A Use Case for Decentralised Identity at Work
This work was part of a research project, the research collaboration partners are University of Manchester, Alliance Manchester Business School, Traidcraft Exchange, and Incudeas Ltd. The team’s work was also supported by open-source communities at the Trust over IP Foundation and the Sovrin Foundation.

This work was supported, in part, by the Bill & Melinda Gates Foundation [INV-001309]. Under the grant conditions of the Foundation, a Creative Commons Attribution 4.0 Generic License has already been assigned to the Author Accepted Manuscript.

The Institute is named in honour of Alan Turing, whose pioneering work in theoretical and applied mathematics, engineering and computing is considered to have laid the foundations for modern-day data science and artificial intelligence. It was established in 2015 by five founding universities and became the United Kingdom’s (UK) National Institute for Data Science and Artificial Intelligence. Today, the Turing brings together academics from 13 of the UK’s leading universities and hosts visiting fellows and researchers from many international centres of academic excellence. The Turing also liaises with public bodies and is supported by collaborations with major organisations.

The Alan Turing Institute
British Library
96 Euston Road
London
NW1 2DB
1. **Purpose**

This document was produced as part of a project titled “Resilience in Value Chain and Worker Vulnerability Reduction - Trusted digital identity and payments in the supply chain”. The project ran from October 2020 to June 2021 as a collaboration between Traidcraft Exchange; University of Manchester, Alliance Manchester Business School, and Incudeas Ltd. The project formed part of the first wave of seven impact projects which are part of The Alan Turing Institute’s Trustworthy Digital Infrastructure for Identity Systems project.

The main purpose of the project was to investigate supply chains in the Indian apparel sector, and the use of informal workers, particularly homeworkers, within them. The aim was to understand if and how a digital solution could increase supply chain resilience and reduce worker vulnerability.

The purpose of this document is to analyse the patterns of relationships between supply chain actors, the human trust infrastructure; and then use these business requirements to inform the design of an identity system as part of a digital supply chain solution for decentralized and distributed patterns of work, manufacture, and employment.

This analysis is one of four reports described below and produced for the steps of research customer and business requirements (1), analysis (2, 3), solution design and concept evaluation (4).

1. **Informal workers in fashion supply chains - Preliminary Consultations to Inform a Tech-Assisted Support System** (Kratika Choubey, Elizabeth Khumallambam, Priyashri Mani and Rohan Preece of Traidcraft India)
   This is a survey report containing the methodology and results of our interviews with supply chain actors in the Indian Textile supply chain. This survey report was developed in two phases. During phase I the research aimed to understand the working conditions, social and labour rights risks, access to social security, workers’ understanding of the supply chain and access to mobile phone technology for homeworkers and other informal workers. The second phase of the research focused on understanding homeworkers’ willingness to join a membership-based collective, register with said collective, willingness to share data with the collective.

2. **A Use Case for Decentralized Identity at Work** This document.

3. **The Risks of Interventions in the Indian Textile Supply Chain** (Martin Carpenter, University of Manchester)
   This report, focuses on the matter of risk and tries to identify the following:
   - The potential harms that naive digital interventions in the digital supply chain might cause Homeworkers to suffer;
   - The ways in which even a well thought out intervention in the digital supply chain might fail to improve the lot of the homeworkers;
   - The practical obstacles that we would expect to encounter when implementing the range of technological interventions developed during this project.
   This work both helped to guide the development in the project, and our future plans.

4. **Potential Solutions to Support Informal Workers in Apparel Sector Supply Chains** (Dr Nick Spencer, Incudeas)

   The purpose of this technical briefing is to
• Outline the drivers and needs within the supply chain that have formed the starting point for this analysis
• Discuss some of the insights arising from analysis of qualitative research
• Outline the approach taken in terms of ideation around possible solutions
• Describe the output of the ideation process which we have articulated in terms of a series of technology interventions that can be deployed at a local level, with the potential to scale to other locations and to extend the capabilities to create greater utility within the supply chain
• Outline the technical design and implementation considerations
• Review the qualitative feedback received during a second phase of research to test these concepts
• Outline the next steps to undertake a more detailed scoping and design stage

2 Executive summary

This paper is about identity in the world of work, using a case study it seeks to understand the needs, vulnerabilities and risks experienced by both informal sector workers and by commercial actors in the Indian apparel manufacturing sector, and then to consider design requirements for a digital identity system that could meet those needs. The sector is largely undigitized and employs an estimated 38 million\(^1\) informal workers and represents 2% of India's GDP. As such, it gives us an opportunity to understand the patterns of human and organisational relationships that enable the supply chain, the nature of trust in those relationships, the resilience in the overall system, and the impacts of this on the risks experienced by different actors.

In the search for a socio-technical solution, the paper starts by defining a series of analytical tools for understanding identity in the world of work; core identity needs and the role of risk decisions in balancing those needs; and a decentralized model for trust and identity infrastructure design. The paper then turns to the case study, and analyses the needs of different actors that could be satisfied by an identity system. We find that for homeworkers the fact that they are not recognised as workers, even by themselves in many cases, is the root cause of many risks and vulnerabilities. They are invisible within supply chains, and therefore outside of existing compliance regimes associated with business and human rights which are designed to protect them. This lack of recognition as workers means they are unaware of their rights, such as minimum wage, have no access to grievance mechanisms to assert those rights which results in low, late or non-payment of wages.

Through analysis of the supply chain, we find that data and money do not flow with product and that informal workers are hidden from ESG (Environmental, Social & Governance) audit and reporting regimes which forces risks and costs down the supply chains to homeworkers. Whilst this creates vulnerabilities for homeworkers, it is to the commercial advantage of brands and manufacturers, a flexible workforce and low-cost production has created a resilient manufacturing sector as demonstrated by the sectoral response to the Covid-19 pandemic.

The paper then turns to a proposed socio-technical solution comprising worker recognition, transparency and collectivisation as the main functions of a solution from an identity perspective. Transparency meets increased demands from consumers and regulators for

---
corporate accountability for ESG impacts of their businesses. The assertion of identity as workers as part of a group or collective, without individual identification increases worker voice and bargaining power with associated vulnerability reduction through access to grievance mechanisms and information regarding worker rights. At the same pseudonymity as part of a group increases security and protection from harms.

Due to the decentralized, distributed and dynamic nature of the apparel manufacturing networks that feed the supply chain, a top-down, centralized or federated identity system must be complemented by a bottom-up, decentralized or Self-Sovereign Identity (SSI) solution. This use of SSI as a thin enabling layer against an infrastructure model that considers both human and technical trust, enables workers and businesses to be recognised and used across multiple supply chains at different times, in different roles and in different places.

As the data is protected through privacy enhancing technologies (PETs) such as verifiable credentials (VC’s) and the use of decentralized identifiers (DIDs), workers are not exposed to risks of identification such as loss of work or reprisals. At the same time, because SSI enables data portability, and keeps the identity with the worker rather than with the place of work or employer, the costs and risks of holding personal data, risks associated with formal employment relationships for brands and manufacturers are mitigated.

The paper concludes by recognising that the supply chain is both a social and an economic construct, starting bottom up with worker collectivisation, adopting decentralised identity technologies, and by providing accessible bridges to digital services, a socio-technical solution can reduce worker vulnerability and increase supply chain resilience.

3 Introduction

This paper examines how a decentralized or SSI solution could underpin technical interventions that would reduce worker vulnerability and improve supply chain resilience in a decentralized and distributed manufacturing context. We have used a case study of homeworkers working in the apparel manufacturing sector in South Asia, and within that a group of homeworkers in Southwest Delhi. By focusing on an edge case, or extreme users, we are able to design a solution that should be readily applicable to other contexts and geographies, or to users with more capacity, for example higher rates of digital inclusion.

The paper is in three parts, firstly it outlines the analytical frame of reference, defining how we look at identity, risk, resilience, access, privacy and trust. Secondly it looks at the socio-economic context from the perspective of the homeworkers, and from an ecosystem perspective by analysing the supply chain to identify system-level considerations in terms of risk, resilience, privacy and access. We then use the Trust over IP Foundation’s “architecture for Internet-scale trust” as a framework for designing a digital solution which considers identity of individuals in their roles as workers, rather than legal identification or identification as employees; identity of organisations as actors in the supply chain and in the broader socio-economic and global regulatory context in which the supply chain operates. Although identity of things has also been considered, for example in relation to equipment and product, and is certainly a factor, for example the designation of a taxable manufacturing entity depends in some states in India on the number of powered machines in use, it is not a significant factor in the case of homeworkers.

With this focus on people, and their relationships both to each other and to the organisations they interact with, or are part of, we have sought to understand the causes of vulnerability, if and how digital identity could reduce vulnerability and increase resilience. By analysing how this works today based on non-digital systems, a human trust infrastructure if you will, we can
draw insights that inform the design of a trustworthy digital identity system, a technical trust infrastructure, for decentralized, distributed and dynamic value-chains.

4 Analytical Tools

This analysis has been conducted using five different analytical tools:

1. A human rights-based perspective of identity in the world of work to understand how and why identity is so important at work.
2. A model for understanding identity needs as a balance of access and value, privacy and security negotiated through risk decisions on the part of the transacting entities, to understand vulnerabilities of workers and commercial risks which could be addressed using identity-enabled technical interventions.
3. A 3D model to evaluate resilience of the human and industrial systems.
4. A simplified model of trust as the interplay between two actors in the context of a common set of beliefs or rules to understand trustworthiness in the socio-technical design.
5. An architectural model of decentralized, or self-sovereign identity (SSI)\(^2\) which provides a framework for designing digital solutions.

4.1 Identity in the World of Work

Our identities as workers are important and different from our identities as citizens or as consumers. One of our human rights is the right to earn a living, and a fundamental lever for asserting our rights and gaining access to decent work, is recognition of our right to work, and our identity as workers. It is the subject of UN SDG 8 ‘Decent Work & Economic Growth’. Furthermore, work forms a key aspect of our subjective identity (how we perceive ourselves), and the perceptions of others in terms of our role and status in society. In many societies, from Confucius’ ‘four categories of people’, to the UK class system, the type of job we do, serves as a means of introducing division between different strata of society, and as a means of social organisation through guilds, professional bodies and trade unions.

\(^2\) Self-Soevereign Identity (SSI) is a set of design principles for an identity system which enables the identity data to travel with the individual and under their control, rather than being held in silo’s by corporations or central authorities. This ability to have transitive trust and verifiability through use of decentralized internet technologies such as DLT’s and P2P connections enables credentials (also attributes or claims) to be securely shared across ecosystems and contexts, so for example a healthcare credential such as a vaccine certificate can be used to prove covid status to an airline. Although there is an underlying philosophy embedded in the principles of personal agency and individual control of identity data, in practice control, management and ownership of identity data is neither practicable, nor desirable for most people.
In the realm of digital identity, much focus has been placed on the challenge of legal identification and national identity systems as an important route to accessing public services and engaging with the state. Yet in our digital lives, we spend more time either working or playing, where legal identification is not necessary. In fact, in many types of interaction, exposing our legal identity undermines other human rights such as the right to privacy. For this reason, it is useful in designing an identity system to consider three different spheres of life separately as each is used for different types of interaction, has different fundamental flows of value or money, and requires a different level of identity assurance.

<table>
<thead>
<tr>
<th>Spheres of Life/ Type of identity</th>
<th>Interaction type / What it’s used for</th>
<th>Flows of Value/ Money</th>
<th>Type of identification, Level of identity assurance (LoA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Life: Legal or civil identity (Political)</td>
<td>Interacting with government, accessing traditional financial services</td>
<td>Receive state benefits, pay taxes</td>
<td>Actor identification and verification. High LoA</td>
</tr>
<tr>
<td>Work: Employee or Student Identity (Economic)</td>
<td>Economic supply &amp; educational interactions. Finding work or workers</td>
<td>Receive reputational benefits, Get paid for work</td>
<td>Role identification and verification. Medium LoA</td>
</tr>
<tr>
<td>Play: Consumer or Social Identity (Social)</td>
<td>Economic demand &amp; entertainment interactions. Social media, gaming and media consumption</td>
<td>Receive some free services, pay for goods and services.</td>
<td>Behavioural identification, Low LoA</td>
</tr>
</tbody>
</table>

Table 1 Differences between identities used across Life, Work and Play spheres of life.

4 In contrast to the standard egocentric view of identity, in this sociocentric view, identity comes from belonging to different social groups, identity attributes are conferred through a series of relationships with other people both living and dead, and with places and things. For a useful overview of different ways of describing these two main differences, see Smith, Karl (2012) From diidual and individual selves to porous subjects, The Australian Journal of Anthropology. https://doi.org/10.1111/j.1757-6547.2012.00167.x
Digital identity systems are of course well developed in what is termed enterprise, or workforce identity and access management, however they are typically identity systems designed to protect the assets of the enterprise and confine themselves to the employer / employee relationship. Or in the case of temporary or contract workers, a worker’s relationship with an employment agency, or as gig workers in the so-called ‘gig economy’ the relationship between self-employed workers with a particular brand or platform. In all cases, workers are essentially units of production for the businesses and identity is employed to control access to business resources and to support compliance with employment and tax law.

This way of framing identity in the world of work separately from other types of identity enables clear delineation of scope for the analysis of requirements, and a core design principle, rooted in human rights and human dignity.

4.2 Identity as it relates to Access, Privacy, Security and Risk

To design an identity system, it is useful to consider the core identity needs of users separately from the other functional requirements of any application. The model used here defines these as access, privacy and security balanced by a series of risk decisions made by each party in a given context. Factors determining context are the nature of the pre-existing relationship between the transacting parties (social), the value of the transaction to each party (purpose), the degree of choice that each party has to perform the transaction (power), the time (temporal) and place (spatial) of the transaction. In this model the identity needs are characterised as.

1. **Access** – the core purpose of the transaction, an actor’s access to a service or resource such as a building or data set.
2. **Privacy** – the data an actor is prepared to share or has to share in order to gain access to the resource or service
3. **Security** – the potential harms that an actor must guard against in accessing that resource or service

![Figure 2 Core Identity Needs showing example balances through risk decisions on each side of the triangle](image)

Of course, compromises have to be made by either or both parties to the transaction, on one or more of the axes in order to fulfil the transaction. For example, a worker seeking a higher paid job will share a great deal of data with a prospective employer at the risk of a loss of privacy, an employer urgently needing workers will compromise security and compliance to more swiftly gain access to workers and fulfil their orders. As such it represents a balance of
power between the two actors and a calculation of risk on each of their parts. The more the actors trust each other, the more value is accrued from the transaction and the simpler it is to carry out.

Furthermore, the risk decision is not made independently by each actor, there are always constraints, and the identity needs of others in the wider social, economic or legal context. For example, a doorman at a nightclub might know that a given clubber is over 18 years of age, but still must check the individual’s photo ID, because the of the policies of the organisation or a need to be perceived by others in the queue that he is giving equal treatment to all clubbers. This process introduces friction to the transaction and requires a ceding of privacy on the part of the clubber, but it enhances the security and reduces the risk of the nightclub owner.

This framing of identity needs in relation to risk decisions, will be used in section 6.8 to summarise the needs of workers, brands and manufacturers from an identity perspective, and in 7.3 to understand the role of collectivisation in the infrastructure design.

4.3 Resilience

Resilience is a term commonly used in the international development community, who describe resilience as a means of vulnerability reduction and especially consider resilience of ecology, community and society in the face of disasters. In the context of identity, resilience is effectively what manages residual risk, or risk with low likelihood\(^5\).

In this document we will draw on a social and a technical model to aid in analysis. Firstly, a 3D Model of Resiliency from Béné et al (2012) which describes three types of capacity necessary to build resilience: Absorptive or Coping Capacity, Adaptive Capacity and Transformative Capacity. The response that is necessary depends on the intensity of the change or the level of transaction costs.

![The 3D resilience framework](image)

*Figure 3 The 3D resilience framework (Bene et al)*

Secondly a technical perspective, again there are many different ways of characterising technical resilience in digital infrastructures which typically focus on availability, stability and

---

security. Turing Institute’s recently defined three attributes of resiliency, one of their core pillars of trustworthiness: recover, detect and protect.  

As a supply chain is both a social and a technical system combining the social (Béné) and technical (Turing) perspectives on resilience shows how different attributes of resilience dominate depending on the capacity of systems or communities to respond to change and the intensity of change for them. In static, vertically integrated supply chains in primary industries with smaller social networks, or those with long lifecycles such as mining and infrastructure, changes are easier to predict and detect. On the other hand, dynamic, networked supply chains in secondary or tertiary industries with short lead-times, such as those in our case study, rely on access to data about both supply capacity and demand to respond to change. The better the data flows throughout the supply chain, the better the capacity to change and responsiveness.

This combined socio-technical frame for resilience will be used in 6.7 to understand the resiliency capacity and response of different actors within the supply chain as a whole, in particular in relation to the impact of the pandemic, and in 7.1 when considering the role of supply chain transparency in infrastructure design.

---

4.4 Trust

There are very many different ways of characterising and understanding trust. In this document a very simple model will be used.

Figure 4 Trust as a relationship between Trustor & Trustee based on a shared Truth.

Trust can be characterised as having three prerequisites. 1) a Trustor’s individual beliefs, 2) an interpersonal or institutional relationship with 2) the Trustee and their past experience of interacting, and 3) a Shared Truth, “shared knowledge, a shared understanding of general, and context specific rules of the game (Shapiro, 1987; Zucker, 1985), and which can provide structural assurances on the behaviour of the trustee for the trustor. These latter include legal instruments, such as laws (Balkin, 2016; Hall, 2002), contracts (Foorman, 1997), government regulatory and oversight bodies, professional codes of conduct, governance and quality assurance, or market-based functions, such as insurance against risk.” In the world of work, that Shared Truth is the laws, regulations and societal norms associated with employment and is also typically under-pinned by a contract.

This model of trust will be used in section 7 of this document to understand the root causes of vulnerability (7.2) and the role of governance in infrastructure design (7.3).

---

https://policyreview.info/open-abstracts/trust-trustless
4.5 The Trust over IP (ToIP) Model

Designing an identity system for workers is nothing new and nothing difficult in a classic industrial model which is controlled and orchestrated by a single organisation, a centralised model. Or which uses open standards and federated models and identity as a service. However, in a decentralized and distributed model where there is no single entity is trusted by all actors, or where transitive trust across organisational, social or jurisdictional boundaries, a different layered infrastructure is needed. The Trust over IP Foundation (ToIP) based at the Linux Foundation is an open-source community that seeks to build trust on the Internet at scale by addressing both technical and human trust within a layered and decentralized system.

![Twin Stacks of Trust over IP Model](https://trustoverip.org/wp-content/uploads/sites/98/2020/05/toip_introduction_050520.pdf)

In the ToIP model, governance frameworks are used alongside technical standards and cryptography to create a Shared Truth that can be verified by different parties in a decentralized system, transferred from one context to another, and in which identity attributes can be verified by Trustees (verifiers) and Trustors (holders) without the need to have a pre-existing Shared Truth. This overall meta-model for internet-scale trust is still unproven and in the early stages of development and true interoperability in both governance and technology stacks is some way off, but using this model, which is not reliant on a central authority enables a solution to be designed bottom-up mapping and scaling the real-world network of human relationships through dynamic peer connections. Decentralized trust therefore offers a model that enables, through the use of technologies such as verifiable credentials exchange and peer connections, a means of only disclosing information pertinent to the transaction and its context which is controlled by the Trustor.

The ToIP model is used to understand both the social and technical components of a system including both mechanisms for building human and technical trust, (sections 7.3 and 7.5).

---

5 Homeworkers in the Indian Apparel Manufacturing Industry - Socio-Economic Context

As well as interviews with homeworkers and other actors in the supply chain, our research included commercial analysis of the global fashion industry, anthropological analysis of factors such as gender, kinship, personhood and migration, and a detailed analysis of the flows of product, money and data in and around the supply chain so as to understand the needs and requirements of the homeworkers, the root causes of exploitation and vulnerability, and the design requirements for proposed socio-technical interventions and digital identity solutions.

5.1 Indian Apparel Manufacturing Industry

The Indian apparel manufacturing industry is a subset of the overall textiles and apparel industry and was worth $90.1bn in 2018, of which $16.1bn\(^9\) was exported and the remainder domestically consumed. The sector is second only to agriculture in terms of value and employment\(^10\) It contributes 15% of export earnings and 2% of GDP.

The Delhi region remains in the top 5 for textile manufacture, but due to high wages, investment is lower here than in other leading regions such as Andhra Pradesh and Telangana in the southeast\(^11\). The Delhi NCR region is focused on EU/US export global supply chains as opposed to domestic or Middle East markets.\(^12\)

5.2 Industry Trends and Outlook

Despite significant supply chain shocks caused by the pandemic, and reduction in growth and employment in the sector, there are a number of key trends which may support resilience and regrowth in the Indian apparel sector.

1) **Growth of domestic consumer demand** due to the rising middle classes and growth of e-commerce\(^13\). This is suggested as a particular opportunity for low-cost fashion brands to reach this burgeoning demand, and reduces the need for domestic manufacturers to upgrade their value chain through product improvements.

2) **Digital channels to market**, especially use of novel social media platforms which is proving a differentiator for local brands in Asian markets\(^14\). Digitisation is not only used in the sale and distribution of clothing, but also engages the customer at the top of the process in co-creating designs. “Omnichannel is accelerated by technology, but empowered by customers creativity.”\(^15\) This is matched on the supply side by initiatives such as SEWA’s and other direct-to-consumer marketplaces such as Amazon and Etsy.

3) **Consumer demand for ‘social justice’** in the supply chain\(^16\) has been matched by supply-side calls to re-balance the power relationship between western brands and Indian manufacturers; “Many suppliers are demanding a relationship based on mutual respect, fairer treatment, a reasonable share of value and better adherence to

\(^9\) [https://www.investindia.gov.in/sector/textiles-apparel](https://www.investindia.gov.in/sector/textiles-apparel)

\(^10\) Estimated to directly employ around 45m people, with an additional 60m in related industries. See Ashok Panigrahi et al, *Impact of the Coronavirus outbreak on Indian Textile sector;*


\(^14\) McKinsey, *The State of Fashion 2020*


\(^16\) McKinsey, *The State of Fashion 2021*
4) **Vertical integration** of supply chains to mitigate risks associated with inputs supply, for example ethically sourced cotton, and provide greater value capture, a form of value chain upgrade. This represents an opportunity in India which is the world’s largest producer of cotton, ranks 2nd for silk production, 6th for man-made fibres (MMF) and 9th in the production of wool.

5.3 Distributed and Dynamic Supply Chains

The supply chain for apparel may be summarised at its simplest level as having five layers. Broadly speaking formal supply chains are in factory settings for manufacture, whereas informal supply chains are outside factories. However, this does not necessarily determine the status of the workers in each of these settings. An informal worker, who has no contract of employment and is normally paid on a piecework basis may work in a formal setting such as a Factory, Dedicated Centre or Fabricator Workshop; equally a Home Based Worker (HBW) may be formally contracted, especially where the work is highly skilled.

**Figure 6 Basic Global Supply Chain**

There are several types of supply chain in operation within India as they relate to homeworkers, from short and simple, to multi-layered and highly complex. The diagrams below are drawn from the homeworkers perspective, therefore the Supplier is both the supplier of work to the homeworker, and the supplier to the brand or retailer. The Contractor is a broker, subcontracting the work from the supplier and distributing to homeworkers. This first simple example is common in Delhi NCR for unskilled or labour-intensive work such as thread cutting and button sewing, homeworkers (HBW) are likely to be female migrants.

---

22 This is due to the practice of exogamy in northern India requiring marriage outside of the social group. Once married, a woman cuts off all ties with her birth family.
The second model is the other end of the spectrum in terms of complexity and is in place in rural areas around regional city hubs such as Bareilly. As well as low-skilled work, there is highly skilled or artisan work such as *zari*\(^{23}\) embroidery. In these models, it is less likely that the women will be migrant workers. In this model there are up to 3 layers of *contractor* and several other actors such as Village, Cluster\(^{24}\) and Dedicated Centre, this unit is also known as a ‘Fabricator’ or ‘Workshop’ and is a more formal work setting where work requiring specialist equipment or more composite work is carried out. Homeworkers may also visit a Dedicated Centre in order to collect materials or be shown how to receive training. Some of these Dedicated Centres are in operation in Delhi NCR, but appear to have no direct relationship with homeworkers, rather this is more likely to be via a female sub-contractor who in turn has a relationship with a male contractor who is within their husbands’ family group.

---

\(^{23}\) Embroidery using metallic threads

\(^{24}\) These actors were not the specific focus of this study, and would benefit from further research, for example considering the extent to which the organisation of the supply chain is dependent on patterns of social organisation and compliance with social norms.
Analysis of different clustering models shows the following key influencers:

- **Geography** – depending on location of homeworkers in relation to manufacturing units (Supplier)

- **Type of work** – more specialist artisan skills require not only more intelligence in the supply chain, but also wider distribution of the work

- **Social norms** associated with extra-familial gender relations, ie if homeworkers are by and large female, and Dedicated Centres are more likely to be have male workers, then a female intermediary (sub-contractor), or a contractor is required to facilitate work getting to homeworkers.

### 5.4 Homeworkers in Kapas Hera

Kapas Hera is a crowded Village of South West Delhi, it is home to 200-300,000 people, of which around 100,000 pre-pandemic worked in the apparel sector. Kapas Hera was originally

---

25 Maps with key locations here: https://www.google.com/maps/d/u/1/edit?mid=15UMEOdCHinDAKhJAXdCV2fwaBDnUkMcd&usp=sharing
an agrarian village but in the 1970’s Kapas Hera was bulldozed under Emergency Powers and the auspices of Sanjay Ghandi’s ‘beautification of Delhi’. It then became a home for workers in the neighbouring industrial zone of Udyog Vihar. 

Figure 9 Map showing Kapas Hera and neighboring Udyog Vihar Industrial Zone in South West Delhi, India

Today up to 90% of Kapas Hera residents are migrants from Uttar Pradesh and Bihar in North Eastern India.26 Within Kapas Hera there are class divisions where locals are the landlords, and workers are their tenants, this is described by the Gurgaon Workers News as ‘the neo-rich business drive of ex-peasants to convert their former villages – in order to rent it out”. Following the bulldozing of the village during the Emergency of the 1970’s27 the area was re-built on a grid pattern. This means that Kapas Hera is considered different from other slum areas where the residents will have built their houses in a haphazard manner, instead the network of buildings is pre-planned and laid out.28 This is an industrial model of organisation as much for the human resources as for the other manufacturing infrastructure such as access to the airport and the lay-out of the adjacent industrial zone.

Homeworkers are a unique category of workers who produce goods and / or provide services, from in and around their own houses30. 9% of India’s workforce, ~42m people (2017-18) are homeworkers, around 5 million in the apparel manufacturing supply chain31. There are two categories of homeworkers; self-employed or own account workers and sub-contracted or piece-rate workers. In Kapas Hera, the majority of these workers are in this second category.

29 You can explore Kapas Hera and its surroundings on Google Earth
30 The ILO Convention 1986 on Home Work (No. 177) defines homework as: “work carried out by a person, to be referred to as a homeworker, (i) in his or her home or in other premises of his or her choice, other than the workplace of the employer; (ii) for remuneration; (iii) which results in a product or service as specified by the employer, irrespective of who provides the equipment, materials or other inputs used unless this person has the degree of economic independence necessary to be considered an independent worker under national laws, regulations or court decisions”.
of piece rate workers, who are sub-contracted by firms, traders, organizations or their intermediaries (contractors and sub-contractors). They receive workers orders with specifications, are provided with raw materials, and are paid by the piece produced. They do not have direct access to the market. This means that they rarely know who their primary employer is or indeed the brand or market they produce for, nor where the products they make are finally sold and at what price.

The majority of Kapas Hera’s homeworkers are women and the majority of these are migrants from Uttar Pradesh and Bihar. Compared to the status of other women in India, already the most dangerous place to live in the world as a woman, these women rank very low in terms of literacy rates, and female work participation. As well as caring for the home and dependents, being a woman in Kapas Hera is most likely to restrict physical movement outside the home, especially if this means interacting with men outside of the family and is one of the key drivers for choosing home-based work. This also highlights the importance of female intermediaries for getting access to work. In short, the role and status of women plays heavily in terms of the type of work that women can access, the opportunities to work outside the home, the risks of physical harm or sexual harassment and of course pay equality.

---

32 In 2018, a Thompson Reuters Foundation report named India the most dangerous country for women, “the most dangerous on three of the topic questions – the risk of sexual violence and harassment against women, the danger women face from cultural, tribal and traditional practices, and the country where women are most in danger of human trafficking including forced labour, sex slavery and domestic servitude."


34 Shukla, THE STATUS AND ROLE OF WOMEN IN UTTAR PRADESH
5.5 Analysing flows of Product, Data and Money in the Supply Chain

An analysis (See Appendix A), was carried out of the flows of data, money and product in this distributed and decentralized pattern of manufacture which highlighted the following key features:

**Contractors & sub-contractors are essential** for the supply chain to function in this way. They perform the distribution, quality checking and collection of product, they are often the only ones who have data on workers and working conditions, they change electronic money into cash in order to pay informal sector workers.

**Informality exists throughout the supply chain** and is also essential to meet the market demands of speed and low costs. Because demand from brands is irregular, a flexible workforce that can be contracted on an ad hoc and temporary basis is the primary means of managing the risks and costs of formal employment for manufacturers. There are informal sector workers in factories and fabricant workshops as well as homeworkers. Furthermore, evidence suggests that the majority of contracts, even between manufacturers and brands are based on verbal agreement rather than formal written contracts or purchase orders.

**Compliance risks and costs flow down the supply chain from brands.** Specifically, compliance related to workers’ pay and conditions against international standards such as ILO, brands’ national compliance regimes such as the UK’s modern slavery act, and individual companies’ codes of conduct are a condition of business that the brand places on the Indian manufacturer, rather than being mutually developed and agreed. They create cost and complexity for manufacturers serving multiple brands especially due to the lack of common, predictable standards where lead times are short. For this reason, manufacturers request assurances of compliance from their contractors and flow down the risks of non-compliance into the informal sector. Typically, the mitigation of these risks is that audit and reporting stop at formal settings (factories and workshops) and at formal sector workers.

**Information flows are disconnected,** for example information about workers with respect to their skills, location and availability is part of information flows about manufacture capacity and this is disconnected from data flows associated with ethical auditing and regulatory compliance. This crucial information for the functioning of the supply chain is controlled by the contractors who regard this information as a trade secret. Workers are recognised as units of production in one data flow, and they are recognised as people with respect to their labour and social rights in another; yet the two are of course related and both sets of data are needed to satisfy consumer demand and verifiability of compliance.

**Payments do not flow with product.** Indian manufacturers and workers are reliant on credit to fill the gaps between payment terms offered by brands (often only paid once product is delivered in the export market), versus the payment terms demanded by suppliers including informal sector workers. This means that manufacturers, contractors and sub-contractors often have to borrow money in order to be able to pay for work to be completed. This in turn impacts informal workers as payments are often late and incomplete.
5.6 Impact of Covid-19 on Apparel Manufacturing Industry and Homeworkers

Figure 10 Cotton applique depicting Covid lockdown from Seven Sisters Collective in Kapas Hera, July 2020

The pandemic has severely and disproportionately impacted the global fashion industry, with overall profits expected to have fallen by 93% in 2020.\(^{35}\) In India, a 30% contraction in domestic demand was recorded for Q1 2020\(^{36}\), and up to 70% of export demand\(^{37}\). Other impacts of the crisis have included factory closures, supply chain bottlenecks and input supply disruption. Most significantly this has severely impacted workers even in formal settings; “The typical worker lost out on at least two to four weeks of work with only three in five workers being called back to the factory. Among those still employed in the second quarter of 2020, declines in earnings and delays in wage payments were also common.”\(^{38}\) This has resulted in an estimated 57% drop in wages for Indian textile workers.\(^{39}\) However, the sector has also benefited as India has become the second largest manufacturer of PPE in the world\(^ {40}\).

Kapas Hera\(^ {41}\) was hit hard by the Coronavirus pandemic\(^ {42}\) and on 3rd May 2020 the village was placed in lockdown. This meant that many factory workers were prevented from crossing the state border with Gurguram to work in Udyog Vidhar factories. This forced a halt to production in the industrial zone, as well as the supply of work for homeworkers. Many migrant workers were forced to return to their homes in Uttar Pradesh and Bihar.\(^ {43}\) For some, this was because their Aadhaar residency was linked to their home village rather than Kapas Hera, and hence they were unable to access state government welfare such as rations. This in turn has hit the income of local landlords. In neighbouring Dundahera village, one landlord commented, “There is no exact survey, but we can say, for sure, that 50 to 60 per cent rooms are vacant currently in the village, and the exodus of labourers has hit our fixed monthly income from the rents,” \(^ {44}\)

5.7 Resiliency capacity and response

Overall, the Indian apparel manufacturing sector has demonstrated an adaptive capacity because of the decentralized and networked supply model where there are many-to-many

\(^{37}\) ILO Research Brief, The supply chain ripple effect: How COVID-19 is affecting apparel workers and factories in Asia and the Pacific, October 2020
\(^{38}\) ILO Research Brief, The supply chain ripple effect
\(^{39}\) ILO Research Brief, The supply chain ripple effect
\(^{40}\) https://www.investindia.gov.in/sector/textiles-apparel
relationships between different actors. This decentralization or distribution extends to separating the who and what of work, from the when and where of work. This reduces the intensity of change experienced by different actors and increases the capacity to recover by making fewer changes to different parts of the system necessary.

Most mid-sized suppliers we heard about have been able to survive precisely because they are used to erratic demand from brands and to switching on and off supply in response to those changes. Although everyone in the supply chain has experienced significant loss of business due to the impact of the pandemic on the industry as a whole, those manufacturers with the most diverse and trusted relationships with brands and the least reliance on machining or automation, were most likely to remain resilient.

In our case study, we found a good example of this; a seamstress in Kapas Hera who was highly skilled and had previously worked in a factory from which she was made redundant as a result of the pandemic. She recovered by taking up homework and through her local social networks had started to organise a group of other homeworkers to start making and selling their own products. A more transformational response was demonstrated by a manufacturer whose main customers had more diverse product ranges and served middle and upper markets. Before the pandemic, the manufacturer had made specialised evening wear and swim wear for export markets, his business and recovered by changing from fashion to provide home furnishing products.

The main losers from the pandemic have been bigger manufacturers with more integrated supply chains, that is those more closely tied to a smaller group of customers with bigger inventory in the chain and heavy indebtedness, orders which were summarily cancelled by western brands, resulted in the collapse of these companies. The vulnerability of homeworkers has also been exposed. Those that did not return home in the first wave of the pandemic in early 2020, have seen severe hardship. Wages are even lower than before, and work is extremely scarce, however the intensity of change for homeworkers is not as significant as that for the manufacturers.

Use of homeworkers has undoubtedly shown the absorptive (sic) capacity of the Indian apparel manufacturing model in the context of restrictions on social contact and movement. Use of small manufacturing units (fabricant workshops) which are typically based in residential areas has also helped to physically distribute work. Once again, we found that these workshops demonstrated adaptive capacity and defensive attributes of resilience. In Kapas Hera, in the Autumn of 2020, the state government cracked down on those businesses operating in residential areas, mere weeks later, these workshops had successfully re-located to nearby urban villages such as Dundahera.

By examining resilience in this way, we see not only the benefits of decentralization, diversity and distribution at a technical level, but also the importance of social networks and human relationships. In our use case there is no such thing as the supply chain, instead there are free-forming ‘session-based’ or ‘order-based’ supply clusters, that come together in time and space to deliver against an order from a brand. These are orchestrated by manufacturers through a human network of relationships that overlay the under-pinning social structures in order to mitigate risks, meet order lead-times, and to be compliant with social norms. Where relationships are few, weak or hidden, the capacity to detect and predict change is compromised because information does not flow and there is greater vulnerability to smaller changes. Whereas wider social networks and more decentralized technical capability there is
a stronger capacity to defend resilience is achieved through persistence rather than requiring a transformational response.\textsuperscript{46}

5.8 Summary of Core Identity Needs related to access, privacy, security and risk

Having understood the human and business context, we can summarise the needs of different actors against the model of privacy, access and value, security and explained in 5.2 above. For worker vulnerability reduction core identity needs were access to regular, decent work and minimum wages, which could be carried out at or very close to home, and where the women’s health and physical safety were assured.

\textbf{Figure 11 Homeworkers core identity needs and risk decisions}

On the other hand, resilience for brands and manufacturers relied on access to a low-cost, cheap workforce, from private supply networks (trade secrets), whilst meeting compliance requirements.

\textsuperscript{46} The implications for digital infrastructure design illustrated by the strategies and qualities of resiliency illustrated in our case study are quite interesting, it is clear that layered and decentralized architectures cannot in and of themselves deliver resilience, in fact too much decentralization without data and information flows or strong human relationships at some level create risks of their own. Further thinking and research on this model could also enable measurements of resilience to be developed.
6 Trust as a Route to Building Resilience & Reducing Vulnerability

The purpose of our research and analysis has been to explore how a technical intervention could support increased resilience in the supply chain and reduce worker vulnerability by addressing core identity needs for workers and businesses through worker recognition and supply chain transparency, and collectivisation. The proposed socio-technical solution addresses the information asymmetry, power imbalances and exploitation in the system.

6.1 Worker Recognition and Supply Chain Transparency

In our case study we identified two needs or capabilities that could be enabled through use of digital identity and better data flows 1) Worker recognition and 2) Transparency

1) Worker Recognition. An estimated 85% of the labour in the apparel manufacturing sector is informal⁴⁷, having no contract of employment. The pressures of vertically integrated supply chains, price competition, long payment terms, lack of written contracts even in the formal sector (between brands and their suppliers), and unpredictable demand; all make the cost and risk of contracts with workers prohibitive for formal sector actors. Furthermore, every actor in

---

the supply chain has multiple relationships with their counterparties, or the next link in the chain. Homeworkers and sub-contractors work for different contractors at different times, contractors work with different manufacturers, manufacturers work with different brands, who in turn work with different manufacturers.

Recognizing both workers as opposed to employees, and the value-add of their work whether formal or informal, would benefit all actors in the supply chain. The pay, working conditions and livelihoods of homeworkers would have to be considered by the brands and the manufacturers, they would be able to access to social protections, and it would be easier to ensure they were paid on time and were treated fairly. For brands and their suppliers, the manufacturers, recognizing informal workers in the chain could have a number of ESG compliance benefits, for example gender diversity of the workforce and the ability to more efficiently and cost-effectively carry out ESG reporting activities. This will become more and more important in the future and all the brands and manufacturers in our research spoke about increased compliance, due diligence and business and human rights requirements. For example, the EU Draft Directive on Corporate Due Diligence and Corporate Accountability. 48 Brands who fail to acknowledge informal workers, which our evidence suggest are in the majority of chains, then they expose themselves to reputational and legal risks when bad practices are exposed. For example, the Leicester, UK sweatshops owned by fashion retailer Boohoo exposed in July 2020.49

If compliance and reputational risks are the stick for brands, then investment potential is the carrot. The Global Impact Investing Network estimates the size of investment funds in impact investment to be AUM (Assets Under Management) $502bn globally in 2018 which are actively managed with the intention “to bring about positive change”. 50 There is also significant growth in the size of the sustainable fashion market size expected to increase from $6.35bn in 2019 to $9.8bn in 2025. 51

Recognizing informal workers and their work, that is the orders they have been given and completed, would reduce risk for manufacturers, who would be able to get business insurance, have recourse against cancelled orders, reduced finance costs, and share the risks of this quixotic market more fairly with brands. In our research we found one example of a manufacturer who maintained his own registration of all the workers including homeworkers in his chain, although he is perhaps an unusual case, he made it clear that there were benefits to him of doing so, he was able to more quickly and easily carry out audits, and supply information to potential customers. He was also able to more efficiently plan work and had more bargaining power with his sub-contractors because he had this information.

A traditional model of workforce identity management, owned and run by the factories or brands would not work in this complex supply chain structure. As has been seen with the tighter and constrained control of materials supply into the manufacturers by the brands’ supply chain management (SCM) frameworks, inflexibility leads to fragility and lack of resilience. A centralized model, even a federated approach would require cooperation at an international level between competing brands and manufacturers. This would only add cost and complexity, in the same way that different codes of conduct have. Instead, a decentralized

49 https://news.co.uk/news/leicester-sweatshop-scandal-one-year-on-exploitation-abuse-prosecutions-1134805
model which enables peer-to-peer connections as the specific supply chain for each order or job demanded, is more appropriate. It would enable the complex patterns of human relationships to be mirrored in the digital world, support transitive trust and verifiability. This could both reduce costs, for example in the case of audit, and speed up supply for example enabling manufacturers or contractors to more easily provide competitive quotes to their customers.

2) Transparency. Worker recognition is part of transparency, but transparency is more than just knowing what is happening upstream in the supply chain, it includes the communication of that information both internally and externally and is part of governance practices, the G in ESG. Supply chain transparency has grown in the last 15 years\(^\text{52}\), driven by legal, regulatory and consumer demands. This has led to huge growth in demand for ESG data expected to reach $1bn by end 2021.\(^\text{53}\)

It was clear from our research that the lack of transparency\(^\text{54}\), particularly outside formal work settings was to the advantage of some actors, for example brands and manufacturers competing on price, and the intermediaries (contractors and sub-contractors) who considered information about who and where workers were to be their trade secrets. This demonstrates that transparency alone, will not achieve benefits for informal workers, may lead to known risks such as order cancellation or reprisals. It must be complemented by other policy and capacity building interventions such as adoption of a homeworker policy, and detailed supply chain mapping\(^\text{55}\).

There are a number of ways in which transparency benefits workers. If workers knew which factories and brands they are working for, they would be able to access a mechanism for raising grievances or training for example. Visibility of supply capacity (workers, their skills, availability etc), could also be complemented by better visibility of demand, this would enable better forecasting, planning and could provide further supply chain efficiencies such as reduction of inventory in the chain and faster turn-around times. For workers, increased awareness of work availability would reduce worker vulnerability, and increase resilience by enabling better planning, so that for their subsistence they could access other sources of income e.g. welfare payments or cheaper borrowing when there is no work.

As well as legislative, regulatory and investor drivers for transparency, there is some evidence of growing consumer demands for greater transparency, even ‘radical transparency’\(^\text{56}\) from fashion brands. Unfortunately, this does not translate into a willingness to pay more for many consumers, particularly older consumers. A recent European survey found that “shoppers are willing to spend more on sustainable clothing but with limitations, signalling a lack of awareness around costs involved.”\(^\text{57}\) A transparent supply chain with more direct connections between brands and workers, could help brands to demonstrate to consumers the real impacts

---


\(^{54}\) See Appendix A


and true costs of cheap, fast-fashion and support price increases that enable payment of minimum wages further down the chain.

6.2 Vulnerability & Trust

In our supply chain example, it is clear from our research that business is underpinned by interpersonal relationships and is based on social and cultural norms. However, the third component of a common Shared Truth that spans the whole of the supply chain is missing. There are many different laws, regulations and codes of conduct that apply for different brands and in different geographies and there are few written contracts in place between any of the actors. Although trust at a human level, based on these interpersonal relationships and social networks, is what pulls the supply clusters together to deliver an order, homeworkers’ vulnerabilities; their socio-economic situation, their lack of knowledge about their rights as workers, their lack of access to regular work and the constraints of social norms all mean they have little choice but to accept any work that comes their way at whatever rates are offered.

For homeworkers, need takes priority over trust to the commercial advantage of brands. Although this also benefits homeworkers to some degree in that they retain their personal privacy and physical security and do have access to some work, there is no doubt that this need is the basis of exploitation in the market. Homeworkers accept the work, because the risk of going hungry is greater than the risk of not getting paid for that work. In a perversion this third pre-requisite for trust, the Shared Truth that underpins the whole supply chain is that there will always be a worker willing to do the work and complete the order no matter what the price. As one homeworker in our research said, “Everyone is so desperate, someone is always willing to work for a lesser amount”, in other words it is trustless.

In the world of technology and digital systems the problem of trustlessness has been partially addressed by use of technologies such as distributed ledgers or blockchains which serve as trusted intermediaries so that two parties who do not know or trust each other can interact. The Shared Truth in these systems is the technical trust afforded by cryptography and algorithmic certainty, of rules enforced through smart contracts so that no single entity or central authority can exert power by acting as a single root of trust. In this decentralized model, the need for interpersonal and institutional trust is replaced with trust in the code itself and the processes by which it is maintained. Despite the many benefits of the blockchain model it has been shown to be insufficient and vulnerable to social engineering,\(^5\)\(^6\) tending towards centralization precisely because it is a purely technical and economic view of the role of people in the system or value chain.\(^5\)\(^9\)

On the other hand, a Shared Truth that is based on common economic, technical and social rules and which recognises workers as people rather than as units of production will build more trustworthiness throughout the system. For companies this means considering worker pay and conditions not only in the compliance or corporate social responsibility (CSR) departments, but also as a qualitative input to purchasing and supply chain management decisions. In practical terms there are a number of mechanisms for achieving this across a decentralized, heterogeneous and distributed market aside from regulation or enforcement, for example common codes of conduct, standards and certification, and common metrics. In a digital system, particularly one which makes use of decentralized identity technologies, the technical and cryptographic Shared Truth can work together with these legal and social Shared Truths to create a more trustworthy system that benefits brands and manufacturers

---


by reducing compliance risks. This benefits workers, reducing their vulnerability by increasing their agency and power within the system and giving them access to justice mechanisms both inside and outside the supply chain.

6.3 Collectivisation, Human Trust & Governance

We have seen that human trust, particularly for homeworkers is on a person-to-person or P2P basis and breaks down because of the lack of a Shared Truth that takes account of the social and economic context. This gap is filled in the ToIP model through governance frameworks that determine the principles, policies, standards and rules for actors at different layers, which is then backed up by technical means of enforcing those standards. In the case of the Indian apparel manufacturing sector which is the application ecosystem at layer 4 of the ToIP model, there are globally accepted principles such as ILO standards and human rights law, which could form the basis for interoperability at an ecosystem level, and which are currently interpreted in different ways by those actors in the ecosystem who are aware of them, and are obliged to report against them, as with India's Business Responsibility Reporting. For homeworkers, this highlights another gap that must be filled to build their trust in the system, that is awareness of their rights as workers and of who is accountable for upholding them in the work context, for example in an order-based supply cluster.

Our research showed that they had little or no visibility of who they were working for at the upper levels of the chain, and very low awareness of their rights as workers. In fact some did not even recognise themselves as workers. They therefore had no mechanism for asserting those rights or holding contractors, manufacturers or brands to account for their failure to uphold them. This lack of social capital and awareness amongst homeworkers in Kapas Hera contrasts with that of female workers in southern India, where worker collectivisation through groups such as SEWA enable worker education, training and give access to welfare and healthcare services as well as supporting regular work and a minimum monthly wage. As a group they are able to stop the race to the bottom in terms of price, to raise worker voice and increase their visibility whereas individuals they are severely restricted by socio-cultural norms from doing so. This kind of organisational model which starts bottom up by building on pre-existing trusted human relationships and removing competition from the equation with common goals and shared risk, is an important starting point for building trustworthiness.

Use of a collective or group model also enables enhanced privacy and security by reducing the need for individual identification and protecting workers from reprisals, it complements worker recognition and transparency in our model of identity needs. Collectivisation or grouping of commercial actors already exists in the form of Multi-Stakeholder Initiatives (e.g., Fair Wear Foundation), industry bodies, trade association (e.g., Fibre2Fashion) and through certification schemes. This increases their bargaining power with policy makers and regulators whilst maintaining compliance with competition law.
A decentralized identity model enables informal, bottom-up or local groups to form in a way that top-down architectures cannot. For example a centralized model based on a national ID scheme such as Aadhaar, would not work because it only applies to Indian residents and cannot be used for other entities such as companies or organisations, it cannot reflect relationships between different entities without some kind of overlay (e.g. an organization and its authorized employees). Furthermore, use of a national identity system such as Aadhar would face legal and privacy hurdles, and subject any users of the system to the UIDAI. This is not to say that decentralized identity technologies might be used as an alternative to centralized or federated models. However, those who are most trusted, at least from our own research by workers are those outside the supply chain such as NGO’s and Trade Unions. Pragmatically, centralized, federated and decentralized identity technologies are all needed to recognise different types of entities and their attributes throughout the value chain. For example, existing enterprise workforce identity and order-management systems operated by brands, manufacturers or workers own organisations, or the federated identities used in online marketplaces and social media sites. In this context, it is perhaps best to see SSI or decentralized identity technologies and approaches as a thin enabling layer which supports the portability of identity data and its verifiability across different application ecosystems, and contexts, rather than as a replacement for existing digital identity systems.

60 The Aadhaar and Other Laws (Amendment) Act, 2019, clarified the use of Aadhaar and in particular KYC verification by private entities. According to the act, individuals can voluntarily use their Aadhaar number to verify their identities, either through Aadhaar-based online eKYC verification, or through offline eKYC. According to the new rules, the Unique Identity Authority of India (UIDAI) has to ensure that the private entities comply with the established standards of safety, security, and privacy. In addition, the UIDAI will only license a private entity for online KYC verification if it was necessary and expedient, to minimise the risk of Aadhaar data from being misused. For offline verification, the requesting entity must (i) obtain the consent of the individual, (ii) inform them of alternatives to sharing information, and (iii) not collect, use or store the Aadhaar number or any biometric information. The amendment also stipulated stiff penalties (Rs 10 million) and jail terms for private entities violating the Aadhaar Act or UIDAI directions on Aadhaar data.

digital realm such as biometrics, voice channels, feature phones or digital assistance, for example through a trusted intermediary. In the ToIP model this role is described as one of guardian⁶¹ (who can act independently of a dependent on their behalf), or as a custodian (who merely acts on the instruction of the dependent to execute transactions in the digital realm). The actions of guardians and custodians are controlled by governance frameworks at layers 2 and 3 of the model⁶². Worker collectives could act as these guardians or custodians on behalf of their members.

For similar reasons, although nearly everyone in India has a bank account and could in theory receive payments into those accounts, homeworkers still want to be paid in cash. They are wary of banks, bank charges and of technology. As well as low levels of financial and digital literacy, cash gives the homeworkers individual agency and control over how and where the money is used. Constraints on independent physical movement of women outside the home also mean that money paid to a bank account could not be readily accessed by women independently of their husbands.

### 6.5 Technical Trust & Decentralized Technologies

The ToIP technology stack has a number of features and an approach to digital identity that could meet the requirements of supply chain transparency and worker recognition without the need for a centralised database or platform model. Features of the ToIP technology stack that make this possible include:

**Enabling self-assertion of attributes such as worker status** which can be verified or endorsed using the P2P model so that for example, a homeworker could assert that they have received and then completed a piece of work. This could be verified by other workers, or by sub-contractors. The bottom-up issuance of credentials forces transparency up the value chain, and could form aggregated data sets that enable formal sector actors in the value chain as well as Civil Society Organisations (CSO’s), governments and regulators to carry out verifiable audits and due diligence on their true end-to-end supply chains, improving trust and accountability throughout. vLEI from GLEIF is an example of self-assertion using ToIP technologies.

**Privacy and Data Protection through Decentralized IDentifiers (DIDs) and Verifiable Credentials (VC’s).** These technologies allow selective disclosure of attributes about an individual, for example ‘is a worker’, without sharing other information such as Aadhaar number, name or location. The proof ‘is a worker’ is trusted because there is a cryptographic exchange of keys through P2P connections at layer 2 and DIDs at layer 1. IATA Travel Pass is an example of the use of ToIP technologies to preserve privacy and protect sensitive health data.

**Scaling across geographies, entities and different order-based supply clusters using Distributed Ledger Technologies (DLT).** A DLT is a ledger or Utility at layer 1 of the ToIP model that provides an immutable record of transactions where the DID enables verification of the claims or credentials. It is resilient and scalable because it is distributed and because it is underpinned by a cryptographic consensus mechanism. Public-permissioned DLTs are most appropriately used for organisations, whereas private permissioned DLTs are more accessible to individuals, and are compliant with privacy regulation such as the General Data

---

⁶¹ See eSSIF lab Guardianship Pattern Mental Model https://essif-lab.pages.gмет.qg/framework/docs/terms/pattern-guardianship for definitions of guardianship and how this works in a self-sovereign identity model

⁶² See Sovrin’s Guardianship Credentials Implementation Guide, April 2021, as an example. https://drive.google.com/file/d/1vBePVx8n3MRQWcePkwVDya9ab4BHEyU/view
Protection Regulation (GDPR) that regards DIDs as Personally Identifiable Information (PII). Bonifii’s Member Pass, is an example of the use of both public DLT for financial cooperative organisations, and private DLT for individual financial cooperative members.

**Trusted Audit using DLT, VCs and Overlay Capture Architecture (OCA).** The ToIP model allows transactions, product and activities within the supply chain to be tracked and audited. Farmer Connect is an example of how this can be used not only for audit, but also to provide direct proof and connections to end-consumers, enabling brands to verify the authenticity of their ethical sourcing claims. Furthermore, there is growing traction in the ToIP community around how the semantic layer could operate to allow different actors to interpret the same dataset to suit their different jurisdictions and purposes. OCA uses a model that allows for data aggregation that respects privacy and data protection laws through Insights-based service providers and the use of Escrow services. Good Health Pass is an example of a model that makes use of ToIP technologies to enable transitive trust in Covid vaccine and testing credentials across geographies and contexts.

**Building Reputation using DLT and VC’s.** We have seen that one of the vulnerabilities of workers caused by their invisibility in the supply chain is that they are unable to build reputation as a worker. This not only reduces their ability to get higher paid and more skilled work, but also undermines their ability to get credit on reasonable terms, forcing them instead to use informal credit networks. Kiva Protocol is an example of using ToIP technologies to enable people such as homeworkers to build a credit history, a reputation either as an individual or as a group, that is verifiable, and which enables access to credit in the form of micro-loans. Good Worker, Yoma and Truu ID are examples of the use of ToIP technologies to create a verified record of training and qualifications for people working in highly decentralized systems.

7 Conclusion

This paper has identified the lack of informal sector worker recognition and supply chain opacity as the root causes of vulnerability and lack of resilience in the supply chain. Of course worker recognition and supply chain transparency are not the only reasons for worker vulnerability. In particular, the status of women and migrants, the lack of awareness of rights as workers, the lack of social capital and the harsh truths of the industry’s low-cost supply-chain management model all contribute to vulnerability. The tension between the current social audit reporting regimes and the commercial and competitive pressures on brands and suppliers is what gives rise to the lack of transparency in the supply chain below the tier 1 manufacturers. Nevertheless, we propose a socio-technical solution that has the following key features.

1. Replacing the economic Shared Truth of ‘there is always someone willing to work for a lesser amount’ with a new socio-economic Shared Truth, that recognises the positive impact of sustainable and responsible supply chain management practices to investors, customers and the communities in which they operate.

2. Addressing information asymmetries and power imbalances that are the root of exploitation by starting bottom-up to build capacity and social capital through collectivisation in self-organising worker groups.

3. Using familiar and accessible bridges to the digital world so that extreme users such as homeworkers can be digitally included and protected from other harms that are inherent in digital solutions for those with poor levels of digital, language or financial literacy.
4. Adopting the ToIP model that uses governance and decentralized technologies in four layers to enable interoperability across diverse, distributed and decentralized ecosystems.

5. Underpinning transitive trust and verifiability through use of decentralized technologies that enable, self-assertion of identity attributes, privacy and data protection, scaling, audit, and reputation building.

Detailed design of a system that would require further research, testing and analysis in order to meet real-world needs as opposed to a theoretical imposition of the ToIP model. In particular, there are challenges in a number of key areas:

- The rights, roles and responsibilities of custodians who carry out digital transactions on behalf of digitally disconnected individuals such as our homeworkers, yet retain individual agency, control of personal data and protections from harm.

- The risks of imposing a solution top down for example government or supplier enforcement of such a solution which would not be trusted by the homeworkers and would almost inevitably drive informal work further into the shadows, creating room for further exploitation and harms.

- The repeatability and scalability of trust in, by and between workers collectives. Any proposed development would necessarily need to start small with a participatory design approach. Questions then arise around a governance framework for an initial deployment maybe around one collective, and the implications of expanding it to include other collectives and organisations as well as other supply chain actors in order to enable full supply chain transparency.

- The socio-technical mechanisms that enable self-assertion of identity attributes, the creation of dynamic groups which are not orchestrated by a central authority such as a brand or manufacturer, and the bottom-up enforcement of transparency.

- The commercial and reputational risks, costs and benefits for brands in adopting a system which recognises and values all workers in their supply chains.

If such a system could be developed and made to work for extreme users such as the homeworkers in Kapas Hera, it is not unreasonable to think that it might be equally useful and applicable to the near 2 billion people in the world who are informal sector workers.63

---

8 References


12. Indian Brand Equity Foundation, (May 2021), https://www.ibef.org/exports/wool-industry-
India is the ninth-largest country in the world with a population of over 1.3 billion people. The state of Uttar Pradesh is the most populous state, followed by Maharashtra and Gujarat.


34. eSSIF lab Guardianship Pattern Mental Model https://essif-lab.pages.grnet.gr/framework/docs/terms/pattern-guardianship

9 Appendix A – Supply Chain Mapping

The following diagrams illustrate flows of product, money and different types of data or information throughout the supply chain. A detailed write-up and explanation of this analysis is available on request from forgottenworkers@incudeas.com

Figure 15 Core flow of product within Kapas Hera / Udyog Vihar export supply cluster

Figure 16 Ilustrative flow of money in and around the supply chain
Figure 17 Flows of Data in and around the supply chain