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RESEARCH ARTICLE

Distributed data network: a case study of the Indian textile homeworkers

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Abstract

In recent years, and with the COVID disruption, many companies have moved toward digitization, adopting digital supply chains for enhanced efficiency. This coincided with the Western Governments mandating, through modern slavery legislation, that multinational companies should mitigate human rights risks in their supply chains. In addition, the Indian government has been making major efforts to equip residents in India with digital identities; first with the Aadhaar identity system, and, on August 26, 2021, the eShram portal aimed specifically at registering informal workers recognizing them formally as part of the Indian labour force. This article shows how a full digitization of the supply chains might be problematic, and in the extreme, might threaten the livelihoods of homeworkers. For the homeworkers to survive the seemingly inevitable digitization, there is a clear need to ensure that they have a direct representation in the digital supply chains. Given the limited ability of the homeworkers to directly represent themselves, we need appropriate models of digital custodianship and policies for promoting their uptake. We discuss the shape that such solutions might take. Finally, an open acceptance by brands of homeworking as a part of their supply chains is called for, paving the way to a public acceptance of these workers' right to a minimum/living wage. To engineer widespread acceptance is an insurmountable task. It is hoped that the eShram scheme will help to change the political balance in India as the informal workers now become "traceable."

Policy Significance Statement

We outline three important nontechnological social policies essential to guarantee a minimum/living wage to 38 million informal textile workers in India. First, the homeworker policy, a recognition of the existence of homeworkers in the supply chains. Second, an all-inclusive power-sharing policy by giving the homeworkers a voice in the design, development, and implementation of the digitization process, and a say in the digitized supply chains. Third, the introduction of digital custodians to help integrate the homeworkers into the digital regimes.

1. Introduction

In recent years, and especially due to the disruptions caused by COVID, there has been a very strong movement toward digitization in many parts of the society. For example, digital passports and online meetings have become hugely more prominent since the pandemic and its aftermath. A further example is

digitized supply chains which have developed with considerable momentum in recent years. There are multiple drivers behind this development, with Büyüközk and Göçer (2018) listing 11 distinct areas in which digital supply chains might be able to offer advantages, including speed, flexibility, and scalability.

In this article, we are mainly interested in another of the claimed benefits of digital supply chains, or digitization in general, namely transparency. The demand from major Western multinational brands for cheap imports has fuelled human rights issues in exporting countries characterized by weak governance. In the last two decades and with recent increased concern about sustainability, countries with stronger governance have started to adopt legislation directly designed to force companies to conduct due diligence on their global supply chains. The first major step was made in June 2004 when the UN Compact was introduced. Since then, legislation of trafficked victims, supply chains transparency, and trade enforcement laws were introduced in the US. The UK has its Modern Slavery Act (2015) that requires large businesses in the UK to submit annual modern slavery reports. At the same time, French, Dutch, German, Swiss, Norwegian, Australian, and Canadian parliaments are rolling out their own legislation. The European Commission proposed, on February 23, 2022, the *Directive on Corporate Sustainability Due Diligence.* When fully implemented, the EU directive will represent first such effort whereby a fine may be imposed for noncompliance. Furthermore, victims will have the opportunity to take legal action to sue for damages if the harms could have been avoided with appropriate due diligence measures. This legislation provides a strong impetus for global brands to demand data concerning their supply chains and especially those supply chains associated with countries of weak governance or where human rights violations are common. It is in this global context that we proposed a distributed data network using the Indian textile homeworkers as a case study. Digitized supply chains, and digitized information *per se*, will help to promote transparency of international supply chains around the world.

A second major factor, in the case of India, concerns the Indian government's drive toward the provision of digital identities for the people of India. The Aadhaar framework is now well-established and provides a biometrically linked identity for all Indian citizens and residents. Much more recent is their drive to register all informal workers in India on the eShram portal.[1] *eShram*, or *eLabour*, can be seen as an extension of Aadhaar that is designed to capture the unorganized working population that constitutes over 93% of India's workforce according to the CIS report (Centre for Internet & Society, 2021). It is not likely that increased taxation revenue is a driving goal since most of these workers are very low-paid, and often oscillate between unemployment and various short-term work. One important component of this population is the workers from the gig economy which is a rapidly rising trend of employment fuelled by the COVID pandemic. The portal will be used to track migrant laborers. The government claims that the data collected will be used to launch new social programs, develop new policies, and create more employment opportunities for workers including those in the unorganized sector. The Indian government even offered work injury insurance to entice the workers to register on eShram.

According to the CIS report, just three months after the launch of the portal, close to 10 crore, or 100 million unorganized workers have registered as per official statistics. The launch of eShram is not without glitches. The CIS report listed 16 recommendations covering a range of issues from operations to governance of data access and storage. Interestingly, the CIS report claims,

> Without a worker-led audit for the data infrastructure owned and operated by platforms, the utilization of such databases for creating a national portal on this scale could paradoxically end up skewed against worker interests. Creating a centralized database could also run into oft-discussed issues around a single point of failure leading to exclusion and ineffective service delivery pathways. As a result, many participants asserted the need for a decentralized governance framework for the portal, and for data management, so that sensitive and private data could be managed and owned directly by workers. This could be done through the inclusion of workers' organizations and unions in a co-operativist database governance arrangement.

[1] https://pib.gov.in/PressReleasePage.aspx?PRID=1749294.

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This view is very much in congruent with our prepositions in this article. It is highly unlikely that eShram will include supply chains due diligence as their records will stop at the supply chains end points instead of traveling "up the chains." Their records of the homeworkers and the local factories might help to determine accident insurance. It is in the CIS report that the civil society organizations recommend that eShram should share their data with 3rd parties and be integrated with existing social security schemes.

Aadhaar and eShram, in combination, provide a very strong policy momentum toward more digitization, the adoption of digitized supply chains, and the involvement of informal workers. However, as we will show in this article by reference to our case study of homeworkers in the Indian textile industry, this federated system can prove very double-edged in supply chains that contain many informal workers including the homeworkers. ILO (1996) defines a homeworker to be: "*a person who carries out work in his or her home or in other premises of his or her choice, other than the workplace of the employer; for remuneration which results in a product or service as specified by the employer, irrespective of who provided the equipment, materials or other inputs used.*" However, in practice, the parties who engage the homeworkers do not normally address themselves as "employers." There is no contractual relationship or any legal obligation between them. Homeworkers, home-based workers, are unorganized workers, self-employed, receiving paid work, especially low-paid piecework, carried out in one's own home. The low-pay condition means homeworkers are typically nontaxpayers and not noticeable, resulting in their coined phrase, *hidden workers.* The most recent ILO study (2021) estimated that prior to COVID-19 there were approximately 260 million homebased workers worldwide, representing 7.9% of the global labor force, and 11.5% of the female labor force. This estimate is likely to have increased amongst the global recessions in the aftermath of the pandemic. The federated system-led digital commercialization could introduce more harm than good if the informal workers lack visibility and representation in the resulting digital supply chain. Moreover, in countries such as India, many such workers have only very low levels of technology ownership and literacy. Indeed, for homeworkers in the Indian Textile Industry, digital supply chains represent an active threat to their livelihoods. This combination motivates us to our proposed use of digital custodians to represent and to protect the interests of the informal workers. We discuss various groups who might be best placed to act as custodians, how the information exchange might be best designed to retain privacy, and the policy changes that are needed to shape a digital construct that is equitable to all.

2. Homeworkers in the Indian textile industry

To substantiate the discussion above, we focus on one specific example, the Indian textile industry in Delhi-NCR and Ambur, and the homeworkers within it. The recommended solution should be scalable to cover supply chains that are much bigger and more complex. This article is derived from a 9-month Turing-funded project, *Resilience in Value Chain and Worker Vulnerability Reduction—Trusted digital identity and payments in the supply chain.* The 9-month project produced five reports (https://enduringnet.org/resilience-in-value-chain/); Carpenter (2021), Choubey et al. (2021), Hickman (2021), Poon (2021), and Spencer (2021), totaling 170 pages, containing between 85,000 to 100,000 words. This short article can be considered as "*strategic narratives*" summarizing the salient points from these reports and the interviews. The main data methodology used in our project involved a small-scale, in-depth survey of women homeworkers and other informal workers (see Table 1). Traidcraft India was commissioned to conduct the structured interviews, and a full report is in Choubey et al. (2021). Data was collected, in the first phase, using semi-structured interview questionnaires from women homeworkers, informal unit workers, contractors, and other supply chain actors. Focus group discussions and informal discussions also facilitated supplementary data collection during this phase. During the second phase, data were collected from homeworkers, a contractor, and civil society representatives. The second phase data collection process was completed via telephone interviews due to lockdown in India owing to the second wave of COVID-19. As we were unable to gain access to workers and contractors because of the pandemic, the Traidcraft team consulted other stakeholders with a practitioners' understanding of the situation homeworkers face. These included CSO/TU (Civil Society Organization/Trade Union)

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Table 1. *Sampling and data collection*

		Method of engagement			
		Delhi			Tamil Nadu
	Type of worker	Interview	Formal group discussion	Informal discussion	Interview
Phase 1	Women homeworkers	20	4	3	5
	Informal unit workers	3			
	Informal workers in factories			2	
	Contractors	2		1	
	Total number of workers/supply chain actors engaged	35			5
	CSOs/TUs	2			
Phase 2	Women Home-based workers	3			
	Contractors and subcontractors (men and women)	1			
	Proxy representatives of the above groups, were not able to engage them in the available time	4			2

representatives, community leaders, and community workers. The timeline for the first phase of data collection was October 2020 to March 2021, and for the second phase of telephone consultations, May 2021 to June 2021.

The team also arranged feedback opportunities with several other stakeholders in no less than 60 zoom meetings,

- two suppliers and three brands over the course of phases 1 and 2.
- four CSOs/TU/NGOs (SEWA, SAVE Tirupur, SABAH Nepal, HNSA)
- two MSIs (Mekong Club and Fair Wear Foundation)
- local textile supply chains expert/consultant
- platform provider (Ulula).

For both phases of data collection in Delhi, Traidcraft was able to draw on knowledge and logistical support from two local CSOs in the Kapas Hera area, Community for Social Change and Development (CSCD); and Ideal Youth for Revolutionary Changes (IYRC). We have also participated in several webinars organized by the Hidden Homeworkers Consortium (i.e., Traidcraft Exchange, Homeworkers Worldwide, and HomeNet South Asia).

Of the project reports, Choubey et al. (2021) and Hickman (2021) focused on giving full descriptions of the Indian textile supply chains and the position taken by the homeworkers within them. In the current section, we give a concise summary of those elements most relevant to the development of a digital solution. According to Panigrahi et al. (2020), the Indian textile industry employed 45 million people in the year 2018–2019. With ILO's (2021) estimate of 85% of the nonagricultural workforce being informal without any social insurance, this means there are 38 million informal textile workers, largely women and migrants, who may never appear in the formal supply chain audits. At the time of our investigation, and before the launch of eShram, homeworkers in the Indian Textile supply chains were "*hidden*" and largely

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undigitized. Unfortunately, eShram was launched after our project was concluded. The industrial scale of registration of informal workers on eShram has a profound impact on the original recommendation and conclusion of our 9-month project, which we try to address in this article.

The role that homeworkers play in the Indian supply chain is that of finishing garments. The initial garment construction and sewing are done in factories before the garments are given to subcontractors who distribute the garments to homeworkers who complete them. The subcontractors then gather the finished garments and deliver them back to the factories who send them to the overseas Western brands. The payments then flow in the reverse order, with the factories paying the subcontractors who are then responsible for paying the homeworkers, normally in cash. While some of the completion work, such as hand embroidery, is highly skilled, the vast majority involves unskilled tasks such as thread cutting. It is these unskilled homeworkers whom we focus on here. Most manufacturers do not, and are not normally required to, know who the subcontractors have assigned the work or how much the homeworkers were paid. The homeworkers sometimes work with more than one subcontractor and have no means of knowing which brands and from which countries are receiving their finished products. There are also examples where the brand-factory-subcontractor-homeworkers link is more permanent. In this case, there is usually a helpline operated by the overseas brand where the homeworkers could raise their grievances. It is important to appreciate that this use of homeworkers is not purely exploitation enacted for the economic benefit of the factories and the ultimate buyers. While the factories do benefit, especially from the ability to handle the erratic fluctuations in demand, the homeworkers themselves considerably desire the wages that the work brings. Homeworkers are nearly all women, and the homeworking provides an often essential source of income that they would otherwise find very hard to earn under the current social and economic structures in India.

Despite this, as documented in Choubey et al. (2021) based on the survey of 35 textile workers in Kapas Hera, Delhi, and 5 leather workers in Ambur, Tamil Nadu, the homeworkers are subject to a range of exploitative behavior due to their very low degree of visibility. All the female workers interviewed for this study, aged between 24 and 45 years, are mostly from Bihar and Uttar Pradesh migrated to the National Capital Region at least 5–10 years ago. All these women are married, have children with an average family size of 4–5 members and typically with only one primary earning member, usually the husband. Out of the 20 people interviewed in Phase I, 13 belonged to the "General" caste, and 7 were *Dalits*/ Scheduled Castes (SC) and Other Backward Classes (OBC). Women homeworkers in Kapas Hera are generally not associated with any trade unions or workers collective. However, a local organization called the Centre for Social Change and Development (CSCD) has recently begun efforts to organize these women, along with other female garment workers, into a membership-based collective. Most of the women in our sample are illiterate, perform work that can be categorized as low-skilled or "unskilled" but is essential to fashion garments and other textiles. The nature of their employment is intermittent—they could be switching between formal and informal employments or between different types of informal employments depending on the availability of work and the homeworkers' personal needs. As we discovered during our project, it is only the subcontractors who even know who the homeworkers are and where they live. The factories simply know that the garments are processed at a given aggregate cost. This invisibility works both ways—the homeworkers simply know that they are processing garments, not who for.[2] Such opaqueness might be gradually removed when the eShram exerted its full impact. The homeworkers could then be more visible as a result. At present, the effect of this very low visibility and transparency is to leave the homeworkers highly reliant on the good will of the subcontractors who engage them for their services. Since these subcontractors are themselves subject to extreme cost and time pressures, it is not a surprise that a variety of forms of exploitation arise. Many homeworkers are heavily indebted, especially with the COVID pandemic, and homeworking income, although meager and scarce, is an important livelihood for this vulnerable group.

[2] See Choubey et al. (2021), Part 1 of Findings, Section A – Homeworkers and other informal supply chain actors in the garment sector, Delhi NCR, pp. 18–22.

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2.1. Global brands and homeworker policies

As noted in Hickman (2021), the Indian apparel manufacturing industry was worth $90 billion in 2021, $16.8 billion of which was exported to serve Western brands. These brands, through their supply chain management policies, have a very strong influence on the treatment of homeworkers. As described in Carpenter (2021), many brands currently have policies that there should be no homeworking present in their supply chains. In practice, given the very strong motivations for engaging homeworkers in the Indian textile industry, such policies have simply meant that no one admits to its occurrence rather than stopping such homeworking from happening. This situation clearly enhances, and reinforces, the dangers of the homeworkers being exploited. In fact, the presence of extensive, unacknowledged homeworking in a company's supply chain represents a very clear risk of human rights abuses. Since removing the homeworking entirely is not feasible, nor socially desirable, the logical next step for the policymakers is ensure that global brands acknowledge the presence of homeworkers in their supply chains.

Ideally, as Traidcraft and Homeworkers Worldwide are campaigning for, companies should be publishing policies acknowledging the existence of homeworking and promising to manage it constructively. However, as we found when we surveyed those reports by global brands, only very few Modern Slavery reports even mention homeworking. Carpenter (2021) identified 113 textile retailers in the Noida-Gurgaon area from the open apparel registry, and 33 Western suppliers/brands were found to be connected to them through the supply chain but only 30 have records that can be traced in the public domain. Of the 30 companies that we were able to trace, 10 were identified to have openly adopted homeworkers' policies, 6 made statements that would have effectively banned homeworking in their supply chains, while 14 were ambiguous on the matter. From this sample of 30 firms, it means that any factory acknowledging the existence of homeworkers in its labor force could risk surrendering between 1/5th (i.e., 6/30) and up to 2/3rds (i.e., 20/30) of its potential export market. We do not claim the evidence here extrapolates to the 8000 UK businesses whose reports we downloaded from the UK Modern Slavery registry. Nevertheless, this serves to illustrate the serious and real threat to our effort in Kapas Hera and Noida in bringing the homeworkers to the surface. With eShram's large-scale registration of unorganized workers, the tracing of homeworkers in Indian textile supply chains becomes more feasible than before. This is one area that requires joint effort from modern slavery act legislators, trade enforcement laws, and ESG investors to also recognize and acknowledge the presence of homeworkers in the supply chains. This will encourage the brands and suppliers to also present their homeworkers policy openly. Political maneuver by the various interest groups, when properly orchestrated, might lead to a considerable effect on improving the livelihood of millions of homeworkers.

2.2. Digital readiness within the Indian textile supply chain

Before moving on to consider the consequences of digitizing the Indian Textile supply chain, we must study the degree of digital readiness of the actors within it. The factories themselves are, partially due to their need to work with Global brands, in general very capable of participating in any form of digital supply chain. While the subcontractors are much smaller scale operations, often single person, they are generally educated well enough and economically well off enough to at least have smartphones and could again participate in a digital supply chain. Our knowledge about the subcontractor is acquired through our contacts in India, namely staff members from Traidcraft India who were commissioned to conduct interviews locally. Apart from their local knowledge, we have included a subcontractor in the list of interviewees.[3]

The homeworkers themselves, however, are currently much less well-equipped to participate. They are often poorly educated, and the vast majority simply do not possess any means of accessing the internet. Many women interviewed have (access to) mobile phones, and some have smartphones. The ownership of smartphone by these women has increased as the children's education has moved online during the COVID pandemic. With their Aadhaar cards, the homeworkers understand how fingerprint and iris scan

[3] Section 4 of Choubey et al. (2021) describes in detail the contractors and the community-based subcontractors.

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are used in identification. The women are familiar with IVR (Interactive Voice Response) technology as they use it to order LPG gas cylinders. Most women with a smartphone did not know how to access the internet or use internet-based applications such as WhatsApp or Facebook. It was mostly younger women, ranging from 24 to 30 years of age who expressed a certain degree of familiarity and comfort in using smartphone technology. However, they are all very eager to learn new technologies and new skills especially with the Indian government's digital policy; all government services in Tamil Nadu are now available through eSevai portals.

While the homeworkers indicated that they prefer to be paid in cash, there is a very real chance of digital payment solutions being adopted in the textile supply chain. One supplier, we consulted, was a strong advocate for this. The combination of Aadhaar and eShram is likely to solidify the role of digital payments for this group of marginalized digital users. The launch of eShram has up the level of digital readiness. Significant potential transparency and traceability advantages are expected through digitization. But as discussed in Carpenter (2021), if the homeworkers lack a strong representation in the digital supply chain, their voice will be excluded, and they will be exposed to exploitation. This then leads on to another critical role for the Self-help Groups (SHGs)—they provide an effective route to support homeworkers with meaningful, active, digital representation within any digital solutions that develop.

2.3. Digital identity and the Indian government

There is one further factor potentially pushing digitization further within India. That is the Indian government, who are keen to move toward the widest possible use of digital identities and to promote digital government. Interestingly, due to India's centralized digital identity system Aadhar, nearly all the homeworkers have a biometrically backed digital identity as an Indian citizen or a resident in India. Until recently, what they lack is an identity as a worker, with a considerable majority of them not claiming the in-work state benefits to which they are entitled. The situation might change soon when the eShram registration is completed and when the government promises are fulfilled.

The earlier digital movement has taken the form of nationwide digital frameworks. Digital India, for example, is a campaign to ensure Government's services are made available to citizens and residents in India electronically by improved online infrastructure with better internet connectivity. The Prime Minister Narendra Modi launched on August 15, 2014 the "Jan Dhan" scheme, which is a universal banking, financial inclusion program aiming to bring banking services to large rural areas. Finally, the Aadhaar identity system means that many Indian citizens and residents possess a digital identity. Since these identities are centrally controlled, and biometrically backed, there are several legitimate concerns about their potential use, as described in Masiero (2017) and Krishna (2021).

In addition to the above, there were several cases where informal supply chains have been moved to work using digital systems. The most prominent of these is the Indian ration card system. This system is responsible for distributing, on a state-by-state basis, a critical state benefit in the form of physical food. Many Indian states have attempted to digitize this supply chain, partly to reduce the amount of waste due to corruption. As described in Masiero and Prakash (2015) and Masiero and Das (2019), these changes had several effects, some of which are far from being seen as positive by people receiving the rations. Another example is a taxi supply chain introduced in Delhi. Again here, the taxi drivers did not benefit directly from the digitization (see Krishna, 2021).

One further, very relevant, example is the Indian governments recent launch of the eShram portal.[4] Centre for Internet and Society (2021) described the practical obstacles to register on the eShram portal. While well-meaning, and logical, the eShram scheme could potentially have a huge flaw for homeworkers in the textile industry. Given the current policies adopted by Western brands in relation to homeworking, any person formally known to be a homeworker might immediately be disqualified from further employment. This extremely unfortunate impasse further shows how delicately any digital interventions must be considered, and underscores the importance of reform needed for the policies adopted by global

[4] https://thewire.in/government/eShram-portal-aadhaar-digital-india-unorganised-workers.

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brands. In conclusion, there is a very strong, definite momentum toward the adoption of digital technology in India, which seems likely to drive the adoption of digital supply chains within the country.

2.4. The consequences of digitization for the Indian textile homeworkers

Given all the previously mentioned momentum driving digitization and the adoption of digital supply chains within India, we must now consider the likely effects of digitizing the Indian textile supply chain. There are two distinct cases to consider here.

The first case would involve some Global brands continuing to refuse to acknowledge the existence of homeworkers in the supply chains. In this case, the digital supply chain would have to omit the homeworkers entirely from consideration. In one sense this would simply formalize the lack of visibility of the homeworkers but doing so would make their exploitation both easier to enact and ultimately harder to address. The second case is where some global brands admit to the existence of homeworkers. As seen in Carpenter (2021), perhaps around a quarter of Western companies have this status, with ongoing campaigns in the area hoping to improve the situation, so it is easy to imagine such a system being set up by some interested brands. In this case, it would be possible to set up a digital supply chain containing the brands, factories, and subcontractors as active participants. The homeworkers would, however, due to their digital position, be forced to remain as purely passive participants, unless represented by *digital custodians.* Whether represented by digital custodians or not, it is important to give the homeworkers a say, a representation, at the design stage of such a digital system.

In theory, a digitized system would provide solid information regarding how many homeworkers have worked on a specific batch of clothes, how much work each did, and how much payment each received. Unfortunately, the only source of this information would be the subcontractors themselves. Given the substantial structural reasons motivating the subcontractors to exploit the homeworkers, they clearly represent a highly unreliable source for this information. To make such a digital supply chain operate well, we must therefore find some second source that can audit the accuracy of the information provided by the subcontractors. This would not need to verify every transaction, merely a sufficient percentage to motivate them to report honestly. The current supply chain contains no entity well-placed to perform this task. Given the strong likelihood of digital supply chains arriving in the Indian textile industry, and the need to have such an entity to make the digital supply chain work well, there is a very strong motivation to find a way to ensure data integrity. We suggested in Sections 2.6 and 3, how governments in- and outside India, might help to promote the creation of a trustworthy distributed data depository.

2.5. Digital (identity) custodian

(Identity) custodian is a well-defined concept and construct in the SSI (Self-Sovereign Identity) literature. It has an important role in a decentralized system and especially a digital one. Acting like a trustee, custodian acts in the best interests of its wards (i.e., homeworkers in this case). Here, we expect custodians (e.g., self-help groups, the local unions, a sympathetic factory owner) to help the homeworkers bypass the digital barrier, and to stand up for their interests in the consortium designing and managing the data collection and data sharing arrangement. Indeed, we visualize this in a wider context such as the modern slavery intelligence network, whereby the victims will be represented by NGOs and CSOs as custodians.

Custodians, whether digital or not, are entities (persons or organizations) who are entrusted to act on behalf of their wards. In theory, custodian could also be an algorithm or an AI (Artificial Intelligence), provided that the wards' interest is protected and served. Here, the key is not because the worker is skilled or unskilled, but if the worker has the capacity to claim and protect its own rights via digital or nondigital means. Indian homeworkers are typically women, rely on their husbands to access mobile phones, most likely digitally illiterate and, due to the gender and family position, have little say on personal matters. We envisage this is one group of the population who will benefit from having custodians protecting their interests.

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Finally, the custodian relationship need not be a permanent one, and its function is by no means universal. One may have a custodian for identity verification, and another custodian for processing grievance. The power and duration of the custodian relationship should be well-defined. The ward should be able to terminate such a custodian relationship or change custodian at any time. These should be spelt out clearly in the governance structure of the custodian relationship.

2.6. A decentralized bottom-up data depository system

To audit the data supplied regarding homeworkers, we need a trustworthy mechanism to obtain information from homeworkers regarding how much work they have completed, their pay, and any major complaints that might have arisen. The low visibility of homeworkers makes this a formidable task. It seems very unlikely that it will be possible for an overseas brand to create and impose an external solution on the homeworkers. Even Traidcraft, a benevolent NGO with formidable experience and expertise, faced major challenges in physically locating homeworkers during the 9-month project. Any form of external appointed auditors, inevitably viewed with some skepticism due to their role, would face correspondingly larger obstacles. Instead, any solution to this problem must arise organically from the bottom of the supply chain.

While the difficulties imposed by the COVID epidemic limited our ability to directly test different models, based on our experience within the project, we were able to identify two models of organizations that might prove suitable. The first was a single, highly socially engaged, factory (or supplier) that had spent considerable time and effort building up its knowledge of the homeworkers. We have encountered a few progressive suppliers to witness how this option works. It is easy to imagine such a company being trusted to act as an auditor by a Western brand. Obviously though, there is little chance of such a model scaling in the general case. Many factories in India are not interested in the homeworkers in their supply chains, and there is little reason for homeworkers to trust them.

A potentially more durable approach, described by Choubey et al. (2021), would be to encourage the homeworkers to form local self-help groups (SHGs) to provide mutual self-support and assistance, and as a group be supported by local CSOs. The SHG is a social structure that is common in Ambur, where women sometimes conduct saving-loan transactions among themselves (Choubey et al., 2021). These groups would then automatically be able to find their local homeworkers and would be well-placed to gain their trust and work together as a collective. There are many relevant CSOs in India, with SEWA (Self Employed Women's Association), SAVE (Social Awareness and Voluntary Education), SABAH (SAARC Business Association of Home-Based Workers), and FairWear Foundation, as some very prominent examples. Given this level of acceptance, this model is well-placed for developing organizations to support homeworkers in any digital supply chains arising in the Indian Textile industry complementing the progressive factory owners and suppliers in the previous model.

Since each local group would be small in scale, with the members knowing each other, they will be able to validate each other's identities. Here, we refer to the data collection point where both the data contributor and the data collector must verify each other's identity to establish trustworthiness for the data collected. In the case where this relationship is between two women living in the same community, identity verification is probably not needed. If a factory is the data collector, then the factory is likely to already have the identity of the homeworkers, or in a position to efficiently verify it. In other cases, where the data collection point is a well-established third party, for example, SAVE, then the ID verification process might be one way, that is, one only need to verify the identity of the data contributor but not the well-established data collector. The CSOs are also in a better position to perform some identity verification, checks on supply chains payments to homeworkers, as well as gather sufficient information to ascertain some average hourly wage that can be cross-checked with similar information collected by factories from the subcontractors. To protect the identity and privacy of the homeworkers, one could anonymize job and payment information, when sending aggregate information over to the factories and Western brands for analysis. The largest practical obstacle to this solution would probably involve the need to train the CSOs and especially the self-help groups in using any supporting software to report homeworker data.

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If we define a collective as a collection of many local groups, there are many useful supporting roles this collective may deliver including acting as regional data collection points where useful labor statistics for this "hidden" bottom layer of the supply chains can be published. A sample of 10 Phase II interviews suggests the response to the collective initiative was mixed (Choubey et al., 2021). The three women homeworkers interviewed at Kapas Hera said they understand what a self-help group is and associated it as "women working together and supporting each other." They are ready to join one if offered and felt their husbands would support their decision. It is then no surprise that they are "happy to share very detailed information (including personal data, full ID) with the collective." The women are wary of scams, and generally do not trust bank, contractor, brand, and supplier to hold their personal information. The local CSO representative thought some women might not appreciate what a collective is, but the local CSO representative is confident that the women are capable of understanding the concept of a collective, and that they would embrace it if the collective can help them get work or support them through COVID. There are other stigmas, for example, concerns about being seen as troublemakers by people higher up the supply chains, women with young children, Muslim minority, the husband's, the family's, and even the landlord's attitude toward a collective could deter the women from registering with a collective. A female subcontractor was suspicious that the collective might take away her livelihood. A CSO explained that a lot of rapport building is needed to build trust before introducing a new collective; these women do not easily trust a new organization or a new set of people. As Carpenter (2021) pointed out, the proposed digital solution is as much of a social intervention as a technological one. Finally, it is also important to ensure interoperability between local groups, especially if they do not belong to the same CSO or the collectives overlap with two or more supply chains. Ideally, and to minimize data risk, the PII (personal identifier information) should be anonymized, to eliminate the collective's responsibility toward personal identity protection.

Due to their vulnerability, anonymity and privacy are important attributes for the homeworkers, without which they do not have the confidence to chase late payments, expose sexual harassment cases, and so forth. They are even reluctant for the collective to act on their behalf if there is any hint of losing their livelihood or creating tension in the community. Harassment is a very serious matter. Any intermediation should involve experienced social workers such as SAVE in Tirupur. The technological challenge is much lighter in comparison.

The considerations for registering the subcontractors are different. In some cases, the male subcontractors act in a manner closer to a factory owner, while a female subcontractor's position will be more akin to a homeworker. The latter might choose to register with a SHG, while the previous may onboard the digital supply chains through the factories. The subcontractors will need some reassurance that their roles do not become redundant in the new scheme. Some suppliers and brands emphasized that the subcontractors are indispensable in the complex, seasonal, and real-time process of work distribution, quality control, and delivery. Once the homeworkers (and their SHGs) are onboard, the subcontractors become the next weakest link. Careful considerations are needed so as not to jeopardize this important group in the chains.

In policy terms, then, the question becomes how the formation of the local groups is to be promoted, and how they represent the homeworkers within the digital supply chains. Western Governments can probably only help with this indirectly, by encouraging companies to form positive homeworker policies. The Indian government would naturally be better placed to have some influence in this area especially after launching the eShram portal. Having identified two sources of plausible candidates for gathering and validating the homeworker productivity and payment data, we now focus on the shape that a digitized supply chain with extensive homeworkers might take. We have not dwelt much into the rich literature surrounding trust, culture, and power dynamics in society, data ethics—the use and reuse of data of vulnerable groups, digital ethics of centralized and decentralized systems controlled by governments or private agents, and so forth. Apart from the space restriction, there is no contribution here in repeating these theories that have been well deliberated elsewhere. Instead, we focus on the context where the rights and working conditions of a sample of Indian textile homeworkers might be represented in the digital supply chains.

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We do not recommend the creation of any new groups or new organizational form as this is very costly and unsustainable over the long term. We are proposing networking and sharing intelligence among existing groups and organizations. We suggested self-help groups as one important type of data collection point because of their rooted presence in some Indian communities. But in some cases, some manufacturers are better collection points. During our grant period, we had meetings with a few manufacturers who are both progressive and active in organizing the homeworkers in their supply chains. One manufacturer even actively looks out for sign of child labor exploitations in the families of the homeworkers. Similarly, we have SAVE (Social Awareness and Voluntary Education) at Tirupur who are collecting data from their 30,000 members for living wage negotiations. SAVE and the said manufacturers are already serving as data collection points.

3. A distributed data network

Having identified the policy need and the basic framework for a digital supply chain populated by homeworkers, we move on to discuss the detailed design of such a system. How might it be implemented, supported, and funded so that it can grow? Here we use OAR (Open Apparel Registry) and StopTheTraffik as two examples of existing UK data depositories that can readily be incorporated into our proposed distributed data network. Both have an open data platform accessible by the public free of charge. OAR has indicated that they have plan to expand their scope to other industries in addition to apparel. Traffik is now the designated vendor supporting the platform use by the UK Modern Slavery Intelligence Network, an organization running alongside the UK Modern Slavery Independent Commission and the UK Modern Slavery Research Centre. These organizations play an important role in supporting UK businesses in the compliance with Section 54 of the Transparency in Business Supply Chains of the UK Modern Slavery Act (2015).

3.1. Workers registration

The launch of eShram has made a significant leap forward in the mapping of homeworkers. Any worker who is unorganized, nonincome tax payee, and aged between 16 and 59, are eligible to register on the eShram portal. The eShram portal is a centralized database of unorganized workers seeded with Aadhaar where personal ID such as name, date of birth, address, photo, fingerprints, iris scan, and bank account details are stored. A 12-digit Universal Account Number (UAN) is uniquely assigned to each unorganized worker after registration on the eShram portal. The UAN number is a permanent number which once assigned will remain unchanged for the worker's lifetime. If a worker does not have an Aadhaar-linked mobile number, he/she can register through Biometric authentication. After registering, the worker will get an accident insurance cover, and it is expected that in future, all the social security benefits of unorganized workers will be delivered through the eShram portal. In crisis and national pandemic-like situations, this database may be utilized to provide emergency assistance to workers. Bank details are being captured to ensure hassle-free delivery of benefits under social security schemes or any benefits by the Central/State government directly to the worker's account. The eShram registration also adds useful information such as labor skill sets and some family details to facilitate employment. The UIDAI (the Unique Identification Authority of India) provides facility for licensed third party to verify personal ID using the Aadhaar authentication API.[5]

The respondents at our phase II interviews said they would trust the known NGOs/trade unions and the collective to hold their PII even though the government is the body they most trust. They do not trust any other organizations (namely banks, suppliers, brands, and contractors) to hold their personal data. The homeworkers may not appreciate how the aggregated data is used, but they would like to understand the potential benefits of this data collection to them. Some women do not wish to share their Aadhaar card and bank account numbers. The Data Protection Laws must protect the storage and usage of PII by all data

[5] https://uidai.gov.in/images/FrontPageUpdates/aadhaar_authentication_api_2_0.pdf.

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controllers and data processors respecting the different jurisdictions along the (global) supply chains. In addition, one should apply more stringent ethical codes due to the vulnerability of homeworkers.

3.2. Mapping of global supply chains

After the labor registration, supply chain mapping is the next most urgent task together with the need to persuade the brands to buy into the open homeworkers' policy. For brands that have a homeworking policy, they are only concerned with those homeworkers in their supply chains, and not just any homeworkers. This traceability is especially important when dealing with harassment cases. Due to the multi-layers and potentially many-to-many dynamic relationships, supply chain information is notoriously difficult to map. At the time of writing, the Open Apparel Registry (OAR https://openapparel.org/) is among the best solutions available for supply chains mapping.[6] OAR is a free and interactive web portal for maps of garment facilities across the globe; it shows which organizations are affiliated with each facility. The OAR compiles and makes accessible data and information disclosed from multiple sources, including brands, retailers, civil society, multi-stakeholder initiatives, manufacturers, and government databases. The information is combined into a central, open-source map and database that provides transparency in clothing supply chains. Each garment facility is assigned a unique ID. The collated database of facility names, addresses, and affiliated parties is powered by an advanced name and address-matching algorithm.[7] The Business & Human Rights Resource Centre explained how this open-source map of garment facilities across the globe has helped human rights campaigners to respond quickly to abuse in supply chains.[8]

3.3. Mapping of modern slavery risks

The Traffik Analysis Hub is a collaboration between Stop-the-Traffik and IBM (Watson), and others aiming to share information about human trafficking across all industries and sectors. The authenticated partners upload data from a large variety of sources. In addition, unstructured open-source data is ingested at scale—including thousands of publicly available news feeds. Using IBM Watson—AI, machine learning, and natural language recognition—an intelligent "golden tagging" schema is applied to the data based on terms and incidents related to human trafficking. The output is actionable data visualization and analytic with supporting interpretive narratives.[9] At the time of writing, the Traffik Analysis Hub has an added feature that can overlay the OAR supply chain map onto their human traffic map to facilitate supply chain risk assessment.

3.4. Information on minimum and living wage

From Sections 3.1 to 3.3, a natural next step is to combine, or overlay the textile supply chain labor information from eShram onto facilities such as Traffik Analysis Hub risk map and the OAR supply chains map, or the Indian equivalent. One useful information to overlay could be the hourly wage and pay rate of the homeworkers collated via the network of local groups in Section 2.5. Homeworker Worldwide, Cividep, and Petland presented a collaborative project in Delhi that is captured in the Hidden Homeworkers Toolkit published by Homeworker Worldwide.[10] The objective is to record work done by the homeworkers with agreed price/wage by capturing information on a job card. The data fields include Agent/Subcontractor, (Homeworker) name, ID number, Month, Date, Article, Pairs, Rate, Value, Grand Total, Advance, Net pay, and the signatures of the worker, agent, and internal auditor. The agents/

[6] https://www.laudesfoundation.org/latest/news/2021/03/in-conversation-withopen-apparel-registry.

[7] https://www.azavea.com/blog/2019/03/28/introducing-the-open-apparel-registry/.

[8] https://www.reutersevents.com/sustainability/open-apparel-registry-powerful-new-tool-shining-light-garment-industry. The OAR supply chains data is published under an open data license, Creative Commons CC-BY-SA 4.0. The OAR ID as a unique and shared ID across software systems and databases.

[9] For the latest YouTube demo, see https://www.youtube.com/watch?v=igmIcwuJdjw.

[10] https://www.homeworkersww.org.uk/resources/hidden-homeworkers-toolkit.

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subcontractors use the job card to record the number of pairs of uppers allocated to each homeworker, the agreed piece rate, and the subsequent wages paid. Both agent and homeworker were asked to sign the card providing a paper trail. In the digitized process that we envisage here, the agent could keep a digitized record via an app, and the local support group could use the app to upload a photo image of the job card, which will then be scanned or manually input the data into the system. A sampling audit process could help to ensure the integrity of the data before porting it into a regional, national, or international collection point such as the OAR for deriving the minimum/living wage information at a physical location where the local support unit is based. Once the transaction and cost information are aggregated, there will not be personal data, or the danger of infringing GDPR or data privacy laws.

4. Discussion and conclusion

In this article, we distinguish identity, identification, and ID.[11] Our 9-month Turing project is focusing on the identity of the homeworkers, the identification of the work done by them, the payments made to the homeworkers, the homeworkers' interactions with the subcontractors and the factories/suppliers, and how the homeworkers might be supported and protected by digital custodian and local self-help groups. We take for granted the existence and access to different personal IDs as these are already in the Aadhaar and eShram systems. The solutions will be much more complicated in other countries where not all individuals have IDs and there is no system ready to store and verify the IDs. Our proposed solution is very similar to SSI (self-sovereign identity) verification credential (of the product and value flows) built on the UIDAI App; the Indian government created for 3rd party to query Aadhaar that is linked to eShram. In SSI, digital identities are managed in a decentralized manner and access is controlled by the ID owners. This technology allows users to self-manage their digital identities without depending on third-party providers to store and centrally manage their personal data and the verification permissions. It is most likely that a digitized network of global supply chains would contain a myriad of government ID infrastructures and private SSI-like systems. The ultimate decentralized and distributed services will bring together public and private IDs controllers and a variety of the identity and identification verification processes. The data holders and owners will cross several supply chains (e.g., fashion vs. fishing), stakeholders (e.g., Salvation Army vs. Unicef), and jurisdictions (e.g., India vs. UK). The challenge here is to make the information collated trustworthy and interoperable for the entire global chains.

The Indian case is facilitated by the fact that the Indian ID system is already fully integrated into government services such as, for example, tax, health, food subsidy, accident insurance, and social care. The challenge here is to consider all the ethical and social issues surrounding the federated ID system. India is a unique case study (that may be hard to replicate in other countries that are less advanced in their adoption of digitized government and digitized IDs). The eShram portal was launch on 26 August 2021 and, at the time of writing, has since attracted over 100 million unorganized workers. Based on the limited feedback from our survey, many Indians trust the government system. Hence, in this Indian case study and given the scale of the task, there is no practical and better alternative other than integrating the Aadhaar and eShram infrastructures into the proposed solution instead of reinventing some expensive private ID systems.

There is currently a strong momentum for increased digitalization, and pressure to progressively digitize the entire supply chains worldwide. There are several risks if this is done without considering its effects on informal workers within these digitized supply chains. We identify the need to ensure proper representation for the homeworkers within any digital supply chains. As shown by our examination of the Indian supply chain, this is a difficult challenge and requires some fresh thinking. The solution proposed in this article is unique to India with the country's ambitious national digital ID and identity infrastructures, Aadhaar and eShram. We outline one possible solution for the textile supply chains leveraging the successful mapping services provided by the OAR and the Traffik Risk Analysis Hub that are already

[11] See https://medium.com/caribou-digital/the-difference-between-digital-identity-identification-and-id-41580bbb7563.

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interoperable and global. Other future equivalent, for example, a registry for another type of supply chains, and another type of risk maps must also be interoperable to avoid silos and gaps in the risk management infrastructure.

However, the more important key ingredients to the success are not technical attributes. We have identified at least three of these. First, a recognition by global brands of the existence of homeworkers in their supply chains instead of banning homeworking. Second, a voice for the homeworker in the design stage, and third, the introduction of digital custodians and various support mechanisms to help integrating the homeworkers into the digital regimes. Apart from the first condition, a trustworthy body or system, is needed for the second and third conditions to exist. We take for granted here that any such framework will satisfy the six pillars of ID (and identification) system, namely, security, privacy, ethics, reliability, robustness, and resilience.[12]

It is important to note that the views and recommendations presented in this article are entirely the authors' view. Indeed, the project team has always recommended a "registration campaign" to be the immediate next step. This is now superseded by eShram, the e-portal introduced after the 9-month project has completed. The team consulted numerous stakeholders the idea of a platform managed and owned by a consortium of stakeholders and homeworkers. Apart from the technical design, this multi-stakeholder platform is a social and political goal that is a challenge much bigger than a 9-month project could attempt to address. In this article, in view of the launch of eShram, the authors proposed a distributed data network consisting of existing systems and organizations, which we believe has a more realistic chance of being materialized. Indeed, with the presence of eShram, Aadhaar, and organizations like Stop-the-Traffick and Open Apparel Registry, we believe the proposed distributed data network is a better and more sustainable solution.

Renieris' (2021) exhorted that "we should resist the urge to narrowly scrutinize the technical contours of a given technology or system; we should instead contest the underlying imaginations that shape it, making sure to ask whose imagination it represents." The government, the industry, and the grassroots would have chosen a different system that will cater for their own goals and principles. Indeed, at the time of writing, the Indian government has responded with eShram,[13] some brands have proposed silo solutions involving some disconnected groups of consortiums,[14] while the grassroots seek solidarity through union representation.[15] Here, we propose a hybrid of distributed and decentralized system, that a centralized federated system (e.g., Aadhaar and eShram) could be a component of, to bring these three perspectives into a single framework. The theory of wicked problems suggests that any solution will be the outcome of an iterative adaptation of social and technological change. Hence, to some degree, the global supply chains and the issues of unorganized workers will also evolve through time, and possibly differently in different jurisdictions. Nevertheless, with a small sample survey, and a narrow focus on only the Indian Textile industry in Delhi-NCR and Ambur, we believe that any workable solution is likely to be of the hybrid form because of (i) the heterogenous user groups whom it must serve, (ii) the multi-dimensional and dynamic nature of supply chains, and (iii) the cross-sovereign states collaboration needed in any global supply chains network. We believe the solution and the exact form of the delivery will constantly evolve as social behavior and technologies are continuously changing. The three

[12] See Turing Trustworthy Digital ID Frameworks (https://www.turing.ac.uk/research/research-projects/trustworthy-digital-infrastructure-identity-systems) and Royal Society (2023) Privacy Enhancing Technologies (https://royalsociety.org/topics-policy/projects/privacy-enhancing-technologies/).

[13] The scale of eShram together with the success of Aadhaar (https://observervoice.com/uidai-deliberates-on-five-focus-areas-including-resident-centricity-and-facilitating-ease-of-living-12878/) become an important springboard for many potential social and business solutions such as one proposed here. Unfortunately, the government eShram was launched after the Turing project has completed; we were not able to incorporate it in our survey and interview of the homeworkers and fully exploit it in our recommendations in the project reports submitted at the end of the project.

[14] The *Marks and Start* Project by Marks and Spencer in collaboration with Farida Shoes and Traidcraft, and the Pentland Brands collaboration with HomeWorkers Worldwide and Cividep India have used different approaches to produce feasible solutions for the many challenges faced by informal workers in this sector.

[15] See, for example, Centre for Social Change and Development (CSCD) and Fair Labor Association (http://www.fairlabor.org/).

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recommendations we proposed, namely, brands' acknowledgment of homeworking, representation rights for the homeworkers, and digital custodians should go a long way to make sure the focus on workers' rights always remains in sight.

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Competing interest. S.-H.P. is the founder and trustee of *Enduring Net*, a charitable incorporated organization established in 2019 (charity number 1186332) focusing on distributed technology, AI, identity, and privacy in humanitarian work. M.C. declares no competing interest exist.

Author contribution. M.C. created the initial draft. S.-H.P. is responsible for the content of the revised version.

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