowing lead firms to collect point-of-sale data and pass it through the supply chain to customize the production according to actual consumer preferences (Bonacich, 2003). Over the past 10 to 15 years, however, a qualitative change in SCM strategies has occurred with a range of new technologies including Radio Frequency Identification (RFID), cloud computing, artificial intelligence and automation technologies. These technologies allow lead firms to significantly enhance the collection, processing, analysis and real-time synchronization of data across the supply chain (Mussomeli et al., 2016). In buyer-driven GVCs, retailers have been introducing technologies for enhanced data collection, processing and analysis to build highly flexible and responsive integrated online and offline retail supply chains aided by integrated digital warehouse and store management systems and digital data sharing with manufacturers (c.f. Azevedo & Carvalho, 2012; Yip & Huang, 2016).

What does this re-coordination of established buyer-driven GVCs mean for value chain governance and labour processes? For value chain governance, GVC scholars and business analysts have highlighted on the one hand how the increased importance of mutual data exchange and digital integration of operations forces lead firms to establish closer and longer-term relationships with suppliers (Berg et al., 2017, p. 18; Brun et al., 2019, p. 51; Frederick et al., 2018, p. 8). On the other hand, more critical scholars have warned about premature conclusions that the trend toward closer lead firms supplier relations will also lead to more balanced power relations and value distribution within established GVCs (Cox & Wartenbe, 2018; Szalavetz, 2019). These scholars have argued that particularly

within buyer-driven value chains, in which smaller suppliers are traditionally dependent on larger buyers (c.f. Gereffi, 1994), lead firm dominance is likely to continue: Given their power to determine production parameters and terms of exchange, lead firms will likely force suppliers to 'take on the cost of technological upgrading, with much of the cost benefit being filtered to the lead firm' (Cox & Wartenbe, 2018, p. 34).

Focussing on the impact of digital supply chain integration on labour processes, studies from LPT have highlighted that building digitally integrated, lean and flexible supply chains requires enhanced control over labour processes and worker performance at the various value chain stages. As a result, digital supply chain integration usually goes along with a standardization of tasks and operations, and with the introduction of digital technologies for performance monitoring and workflow optimization (Newsome et al., 2013; Taylor, 2010). Several studies have examined labour process transformations linked to the introduction of 'smart store' (Evans & Kitchin, 2018), 'smart warehouse' (Moore & Robinson, 2016) or 'smart manufacturing' systems (Pardi et al., 2020) as core elements of digital SCM. These studies found that with the introduction of these systems, labour processes in stores, warehouses and factories have been standardized, rationalized and densified, and new technologies for intensified digital labour control have been introduced. These transformations of labour processes have been subsumed as more general features of work under digital capitalism under the notion of 'Digital Taylorism', representing a new type of workplace regime in which digital devices and algorithms assume central managing functions including labour process planning and worker instructing and monitoring (Fuchs et al., 2021; Staab & Nachtwey, 2016). One central argument in this context is that 'Digital Taylorism' relies on the increasing transfer of modes of organizing and rationalizing work from the industrial to the service sector. This 'industrialization of service work' involves the standardization, fragmentation and de-skilling of tasks in sectors, such as retail and logistics, and is generally experienced by workers as a degrading of work quality (Staab & Nachtwey, 2016, p. 467).

3 | DIGITAL RESTRUCTURING AND LABOUR PROCESS TRANSFORMATIONS IN THE FAST-FASHION GVC

3.1 | Digital restructuring in the fast-fashion GVC

The fashion value chain has been studied extensively in GVC analysis as a classic example of a buyer-driven value chain, in which multinational retailers — typically from the Global North — set up decentralized networks of suppliers typically located in exporting countries of the Global South, which act as 'Original Equipment Manufacturers' (Gereffi, 1994, p. 97). In this article, we focus on the fast-fashion value chain as a specific type of fashion value chain. 'Fast-fashion' refers to a business model in which apparel retailers pick up the latest fashion trends and transform them into affordable products for mainstream consumer markets (Tokatli, 2008, 22 f.). The emergence of fast-fashion can be understood itself as the outcome of a first round of value chain restructuring in the global apparel industry in the 1990s and early 2000s. This round of value chain restructuring was driven by several, then new, technologies including barcode scanners, computer-aided design, computer-aided manufacturing and electronic data interfaces, which enabled apparel retailers to restructure their value chains according to 'lean' and 'quick response' strategies (Abernathy et al., 1999). Geographically, this first round of value chain restructuring was characterized by the increasing shift of retailers' sourcing activities to newly industrializing countries, particularly in Asia, to keep prices low (Taplin, 2014). Simultaneously, apparel retailers prioritizing sourcing flexibility and time-to-market over price as competitive edges, started to set up 'near-sourcing' networks in regions closer to consumer markets such as South Europe, North Africa and the Middle East for the EU (Abernathy et al., 2006).

Over the past decade, the fast-fashion sector has, however, entered yet another round of technological and geographical restructuring linked to new digital technologies such as RFID, cloud-computing and robotic automation. These restructuring processes have been driven by two broader transformations of the fast-fashion market under digital capitalism. First, consumer preferences have increasingly been shifting toward online channels, a shift that has been

actively promoted by fast-fashion retailers to attract new customer groups and reduce costs from physical stores. In this line, traditional 'brick and mortar' fast-fashion retailers have, for example, introduced exclusive online collections and services such as next-day delivery for online orders. As a result, in Germany, the EU's largest importer of garments and shoes, revenues from fashion online sales increased from 2.81 billion Euros in 2006 to 21.18 billion Euros in 2020, accounting for 30 per cent of total sales in 2019 (Handelsverband Deutschland, 2020; Statista, 2021). Most recently, the trend toward online shopping has been further catalysed with the temporary closure of physical stores in most consumer markets during the Covid-19 pandemic.

Second, a new generation of 'ultra-fast' pure online retailers has entered the fast-fashion market, setting new standards in terms of value chain responsiveness and flexibility. Whereas traditional fast-fashion retailers need between 5 weeks and 6 months for the whole product cycle, pure online retailers, such as ASOS or Boohoo, design and deliver a new product in under a week (Weinswig, 2017). To this end, new 'ultra-fast' fashion retailers typically rely on near or on-shore 'on demand' supplier networks, producing a broader range of products in smaller numbers. As a result, 'ultra-fast' fashion retailers are also able to save costs by working with minimum inventories (Camargo et al., 2020, p. 547).

In light of the growing importance of online sales and new competition by 'pure online' ultra-fast fashion retailers, it is of increasing strategic importance for traditional fast-fashion retailers, such as Zara or H&M, to further integrate their online and offline sales, and to enhance the speed, flexibility and cost-efficiency of their supply chains. In this vein, established fast-fashion retailers have over the past years undertaken several measures to re-structure (1) their modes of supply chain coordination, (2) their retail and logistics operations and (3) their supplier networks. First, fast-fashion retailers have re-structured their modes of supply chain coordination by introducing digital SCM systems combining RFID technology with cloud computing and artificial intelligence (Nayak, 2019). RFID scanners can identify several articles at once by their unique serial number over a distance of up to 8 m, thereby, creating opportunities for enhanced capturing, sharing and analysis of real-time sales and inventory data across the supply chain (Azevedo & Carvalho, 2012). Fast-fashion retailers are making use of these new opportunities for advanced data sharing and analysis to enhance production planning and transport flows (Yip & Huang, 2016). For instance, Inditex — Zara's mother company — has recently invested 1.7 billion Euros into developing its own IT architecture 'Inditex Open Platform', as the basis for the company's digital SCM system. The platform also takes over central managing functions in the sourcing and logistics process by calculating the ideal location and transport routes for production and store replenishment orders (Inditex, 2020). Similarly, H&M has introduced an 'Amplified Intelligence' department, which uses advanced analytics and artificial intelligence to produce consumer trend forecasts based on data from online sales and stores (H&M, 2018b).

As a second measure, fast-fashion retailers have restructured their retail and logistics operations in two ways: On the one hand, they have introduced digital store and warehouse management systems using RFID and automation technologies along with cloud computing to track inventories and optimize work processes (Nayak, 2019). By synchronizing store and warehouse inventories in real time, digital management systems furthermore enable the integration of online and offline sales and thereby the introduction of 'omni-channel' sales concepts (Köhnen & Nutzenberger, 2019). Since 2014, Inditex, for example, has gradually introduced RFID and automated warehouse technologies in its vertically integrated distribution centres (Aftab et al., 2018). H&M has also introduced automation technologies in selected logistics centres and in addition opened six new, technologically advanced logistic centres in Europe and the US between 2018 and 2020 (H&M, 2018a). On the other hand, leading fast-fashion retailers have established strategic collaborations with multinational logistic contractor GXO for regional distribution of online orders (Díaz Pardo, 2021).

As a third measure, fast-fashion retailers have been restructuring their supplier networks by pursuing closer and longer-term relationships with strategic suppliers and by strengthening regionalized sourcing (Berg et al., 2017; Hammer & Plugor, 2016). Building closer and longer-term relations with suppliers is a pre-condition for digitalizing sourcing processes through technologies, such as 3D sampling or automated production order placement, which require the synchronization of lead firms' and suppliers' IT architectures. 3D sampling and automated order placement allow retailers to reduce time-to-market by avoiding shipping of physical samples and

by minimizing communication and human errors in the order process (Berg et al., 2017). H&M first introduced 3D design and sampling in its value chains in 2018 (H&M, 2018b), whereas Inditex's SCM system was then already sending automated replenishment orders to core suppliers (Aftab et al., 2018). Moreover, fast-fashion retailers are strengthening regional sourcing to reduce time-to-market for highly fashionable, time-sensitive items (Berg et al., 2017). Whereas Inditex has from its early days on been sourcing about 50 per cent of garments from Europe and neighbouring countries, H&M has more recently announced plans to follow Inditex's example (Stratton, 2018). Recent disruptions of global trade during the Covid-19 pandemic and new automation technologies provide additional incentives for near-sourcing or even re-shoring of production (Berg et al., 2020). In this line, industry analysts have observed increasing garment orders by EU brands from European suppliers following the Covid-19 crisis (Hentschel, 2020). Moreover, first retailers and manufacturers are experimenting with setting up automated factories in consumer markets. Fast-fashion retailer C&A is planning an automated German jeans factory (Seidel, 2021), while the Vietnamese manufacturer Saitex has already opened an automated jeans mass-manufacturing facility in Los Angeles (Roberts-Islam, 2021).

Whereas these tendencies and projects are not yet indicative of a larger-scale geographical shift in fast-fashion retailers' sourcing activities and significant cost barriers remain for onshore garment production, it can nevertheless be expected that at least retailers' near sourcing activities will further pick up in the coming years (Berg et al., 2020). Against this background, particularly suppliers in established Asian production countries with significant wage increases in past years, such as China or India, are under increasing pressure to enhance the flexibility and cost-efficiency of their manufacturing operations through automated and digital production technologies, if they want to remain part fast-fashion retailers' supplier networks in the long-term.

3.2 | Linking digital restructuring, value chain governance and transformations of labour processes in the fast-fashion GVC

Scholars and policy makers have only recently started to address the impact of digitalization on governance and labour in the (fast-) fashion GVC (Azmeh & Nadvi, 2014; Butollo, 2021; Li et al., 2019). For value chain governance, scholars and business analysts have argued that enhanced data sharing between fashion retailers and their suppliers could effect a shift from traditional captive governance structures toward more relational modes of value chain coordination (Azmeh & Nadvi, 2014; Berg et al., 2017). Azmeh and Nadvi (2014, p. 713), for example, have illustrated how large tier-one garment suppliers increasingly assume the role of strategic partners for large department store retailers by developing joint digital inventory management platforms. Their findings, however, cannot necessarily be transferred to the value chains of fast-fashion retailers. Whereas fast-fashion retailers' suppliers have taken on additional functions in preparing garments for digitalized retail systems (such as attaching RFID-security tags), there is little evidence that suppliers also embrace strategic inventory management functions. Similarly, business research suggests that suppliers' unilateral dependence on fast-fashion retailers is likely to increase with the advanced integration of the manufacturing stage into retailers' digital supply chains. In a McKinsey survey, almost 50 per cent of the surveyed garment sourcing officers mentioned sourcing process digitalization as one of their top three priorities for the next year (Berg et al., 2017, p. 7). However, only 17 per cent of garment sourcing officers surveyed in another McKinsey considered (co-)investing in their suppliers' technological capacities (Berg et al., 2020, p. 114). Hence, suppliers will likely have to stem investments into digitalization alone, while at the same time, needing to ensure compatibility of their IT systems with those of their key buyers.

The consolidation of fast-fashion retailers' value chain power through digital supply chain integration also affects labour. By introducing digital SCM systems, fast-fashion retailers are able to increasingly control labour processes in the vertically integrated retail and logistics operations *and* in the outsourced garment manufacturing operations. Hence, we hold that current labour process transformations at the retail, logistics and manufacturing stages of

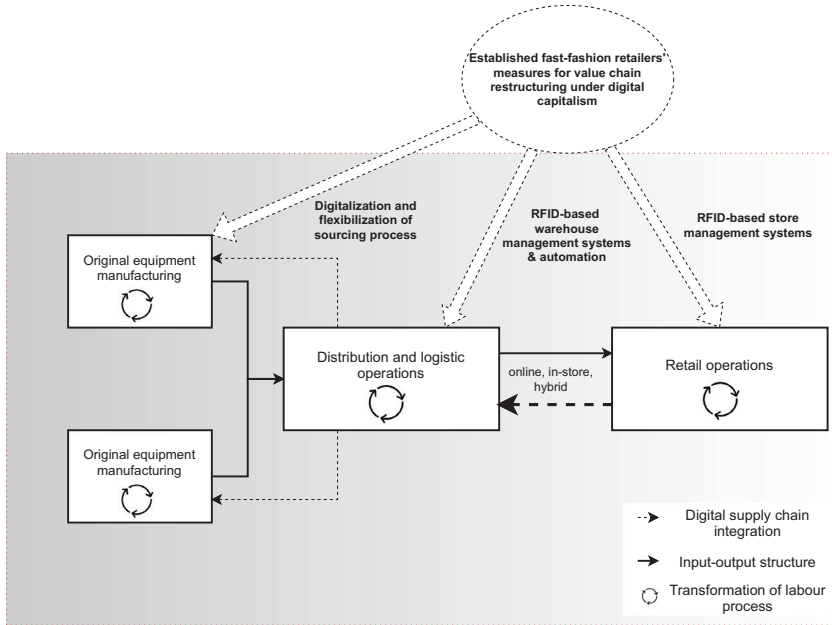

FIGURE 1 Linking digital value chain restructuring, governance and labour process transformations in the fast-fashion GVC. Source: own elaboration

fast-fashion GVCs are primordially driven and shaped by fast-fashion retailers' strategic goals of enhancing supply chain speed, flexibility and cost-efficiency. We argue that, consequently, digital labour process transformations in the fast-fashion value chain are likely to show characteristics associated with 'Digital Taylorism'. At the same time, however, the introduction of new digital technologies represents a field of contestation between workers and managements. Hence, where strong worker representation exists, workers may be able to exercise significant influence over the deployment of new digital technologies and over how these affect working conditions. Figure 1 illustrates the links between retailers' current digital value chain restructuring strategies, governance structures and labour process transformations in the fast-fashion GVC.

4 | CASE DESIGN AND METHODOLOGY

In the following, we analyse digital labour process transformations and their impact on working conditions in the fast-fashion value chain through the lens of a qualitative, meso-level embedded case study (Gereffi, 2019; Yin, 2014) of two leading global garment retailers: Zara and H&M. Zara is the flagship brand of Inditex, a Spanish fast-fashion retail company owning several brands. Zara has stores in 96 countries and online sales channels in 202 countries (Inditex, 2021b). Around 50 per cent of Inditex's (partly company-owned) factories are located in Europe and neighbouring regions, allowing Zara to release 24 collections per year (Aftab et al., 2018). Inditex has been perceived as a pioneer in implementing an RFID and cloud-based digital SCM system, starting its rollout in Zara stores and logistics centres in 2014 and completing it in 2017 (Nayak, 2019). H&M is a Swedish fast-fashion retailer owning several brands, of which H&M is the biggest. The brand H&M maintains stores in 72 countries, of which 52 also possess an online market (H&M, 2021a). H&M still follows a predominantly distant sourcing strategy, with more than 73 per cent of its manufacturing factories located in East, South-East and South Asia (H&M, 2021b). Accordingly, with only 16 collections a year, H&M has fewer collections than Zara (Weinswig, 2017). H&M has started the roll out of its RFID-based digital SCM system in 2016, completing implementation in 20 countries by 2020 (H&M, 2020).

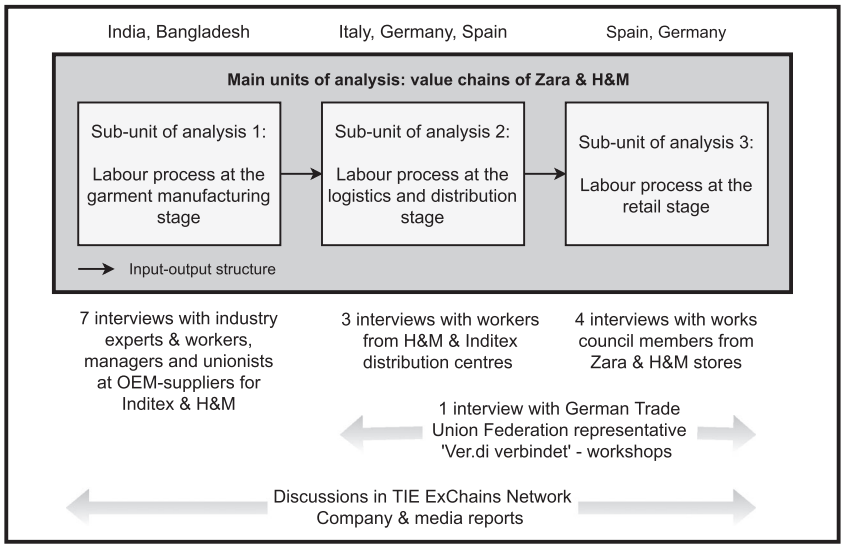

FIGURE 2 Embedded case study design and empirical data sources

To analyse how Zara's and H&M's digital supply chain integration projects are transforming labour processes and working conditions, we defined three different stages of the value chain as sub-units of analysis (Yin, 2014, p. 65): the garment manufacturing stage, the logistics and distribution stage, and the retail stage. To analyse labour process transformations at these three stages of the value chain, we primarily draw on data from two participatory research and discussion processes in the context of the TIE ExChains union network and of the union project 'ver.di verbindet'. The TIE ExChains network connects workers from the garment industry in Sri Lanka, India and Bangladesh and from the retail and logistic sectors in Germany, Italy and Spain with the aim of strengthening local worker organizing and collective bargaining through transnational solidarity. The 'ver.di verbindet' project has — between 2018 and 2020 — brought together more than 800 workers, works council members and unionist from the German retail, logistics and e-commerce sectors to develop demands and guidelines for collective bargaining around digitalization processes. Data from workshops in the TIE ExChains network and in the 'ver.di verbindet' project were complemented with data from 15 in-depth interviews with garment industry experts, factory managers, workers and unionists from Bangladesh, India, Spain, Italy and Germany conducted between March 2017 and April 2021. Furthermore, we evaluated data from H&M and Inditex company reports and from articles published on relevant online fashion news platforms and in specialized magazines for the garment retail sector (e.g., fashionunited.com, Textilwirtschaft). Figure 2 visualizes the embedded case study design and gives and overview of the empirical data sources unperpinning the following empirical analysis.

5 | DIGITAL LABOUR PROCESS TRANSFORMATIONS AND EFFECTS ON WORKING CONDITIONS IN THE VALUE CHAINS OF INDITEX AND H&M

5.1 | Digitalizing Taylorist workplace regimes in garment manufacturing

As illustrated in the previous section, suppliers for Zara and H&M are experiencing increasing pressure to invest in digital technologies to speed up and flexibilize production. Here, we focus on garment manufacturers in India and Bangladesh, which represent about 40 per cent of H&M's and about 10 per cent of Inditex's tier 1 factories (H&M, 2021b; Inditex, 2021a). With the general shift toward fast-fashion and linked retailer pressures for shorter lead times

and lower prices, Bangladeshi and Indian export-garment manufacturers have over the past 15 years implemented assembly line production models characterized by Taylorist workplace regimes. In these regimes, the complex production process is broken down into single, standardized tasks — such as cutting, stitching and trimming — with each task being carried out by a different worker. To maximize production efficiency, garment manufacturers have in addition introduced various digital and automation technologies such as computer-aided design and cutting technologies, digital marker making software or automated fabric spreading and laser cutting machines. In the same vein, manufacturers have introduced semi-automated sewing machines for time-intensive, complex sewing operations such as J-stitch machines or welt pocket making machines. Whereas these machines still require operators to place the fabric correctly onto the machine, the stitching itself is carried out automatically, thereby, making the stitching process faster and less prone to errors (INT14). Only with retailers' recent push for end-to-end digital supply chain integration, manufacturers have, however, started to adopt more advanced digital technologies associated with 'industry 4.0', such as 3D design software for sample making or digital sewing machine networks (INT15). According to an interviewed textile engineering expert, a major challenge to introducing more advanced digital production technologies lies in the non-compatibility of digital production technologies developed by different companies and in a lack of compatibility of these technologies with existing production systems (INT15).

The introduction of computer-assisted, semi-automated and digital design and production technologies have led to contrasting up-skilling and de-skilling processes for different groups of workers. On the one hand, an increasing number of positions in the pre-production and finishing process now require technical knowledge to use special software and to program and maintain digital machines — knowledge usually acquired through university education or vocational training courses (INT2). On the other hand, the introduction of semi-automated machines for complex stitches has led to a decrease of skill requirements in the actual production process, as an interviewed garment industry consultant from India explains:

> When you grade the machine operators according to skill-levels, to do a J-stitch manually, for example, you need at least a semi-skilled operator, whom you pay 150 dollars a month. But when you use the semi-automated machines, you can use a less-skilled operator, even at the helper level. So, you give him 100 dollars a month and have less costs while at the same time getting a higher productivity. (INT14)

The growing co-existence of unskilled and skilled jobs has, in turn, led to increasing workforce segmentation not only along skill-level lines but also along gender lines. Despite the highly feminized nature of the Indian and Bangladeshi garment sector, where women represent the majority of workers, it is predominantly men who get trained and promoted into higher skilled positions involving the operation of digital machines, for example, for digital marker making or for laser-based cutting processes. Women, in contrast, frequently remain stuck in the lower value-skilled positions in the sewing process, which is characterized by increased de-skilling due to the introduction of semi-automated sewing machines (ILO, 2019, p. 19). In India, de-skilling processes are partially mitigated by the overall higher skill requirements resulting from India's specialization in higher value-added, more complex garments. Since these products are produced in smaller quantities and, therefore, require more frequent variations in styles and stitches, machine operators may still enhance their skill and pay levels by learning to operate various types of machines and performing different stitches. In Bangladeshi garment factories such opportunities for up-skilling are, however limited, since their production is specialized in the mass-scale production of basic garments with round the year demand (INT14).

Besides increasing worker segmentation along skill- and gender levels, digitalization strategies of Indian and Bangladeshi garment manufacturers are also increasing work pressure through new technologies for real-time performance monitoring. Since timely completion of production orders has become a key requirement for H&M's and Inditex's strategic suppliers, efficient worker performance monitoring is a core strategic capacity for garment manufacturers (INT1). In this vein, Indian garment manufacturers have introduced digital sewing machine networks, in which each individual sewing machine possesses a sensor that automatically records data on machine activity and

sends it to a central cloud server via WiFi. Thereby, digital sewing machine networks allow manufacturers to monitor various parameters of individual worker performance — such as idle time, dexterity, efficiency and fatigue levels — in real time. To provide workers incentives for enhancing productivity, an HR manager at a major Indian supplier for H&M and Inditex suggests using bonuses and pay ranks to link productivity parameters to wage components (INT1). Against this backdrop, Indian garment union representatives warn that in face low unionization rates and repressive employer regimes new digital technologies with real-time performance monitoring are likely to exacerbate existing pressures on workers to work without breaks, thereby aggravating health risks such as kidney damage, back pain or repetitive strain injuries (INT9). Given that the majority of workers in the sewing process are female, increased digital control over worker performance and associated health risks — once more — disproportionally affect women workers.

5.2 | Uneven effects of automation and digital warehouse management systems on workers in Inditex's and H&M's logistics networks

Compared to the garment manufacturing sector, where adoption of digital technologies is at a relatively early stage, labour processes in Inditex's and H&M's logistic centres have been significantly transformed over the last years by RFID-based, (semi-)automated digital warehouse management systems. The core of Inditex's logistic network are 10 vertically integrated logistics centres in Spain, where garments arriving from Inditex's global supplier network are registered and then distributed either directly to stores or to regional distribution centres. Whereas Inditex had traditionally organized distribution in house, with the growing importance of the online sales segment, the company has since 2018 relied on the global logistics provider GXO Logistics to handle regional distribution of online orders. GXO, formerly part of XPO, is according to the company's own information the 'world's largest pure-play contract logistics provider', offering smart logistics solutions in particular for the e-commerce sector (GXO, 2021). More recently, GXO has also taken over the operation of Inditex's newest auxiliary European logistics hub in Leylstad, Netherlands. The central node of H&M's logistic network, in turn, is its vertically integrated central distribution centre in Hamburg, Germany. From there, garments are distributed to stores and end-customers via regional logistics centres. Unlike Inditex, H&M however maintains a much more decentralized network of vertically integrated regional logistics centres located in Europe and the US, distributing garments both to stores and to end customers. Regional logistic centres are operated in part by H&M itself and partly by external contractors, with GXO also being one of H&M's key contractors.

Degrees of automation and digitalization vary across the different distribution centres in Inditex's & H&M's logistics networks. In Inditex's central distribution centres, most labour process steps have been automated over the past decade including the traditionally highly labour-intensive areas of (un)loading, picking and packing. Workers are now assisted in the (un)loading and packing process by robots that can handle boxes or hanging garments. In addition, the picking process has been automated almost entirely. Enabled by RFID scanning technology and the in-house 'XWMS' warehouse management system, robots pick articles for store or customer orders from shelves. Articles are then transported to the packing area via a complex system of transport belts, slides and chutes. Human labour is, however, still needed in the packing process to check that each order has been correctly compiled, to mark the order as completed in the system, and to label the finalized parcels. According to an interviewed union representative at Inditex's central logistics centre in Zaragoza, the newly introduced RFID-based warehouse management system and automation technologies have so far had predominantly positive effects for workers by decreasing physical strain on workers and thereby reducing work-related accidents and injuries. Moreover, the share of women in the workforce has increased: The gross of tasks involved in compiling, checking and labelling orders is now carried out by men and women almost equally, with about 60 per cent of workers in Inditex's central logistic centres being men and about 40 per cent being women (INT13).

Despite the overall positive effects from automation in Inditex's logistic centres, the interviewed union representative also recognizes several risks associated with RFID-based warehouse management systems and automation technologies such as heightened work pressure and tightened digital performance monitoring. According to our

interviewee, these risks have, however, not yet materialized for directly employed workers in Inditex's distribution centres due to a strong union presence:

> Until now, the company has not implemented very aggressive measures to monitor or push workers [...]. There are peak times when supervisors will push a bit more [...], but we, as the union, always maintain that as long as workers are in position, management cannot interfere with their work speed because we do not yet have performance standards. I think introducing performance standards and measuring would also not be in the company's interest because then we would also demand a bonus for periods with heightened work intensity. (INT13, authors' translation)

Precarious, physically straining work characterized by high work pressure, long working hours and low wages however persists in the lower value-adding segments of the labour process in Inditex's logistic centres, segments that have traditionally been carried out by contract workers. One example is ironing, which is performed exclusively by female workers employed through a third-party contractor. Exploitative working conditions also prevail in Inditex's outsourced regional logistic centres operated by GXO. In those centres, picking and packing processes are still performed manually with RFID-technology monitoring individual workers' movements and performance (c.f. FESMC-UGT, 2016).

Uneven effects of digitalization and automation technologies on workers can also be observed across H&M's logistics network. So far, automation technologies have been introduced only in selected logistics centres, for example, in H&Ms logistics centre in Poznan, Poland or in H&M's recently opened 'high-tech' logistics centre in Milton Keynes, UK, where 'technological solutions [..] reduce the need for employees to engage in repetitive tasks' (H&M Logistics Manager, cit. in Hughes, 2019). In contrast, in H&M's central and largest distribution centre in Hamburg, Germany and in most regional online sales logistics centres, picking and packing processes are still performed manually. Nevertheless, manual picking and packing processes in H&M's logistics centres have undergone significant transformations with the introduction of RFID-based digital warehouse management systems and 'pick by voice' technology. The warehouse management system now determines which workers should pick which items in which sequence, calculating the most time-effective route through the warehouse. Workers receive detailed commands via personalized RFID scanners and headsets and need to confirm every work step by speaking a control number or 'okay' into the microphone (INT5).

Workers predominantly experience RFID-based warehouse management and 'pick by voice' systems as a deterioration of work quality. In workshops conducted within the project 'ver.di verbindet', workers report feeling reduced to mere 'appendices of technology', since all planning tasks are now carried out by a software with workers merely carrying out instructions. This de-skilling of tasks has also opened the way for the increased use of contract workers, leading to an increasing precarization of employment relations. The use of contract workers as a form of exploitation is particularly prevalent in H&M's outsourced online logistics centres in Italy operated by GXO, as a unionist points out:

> XPO [note: now GXO] outsources the actual work process to subcontracting registered as "cooperatives," which formally employ workers. Workers receive temporary, part-time contracts but are made to work 11 h per day, 6 days a week, receiving their working schedules on a day-to-day basis. (Open letter by Italian unionist, published by Labournet.tv, 23 August 2016; authors' translation)

Besides the perceived de-skilling of tasks, workers also report increasing feelings of isolation due to the 'pick by voice' systems. As a participant in a 'ver,di verbindet' workshop explains, the voice recognition software will 'go mad' if workers say any other words than the required confirmations. Hence, it becomes impossible for workers to even exchange a few words with colleagues in the hallway. This communication barrier has also hindered unions' work since casually communicating with co-workers is an essential part of their workplace organizing (INT8).

Last, digital warehouse management systems in H&M's logistic centres have generally led to increased stress levels for workers due to the heightened pace and tight structuring of work processes. Shorter product and distribution

cycles have led to a 'compression of work', with pickers having to prepare various orders simultaneously. Whether workers are able to cope with these denser work schedules is, in turn, tightly monitored by management through tracking individual workers' movements and performance, placing additional stress on workers (INT10).

5.3 | Industrialization of service work and worker resistance in Zara and H&M stores

Next to the logistics stage, the vertically integrated retail stage represents the second core strategic sector for retailers' digital supply chain integration projects. In this section, we look at Inditex's and H&M's retail operations in Spain and Germany, representing the two retailers' largest consumer markets. In both countries, the garment retail sector is characterized by a proportionally high share of women workers compared to the overall participation of women in the labour market. In Germany, about 80 per cent of workers in garment retail are women (Statistisches Bundesamt, 2019) and in Spain about 55 per cent (EY, 2020). Both H&M and Inditex have over the past 5 to 7 years introduced RFID-based store management systems. These systems track which articles are available on the shop floor or in stock, recording their precise location. Smart checkout points automatically register which items have been sold and feed the information into the central system. Workers and supervisors are able to access this information at any time via 'personalized digital assistants' (PDAs, a handheld tablet). Together with RFID-based store management systems, H&M and Inditex also introduced 'omni channel' services for customers, such as 'Click & Collect' or 'Scan & Buy' (Köhnen & Nutzenberger, 2019).

In workshops within the ·ver.di verbindet project and the TIE ExChains network, Zara workers and works councils from Spain or Germany have highlighted several transformations of labour processes linked to RFID-based digital store management systems. These transformations include the de-qualification and de-skilling of tasks, heightened work intensity, new digital forms of work control, increased workforce segmentation and precarization of employment. Experiences of de-skilling and de-qualification result from the increasing standardization and rationalization of work routines in Zara stores, where digital technologies have gradually taken over planning, management and customer attention tasks. Zara workers report that, before the digital re-structuring of retail operations, employees performed a repertoire of several different tasks autonomously, including checking and replenishing sales floor inventory, visually arranging collections and advising customers. Now, the store management system automatically registers that a certain item needs to be replenished and notifies workers via their PDAs. Similarly, the system identifies items that are not selling well and suggests re-locating the item to a different section, from where other items have been selling faster (INT6). The fact that central tasks of inventory and stock management are now performed by the digital store management systems and do not require workers' experience and specialized knowledge anymore has furthermore enabled Zara to outsource the management of in-store warehouse sections to subcontractor firms. Workers employed through these firms are predominantly male migrant workers, who receive significantly less pay and benefits than directly employed workers (INT7). Hence, the outsourcing processes enabled through new digital store management systems create new workforce divisions along intersecting lines of gender and employment type in a sector that has traditionally been characterized by rather low gender segmentation of tasks.

In addition to stock and inventory management tasks, digital store management systems increasingly take over customer attention tasks. Technologies, such as the Zara app, providing styling tips, or 'interactive mirrors' lead customers to seek less advice from employees. 'Interactive mirrors' automatically recognize the garment a customer is fitting on via the RFID label and provide tips for combinations with other articles (INT7). Moreover, since the introduction of 'click and collect,' an increasing number of customers only visit the store to pick up items ordered or reserved online. Employee-customer-interaction, hence, is reduced to supervising customers in the changing rooms or fetching packets for customers. This tendency is further accentuated by Zara's new 'Ship from Store' concept, leading to the increasing performance of logistical tasks by Zara retail workers, who now pick and pack items for online orders sent to customers directly from the store (INT11). As a result, workers' routines comprise an increasing percentage of standardized, repetitive tasks — also due to Inditex's general strategy to standardize operations and

visual presentation across its physical store network. A visual designer from a Zara store in Spain summarizes workers' related experiences of de-skilling and de-valuation of work:

> When I started working at Zara 12 years ago, employees still required several professional skills: good customer relations, consulting skills, knowledge of different fabric types, a feeling for aesthetics, for fashion. Now, none of this plays a role anymore, […] it is no longer part of our job profile. Now, we are just numbers and all that matters is our productivity. (INT7, authors' translation)

Last, digital store management systems have also led to an increasing flexibilization of working hours and precarization of employment. Digital management systems enable store managers to more accurately predict staff requirements based on sales data and standardized performance times for specific tasks. To account for variations in customer traffic, the shift system at Zara has been restructured to encompass more shorter shifts per day. Workers report that, as a result, pressure to be constantly available has significantly increased, as has the share of workers with 'flexible contracts'. 'Flexible contracts' only guarantee a limited number of weekly working hours, with extra hours being allocated to individual workers according to staff demands and workers' availability. This pressure for flexibility has led store managers to employ predominantly younger and/or male workers because mothers are deemed less flexible due to their care responsibilities. In addition, Zara works councils report that the company has been deliberately targeting female employees with children, issuing warning notes even for small issues to make them sign voluntary termination agreements (INT6).

In the 'ver.di verbindet' workshops, workers from German H&M stores reported similar trends toward increasing standardization of work processes, heightened pressures for worker flexibility and a rise in 'flexible contracts' over the past years. So far, H&M has laid the organizational and technological basis for introducing the RFID-based store management system in German stores by equipping checkout systems with RFID scanners and by standardizing workflows according to a central 'store operations' concept (INT12). However, due to opposition from works councils, the RFID-related store management system and related 'omni-channel' services, such as 'click and collect,' are not yet functional in German H&M stores. According to German co-determination laws, introducing new digital technologies that significantly change work processes requires an official company agreement between management and works councils. When introducing the RFID system in Zara stores, the Zara Germany management circumvented this process by introducing the various technological elements, such as scanners or smart cash registers, step-by-step in testing phases: 'That's how it happened with every technological innovation. They were just "thrown in" without really informing workers or works councils beforehand or asking for their opinions', reports a Zara works council member from Germany (INT13). Due to discussions in the TIE ExChains network and the 'ver.di verbindet'-project, H&M works councils have, however, learned from their colleagues' experience at Zara and opposed H&M's attempts to introduce new RFID-based technologies in a similar manner. Currently, ver.di is seeking to negotiate a collective bargaining agreement with H&M to specify how the digitalization of H&M's retail operations in Germany can be advanced without negative effects on quality of work and employment (INT12).

6 | CONCLUSIONS

This article has drawn on case studies of Zara and H&M to analyse how digital value chain restructuring in the fast-fashion GVC impacts labour processes and working conditions. We have proposed understanding current digital labour process transformations in garment manufacturing, logistic and retail as driven and shaped by fast-fashion retailers' digital SCM strategies directed at enhancing supply chain speed, responsiveness and cost-efficiency, and at advancing the integration of offline and online sales channels.

Our analysis shows that labour transformations at the manufacturing, logistics and retail stages of H&M and Inditex's supply chains show general trends of work transformation under digital capitalism, including the de-skilling,

standardization and rationalization of tasks, heightened work intensity and new digital forms of labour control. However, several differences regarding implications for working conditions can be observed, with effects of digitalization processes on workers being mediated by workers' position in the value chain, and by gender and capital labour-power relations. At the manufacturing stage, digital cutting and design technologies, and semi-automated sewing machines have led to up-skilling in the more capital-intensive pre-production steps, while effecting de-skilling processes in the labour-intensive sewing process. As a result, workforce segmentation along skill-level and gender lines has increased, with male workers benefitting more than women workers from up-skilling processes. In addition, in face of low unionization rates, negative characteristics of Taylorist labour process organization and control in garment manufacturing are further aggravated with the introduction of digital sewing machine networks enabling real-time worker performance analysis.

Conversely, at the logistics and retail stages qualitatively new 'digital Taylorist' forms of labour process organizations are emerging with the introduction of automation technologies and RFID-based warehouse and store management systems. In both warehouses and stores, digital management systems are not only monitoring worker performance but also taking over central planning and decision-making functions. Schröter (2019) has coined the term 'delegation technology' for these digital management systems to distinguish them from 'assistance technologies' that merely collect and evaluate data to facilitate human management and decision-making processes. As delegation technologies, fast-fashion retailers' digital warehouse and store management systems exercise autonomous control over workflows and supply chain coordination via algorithms. RFID-scanners and PDAs provide workers with detailed instructions, while collecting data on workers' movements and activities to optimize workflows. Digital warehouse and store management systems, hence, permanently absorb workers' informal and 'tacit' knowledge and make it exploitable for management, thereby reducing workers' bargaining power and opening ways for an increasing precarization of employment.

Nevertheless, not all workers across H&M and Zara's logistics and store networks have been equally affected by new digital management systems. In Zara's vertically owned distribution centres, representing central strategic nodes in Inditex's logistics network, digital warehouse management systems have enabled the automation of physically straining picking and packing processes while strong unions have prevented digital individual performance control. In contrast, in Zara's outsourced logistics centres and in the bigger share of H&M's company-owned and outsourced logistic centres, 'pick by voice' systems are used to squeeze workers more effectively, leading to heightened work intensity and increased stress and alienation for workers. At the retail stage, German H&M works councils have learned from the experiences of their colleagues in Zara stores, where new digital store management systems have led to a de-skilling of tasks and to the precarization and flexibilization of work, affecting particularly female employees. As a result, ver.di is currently seeking to negotiate a collective bargaining agreement with H&M to prevent negative effects on employment and work quality from the digitalization of H&M's retail operations in Germany.

Our analysis has contributed to debates on labour, digitalization and global value with three important insights into the restructuring of buyer-driven value chains under digital capitalism. First, we have shown how, under digital capitalism, sources of value chain and market power for established lead firms in buyer-driven GVCs are increasingly shifting from the capacity to control and coordinate geographically fragmented supplier networks to controlling highly responsive, digitally integrated supply chains and logistics networks (c.f. Butollo, 2021). Established lead firms, such as H&M and Inditex, are therefore increasingly investing in customized digital SCM systems and IT architectures to enhance their capacities to optimize and synchronize labour processes across the supply chain. Second, in this line, we have also illustrated how specialized logistics companies are emerging as new important players in buyer-driven value chains, given the heightened logistical demands from growing online sales (c.f. Coe, 2014). Multinational, specialized logistic contractors, such as GXO Logistics, already managing online order last-mile logistics for H&M and Inditex, can hence be expected to accumulate increasing value chain power over the next years. Third and last, we have shown how enhanced labour control as well as the standardization and rationalization of labour processes are central elements of fast-fashion retailers' digital supply chain integration strategies, thereby contradicting more optimistic accounts that digitalization processes may improve working conditions in garment manufacturing and retail (see Denuwara et al.,

2019). Simultaneously, however, our analysis has shown that the introduction of new technologies and linked labour process transformations can also be resisted and co-determined by workers, thereby highlighting technology as a core field of contestation within capitalist relations of production.

ACKNOWLEDGMENTS

We sincerely thank Martina Fuchs and Hans-Christian Busch for their helpful comments. We are grateful to the Hans Böckler Stiftung for the financial support of the research project "(Spatial) employment effects of increasing online trade" (2019-671-3).

Open access funding enabled and organized by Projekt DEAL.

CONFLICT OF INTEREST

We, the authors, declare that no conflict of interest has influenced our research.

ORCID

Tatiana López https://orcid.org/0000-0002-7597-4331

REFERENCES

Abernathy, F. H., Dunlop, J. T., Hammond, J. H., & Weil, D. (1999). *A stitch in time: Lean retailing and the transformation of manufacturing–Lessons from the apparel and textile industries*. Oxford University Press.

Abernathy, F. H., Volpe, A., & Weil, D. (2006). The future of the apparel and textile industries: Prospects and choices for public and private actors. *Environment and Planning A*, *38*(12), 2207–2232.

Aftab, M. A., Yuanjian, Q., Kabir, N., & Barua, Z. (2018). Super responsive supply chain: The case of Spanish fast fashion retailer Inditex-Zara. *International Journal of Business and Management*, *13*(5), 212.

Ageron, B., Bentahar, O., & Gunasekaran, A. (2020). Digital supply chain: Challenges and future directions. *Supply Chain Forum: An International Journal*, *21*(3), 133–138.

Azevedo, S. G., & Carvalho, H. (2012). Contribution of RFID technology to better management of fashion supply chains. *International Journal of Retail & Distribution Management*, *40*(2), 128–156.

Azmeh, S., & Nadvi, K. (2014). Asian firms and the restructuring of global value chains. *International Business Review*, *23*(4), 708–717.

Berg, A., Haug, L., Hedrich, S., & Magnus, K.-H. (2020). Time for change. How to use the crisis to make fashion sourcing more agile and sustainable. https://www.mckinsey.com/~/media/McKinsey/Industries/Retail/Our%20Insights/Time%20for%20change%20How%20to%20use%20the%20crisis%20to%20make%20fashion%20sourcing%20more%20agile%20and%20sustainable/Time-for-change-How-to-use-the-crisis-to-make-fashion-sourcing-more-agile-and-sustainable.pdf

Berg, A., Hedrich, S., Lange, T., Magnus, K.-H., & Mathews, B. (2017). The apparel sourcing caravan's next stop: Digitization: McKinsey Apparel CPO Survey 2017. https://www.mckinsey.com/~/media/mckinsey/industries/retail/our%20insights/digitization%20the%20next%20stop%20for%20the%20apparel%20sourcing%20caravan/the-next-stop-for-the-apparel-sourcing-caravan-digitization.pdf

Bonacich, E. (2003). Pulling the plug: Labor and the global supply chain. *New Labor Forum*, *12*(2), 41–48.

Bousonville, T. (2017). Logistik 4.0: Die digitale Transformation der Wertschöpfungskette. Essentials. Wiesbaden: Springer Gabler. http://www.springer.com/

Briken, K., Chillas, S., Krzywdzinski, M., & Marks, A. (Eds.). (2017). *Critical perspectives on work and employment. The new digital workplace*. Macmillan Education Palgrave.

Brun, L., Gereffi, G., & Zhan, J. (2019). The "lightness" of Industry 4.0 lead firms: Implications for global value chains. In P. Bianchi, C. Durán, & S. Labory (Eds.), *Transforming industrial policy for the digital age* (pp. 37–67). Edward Elgar Publishing.

Butollo, F. (2021). Digitalization and the geographies of production: Towards reshoring or global fragmentation? Competition & Change. Advance online publication.

Camargo, L. R., Pereira, S. C. F., & Scarpin, M. R. S. (2020). Fast and ultra-fast fashion supply chain management: An exploratory research. *International Journal of Retail & Distribution Management*, *48*(6), 537–553.

Coe, N. M. (2014). Missing links: Logistics, governance and upgrading in a shifting global economy. *Review of International Political Economy*, *21*(1), 224–256.

Cox, R. W., & Wartenbe, M. (2018). The politics of global value chains. In R. Kiggins (Ed.), *International political economy series. The political economy of robots: Prospects for prosperity and peace in the automated 21st century* (pp. 17–40). Springer International Publishing.

Denuwara, N., Maijala, J., & Hakovirta, M. (2019). Sustainability benefits of RFID technology in the apparel industry. *Sustainability*, *11*(22), 1–14.

Díaz Pardo, C. (2021). Inditex frente a su armario: así crece su gran proveedor logístico. https://www.economiadigital.es/galicia/empresas/inditex-frente-a-su-armario-asi-crece-su-gran-proveedor-logistico.html

Evans, L., & Kitchin, R. (2018). A smart place to work? Big data systems, labour, control and modern retail stores. *New Technology, Work and Employment*, *33*(1), 44–57.

EY. (2020). Informe sector moda en España: Análisis del impacto de la crisis del Covid-19. https://assets.ey.com/content/dam/ey-sites/ey-com/es_es/news/2020/04/ey-informe-sector-moda-en-espana-covid-19.pdf

FESMC-UGT. (2016). UGT denuncua el trato de XPO Logistics a sus trabajadores y trabajadoras. https://www.fesmcugt.org/2016/06/09/ugt-denuncia-el-trato-de-xpo-logistics-a-sus-trabajadores-y-trabajadoras-id-2109/

Flecker, J., & Meil, P. (2010). Organisational restructuring and emerging service value chains: Implications for work and employment. *Work, Employment and Society*, *24*(4), 680–698.

Frederick, S., Bamber, P., & Cho, J. (2018). The Digital Economy, Global Value Chains and Asia. https://gvcc.duke.edu/wp-content/uploads/DigitalEconomyGVCsAsia2018.pdf

Fuchs, M. (2020). Does the digitalization of manufacturing boost a 'smart' era of capital accumulation? *Zeitschrift Für Wirtschaftsgeographie*, *64*(2), 47–57.

Fuchs, M., Dannenberg, P., & Wiedemann, C. (2021). Big tech and labour resistance at Amazon: Online first. *Science as Culture*, 1–15.

Gereffi, G. (1994). The organization of buyer-driven global commodity chains: How U.S. retailers shape overseas production network. In G. Gereffi & M. Korseniewicz (Eds.), *Commodity chains and global capitalism* (pp. 95–122). Praeger Publishers.

Gereffi, G. (Ed.). (2019). *Global value chains and development: Redefining the contours of 21st century capitalism (First Edition)*. Cambridge University Press.

Gereffi, G., Humphrey, J., & Sturgeon, T. (2005). The governance of global value chains. *Review of International Political Economy*, *12*(1), 78–104.

GXO. (2021). GXO Logistics, Inc. Completes Spin-Off from XPO Logistics, Inc. https://gxo.com/news_article/gxo-logistics-inc-completes-spin-off-from-xpo-logistics-inc/

H&M. (2018a). H&M group annual report 2018. From file:///C:/*Users/wmc205/Desktop/Revision%20Digi-Artikel/H&M_2018_Annual%20Report%202018.pdf*

H&M. (2018b). H&M group sustainability report 2018. https://about.hm.com/content/dam/hmgroup/groupsite/documents/masterlanguage/CSR/reports/2018_Sustainability_report/HM_Group_SustainabilityReport_2018_%20FullReport.pdf

H&M. (2020). H&M Group Q2 six-month report 2020. https://hmgroup.com/wp-content/uploads/2020/09/2735858.pdf

H&M. (2021a). H&M group market overview. https://hmgroup.com/about-us/markets-and-expansion/market-overview/

H&M. (2021b). H&M group supplier list. https://hmgroup.com/sustainability/leading-the-change/supplier-list.html

Hammer, N., & Plugor, R. (2016). Near-sourcing UK apparel: Value chain restructuring, productivity and the informal economy. *Industrial Relations Journal*, *47*(5-6), 402–416.

Hammer, N., & Riisgaard, L. (2015). Labour segmentation in value chains. In K. Newsome, P. Taylor, J. Bair, & A. Rainnie (Eds.), *Putting labour in its place: Labour process analysis and global value chains* (pp. 83–116). Palgrave Macmillan.

Handelsverband Deutschland. (2020). *Online Monitor 2020*. HDE.

Hentschel, M. (2020). Nearshoring & on-demand–Short-lived disruption, or long-term transformation? https://www.theinterline.com/09/2020/nearshoring-on-demand-short-lived-disruption-or-long-term-transformation/

Hughes, H. (2019). H&M to open Milton Keynes distribution centre. https://fashionunited.com/executive/report/h-m-to-open-milton-keynes-distribution-centre-800-jobs-available/2019040127049

ILO, I. L. O. (2019). *The future of work in textiles, clothing, leather and footwear: Working Paper No. 326*. ILO.

Inditex. (2020). 2022 Horizon. https://www.inditex.com/documents/10279/304402/2022+Horizon_eng.pdf/0c482bbd-692e-1346-5af5-0c6bf1c5e02f

Inditex. (2021a). Supplier map. https://www.inditex.com/about-us/inditex-around-the-world#continent/000

Inditex. (2021b). Who we are. https://www.inditex.com/about-us/who-we-are

Köhnen, H., & Nutzenberger, S. (2019). Digitalisierung im Handel—beteiligungsorientiert gestalten. In L. Schröder (Ed.), *Arbeitsschutz und Digitalisierung: Impulse für eine moderne Arbeitsgestaltung: Gute Arbeit ver.di-Reader 2020*. BUND Verlag.

Li, F., Frederick, S., & Gereffi, G. (2019). E-commerce and industrial upgrading in the Chinese apparel value chain. *Journal of Contemporary Asia*, *49*(1), 1–30.

Moore, P., & Robinson, A. (2016). The quantified self: What counts in the neoliberal workplace. *New Media & Society*, *18*(11), 2774–2792.

Mussomeli, A., Gish, D., & Laaper, S. (2016). The rise of the digital supply network: Industry 4.0 enables the digital transformation of supply chains. https://www2.deloitte.com/content/dam/insights/us/articles/3465_Digital-supply-network/DUP_Digital-supply-network.pdf

Nayak, R. (2019). *Radio frequency identification (RFID) technology and application in fashion and textile supply chain.* Textile Institute professional publications. CRC Press, Taylor & Francis.

Newsome, K., Thompson, P., & Commander, J. (2013). 'You monitor performance at every hour': Labour and the management of performance in the supermarket supply chain. *New Technology, Work and Employment*, *28*(1), 1–15.

Pardi, T., Krzywdzinksi, M., & Luethje, B. (2020). *Digital manufacturing revolutions as political projects and hypes:eVidences from the auto sector: ILO Working Paper 3*, April 2020. ILO.

Roberts-Islam, B. (2021). The New Automated Jeans Factory In L.A.—A Blueprint For Reshoring Apparel Manufacturing? https://www.forbes.com/sites/brookerobertsislam/2021/03/10/the-new-automated-jeans-factory-in-la-a-blueprint-for-reshoring-apparel-manufacturing/?sh=5aa830ff301c

Schröter, W. (2019). Der mitbestimmte Algorithmus. In W. Schröter (Ed.), *Der mitbestimmte Algorithmus* (1st edn., pp. 101–150). Talheimer.

Seidel, H. (2021). C&A will in Mönchengladbach Jeans produzieren—und forschen: Textilwirtschaft, 22.05.2021. https://www.textilwirtschaft.de/business/news/ab-herbst-2021-ca-will-in-moenchengladbach-jeans-produzieren-und-forschen-230847

Staab, P., & Nachtwey, O. (2016). Market and labour control in digital capitalism. *TripleC: Communication, Capitalism & Critique. Open Access Journal for a Global Sustainable Information Society*, *14*(2).

Statista. (2021). Online-Umsatz mit Kleidung und Schuhen in Deutschland in den Jahren 2006 bis 2020 (in *Milliarden Euro).* https://de.statista.com/statistik/daten/studie/164515/umfrage/umsatz-im-online-modehandel-in-deutschland-seit-2006/

Statistisches Bundesamt. (2019). 45341-0004: Beschäftigte im Handel: Deutschland, Jahre, Stellung im Beruf, Geschlecht, Wirtschaftszweige. https://www-genesis.destatis.de/genesis/online

Stratton, F. (2018). H&M Tries on supply chain improvements. https://www.inboundlogistics.com/cms/article/hm-tries-on-supply-chain-improvements/

Szalavetz, A. (2019). Digitalisation, automation and upgrading in global value chains–Factory economy actors versus lead companies. *Post-Communist Economies*, *31*(5), 646–670.

Taplin, I. M. (2014). Global commodity chains and fast fashion: How the apparel industry continues to re-invent itself. *Competition & Change*, *18*(3), 246–264.

Taylor, P. (2010). The globalisation of service work: Analysing the transnational call centre value chain. In P. Thompson, & C. Smith (Eds.), *Working life: Renewing labour process analysis* (pp. 244–268). Palgrave Macmillan.

Taylor, P., Newsome, K., Bair, J., & Rainnie, A. (2015). Putting labour in its place: Labour process analysis and global value chains. In K. Newsome, P. Taylor, J. Bair, & A. Rainnie (Eds.), *Putting labour in its place: Labour process analysis and global value chains* (pp. 1–26). Palgrave Macmillan.

Tokatli, N. (2008). Global sourcing: Insights from the global clothing industry the case of Zara, a fast fashion retailer. *Journal of Economic Geography*, *8*(1), 21–38.

Weinswig, D. (2017). Fast Fashion Speeding Toward Ultrafast Fashion. https://coresight.com/wp-content/uploads/2017/05/Fast-Fashion-Speeding-Toward-Ultrafast-Fashion-May-19_2017.pdf

Yin, R. K. (2014). *Case study research: Design and methods* (5th edn.). Sage.

Yip, A. C., & Huang, M. (2016). Strategic values of technology-driven innovation in inventory management: A case study of Zara's RFID implementation. *International Journal of Inventory Research*, *3*(4), 318.

How to cite this article: López, T., Riedler, T., Köhnen, H., & Fütterer, M. (2021). Digital value chain restructuring and labour process transformations in the fast-fashion sector: Evidence from the value chains of Zara & H&M. *Global Networks*, 1–17. https://doi.org/10.1111/glob.12353