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Digital worker feedback infrastructures: The digitalisation of worker rights monitoring in global value chains

Christoph Sorg¹ , Carolina Alves Vestena², Christian Scheper² and Sabrina Zajak¹

¹Ruhr-University Bochum, Institute for Social Movements, Bochum, Germany and ²Universität Duisburg-Essen, Institute for Development and Peace, Duisburg, Germany

Corresponding author: Christoph Sorg; Email: christoph.sorg@rub.de

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Abstract

In this paper, we present empirical research on what we call ‘digital worker feedback infrastructures’ (DWFIs); these are communication systems based on digital technologies that allow for creating so-called ‘feedback data’ via different forms of information input of workers in global value chains (GVC). The paper provides an overview of over 50 current DWFIs in GVCs and asks about the main differences between management-oriented and worker-centred digital feedback infrastructures in their usage of worker data. In the first part, we trace the emergence of DWFIs at the intersection of different trends: the continuous non-improvement of working conditions through auditing, the permanent politicisation, and contestation of this fact through labour and activist networks as well as the development of new digital technologies. In the second section, we elaborate the main features of DWFIs and analyse potential shortcomings in the context of the ‘ethical’ audit and monitoring regime for GVCs. Third, we use our dataset to present an overview of the heterogeneity of DWFIs. We pay particular attention to examples of civil society developed tools as we suggest that they provide a glimpse of the potential of worker feedback technologies from below, which could contribute to better monitoring of worker rights and facilitate a more democratic coordination of workplaces and GVCs.

Keywords: digitalisation; global value chains; labour governance; social audits; worker rights

Introduction

Worker rights have not fared particularly well in the last decades. In OECD countries, wages seem to have decoupled from productivity increases, while social safety nets have eroded in many states. The COVID-19 pandemic has further worsened working conditions for many workers around the globe (ILO 2022). Due to international and regional power asymmetries, the situation is even more dire further upstream along global value chains (GVCs). Working conditions tend to be harder and salaries even lower at production sites in the Global South, with class-based exploitation intersecting with inequalities of gender, ethnicity, and citizenship (Bair 2010; Levy 2008; Tsing 2009). In addition, forced and child labour continue to be common in various industries (LeBaron 2020).

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International labour and trade union rights have hardly precipitated effective protection and participation mechanisms for workers in the Global South (Bartley 2020; Locke 2013). In the search for solutions to this problem, attention has often focused on the transnational lead firms at the end of the value chain, especially the trading and branding firms. However, decades of privatised labour rights governance via codes of conduct, monitoring, and social audits have failed to substantially improve worker and human rights in GVCs (LeBaron and Lister 2015; Sum and Pun 2005). Existing literature has identified multiple failures in the auditing process, in particular the lack of inclusion of workers in audits and the absence of support for collective rights (Lund-Thomsen 2019; Raj-Reichert 2020). The introduction and ‘continuous improvement’ of auditing procedures also has not silenced trade unions, social movements, and transnational labour rights networks, who continue to criticise bad working conditions and substantial labour rights violations at global production sites (Zajak et al 2017). These continuous struggles for workers’ rights in GVCs have been colliding with another socio-economic development within the last years: the increasing impact of digital technologies on basically all the ways multinational corporations manage production, work, and employment relations within GVCs (Raj-Reichert et al 2021).

As a result of this threefold dynamic (the continuous non-improvement of working conditions through auditing, the permanent politicisation and contestation of this fact through labour and activist networks and the development of new digital technologies), we can observe the rise of digital ‘worker voice tools’ that are supposed to give workers in GVCs a ‘voice’ via digital channels and thus transform labour governance (Farbenblum et al 2018). Similar to the beginnings of the social auditing industry, there is a lot of hope and high expectations on the potential for a technological fix of worker and human rights abuses in GVCs through new technology. However, we know surprisingly little about this phenomenon, neither in terms of empirical research nor as theoretical conceptualisations (notable exceptions: Berg et al 2020; Rende Taylor and Shih 2019). This paper contributes to filling this gap through (a) an extensive analysis of such tools based on qualitative analysis but also a quantitative data set, containing most existing tool initiatives with a global (interregional) reach and (b) through presenting a conceptualisation of digital worker feedback infrastructures (DWFIs). By doing so, we will emphasise the potential these tools can have by enabling workers’ collective organising and, at the same time, present a nuanced view of the risks implicit in using technology to address human rights issues in GVCs.

The concept ‘worker voice tool’ relates to the hope that workers actively use these tools to document worker and human rights violations and thus receive a voice in global labour governance. While the concept originated in the field, it heavily resonates with the heterogeneous literature on employee voice as ‘the ways and means through which employees attempt to have a say, formally and/or informally, collectively and/or individually, potentially to influence organisational affairs relating to issues that affect their work, their interests, and the interests of managers and owners’ (Wilkinson et al 2020, p. 5). Research on employee voice ranges from organisational behaviour studies to transaction cost economics, workplace industrial relations, and Labor Process Theory. Accordingly, the notion of employee voice also ranges from ‘employee input to enhance corporate performance’ (Morrison 2011) to ideas of ‘industrial citizenship’ (Casey 2020) and ‘worker control over the labour process’ (Marks and Chillias 2020). In line with this pluralism in research on employee voice, notions of voice also differ in the field of worker voice tools. Much of the conception of worker voice tools overlaps with management-centric notions of voice (common in organisational behaviour studies) as individual communication constructive for management, which renders invisible power relations and conflicts of interest between workers and management (Barry and Wilkinson 2016).

Since the actual impact of the ‘voice’ in ‘worker voice’ is thus far from clear in the set of tools we investigated (Esterhuizen 2016), we suggest the term ‘digital worker feedback

infrastructures' as a better fitting and analytically more accurate concept. Following Rende Taylor and Shihs (2019) reflections on worker feedback technologies, we define DWFIs as communication systems based on digital technologies that allow for creating so called 'feedback data' via different forms of information input of workers in GVCs. This data is feedback data because it can be used to create information feedback loops for supply chain management and labour governance. Such feedback loops are nothing new nor are they reducible to digital technologies. On the contrary, they are an integral part of what Malets and Quack (2017) called transnational recursive governance. We extend that idea to (digital) data-driven recursivity. In the age of industrial internet platforms and cloud computing, continuous improvement via feedback loops has become increasingly pivotal for the improvement of products, production process, and supply chain management (Butollo 2019). In our case, we explicitly refer to different types of feedback data from workers, produced through various digital infrastructures. DWFIs for instance include data generated via management-created surveys among workers about working conditions in supply chains, via hotlines for workers to report grievances, or they may yet create other feedback loops between management and workers. While such recursive loops have been used in the past, we can now observe how feedback data gets aggregated and (automatically) analysed in dashboards for the friendly use of management. The data can then easily be integrated into larger analytics frameworks such as supply chain risk assessment or supplier monitoring.

Morozov (2019) has identified feedback infrastructures as pivotal sites of conflict in the age of digitalisation. They constitute the means of producing feedback data, that is, control over which data gets produced and which does not. Morozov mainly focuses on feedback data carrying more information than price signals on markets. For instance, flight platform algorithms not only operate based on prices but also through a wide range of consumer preferences such as departure times, number of stopovers, or type of aeroplane. But although feedback infrastructures have become increasingly pivotal for economic action, they remain in private (monopolistic) hands and thus contribute to a centralisation of private power (Jochum and Schaupp 2022; Morozov 2019; Srnicek 2016). However, they are also important in political terms, as data collection is only the first step followed by various process of decision making for interpreting, presenting and sharing that data with ultimate consequences for the translation into practices (Scheper and Zajak 2019).

In the realm of labour governance and modes of labour control this means that DWFIs determine what counts as 'risk' for multinationals, which labour rights violations become evident or concealed, what can be done with this data and who has access to it. We believe it is crucial to analyse and understand DWFIs in particular as providers suggest that they are tools for worker participation and worker voice. But DWFIs do not create 'neutral' channels for workers to communicate grievances and thus improve labour standards. Instead, the particular mode of data generation may distort the picture of the quality of work, reproduce the hegemony of exploitative business models in GVCs, and increase the control of lead firms over their suppliers.

Our article asks the following questions: How are DWFIs designed? How can we differentiate them and create typologies in terms of relevance of worker input for the whole feedback process? What differences does the specific ownership structure and social context of the emergence of specific infrastructures play? We analysed the key functions of 50 transnationally operating DWFIs. As a result, this article offers an overview of two major types of DWFIs – management-oriented and worker-centred – and key categories of their functions. Our argument for the two main types we suggest is twofold. First, we suggest that despite a variety of infrastructures with different designs of feedback loops and histories of their emergence, we can observe similar dynamics as in other areas of the marketisation of virtues (Vogel 2006), where social causes such as improving working conditions increasingly become commodified (McGrath and Mieres 2021). However, our

second argument is that by differentiating between management-oriented tools and worker-centred tools, we are able to show that the type of actor constellations creating these technologies makes a difference in its structuring and potential for usage and social change (e.g. in the form of remediation). Our paper therewith contributes to recent debates on social standards in GVCs (LeBaron 2020; Lund-Thomsen 2019; Raj-Reichert 2020), on the relevance of digital tools for the governance of GVCs (Butollo et al 2022; Foster and Graham 2017), and on the contested role of control over feedback infrastructures in the age of big data (Jochum and Schaupp 2022; Morozov 2019; Zuboff 2019).

In the first part, we trace the emergence of DWFIs at the intersection of limited audits, contestation through labour and activist networks, and the development of new digital technologies. In the second section, we present our method. In the third section, we introduce the emerging field of DWFIs, present main features, and analyse potential shortcomings in the context of the 'ethical' audit and monitoring regimes in GVCs. In so doing, we differentiate the two main types of DWFIs. We pay particular attention to examples of civil society developed tools, as we suggest that they provide a glimpse of the potential of worker feedback technologies from below, which could contribute to better monitoring of worker rights and facilitate a more democratic coordination of workplaces and GVCs.

The emergence of DWFIs

Digitalisation is a phenomenon which affects virtually every process in the global economy today. Digital technology is used in the manufacturing of products or the outsourcing of services through online platforms in the gig economy. In recent years, discussions about the digital economy have seen a shift from concerns with automation and an alleged end of work (Pettersen 2019; Spencer 2018) towards questions of algorithmic management and data politics (Jochum and Schaupp 2022; Morozov 2019; Staab and Nachtwey 2016). With labour costs decreasing, investment patterns have shifted away from robotics and towards intangible capital such as patents, software, and R&D, which is more flexible and scalable than physical capital (Moody 2018; Sorg 2023). GVCs have also been impacted by this development, for instance in the form of data-based supply chain management (Foster and Graham 2017; Humphrey 2018).

The organisational model to emerge out of these technological transformations is the platform, which has been analysed in a growing body of literature (Srnicek 2016; Staab and Nachtwey 2016). More recently attention has been shifted to platforms such as Amazon, Facebook/Meta, or Google as feedback infrastructures, as they provide a space for the interaction of users, producers and consumers, while extracting the data produced via said encounter and the general activities of users. Morozov (2019) calls this feedback infrastructure as the data is then used to continuously improve algorithms and services, and to attract new users.¹ Once the platforms grow, network effects make them even more attractive for users in markets that have an inbuilt tendency towards monopolisation, thus providing yet more data for the expanding 'socio-technical ecosystem' (Staab and Nachtwey 2016).

While this logic originated in companies of the commercial internet (Srnicek 2016; Staab and Nachtwey 2016), emerging industrial internet platforms have recently started to increase the relevance of such feedback infrastructures in industrial value chains as well (Butollo and Schneidmeyer 2022). Related discourses about a supposed 'Fourth Industrial Revolution' promise the creation of large-scale data ecosystems, which are supposed to integrate the whole value chain into overarching cloud architectures. For example, Volkswagen has partnered with Amazon Web Services among others in

developing a global industrial cloud, which connects all of its factories in the US, Mexico, Brazil, Argentina, South Africa, China, India, and all over Europe and aims to include Volkswagen's suppliers and logistical partners into the cloud as well (Butollo 2019). Proponents of such architectures expect increasing profitability, efficiency, and resilience, but also frame these efforts in contexts of 'requirements for transparency and controllability of the supply chain up to the own company' (Gaia-X Hub Germany Undated), as in the case of the European Union-sponsored Gaia-X project to establish a federated European data infrastructure. This overarching feedback infrastructure allows for increasing standardisation, integration, and coordination of the supply chain, anticipating delivery shortages and other potential risks or 'optimising' the use of labour.

However, workers can no longer be optimised further and further. Workers across the Global South suffer from high levels of exploitation, even more so if they are subjected to intersecting forms of oppression (Sproll 2022). The situation of worker and human rights in GVCs has been criticised and contested for decades, but both private and public attempts at regulation have so far failed to remediate the situation (Banerjee 2018; Pye 2017). The state of affairs has even further deteriorated since 2020 with the COVID-19 pandemic, with government-imposed lockdowns and collapsing demand precipitating large income losses in many countries (e.g. Asia Floor Wage Alliance 2020; Scheper and Vestena 2020).

This acute situation shows that despite a variety of transnational standards and certification initiatives, digital cloud solutions, and CSR programs, practices at production sites continue to be determined by poor working conditions, especially in labour-intensive parts of consumer goods industries, such as garment or coffee production (Davenport and Low 2012; Locke 2013). A large number of studies has shown that while public oversight has been dismantled, private governance practices through monitoring and social audits of labour rights in GVCs have hardly precipitated actual improvements of the situation of workers (cf. Barrientos and Smith 2007; Locke 2013; Zajak *et al* 2017). Against the backdrop of this ongoing criticism and high costs of transnational audit systems, companies and service providers in GVCs have been striving for many years to test better mechanisms for monitoring social and environmental standards. These include digital benchmarking systems based on self-reporting or the increase in certification systems for upstream parts of production. However, they do not allow active participation-cum-data provision by workers and are not very suitable for monitoring the social quality of labour processes.

Digital communication technologies involving workers promise to fill this gap, while improving the quality of data and significantly reducing the costs of data collection and scaling. These emerging DWFIs promise to gather accurate information on working conditions, provide channels for complaints in case of abuse and to inform workers themselves about their rights. The rise of supply chain legislation that increasingly pushes multinationals for accountability in their supply chains (LeBaron and Rühmkorf 2017, 2019), such as recent legislation in Germany and the European Union, will increasingly force companies to collect data on social and ecological conditions further upstream along the value chain (Scheper *et al* 2023).

In the context of emerging data ecosystems, they could even provide 'automatically' generated, scalable, and standardisable data sets to fulfil due diligence requirements and allow for automated data analytics. To date there are only few studies. Initial scholarly work rather reflects broader considerations, e.g. in the context of debates to combat 'modern slavery' (LeBaron 2020). They remain very sceptical if such tools can protect migrants labour rights (Berg *et al* 2020; Rende Taylor and Shih 2019). However, one exception is Farbenblum *et al* (2018), which gives a first overview of the potentials and risks of new technologies for migrant workers. The authors show that there are diverse interactions between corporate and worker strategies. For example, workers may well use the tools to obtain information, network, and influence. Such uses may represent an

enabling potential for workers to use information in their favour and have various policy and regulatory implications. On the other hand, companies can also use DWFIs strategically to improve their image or maximise profits via data analytics. They stress that the misuse of data also poses major risks for workers (Farbenblum et al 2018). However, with the exception of these studies, we have had little empirical knowledge about the extent or structure of these tools, the differences between them, let alone the ways in which workers are involved in the feedback process.

Methodology

In this paper, we present data from a research project on such tools that are specifically developed for monitoring and managing working conditions in GVCs and are also used in social audits. Which types of DWFIs exist and how are they structured? How can we differentiate and compare them in terms of worker involvement in the feedback process?

For the collection and analysis of digital tools, we use a methodological pluralism of quantifying and qualitative approaches of empirical social research (Kelle 2008). The design consists of (a) building a database of international DWFIs based on public website information (as of July 2022) and (b) qualitative, semi-structured interviews. The field of DWFIs is extremely heterogeneous, and the boundaries to other digital applications in GVCs are fluid. We therefore first define DWFIs here as specialised digital applications for addressing labour-related concerns that enable active feedback on the part of workers along the value chain. We used this basic definition to search online for internet presentations of such tools in order to include them into our dataset. We only included those providers of DWFIs into our dataset, which were used by at least one GVC and information about the digital tool was available online in English language. Restricting the selection to tools that provide information in English was helpful in gaining an overview of those that have a truly global outreach, as in most cases their pilot version in English can, in fact, be made available in translated versions in several languages. However, this restricted selection also led to the exclusion of some local and regional tools, as we identified in a further interview-based phase of the project.² We used qualitative content analysis of the information available on the websites (see Mosca 2014 for this methodological approach) and content and structure translated the information into key variables characterising the content and features of those tools.

- a) The database includes information on the structuring, features, and data policy of 50 internationally operating providers of such tools we mapped during the years of 2020 to 2022. In order to first gain an overview of company- and sector-specific DWFIs, we snowballed 50 tools³ that claim to include the voice of workers in GVC via digital technologies. Variables in our database include the domicile and legal status of the providers, as well as the language of the website and tool, the prevalence of the tools, technology used, data management, and the features of the tools for different stakeholders (workers, lead companies, suppliers, unions, auditors, and human resource providers). This approach allows us to give an overview and compare DWFIs as presented on websites. It does not allow us to assess the quality or function of worker feedback and definitely not the real-life implications for workers (the data from field study where we focused on the particular implications for workers at production sites is not part of this paper).
- b) We complemented the website analytics with fourteen semi-structured interviews in order to gain a deeper understanding of the relevance of workers input and the specific usages of the data. We conducted online interviews with profit and non-profit providers, union members, transnational standard initiatives and

companies. These focused on the role of programmers and data managers, as well as the different uses of the technologies and their functions in the whole system of DWFIs. In addition, we asked about providers' assessments of the potential of DWFIs, particularly with regard to trends towards further digitalisation of value chains and the Corona crisis. The interviews were systematically coded using MAXQDA software and qualitatively analysed to evaluate the trends identified based on the database.

In the following section, we use both types of data in order to (a) give an overview of existing infrastructures (global mapping) and (b) compare key features of management-oriented and worker-centred tools.

DWFIs: a first overview of an emerging field

The use of diverse technical support to better communicate with workers has gradually evolved from different services at the workplace level. For example, at the plant level, digital tools have been used for some time to improve communication between workers and human resource management. The initial focus here was to better communicate workers' concerns to management (Interview provider 1). This motive is increasingly being extended into the supply chain management of large transnational corporations, becoming a growing service market. So, the field is highly dynamic, and we cannot provide a whole analysis of its continuous unfolding over time. Rather we provide a comparative overview of existing tools in the time period 2020–2022:

The majority of such applications are provided by profit-oriented companies or non-governmental organisations (NGOs), but some are also developed by or with the participation of trade unions or public institutions. Although all tools address the situation of workers in GVCs, the headquarters of providers are often in North America or Europe. However, some exceptions can also be found in the Global South, especially in South and Southeast Asia. While some of the basic functions are shared by many of the tools, we do see differences in functionalities, depending on the types of workers, the world regions and/or countries where the tool is used. The degree of digitalisation within a country plays an important role in whether and how these technologies can be applied altogether. A representative of a large tool provider, for example, explained the relevance of the locality and the age of workers:

'In case workers don't have access to smartphones, they can send a text message as well. But the features on that are very limited. Most of our features are on the App, Android or IOS App. When it comes to India, the smartphone penetration is really low. The smartphone penetration is higher if the factory is located closer to a city or a town, or a metropolitan city. The way the manufactory industry is set up in India, is that it is a little bit away from the main cities'. (. . .)

'Especially if you look onto the garment-industry in India, the age group of the workers is really young: From 18 until 35/37. That's the age group where they have a very good using of smartphones and other digital platforms' (Interview provider 2).

The app 'Golden Dreams' developed by the non-profit Isaara Institute, for example, targets Burmese migrants in Thailand, over 90% of whom own a smartphone. The app informs migrants about their rights, connects them to a hotline, and lets them publicly rate their employers (inspired by Yelp and Tripadvisor). In contexts where providers expect lower smartphone penetration, they rely on other technologies. 'Engage' from Dutch company & Wider for example uses IVR (interactive voice response) technology, which does not require workers to be literate. Workers hear questions in their native language and

respond by pressing 1, 2, or 3 on their cell phones. The generated data then appears automatically and anonymously on the client's dashboard. The Worker Engagement Dashboard from social enterprise Labor Solutions illustrates how some providers combine different technologies: Digital surveys can be answered via the app, SMS, WhatsApp, QR code, WeChat, or onsite, but all data are integrated on a dashboard. In some cases, websites are used, especially for public review platforms where workers rate their employers.

In terms of functionality, providers have explained to us that they usually started with very few elements of feedback infrastructures, but quickly added more and more functions which together comprise the DWFIs, e.g.:

'We simply built the channel to voice their [workers'] concerns, either towards their employees or to a third-party. That's how we started. And now we expanded not only to the application but also we have surveys, e-Learning, some offline and offside counselling and training, etc'. (Interview provider 1).

'Then there are other features, like company HR-features, which allows the management to send company broadcasts, newsletters, playlists, but it is all on-way-communication from the management to the workers'. (Interview provider 1).

'(. . .) we're hoping to develop animations and videos as well, but that's down the road. So, they really see that as a tool where they can update information very quickly, so it's quite a good HR [human resources] tool for them as well as a worker voice tool'. (Interview provider 3)

Providers also consider the increasing use of digital apps that will allow management to better engage with workers, even within the factory in the future:

'[Using the App] means constant engagement with your workers. Send broadcasts, send surveys, send newsletters! A lot of interaction that happens from the factory management-side. Then the workers would eventually get used to the platform and interact as well. That's what we recommend with the brand'. (Interview provider 2).

There is also a wide variety in the form and function of the information flows provided by the tools. Drawing from concepts that originated in research on employee voice, we may group them into four categories, all of them formal, non-union channels of worker voice aiming for the benefit of workers and/or companies.

The first category is the transmission of information from management and/or providers to workers without their active input. The underlying assumption is that such information provision indirectly improves worker rights and/or corporate performance even without the active input of workers. Information, e.g. on labour rights or even sanitary measures in the face of the Covid pandemic, made available to workers through e-learning features or management broadcasts. For example, the app 'WorkerConnect' informs workers about local labour law, while the app Atun keeps workers updated on COVID-19 issues. Atun is an example of how information services can be closely linked to e-learning: Corresponding courses inform workers about the pandemic, health, family issues, finances, or emotional well-being. The app QuizRR uses a 'gamification' approach to convey various contents in a playful way. Unless this is the only category served by a tool, it does not meet our definition of DWFIs.

The second (and by far the largest) category reverses the flow of information: instead of management, workers send information. The underlying assumption is that such flows may fix grievances, improve worker satisfaction, and/or improve corporate performance. They may be a direct or indirect form of voice, depending on whether the information is provided to buyer or supplier management. Information flows may consist of complaint

hotlines designed to give workers a direct channel to communicate grievances in the workplace. Laborlink, Clear Voice, and Phulki developed the hotline ‘Amader Kotha’ (Bengali for ‘our voice’), which receives thousands of calls in person every month and then contacts the management of the supplier companies (including the lead company in urgent cases) about the workers’ complaints. Subsequently, Amader Kotha reports on the outcome of initiated complaint procedures. Selected callers are asked via IVR whether they are satisfied with the outcome. Complaint channels can also be linked to other technologies such as SMS or WeChat.

Management may also conduct surveys via IVR, such as & Wider’s Engage described above. The ‘Laborlink’ tool claims to have already reached over one million workers in 16 countries in 2017 and has since been purchased by Elevate. It offers a standardised set of 17 questions that can be adapted according to companies’ needs and reach workers in different locations in the value chain through cell phones. The results of such surveys are collected for local factory management in a dashboard where individual questions can be broken down by social categories such as gender, age or position, and responses to a particular question can be tracked across multiple surveys. Companies such as Elevate, & Wider, and Ulula hope to be able to provide a more anonymous and cheaper collection of larger amounts of data than traditional social audits. But although the tools are designed to collect workers’ ‘voices’, the kind of input workers are able to make usually is controlled by the lead firm and/or supplier management, as a provider explained:

‘So the management would need to do some kind of promotion before they download the app: ‘This is your company code and you need to type in this code’. And then they need to create username and password, you know? Type in their employee-ID and then they are able to register. After the login to the application, they are able to see different features, depending on what the company has chosen to activate’. (Interview provider 1).

The third category is the transmission of information to workers including their active input unfiltered by management. This means that workers are producing information to help other workers, a process mediated by digital platforms. On review platforms like ‘Contratados’ and ‘Recruitment Watch’ or in apps like ‘Golden Dreams’ and ‘Jornaler@’, workers can rate their employers and warn other workers about bad conditions. All providers have in common that they consider data protection and the guarantee of anonymity of interviewed or involved workers to be a central priority (e.g. Interview providers 1 and 4). Data protection is ensured by secured servers and contractual provisions with the contracting companies, regardless of the sometimes very different technologies used (Interview provider 1).

Finally, the fourth category encompasses peer-2-peer infrastructures that enable direct contact between workers (and thus collective action). This form of direct and horizontal communication is, however, not yet found in the global value chain tools we researched. An example for such a peer-2-peer infrastructure would be the non-profit platform ‘coworker.org’, where workers and labour activists can start labour rights campaigns and petitions.⁴

This lack of worker-to-worker connections beyond mediated information flows reflects the lack of worker rights at the upstream end of GVCs. While the employee voice literature documents the decline of union membership and the related transition from collective and indirect worker voice to individual and direct worker voice (Kochan *et al* 2019), concepts that originated in high-income liberal democracies do not necessarily travel well to other contexts, for instance to authoritarian regimes without independent unions or to the lived reality of migrant workers without access to worker participation structures (Table 1).

Table 1. Summary of the four categories

Tool category	Active worker input?	Basis of information	Direction of information flow	Frequency of use	Relationship between workers and lead firm
Information platform	No	Collective	Management => worker	Frequent	Direct or indirect
Review platform	Yes	Individual	Worker => worker	Rare	Indirect
Survey or grievance channel	Yes	Individual	Worker => management	Frequent	Direct or indirect
Peer-2-peer channel	yes	Collective	Worker => worker	Rare	Indirect

Table 2. Overview of DWFIs

	Number of tools ⁶	Directed at	Focus	Features for unions (%)
Management oriented	12	Management	Supply chain resilience, workforce management	0
Worker centred	34	Workers, migrants, multiple stakeholders	Worker and migrant rights, combating forced labour	35

Management- versus worker-centred DWFIs

In order to emphasise the main trends that shape the development of DWFIs, which are in turn based on this variety of tool functions, features, and emerging building blocks for DWFIs, it is possible to group the different tools according to their main target group orientation. Table 2 provides a first overview. With regard to the 50 DWFIs evaluated in the database, we have divided them into two groups: We call tools ‘management-oriented’ when they are programmed by for-profit providers for the purpose of using worker data to facilitate managerial procedures such as risk management or the fulfilment of reporting duties. The main focus of the tools is the increase of supply chain resilience – a vocabulary, which gained increasing prominence during the Covid pandemic in supply chain management – and to facilitate and optimise workforce management. Unsurprisingly, they don’t offer any features for trade unions. We call tools ‘worker-centred’ when non-profit providers have primarily designed them to address workers’ concerns or goals (for example, to help them resolve their grievances).⁵ They may be aimed at workers, but sometimes at other stakeholders who share key concerns. They are usually run by NGOs, which often already have a background in supporting workers to solve key social and political problems in different world regions. Some of these tools also offer features for trade unions and would like to collaborate more with unions directly. As one developer of a worker-centred DFWI explains:

‘In particular, we are really interested in working with, for example, trade unions or workers-advocacy organisations. I think, there the criteria is, we want to be identifying who, within civil society, has influence over not just looking at this issues and saying: ‘oh this is interesting’ but how has the ability to drive change and provide remedies? Certain trade unions have a collective influence over conditions’. (Interview provider 8).

Table 3. Features of DWFI

	Information about worker rights (%)	Employer reviews (%)	Digital surveys (%)	Of those: Management involved in survey design (%)	Data analysis for management (%)
Management oriented	29	0	75	78	67
Worker centred	59	28	28	25	27

Yet trade unions are rather reluctant to use these tools and are still not managing to develop their own digital infrastructures – even if they show interest in developing their own tools. To give one example on how a representative of a large German trade union described major hurdles so far:

‘(. . .) I am still firmly convinced that we need something that runs outside of these things like Facebook, WhatsApp or Telegram or something like that – where we have sovereignty over it. (. . .) And that’s what’s happening at the moment with [our trade union], that they are building something themselves. But for the time being, it is only intended for the level of the company, not even across a whole corporation, but it should be scalable and then at some point be developed further so that it can be extended to the corporate level’. (Interview union)

Future research should take a closer look at trade union positions towards worker-centred tools, which at present are often characterised by indifference or lack of information about the technical requirements or potential of DWFI. However, the more these DWFI diffuse, the more relevant it becomes for trade unions to position themselves vis-à-vis different providers (also see further below).

Management-oriented and worker-centred tools cannot only be differentiated according to their different logics, but their feedback infrastructures are also composed in different ways. Table 3 gives an overview of key features of DWFI and their different distribution across tool types. The table shows that both types tend to include information about workers’ rights (management oriented less than worker centred). But they show considerable differences in the role digital worker surveys play (less in worker centred than management oriented), or if data analysis are provided to management. Also interesting is that employer reviews do not exist at all in the management-oriented group (however also not commonly used by worker-centred tools). While the characteristics of digital infrastructure may change over time, and some elements are more common to all than others, we believe that this contrast supports the argument that forms and functions differ across DWFI, particularly according to management or worker orientation.

Next we take a closer look at the role of worker feedback in the different types of DWFI.

Management-oriented DWFI: risk assessment meets technological solutionism

Management-oriented tools have their origins primarily in the emergence of new profitable markets for collecting, verifying, and analysing data on labour conditions in GVCs. They were particularly designed to serve a demand created by new requirements for human rights due diligence, particularly complaint channels, and to technically address the known weaknesses of social audits. Auditing supplier companies is complicated and costly, especially if they are only indirect business partners. Social audits are frequently

announced and take place in ‘showcase factories’, although major violations are to be expected in non-audited ‘shadow factories’. Workers who are interviewed are visible and face consequences if they give the wrong answers; a problem that has already been discussed in research on social audits (LeBaron et al 2017). Tools such as Laborlink, Labor Solutions, and Ulula promise better, cheaper, and a greater amount of data on working conditions by digitising monitoring and audits. The websites of management-oriented tools are thus aimed at companies that want to improve the flow of information between management and workers or/and between lead companies in order to have more reliable data for corporate risk assessment and for reporting duties. They primarily offer feedback technologies such as digital surveys and complaint channels. In some cases, however, these tools are also linked to information and e-learning offerings.

Management-oriented tools are usually provided by for-profit organisations and auditors who are paid by firms. They do not report worker and labour rights abuses to public authorities. Tool providers often monitor suppliers picked by commissioning firms. Any misconduct they may find is treated as confidential information in order to avoid negative publicity for the firm. This is little surprising since if the data actually made labour abuse transparent in value chains, this data would threaten the business models of the very lead firms who pay for the data. There is thus no reason to assume that new digital technologies themselves solve the structural problem of the dependent and inferior position of workers in GVCs, which in turn reflect existing hierarchies in the global division of labour. As DWFIs primarily serve managerial purposes, the tools promise ‘technological solutionism’ (Morozov 2014; Rendueles 2013), i.e. technological fixes to problems that are social and political in nature. We certainly see the danger that digital tools further dehumanise workers and turn them into sources of automated data analytics and their everyday struggles for survival into mere data problems through excessive technological optimism. We also may see some subversive potential implied in the use of data that workers can claim for themselves. However, when we look more closely at the emerging market of DWFIs, we remain sceptical that this potential can be realised.

Asking providers, they are also well aware of the problems of managerial- and data-driven feedback technologies: These include the loss of context in the quantification and collection of data, as well as the inaccurate translation of everyday problems of workers into the quantified and comparison- and governance-oriented ‘language’ of management. The latter may make it possible to digitally record and aggregate existing problems in the value chain, but it harbours the risk that the information collected will be evaluated, interpreted, and selected primarily according to management-oriented criteria. Therefore, some of the big providers complement the digital tools and surveys with personal assistance to the workers in answering the questions:

(. . .) nothing really beats an in-person experience and you still need human interaction to make many of these digital tools truly effective’. (Interview provider 5).

The actual voice of the workers, i.e., for example, also the possibility of participating in defining problems, priorities and strategies for solutions, recedes into the background. The focus is more on customised query options for the management of large clients, e.g. transnational brands:

‘For example, we have standard types of cases. (. . .) The manager needs to categorise the cases into working hours, wages . . . so we have a standard list of that already and it’s already on the dashboard. They can just choose them and go ahead. Some of the brands will say ‘ok, I don’t want your case categorisation. We have our own code of conduct based on our sort of industry’. Then we would tailor that a bit for them’ (Interview provider 2).

(. . .) of course, the brands can always modify [a survey]. In fact, our platform allows them to do that. So, they can modify the questions however they want to and then they can send it out to their workers'. (Interview provider 2).

The infrastructures also do not offer any tools which could be used for worker empowerment, such as connecting workers with each other (Interviews corporation, union, provider 5). Workers have no access to the data they produce, which further reproduces or even reinforces information asymmetries. Especially in this context, interviewees also questioned whether the promised security of the data is indeed ensured (e.g. interviews multi-stakeholder initiative, union).

Worker voices are turned into data to complement other resources for better risk management (Scheper *et al* 2023). They fit seamlessly into other feedback infrastructures that produce data on supply chain-related risks, including new tools for predictive risk analytics for GVCs (Heimstädt and Dobusch 2021).

Worker-centred DWFIs: modest attempts for worker participation in increasingly worker hostile and digitalised environments

Worker-centred tools attempt to serve a different purpose and aim at designing DWFIs that focus more on this needs of workers. The bulk of them emerged in a different social field, namely in the context of civil society campaigns against so-called 'modern slavery'. Labour rights activists and NGOs have for some time addressed the problematic situation of forced labour and migration movements of workers, while also tackling the issue of unions being weak, criminalised, or illegal in many countries at the beginning of GVCs (Rende Taylor and Shih 2019). In this regard, these organisations saw the use of DWFIs by civil society networks as a key opportunity to strengthen workers' rights and power via digital technologies.

Unlike their management-oriented counterparts, the functions of worker-centred tools in our analysis are relatively eclectic and more often limited to specific single issues. Some also specialise in feedback technologies designed to enable workers to communicate their dissatisfaction, concrete problems on the migration route, or a lack of protection of their labour rights. In their analysis of worker feedback technologies Lisa Rende Taylor and Elena Shih (2019) find that 'remediation-centred tools' identify forced labour better than commercial tools developed in the context of what we would call management-oriented DWFIs. In addition to feedback technologies, these are non-profit tools, which offer, for example, legal support, review platforms, or inform workers about human rights. Their websites do not primarily address companies, but are aimed at workers, stakeholders through NGOs to trade unions.

Worker-centred digital tools provide opportunities for activists and NGOs to reach relatively isolated social groups, such as migrants or precarious workers, who are traditionally difficult to organise or excluded from existing mobilising structures such as unions. For example, the Migrant Rights Violation Reporting System documents labour and human rights violations against migrant workers and their families in the South Asian context. Via Golden Dreams and Recruitment Advisor, migrants can warn other migrants about bad working conditions. Issara Institute focuses specifically on Burmese workers in Thailand with its feedback technology, IM@Sea on migrant workers in the Thai seafood industry, and Contratados on recruitment practices along Mexican-American migration routes. The app 'Shuvayatra' informs Nepali migrants about their rights and offers many features such as currency and credit calculators. These are just a few examples of the many ways in which worker-centred tools can be used. In interviews, representatives of the respective providers emphasise that digital communication can be helpful – especially in

the context of a pandemic. However, they also stress that digital networking methods are only one small step for reaching out to workers, as they highlight that marginalised workers in particular need to be supported personally in order to gain trust (cf. interviews provider 6, provider 7).

Worker self-organised monitoring implies peer-2-peer network structures. These are relatively rare so far, but moving beyond DWFIs in GVCs we can see some first experiments with digital organising of US labour. ActionKit provides organisers with the tools to set up their own DWFIs: A simplified tool kit helps activists set up web pages with features such as donation systems or surveys and use data analytics to contact a specific subset of followers or analyse overall activities. UnionTrack creates feedback infrastructures between unions and their members, featuring communication channels, surveys, and data analytics. The National Domestic Workers Alliance established a platform for domestic workers that facilitates employers collectively paying benefits for their cleaners. In addition, they created a chatbot to engage Spanish-speaking domestic workers, which they used in the pandemic to survey domestic workers' needs. It seems that isolated and marginalised workers, such as domestic workers, who do not collectively meet in a workplace might particularly profit from digital organising.

Outlook: potential future developments

The construction of management-oriented DWFIs largely overlaps with notions of worker voice rooted in organisational behaviour and/or human resource management (Wilkinson et al 2020, p. 5). Workers' voices through direct channels are individual sources for management to improve corporate performance (in this case mostly: risk aversion) and do not necessarily serve the main objective of workers to participate in decisions about their workplace (Barry and Wilkinson 2016). Worker-centred DWFIs share more similarities with the view of worker voice as the collective representation of employees, either as a tool for or a complement to trade unions. However, some users and trade union representatives are sceptical about the security of the data and the effectiveness of the tools, particularly in terms of the level of response to workers' grievances expressed through the grievance mechanisms.

The uses and impacts of the tools in the concrete daily life of workers are also directly linked to the working conditions and the social context: places where freedom of association is consistently guaranteed may be those where workers will use the tools with less reservation. Regions where trade unions or civil society organisations already have limited activities may indicate that workers will be less confident in digital communication tools. This is a general trend that goes beyond the division between management-oriented and worker-centred tools. Along these lines there may be space for action and design that integrate the productivity-enhancing focus of management-oriented tools and the decent work focus of worker-centred tools (Hasle and Vang 2021). However, there remains a tension between market imperatives for profitability, management interest for control and risk aversion, and worker interest in decent work that tool design cannot resolve. Further research may further flesh out such questions of tool design and thus contribute to 'humanizing research on working conditions in supply chains' (Soundararajan et al 2021). Table 4 summarises our two clusters of DWFIs, highlighting the articulation of workers' voices and the existence of collaboration with unions.

So far we explained why the concept of worker voice tools is not accurate to define this emerging landscape of digital infrastructures. On the one side, there are significant differences between management-oriented and worker-centred tools; on the other, the very use of the concept of 'voice' would imply more direct and horizontal forms of communication either among workers or with the management of companies, which we did not find in the field. We

Table 4. Types of DWFI, workers' voices, and collaboration with unions

DWFI type	Management oriented	Worker centred
Voice as	Contribution to good governance, reduce supply chain risk	Defence of worker rights, collective organisation
Individual or collective	Individual	Collective +individual
Direct or indirect	Direct or indirect	Indirect
Union or non-union	Non-union	Complement to union (or rarely union involvement)

also stressed that the development of DWFI is highly dynamic. But what can we expect for the future? Which forms are likely to dominate the field of DWFI?

In the context of broader trends in platformisation elaborated above, one would expect network and scale effects among DWFI to precipitate tendencies towards monopolisation. Indeed, one interviewee from a multinational company explicitly remarked that CSR departments are not interested in smaller tools, but in standardised large-scale solutions (Interview company). More data will mean better assessment, which may entail more customers and thus even more data. Considering the fact that the biggest audit and certification firms are multinational stock companies themselves, these are likely candidates to purchase smaller (for-profit and nonprofit) start-ups and integrate them into their emerging feedback infrastructures and multinational platforms. We can already see this tendency with the purchase of the start-up Laborlink by the large supply chain service provider Elevate, for instance.

Given the power relations, business models, and economic pressures within GVCs, it is not far-fetched to fear an integration of DWFI, predictive risk intelligence and other technologies in attempts to maintain and extend lead firm control, legitimacy, even hegemony over some chains. Indeed, Elevate has integrated Laborlink into its 'supply chain [Environmental Social Governance] due diligence platform'. 'Worker sentiment surveys' constitute one data source for supplier monitoring, which provides 'risk assessment' data analytics for 'investors and corporates'. Considering that value capture in GVCs increasingly relies on intangible assets and information rents (Durand and Milberg 2020), management-oriented DWFI provide another power resource for lead firms.

In addition, we expect a further integration of DWFI into bigger GVC-related data environments due to the recent developments in supply chain legislation that seem to increasingly demand lead firms provides transparency over their supply chains. The development of cloud-based ecosystems that aim to integrate the whole supply chain and promise to assess social and ecological impacts of product lifecycles will be even more likely if data-based lifecycle assessment becomes popular in policy repertoires in labour and human rights related issues but also in attempts to combat accelerating climate change.

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Notes

- 1 The concept of 'feedback' relates to the returning popularity of cybernetics as the science of communication and control.
- 2 We conducted case studies in the Brazilian garment and coffee sectors in order to analyse the relevance of local, non-English tools and how workers are actually using them in a specific context. These results will be presented elsewhere at a later point.

- 3 We have looked for as many tools as we could find – the number 50 is a coincidence.
- 4 Through the site, 38,000 Starbucks baristas were able to network in 2020 and win the right to visible tattoos in a first campaign. As a result of this first initiative, baristas won wage increases, paid sick days, extended parental leave, and a paid closure of Starbucks cafes at the start of the COVID-19 pandemic.
- 5 This conceptualisation resembles Rende Taylor and Shih's (2019) distinction between 'remediation-oriented' and 'due-diligence-oriented' technologies, which we find also very helpful to highlight the different scopes of digital tools concerning, on the one side, remedies to workers' grievances and, on the other, the demands of due diligence laws concerning monitoring and screening of human or workers' rights violations.
- 6 The total number of tools is below 50 because there were a couple of tools that we could not clearly assign to one of the two categories so we excluded them from this table.

References

- Asia Floor Wage Alliance (2020) The Emperor Has No Clothes: Garment Supply Chains in The Time of Pandemic. Available at <https://asia.floorwage.org/reports/the-emperor-has-no-clothes-garment-supply-chains-in-the-time-of-pandemic-issue-iii/> (accessed 31 August 2022).
- Bair J (2010) On difference and capital: gender and the globalization of production. *Signs* 36, 203–226.
- Banerjee S (2018) From 'Plantation Workers' to Naukrāni. *Journal of South Asian Development* 13, 164–185.
- Barrientos S and Smith S (2007) Do workers benefit from ethical trade? Assessing codes of labour practice in global production systems. *Third World Quarterly* 28, 713–729.
- Barry M and Wilkinson A (2016) Pro-social or pro-management? A critique of the conception of employee voice as a pro-social behaviour within organizational behaviour. *British Journal of Industrial Relations* 54, S. 261–284.
- Bartley T (2020) *Rules without Rights: Land, Labor, and Private Authority in the Global Economy*. Oxford: Oxford University Press.
- Berg L, Farbenblum B and Kintominas A (2020) Addressing exploitation in supply chains: is technology a game changer for worker voice? *Anti-Trafficking Review* 14, 47–66.
- Butollo F (2019) Data, Artificial Intelligence and Industrial Internet Platforms. Working paper presented at SASE 2021.
- Butollo F, Gereffi G, Yang C and Krzywdzinski M (2022) Digital transformation and value chains: introduction. *Global Networks*. <https://doi.org/10.1111/glob.12388>
- Butollo F and Schneidmesser L (2022) Platforms in industry – disruptors of traditional manufacturing? Policy Brief. Available at https://digitalage.berlin/wp-content/uploads/2022/02/Brief_ButolloSchneidmesser_4.pdf (accessed 15 September 2023).
- Casey C (2020) Industrial democracy in the twenty-first century. In Wilkinson A, Donaghey J, Dundon T und Freeman RB (Hg.), *Handbook of Research on Employee Voice*, 2nd Edn. Cheltenham, UK, Northampton, MA, USA: Edward Elgar, 66–81.
- Davenport E and Low W (2012) The labour behind the (Fair Trade) label. *Critical Perspectives on International Business* 8, 329–348.
- Durand C and Milberg W (2020) Intellectual monopoly in global value chains. *Review of International Political Economy* 27, 404–429.
- Esterhuizen L (2016) Are worker voice tools really about workers' voices? Available at <https://ulula.com/blog/worker-voice-tech/are-worker-voice-tools-really-about-workers-voices/> (accessed 31 August 2022).
- Farbenblum B, Berg L and Kintominas A (2018) *Transformative Technology for Migrant Workers: Opportunities, Challenges and Risks*. Available at <https://www.opensocietyfoundations.org/uploads/df50370-e15a-4a78-99f9-3954c0e73bb3/transformative-technology-for-migrant-workers-20181107.pdf> (accessed September 15 2023).
- Foster C and Graham M (2017) Reconsidering the role of the digital in global production networks. *Global Networks* 17, 68–88.
- Gaia-X Hub Germany (Undated) Supply chain collaboration in a connected industry. Available at <https://www.data-infrastructure.eu/GAIX/Redaktion/EN/Artikel/UseCases/supply-chain-collaboration-in-a-connected-industry.html> (accessed 31 August 2022).
- Hasle P and Vang J (2021) Designing better interventions: insights from research on decent work. *Journal of Supply Chain Management* 57, 58–70.
- Heimstädt M and Dobusch L (2021) Riskante Retweets: "predictive risk intelligence" und Interessenvertretung in globalen Wertschöpfungsnetzwerken. *Industrielle Beziehungen. Zeitschrift für Arbeit, Organisation und Management* 28, 194–211.
- Humphrey J Value chain governance in the age of platforms. *IDE Discussion Papers* (714).
- ILO (2022) *World Employment and Social Outlook: Trends 2022*. Available at https://www.ilo.org/wcmsp5/groups/public/-dgreports/-dcomm/-publ/documents/publication/wcms_834081.pdf (accessed 31 August 2022).

- Jochum G and Schaupp S (2022) Forces and relations of control. In Nuss S und Butollo F (Hg.), *Marx and the Robots. Networked Production, AI, and Human Labour*. London: Pluto Press, 255–268.
- Kelle U (2008) *Die integration qualitativer und quantitativer methoden in der empirischen sozialforschung*. Wiesbaden: Vs Verlag Fur Sozialwisse.
- Kochan TA, Yang D, Kimball WT and Kelly EL (2019) Worker voice in America: is there a gap between what workers expect and what they experience? In: *ILR Review* 72, S. 3–38.
- LeBaron G (2020) *Combatting Modern Lavery: Why Labour Governance Is Failing and What We Can Do About It*. Cambridge, UK, Medford, MA: Polity Press.
- LeBaron G and Lister J (2015) Benchmarking global supply chains: the power of the ‘ethical audit’ regime. *Review of International Studies* 41, 905–924.
- LeBaron G, Lister J and Dauvergne P (2017) Governing global supply chain sustainability through the ethical audit regime. *Globalizations* 14, 958–975.
- LeBaron G and Rühmkorf A (2017) Steering CSR through home state regulation: a comparison of the impact of the UK Bribery Act and Modern Slavery Act on Global Supply Chain Governance. *Global Policy* 8, 15–28.
- LeBaron G and Rühmkorf A (2019) The domestic politics of corporate accountability legislation: struggles over the 2015 UK Modern Slavery Act. *Socio-Economic Review* 17, 709–743.
- Levy DL (2008) Political contestation in global production networks. *The Academy of Management Review* 33, 943–963.
- Locke RM (2013) *The Promise and Limits of Private Power: Promoting Labor Standards in a Global Economy*. New York: Cambridge University Press.
- Lund-Thomsen P (2019) Corporate social responsibility in global value chains. In Ponte S, Gereffi G and Raj-Reichert G (eds), *Handbook on Global Value Chains*. Cheltenham: Edward Elgar Publishing, pp. 285–295.
- Malets O and Quack S (2017) Varieties of recursivity in transnational governance. *Global Policy* 8, 333–342.
- Marks A and Chillas S (2020) Labour process perspectives on employee voice. In Wilkinson A, Donaghey J, Dundon T und Freeman RB (Hg.), *Handbook of Research on Employee Voice*, 2nd Edn. Cheltenham, UK, Northampton, MA, USA: Edward Elgar, 97–113.
- McGrath S and Mieres F (2021) Ripe to be heard: worker voice in the fair food program. *International Labour Review* 160, 631–647.
- Moody K (2018) High tech, low growth: robots and the future of work. *Historical Materialism* 26, 3–34.
- Morozov E (2014) *To Save everything, Click Here: The Folly of Technological Solutionism*. New York: PublicAffairs.
- Morozov E (2019) Digital socialism? The calculation debate in the age of big data. *New Left Review*, 33–67.
- Morrison EW (2011) Employee voice behavior: integration and directions for future research. *The Academy of Management Annals* 5, S. 373–412. <https://doi.org/10.1080/19416520.2011.574506>
- Mosca L (2014) Methodological practices in social movement online research. In Della Porta, D (Ed.), *Methodological Practices in Social Movement Research*. Oxford: Oxford University Press, 397–417.
- Petterson L (2019) Why artificial intelligence will not outsmart complex knowledge work. *Work, Employment and Society* 33, 1058–1067.
- Pye O (2017) A plantation precariat: fragmentation and organizing potential in the palm oil global production network. *Development and Change* 48, 942–964.
- Raj-Reichert G (2020) The powers of a social auditor in a global production network: the case of Verité and the exposure of forced labour in the electronics industry. *Journal of Economic Geography* 20, 653–678.
- Raj-Reichert G, Zajak S and Helmerich N (2021) Introduction to special issue on digitalization, labour and global production. *Competition & Change* 25, 133–141.
- Rende Taylor L and Shih E (2019) Worker feedback technologies and combatting modern slavery in global supply chains: examining the effectiveness of remediation-oriented and due-diligence-oriented technologies in identifying and addressing forced labour and human trafficking. *Journal of the British Academy* 7 (s1), 131–165.
- Rendueles C (2013) *Sociophobia: Political Change in the Digital Utopia*. New York: Columbia University Press =<https://ebookcentral.proquest.com/lib/uow/detail.action?docID=5276043>.
- Scheper C and Vestena CA (2020) Die Pandemie offenbart die Defizite des transnationalen Menschenrechtsschutzes: Ein Plädoyer für eine Konfliktperspektive auf globale Lieferketten. *Zeitschrift für Friedens- und Konfliktforschung* 9, 429–441.
- Scheper C, Vestena CA, Sorg C and Zajak S (2023) Menschenrechtliche Sorgfaltpflicht und der Einsatz von Worker Voice Tools: Partizipation als Risikomanagement? In Haipeter T, Helfen M, Kirsch A and Rosenbohm S (eds). *Soziale Standards in globalen Lieferketten*. Bielefeld, Germany: Transcript, pp. 75–96.
- Srnicek N (2016) *Platform Capitalism*. Oxford: Polity Press.
- Sorg C (2023) Failing to plan is planning to fail: toward an expanded notion of democratically planned postcapitalism. *Critical Sociology* 49/3, 475–493 089692052210810.
- Soundararajan V, Wilhelm MM and Crane A (2021) Humanizing research on working conditions in supply chains: building a path to decent work. *Journal of Supply Chain Management* 57, 3–13.

- Spencer DA (2018) Fear and hope in an age of mass automation: debating the future of work. *New Technology, Work and Employment* 33, 1–12.
- Sproll M (2022) Social upgrading in global value chains from a perspective of gendered and intersectional social inequalities. In Teipen C, Dünhaupt P, Herr H and Mehl F (eds), *Economic and Social Upgrading in Global Value Chains*. Cham: Springer, pp. 145–169.
- Staab P and Nachtwey O (2016) Market and labour control in digital capitalism. *tripleC: Communication, Capitalism & Critique. Open Access Journal for a Global Sustainable Information Society* 14, 457–474.
- Sum N-L and Ngai P (2005) Globalization and paradoxes of ethical transnational production: code of conduct in a Chinese workplace. *Competition & Change* 9, 181–200.
- Tsing A (2009) Supply chains and the human condition. *Rethinking Marxism* 21, 148–176.
- Vogel D (2006) *The Market for Virtue: The Potential and Limits of Corporate Social Responsibility*. Washington, DC: Brookings Institution Press.
- Wilkinson A, Dundon T, Donaghey J and Freeman R (2020) Employee voice: bridging new terrains and disciplinary boundaries. In Wilkinson A, Donaghey J and Dundon T (eds), *Handbook of Research on Employee Voice*. Cheltenham: Edward Elgar P/L ProQuest Ebook Central, pp. 3–16.
- Zajak S, Egels-Zandén N and Piper N (2017) Networks of labour activism: collective action across Asia and beyond. An introduction to the debate. *Development and Change* 48, 899–921.
- Zajak S and Scheper C (2019) The dual nature of transparency: corporatization and democratization of global production networks. In Berger S and Owetschkin D (eds), *Contested Transparencies, Social Movements and the Public Sphere: Multi-Disciplinary Perspectives*. Cham, Switzerland: Springer, pp. 211–232.
- Zuboff S (2019) *The Age of Surveillance Capitalism: The Fight for the Future at the New Frontier of Power*. London: Profile Books.

Dr Christoph Sorg is a post-doc researcher at Humboldt University Berlin. He has previously worked on resistance against debt and published the book “Social Movements and the Politics of Debt” with Amsterdam University Press. More recently he has done research on theories of capitalism, economic planning and digitalization. His new research project studies how economic planning is conducted in market economies, with a special focus on the impact of digitalization.

Dr Carolina A. Vestena is an Interim Professor of Political Theory at the University of Kassel, Germany. She holds a PhD in Political Theory (Germany) and a PhD in Socio-Legal Studies (Brazil) and has conducted research on digitalisation and collective forms of organisation of social and labour movements in global value chains. She published the book “Law in Movement: Collective Mobilisation of Law in Times of Austerity Politics” (*Das Recht in Bewegung: Kollektive Mobilisierung des Rechts in Zeiten der Austeritätspolitik*).

Dr Christian Scheper is a Senior Researcher at the Institute for Development and Peace, Faculty of Social Sciences, University of Duisburg-Essen, Germany. He holds an MA in International Relations from the University of Exeter and a PhD from the University of Kassel. His research interests include global governance, transnational corporations, global value chains, human rights and labour standards. Recent projects have focused on the politics of law and regulatory governance in the garment and coffee industries, corporate due diligence, the digitalisation of supply chain politics, and transnational authority conflicts.

Prof. Dr. Sabrina Zajak is head of the department Consensus & Conflict at the DeZIM centre for integration and migration research. She is an associate professor at the Faculty of Social Sciences at the Ruhr University Bochum. In the department she supervises numerous projects in the field of political participation, diversity and discrimination, conflict and civil society research. At the Ruhr-University she was engaged in research on civil society participation and mobilization in national and international contexts and led, among others, the junior research group on transnational civil society alliances.

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