Economic Commission for Europe
Executive Committee
Centre for Trade Facilitation and Electronic Business

Twenty-eighth session
Geneva, 10-11 (am) October 2022
Item 5 (b) of the provisional agenda

Recommendations and standards:
Deliverables in support of sustainable development and the circular economy as the outcomes of the sixty-ninth session of the Economic Commission for Europe

Report on the Blockchain Pilots Project for the Garment and Footwear Sector

Draft Proof-of-Concept Report: Harnessing the potential of blockchain technology for due diligence and sustainability in cotton and leather value chains

Submitted by the secretariat

Summary

This draft proof-of-concept report presents key findings from the ongoing Blockchain Pilots Project: Harnessing the potential of blockchain technology for due diligence and sustainability in cotton and leather value chains. This project has engaged representatives from the global cotton and leather industry to test the application of the ECE traceability and transparency standard in a blockchain system to trace products. It uses a multistakeholder approach and covers global value chains. The draft report also provides recommendations regarding the key implementation challenges as well as opportunities for expanding the project to cover other textile and leather fibres and materials.

This project was implemented in the context of the ECE-United Nations Centre for Trade Facilitation and Electronic Business (UN/CEFACT) initiative, “Enhancing traceability and transparency of sustainable value chains in the garment and footwear sector”.

Document ECE/TRADE/C/CEFACT/2022/9, in draft form, is submitted to the twenty-eighth session by the secretariat for information.
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I. Summary

1. Decades of unsustainable consumption and production practices in complex and fragmented garment and footwear value chains has left serious environmental, labour and social impacts. Addressing these issues has become a priority for consumers, governments and industry. Within the garment and footwear sector, the cotton and leather value chains in particular carry a high risk of major sustainability impacts in areas such as animal welfare; water and air pollution; solid waste; exposure of workers to hazardous chemicals; forced labour and child labour.

2. Traceability and transparency in cotton and leather value chains are needed to address these issues because global fragmentation in the production of cotton and leather-based products, and the of high number of actors involved, make it difficult to map where, how and by whom our clothes and shoes are made.

3. Advanced technologies (distributed ledger technology, artificial intelligence, machine learning, and the internet of things) are creating promising opportunities to implement traceability and transparency. They allow for verifiable tracking and tracing of products through every stage of production and enable industry actors to improve, and make available, information about a product’s origin and sustainability performance in a trustworthy way.

4. In support of the United Nations Sustainable Development Goal (SDG) 12 for responsible consumption and production\(^1\), since January 2020, the United Nations Economic Commission for Europe (ECE) has been implementing a project for a blockchain system to support companies in their effort to comply with relevant norms and standards for traceability, transparency and sustainability in cotton and leather value chains. Participants include 73 entities from 20 countries\(^2\) (5 international organizations, 1 DNA solution provider, 4 academia/think tanks, 6 standards & certification bodies, 11 brands/retailers, 36 manufacturers/suppliers, 5 farmers/raw material providers, 1 NGO, and 4 industry associations). They represent all value chain stages, from the cotton field and animal farming stage (farmers, cooperatives, traders), through pre-manufacturing and manufacturing (tanners, spinners, weavers, dyers, finishers, manufacturers), to branding and retailing. The eight cotton and five leather-based products which were traced represent some of the world’s most sold items in terms of volume, including jeans, shirts, t-shirts, pyjamas, socks, shoes and handbags.

5. The pilots project was launched as a platform to allow companies, organizations and stakeholders to test this innovative approach to creating more traceable and transparent activities and products in the fashion industry.

6. Based on this objective, a project was setup with the following ambitious plan and milestones:

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1 The SDGs are part of the United Nations 2030 Agenda.
2 Belgium, Brazil, Chile, China, Czech Republic, Denmark, Egypt, France, Germany, India, Indonesia, Italy, Peru, Switzerland, the Netherlands, Türkiye, the United Kingdom, the United States, Uzbekistan and Vietnam.
7. The initial target was to have the ECE global framework for traceability and transparency in textile and leather value chains implemented in at least one country and four companies by 2022. This target has been exceeded, as shown below:

<table>
<thead>
<tr>
<th>Target</th>
<th>Achieved</th>
<th>Multiple</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of companies involved</td>
<td>4</td>
<td>73</td>
</tr>
<tr>
<td>Number of countries covered</td>
<td>1</td>
<td>20</td>
</tr>
</tbody>
</table>

8. This draft proof-of-concept report provides key insights into the project’s scope, goals, and methodology as well as an overview of the most relevant pilot project use cases as of the date of this report. The draft report then provides an overview of key developments and recommendations regarding the key challenges as well as the opportunities for expanding this project to cover other textile fibres and materials.

9. The supply chain traceability implemented in the current blockchain-based pilot system will be adapted to integrate other textile fibres into the pilots project. Moving forward, recommendations may be developed regarding governance rules and principles, and the effectiveness and sustainability of this technology for traceability in garment and leather value chains will be evaluated. In addition, given that multiple platforms for traceability exist, ECE is uniquely positioned to test its approach on multiple platforms and set interoperability standards. In this regard, and with an eye to scalability, the ECE has already begun work to define the structure of an application programming interface (API) that would enable scalability and interoperability with companies’ existing data management systems. Furthermore, there are ongoing discussions on further testing and enabling the ECE framework on different technological platforms.

10. This draft report also looks at recommendations for addressing the challenges facing SMEs, small-scale actors and vulnerable groups and explores the benefits of blockchain-based solutions for supporting supply chain traceability and sustainability. Finally, the draft report concludes with key recommendations for policymakers, the industry, civil society organizations and technology solution providers.

11. The pilots project was implemented in the context of the ECE–United Nations Centre for Trade Facilitation and Electronic Business (UN/CEFACT) initiative, “Enhancing traceability and transparency of sustainable value chains in the garment and footwear sector”, jointly implemented with the International Trade Centre (ITC) with funding from the European Union since 2019. This initiative is also known as “The Sustainability Pledge”.

Figure 1: Blockchain Pilots Project: Harnessing the potential of blockchain technology for due diligence and sustainability in cotton and leather value chains
II. Background

12. Past, unsustainable practices have created pressure from consumers and governments on the garment and footwear industries to reduce or eliminate any negative social, environmental and economic impacts created by their value chains. Improved traceability and transparency are key tools in achieving this objective and have become a priority because they increase the industry’s ability to manage its value chains more effectively; reduce its impact on the global environment, identify, mitigate and address labour and human rights violations and sustainability impacts; combat counterfeits; and manage operational and reputational risks.

13. Today’s value chains are often opaque, which is a key obstacle to achieving sustainability goals in the sector. This can be attributed to the complex web of actors and facilities involved. In recent decades, sourcing and production has been outsourced to a global network of suppliers and factories with brands losing oversight and control of their value chains. Most brands and retailers can identify and track their immediate (tier 1) suppliers, but information is often lost about the suppliers of their suppliers (tier 2) and even more so when it comes to the suppliers of their suppliers’ suppliers (tier 3 and so on). An ECE study demonstrated that only around 34 per cent of fashion companies implement tracking and tracing in their supply chain—of which only half (17 per cent of the total) have a visibility as far as tier 2.3

14. That being said, the implementation of traceability in supply chains is a complex endeavour that requires the collaboration of all stakeholders involved, the use of a supporting business and data model, open and shared information, and the deployment of reliable technical solutions. The global fragmentation of production is a key feature of the sector, which is further complicated by the prevalence of subcontracting and informal work, especially in upstream supplier tiers. As a result, it is difficult to provide consumers with complete and trustworthy information about a product’s provenance and its sustainability performance.

### Sustainability risks in cotton value chains

Cotton represents 24 per cent of the fibre market in the apparel industry4 which makes it the world’s most widely used natural fibre, with an approximate yearly global production of 25 million metric tonnes.5 Worldwide, about 26 million farmers grow cotton in 75 countries, while cotton growing and processing for textiles and apparel provide jobs and incomes to approximately 100 million families6.

Therefore, cotton is a key driver of economic growth, of job creation, and millions of households are economically dependent on this commodity. At the same time its impact on climate, water scarcity, water pollution (due to the use and release of hazardous chemicals), and human health and ecosystems, is particularly concerning. Global cotton cultivation is estimated to require 200 thousand tonnes of pesticides and 8 million tonnes of fertilizers per year, some 16 per cent and 4 per cent respectively of the total global use of pesticides and fertilizers, despite cotton accounting for only 2.5 per cent of arable land use.7 Cotton garment production, from field to shelf is a very complex supply chain where the lack of strict regulations can contribute to the neglect of social criteria resulting in poor health and safety measures and making workers vulnerable to poor working conditions8. It is also worth mentioning that while most of the pickers and industrial workers are women, the vast majority of management and supervisory positions are given to men, which highlights the

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6 Ibid


importance of considering this gender gap in the measures taken to transform this sector. Cotton cultivation is also associated with high social risks, including injuries, exposure to hazardous substances, low wages, forced and child labour, gender inequality, and in some countries with governance issues such as corruption, the fragility of legal systems. In addition, the volatility of market prices and the uncertainty stemming from current purchasing and subcontracting practices have increased informality and precarity.

As described above, cotton production has a tremendous impact on the people and the planet; therefore a major challenge for the industry is to improve cotton production practices and, very importantly, to link these better practices to sustainably sourced cotton used by brands, retailers, manufacturers, farmers and producers. This makes traceability and transparency core elements and a priority in many of the current sustainability initiatives in the apparel sector, so as to better map out the actors as well as identify, prevent and mitigate the risks along the entire value chain process.

**Sustainability risks in leather value chains**

Leather is one of the most ancient materials in the world and is a by-product of the meat and dairy industries. Currently, leather production uses more than 12.5 million tonnes of fresh hides per year. The industry accounts for US$10 billion yearly and employs approximately 6 million workers worldwide, compared to 7.1 million workers in the footwear industry. Leather represents a crucial driver of economic growth, particularly in developing countries such as Brazil, Bangladesh and Indonesia, where production has been steadily moving upwards since the 1990s. However, as fundamental as this sector may be for the industrialization and poverty eradication of such countries, the potential for negative environmental impacts is important.

The industry is not only characterized by excessive water use, but also by significant water pollution owing to the tanneries’ use of chemicals to transform raw hides and skins into leather that can harm the environment. In fact, more than 90% of produced leather is tanned with chemicals, including chromium, formaldehyde, and arsenic. Untreated effluents in some less advanced regions where licences and regulatory permits do not exist, can often be released into waterways, affecting surrounding land and human communities. In addition, the leather manufacturing process creates high levels of solid waste, especially at tanneries, resulting annually in 800 thousand tonnes of leather waste. In leather production, the hides and skins of around 1.4 billion animals were used globally in 2020, whereas the most used types were cattle hides with 8.6 million tonnes, followed by sheep hides with 1.9 million tonnes.

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10 UNEP, Sustainability and Circularity in the Textile Value Chain
11 This includes fresh cattle hides, buffalo hides, goat skins, and sheep skins. Source: FAOStat, 2020 data. Available at: https://www.fao.org/faostat/en/#data/QCL.
18 FAOStat (2020).
The leather value chain, from farm to shelf can be complex, with scattered production of hides and skins, and tanning processes taking place around the globe. The production of finished leather, on the other hand, is geographically concentrated, with 70% stemming from only ten countries, of which four currently dominate the industry (China, India, Italy, and the Republic of Korea). In some countries, the farming and slaughtering of livestock takes place in an environment that lacks animal welfare regulations, thus allowing the unethical treatment of these animals. Furthermore, in many low-cost countries there are social issues, including poor working conditions, forced labour and low wages, as well as a lack of process controls related to chemical use, water conservation, recycling and waste management. Nevertheless, the leather industry is highly regulated with tightly controlled auditing programs and standards, ensuring the responsibility of value chain partners who are manufacturing leather. Brands increasingly source from leather manufacturers that use certified chemicals and that are audited according to these standards.

Leather is a valuable commodity traded in global exchanges and is subject to market price volatility linked to the demand for the various goods that use leather in different industries (footwear 47%; automotive 17%; garments 10%; furniture 10%; gloves 4%; and other leather products 12%). It is highly dependent on consumer demand, which is increasingly asking for sustainably and fairly produced leather goods. To combat the industry’s potential effects on people and the planet, as well as to localize, identify and reduce such risks, leaders and experts all agree that traceability and transparency need to be core elements in the value chains of the leather industry of the future.

III. The blockchain pilots project: scope and goals

15. For two years, starting in January 2020, the United Nations Economic Commission for Europe (ECE) implemented a pilots project for a blockchain system in cotton and leather value chains to support companies in their effort to comply with relevant norms and standards for sustainability and circularity, and to support United Nations Sustainable Development Goal (SDG) 12 for responsible consumption and production. The pilots covered the full spectrum of value chain tiers, engaging with a variety of actors, from the cotton field and animal farms (farmers, cooperatives, traders), through pre-manufacturing and manufacturing (tanners, spinners, weavers, dyers, finishers, manufacturers), to branding and retailing. The eight cotton and five leather-based products which were traced represent some of the world’s most sold items in terms of volume, including jeans, shirts, t-shirts, pyjamas, socks, shoes and handbags.

16. This draft proof-of-concept report presents key findings from the pilots project, which engaged representatives from the global cotton and leather industry to test the application of the ECE traceability and transparency standard in a blockchain system to trace cotton products with the use of DNA markers. It uses a multistakeholder approach and covers global value chains. The draft report also provides recommendations regarding the key implementation challenges as well as the opportunities for expanding the project to cover other textile fibres.

17. The project was implemented in the context of the ECE-United Nations Centre for Trade Facilitation and Electronic Business (UN/CEFACT) initiative, “Enhancing traceability and transparency of sustainable value chains in the garment and footwear sector”, jointly

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20 UNIDO, “The global leather value chain: the industries, the main actors and prospects for upgrading in LDCs”, International Journal of Technological Learning Innovation and Development (February 2008). Available at: https://www.researchgate.net/publication/23646324_The_global_leather_value_chain_the_industries_the_main_actors_and_prospects_for_upgrading_in_LDCs.
implemented with the International Trade Centre (ITC) with funding from the European Union since 2019. This initiative is also known as “The Sustainability Pledge” 22.

18. This project has been applying standardized tools, developed under the project, to identify and codify the key data entities that need to be collected and exchanged by all value chain actors at specified data collection points, so that, ultimately, the sustainability performance of products, processes, facilities can be assessed.

19. The objective is to provide the industry with a scalable proof-of-concept for (1) end-to-end traceability and transparency from field to consumer in cotton and leather value chains, and (2) for using blockchain technology to support this objective. The overall goal is to enhance due diligence and responsible business models and improve sustainability by supporting companies in their efforts to comply with relevant norms and standards for traceability, transparency and sustainability in cotton and leather value chains.

20. This proof-of-concept will result in an open-source tool that can be made available to companies developing global public goods, to support them in the identification, collection and sharing of a minimum set of standardized product information on traceability, transparency and sustainability performance, based upon the user’s value chain risk analysis. The purpose is to help them ensure that sustainability claims are based on relevant and reliable data, provided by all actors intervening along the value chain.

21. Blockchain technology can help address some of the industry’s key concerns in the following ways:
   - By increasing data trustworthiness through immutable data storage
   - By providing data traceability (i.e. the ability to clearly identify the origin of data)
   - By increasing value chain collaboration and connectivity through a decentralized data management system
   - By improving cost-efficiency through facilitated digital document sharing and archiving

22. These technical capabilities can play an instrumental role in improving risk management for companies that have embraced sustainability through compliance with environmental and social requirements. This results in enhanced trust between suppliers and brands and facilitates global, competitive market access.

23. The project is embedded within an international framework initiative to enhance traceability and transparency in garment and footwear value chains. Under this initiative, policy recommendations and guidelines, a call to action, and an information exchange standard23 were adopted in April 2021 at the 27th UN/CEFACT Plenary (UN/CEFACT is an intergovernmental working party of the ECE). One of the key drivers is to assess the capacity of companies to make risk-informed decisions while using the ECE-UN/CEFACT traceability and transparency approach and standards in a blockchain environment.

24. In the beginning, key targets were identified, including the development of a scalable pilot framework that could be used across the entire textile sector and multiple leather value chains, and which could support a range of sustainability claims using an effective and reliable technology solution. The idea was to be able to test several scenarios and hypotheses

22 The project website and key documents are available at: https://unece.org/trade/traceability-sustainable-garment-and-footwear

during the roll out. The pilots project aimed to stand alone—to be able to function independently of other projects or software. The end-to-end traceability methodology should help companies clearly identify the required data collection points, in line with relevant norms and standards for sustainability, and align partners across the value chain. Eventually, the proof-of-concept will lead to a better understanding of the modelling required to build an end to end, field to retail (and beyond) traceability application for garment and footwear value chains, whether using blockchain or other technology-based applications, and a good understanding of on-the-ground operating environments and constraints.

25. An ecosystem of actors from approximately 73 entities (cotton cooperatives, farmers, traders, tanners, fibre and fabric producers, manufacturers and brands) were engaged in the various sub-pilots to build claims for traceable and transparent value chains across 20 countries.24

Figure 2:
Breakdown of 73 piloting organizations

26. Over 121 people from the areas of sustainability, operations, IT, legal departments and certifiers were trained to use the ECE-UN/CEFACT methodology to enhance traceability and transparency using a blockchain-based system. The unexpectedly high number of participants revealed the critical importance of this topic for the industry. The pilot’s geographical scope expanded, in line with increasing industry interest, from a Mediterranean and European-based scope to a global scope, involving several world subregions, which eventually led to the extension of the implementation period25.

27. This project traced eight cotton and five leather-based products and provided documentary evidence to substantiate related sustainability claims made by brands and retailers. It did so, using a blockchain-based platform to create backward and forward traceability and by registering documentary evidence.

28. Some of the cotton use cases also aimed to achieve physical traceability to complement the digital traceability by connecting the physical and the digital traceable assets using unique, physical DNA markers to strengthen their claims about cotton’s origin, quality and authenticity. These physical markers helped to ensure the authenticity of the digital data by providing a common identifier. For example, if an auditor has a trustworthy electronic certificate for organic cotton that has a DNA marker, and the auditor examines the physical cotton and finds that it has the DNA marker, then he knows that the certificate is valid for that cotton and that no one has substituted or mixed it with cheaper, non-organic cotton. Physical traceability adds an additional layer of trustworthiness to digital traceability and thus supports overall risk mitigation, claims enforcement and quality control. The DNA marker is a promising technology and should be considered as a possible solution to

24 See Figure 3 – The geographic coverage of the pilot.
25 The pilot should have initially been implemented by 2020; however, due to the COVID-19 pandemic, activities slowed as they were scaled down to a fully virtual format.
immutable physical identification, among the other tools that are available in the market thanks to emerging technologies. The methodology for traceability and transparency developed in this project is agnostic in terms of product-marking technology, and for this reason is compatible with many other solutions (e.g. RFID, NFC, QR codes, chemicals, optical, surface fingerprint, laser-based solutions, etc.) and is open to future developments. At the same time, it is important to keep in mind that different solutions have different levels of security; for example a QR code can be removed or duplicated while a DNA marker cannot.

29. Figure 3 provides an overview of the geographic country coverage of the cotton and leather blockchain pilots (for 13 use cases) and the corresponding stages in the value chain. For analytical purposes, the value chain participants were divided into four categories\(^{26}\), (1) raw material suppliers, (2) fabric and fibre producers for cotton (3a) product manufacturers for cotton, (3b) product manufacturers and traders for leather, and (4) retailers/brands. The level of fragmentation in the value chain use cases varies. Some use cases present an integrated value chain embedded in a single country; the majority present a value chain stretching across more than two countries. In cotton and leather value chains, information exchange is usually fragmented across several countries, which eventually leads to complex data collection.

**Figure 3:** Cotton and leather blockchain pilots—geographic coverage

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A. The ecosystem of actors involved in the pilots

This section will map all the entities (+73) involved in the pilots according to the ECE “Mapping of the Garment and Footwear Sector Ecosystem”, which uses three core categories of actors:

1) **Core business function actors**: raw material suppliers; commodity merchants/auction houses; material, fabric and fibre producers; product manufacturers; brands/retailers

2) **Extended enterprise actors**: third-party certification/inspection bodies; technology providers

3) **Wider business ecosystem actors**: intergovernmental bodies; platforms/initiatives/foundations; NGOs; financial institutions

Figure 4: Ecosystem of actors involved in the pilots

<table>
<thead>
<tr>
<th>Category</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Core Business Functions</td>
<td>20%</td>
</tr>
<tr>
<td>Wider Business Ecosystem</td>
<td>73%</td>
</tr>
<tr>
<td>Extended Enterprise</td>
<td>7%</td>
</tr>
</tbody>
</table>

B. Definitions

**Core business function actor**: These are the organizations and entities that are directly involved in the production and processing of the fibres, fabrics and components used within the garment and footwear value chain, as well as in design and retail. These companies are engaged in activities ranging from the provision of raw material, including extraction and cultivation, to processing and producing fibres, fabrics or finished leather, manufacturing garments or footwear, design and retail.

**Extended enterprise actor**: These are the organizations that support, administer and enable the value chain to operate and function. The core business function actors in the garment and footwear value chain are, in turn, served by organizations that support and facilitate the operation of the value chain. These stakeholders provide services such as sourcing, logistics, fulfilment, transport, shipping and distribution; and assurance and monitoring systems ranging from quality assurance through to sustainability certification.

**Wider business ecosystem actors**: These are the organizations that provide frameworks and policies and advocate for enhanced due diligence, sustainability and responsibility in value chains and ecosystems. Due diligence regulation is evolving rapidly at both the national and regional levels, and multiple entities are involved, from national governments to intergovernmental organizations. Organizations involved in shaping the agenda at the policy level and advocating and influencing for implementation of responsible business conduct are wide ranging and include multistakeholder initiatives, civil society groups, financial institutions, business platforms, and research bodies.
31. Building on the project’s business process analyses for textiles and leather, the standard value chains for each were mapped to identify the standardized processes within them—from raw material farming, through manufacturing and retailing, up to the recycling and the post-consumption stage (see figure 6 and 7).
IV. Preparation: how to build a use case?

32. For many years, companies in the garment and leather industry have focused their business attention on controlling only the activities of partners close to them in their value chain, typically those in tier 1 and 2. The control and monitoring of business partner activities further out in the same value chain (i.e. tiers 3+ or even 2+) have been typically delegated to the business partners having a direct relationship with those in the “blind spots”. The increased need for traceability and transparency and the recent attention of policymakers on implementing real due diligence requirements that cover all the steps in a value chain have pushed companies in the industry to start to implement their own programmes to increase control over their businesses and their partners along most of the value chain.

33. Some leading companies have decided to implement a strategy to verticalize their business. For example, through a process of acquisition, some of the big brands have purchased the SMEs in the upstream part of their value chain. This approach has guaranteed better availability of raw material and product quality for these companies. In parallel, the responsibility for good practices has moved to the parent companies who have started to implement new programmes that create full traceability and transparency in their operations.

34. Other large companies in the industry have decided to not “buy-in” the partners they do not control; their strategy has been more inclusive, to create a stronger partnership with their suppliers in the upstream part of the value chain, asking for information to be shared along the entire value chain. This second approach provides greater business flexibility; however, for implementation it requires more effort and time and depends upon the cooperation of all parties, thus resulting in a greater exposure to business risks.

35. In both cases, companies who lead extensive value chains have initiated and are implementing specific plans to increase their control over the origin of their goods (raw materials, semi-finished and finished) and the social and environmental practices underlying their production. In general, these plans are based on the following:

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• Identification of the assets, partners and activities along the value chain
• Assessment of production practices against the most recognized standards and good practices
• Data management to control, verify and manage these activities for an end-to-end view of the entire value chain

36. In line with this overall approach, the project team provided guidance for the use cases implemented in this project, drawing upon the following:
   • The steps defined in the ECE guidelines for Recommendation No. 46 on enhancing traceability and transparency of sustainable value chains in the garment and footwear sector
   • The Business Process Analysis, and Business Requirements Specifications for the Textile Sector and The Business Process Analysis, and Business Requirements Specifications for the Leather Sector
   • The guidelines on the formulation of sustainability claims.

37. A description of this guidance can be found below.

Figure 8:
Steps in building a use case

A. Step 1: Identification of the traceable asset, analysis of inputs and processes, and onboarding of value chain partners

38. This first step involves the identification of products (intermediary, semi-finished, such as yarn and fabrics; or finished, such as a pair of jeans, shoes or a shirt) to be traced forward or backward along all stages of the value chain. Once the product is selected, the following step is the evaluation of the inputs used (e.g. cotton fibre quality, type of leather, water, chemicals etc.) along with analyses of the production processes relevant to the identified traceable asset. Afterwards, the mapping of the value chain partners involved in all the stages of the selected product value chain is performed.

39. Once partners are identified, they are invited to get directly involved in the traceability and transparency process. For this step, the various pilots adopted the approach of creating a working group among supply chain partners, led by the one that requested the traceability and transparency of the asset and its associated processes. Normally, the manufacturer/brand wishing to trace an asset would contact its supply chain to collect information about a specific product and explain the importance of enhancing the product’s traceability and transparency.

1. **Tools:**

   - ECE (2021) Recommendation No. 46: Enhancing traceability and transparency of sustainable value chains in the garment and footwear sector (ECE/TRADE/463) and its implementation guidelines
   - ECE (2022) Business Process Analysis for Sustainability and Circularity in the Leather Value Chain

B. **Step 2: Evaluation of sustainability hotspots and mitigation measures in place**

40. As a next step, pilot partners are asked to assess the main sustainability hotspots for the raw material production and processing (for cotton or leather) and the industrial phases associated with the selected traceable assets. They can refer to the risk information for the corresponding value chain, available from the ECE (see tools below) and NGOs, and past experience and mitigation measures they already have in place, including auditing and third-party certification.

   **Tools:**

   - ECE (2022) Business Process Analysis for Sustainability and Circularity in the Leather Value Chain

C. **Step 3: Identification of related claims**

41. Once the product and the raw materials, as well as the industrial processes and sustainability hotspots are identified and evaluated, partners are guided in the formation of one or more claims based on the mitigation measures they have in place, the relevant regulations on claim formulation and the guidance on claims developed under the ECE project.

   **Tools:**

   - ECE (2021) Recommendation No. 46: Enhancing traceability and transparency of sustainable value chains in the garment and footwear sector (ECE/TRADE/463), Part II, Section C.1: Sustainability claims
   - ECE (2022): Guidance on Sustainability Claims

<table>
<thead>
<tr>
<th>Sample of a multi-issue sustainability claim</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cotton Example</strong></td>
</tr>
<tr>
<td>“The fabric of these jeans is made of 65% regenerated cotton yarn coming from the pre-consumer waste of our Italian fabric supplier and of 35% virgin cotton sourced from Türkiye. From the yarn up to the finishing of the denim material the processing steps avoid the use of chemicals that are harmful to health and the environment”.</td>
</tr>
<tr>
<td><strong>Leather example</strong></td>
</tr>
</tbody>
</table>

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31 See Annex A. Supporting publications for links to these tools
32 Document in draft form at the time of publication of this report – final version to be published in 2022
33 A multi-issue claim covers multiple sustainability hotspots
“The leather in this product has been sourced from Denmark and manufactured in Germany, in accordance with Leather Working Group, ISO and ZDHC standards which promote sustainable environmental and responsible chemical use practices.”

Figure 9:
Focus of sustainability claims for the ECE blockchain pilots project

<table>
<thead>
<tr>
<th>Claim</th>
<th>Focus area</th>
</tr>
</thead>
</table>
| A high-level statement about a characteristic of a product or about a process or an organization associated with that product and material (traceable asset) | - Origin of materials
- Animal welfare (leather)
- Fibre content, including organic and recycled fibres (cotton)
- Use of chemicals
- Social/environmental performance of products, processes and facilities, based on a set of minimum sustainability criteria 34 |
| Sustainability claim: A claim that covers one or multiple sustainability dimensions (economic, environmental, social)                               |

D. Step 4: Data identification, training and data upload in the blockchain platform

42. Once the claims for the product and/or the materials to be traced are formulated, the partners are asked to work with project staff to develop a data collection template for traceability and transparency, called a “TT matrix”. When completed, this matrix should contain all the data to be collected for all the business processes in the value chain. The partners then fill in the matrix selecting the row in the TT matrix where they find the sustainability risks they want to address and they enter the certification(s) or standard(s) to accomplish this. The data to be collected will differ according to the selected claim(s). The TT matrix data collection template is aligned with the ISO 19987 (EPCIS) standard 35 and is based on the so-called “5Ws” model (who, what, where, why (how), when) 36 as explained in the ECE Recommendation No.46 and guidelines, and in Part 2 of the project’s business requirements specification. After being collected, the data is then uploaded onto the blockchain-based platform using a software tool, as described further below.

1. Tools

- TT matrix (data collection template for traceability and transparency) for cotton and leather value chains
- ECE Recommendation No.46 and guidelines
- BRS for traceability and transparency, Part 2

34 Minimum criteria are identified in ECE Recommendation No. 46 and aligned with the OECD Due Diligence Guidance for Responsible Supply Chains in the Garment and Footwear Sector, as well as the set of sustainability standards included in the ITC Sustainability Map.
36 See ECE Recommendation No. 46, Part II: Guidelines, Section C.6: Events.
Figure 10:
Examples of “5W” information collected by value chain partners

43. The five EPCIS dimensions\(^{37}\), what, when, where, who and why are shown in the above figure. The “how” dimension is part of the “why” dimension and includes data on sustainability performance. Each of the traceability event types shown on the right, from transaction to object event, provide the collected data: when the event occurred; at which location; what objects (e.g. products/materials) were involved as input or output of a transformation; which business partners (parties) were involved; and under which sustainability conditions production was done. Supply chain visibility can be established when business partners share traceability events, including the related sustainability details. The blockchain platform uses the transaction event and transformation event along with certification evidence.

44. After appropriate training, business partners use the TT matrix to collect the information related to the 5W model for the relevant business processes, especially identifying transparency data (i.e. the data/documents supporting their claims) and involving their suppliers in order to cover the whole value chain (to the extent possible). In accordance with the assurance models identified within the project (e.g. self-declared, self-assessed, second-party verified, third-party certified), business partners provide one or more documents to substantiate their claim. For example, for claims on country of origin they could use transaction documents (shipping notes, commercial invoices, delivery notes, transportation documents, packing lists) and, for social and environmental claims, they could provide assurance documents (certificates, audit/inspection reports, laboratory test result reports, NGOs/civil society attestations, declarations).

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\(^{37}\) The blockchain platform uses the concepts in the ISO traceability standard EPCIS. This is a standard for creating and sharing event data, both within and across enterprises. The ECE T&T proof of concept sufficiently substantiated “back and forward tracing” and “traceability models” (e.g. mass balance) by registering EPCIS transaction and transformation events. The other two EPCIS events, for aggregation (packing and unpacking) and object (harvested, moved, etc.) were left out because they would have caused a lot of manual data input for the users without having any added value. On the other hand, the “certification/verification event” (a future feature of EPCIS) was included. Companies or certification bodies were able to upload certificates and other evidence for verification.
Figure 11: Traceability and sustainability transparency-related documents

<table>
<thead>
<tr>
<th>Traceability-related documents</th>
<th>Sustainability Transparency-related documents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shipping notes</td>
<td>Certificates</td>
</tr>
<tr>
<td>Commercial invoices</td>
<td>Audit/inspection reports</td>
</tr>
<tr>
<td>Delivery notes</td>
<td>Laboratory test results reports</td>
</tr>
<tr>
<td>Packing lists</td>
<td>Laboratory test certificates</td>
</tr>
<tr>
<td>Transportation documents</td>
<td>Declarations</td>
</tr>
</tbody>
</table>

45. Once made available through the TT matrix, the data and the necessary documentary evidence is uploaded to the blockchain platform by each business partner from the upstream to the downstream parts of the value chain in order to define the supply chain on the platform and the disclosure levels related to the uploaded documents. Uploading the data is done using an online tool, which means that supply chain partners did not need to interact directly with the blockchain used, as this was done by the tool. The upload is supported by training and coaching sessions delivered by the ECE experts team and involves, to the extent possible, representatives from all the users/actors involved in the value chain (usually about ten people).

**Tool:** (2021) Blockchain Platform User Manual (version 1.6)

46. ECE together with SUPSI University developed a user manual to provide guidance to end users for navigating and utilizing the platform that was developed for the pilots using a blockchain-based system for traceability and due diligence in the garment and footwear value chains. This manual gives users a general overview of the system, as well as practical steps on how to register transformation events, transaction events and certifications and assessments. It also provides participants with guidelines for connecting an entire supply chain to the system and information on system security aspects. A specific glossary has been developed to familiarize users with the wording and the most common terms of the methodology on the platform.
V. The technology

47. During the pilots, participating partners were asked to identify the data needed, who had the right to access data, and then to organize the data’s collection along their respective value chains. Their only interaction with “technology” was with the software tool that was used in the project for the collection and retrieval of data and with product identification technology such as the DNA markers used in some of the cotton use cases. Therefore, the project’s blockchain technology manifested itself to users as either limitations to what they could do within the software tool or as additional information or additional assurances about the reliability of the data that the software tool was able to provide them.
48. As a result, the technical evaluation below is one made by the project team members responsible for implementing the platform. Later in the report, information from the users’ perspective on the overall experience of implementing the pilot use cases is provided.

49. Both the textile and leather industries have highly fragmented environments with many partners, often from different countries, participating in each value chain. Unlike other industries, only a few big players have started a verticalization process to create their own end-to-end systems which would allow them to manage assets and information from the origin of the raw material to the end consumer. In the current environment, the business setup of each value chain remains a traditional step-by-step transfer of materials and information from the less transparent upstream part until the more traceable downstream part of the value chain.

50. This high business and geographic fragmentation, together with the high number of players, means that it is not feasible to use one extended IT system to cover a value chain’s traceability and transparency needs. The human, financial and technical capabilities of the partners are just too diverse. In addition, a system that covers all the value chain steps and actors in all the value chains in an industry is not feasible because of the inability to scale up to that level of diversity in exchanges and processing. Traditional and proprietary ERP systems are not capable of scaling up to that level of information volumes and transaction diversity due to technical difficulties and the needed resources and costs which increase exponentially when extending these systems into large-scale projects. The relatively recent development of distributed ledger technology (DLT) applications (also known as blockchains) have been a game changer in this context. DLT-based systems have the potential to combine an easy-access system, similar to that of the Internet, with much higher levels of data security, including the ability to verify and trace data with a very high degree of certainty. Thus, such systems can cover multiple actors in a complex, global environment. In addition, by its nature, DLT requires that data be managed economically by keeping the data flow to the minimum, including only what is essential. For those participating, a DLT system can become the unique source for shared data (a single source of truth) with a key, neutral characteristic: no one can change the data once it is stored (it is immutable).

51. When implementing a DLT-based system such as this blockchain-based IT solution, some important challenges need to be addressed. Those which have been considered in this project include the following:

1) The governance model determines the rules of the game and guarantees a neutral data registration process that cannot be influenced by the biggest players in the industry. The voice and needs of vulnerable stakeholders also need to be considered. In many cases a governing body is also needed in order to manage the distribution of the costs and efforts to maintain the DLT solution and to ensure that any issues are efficiently handled. The ECE, as an international organization, has played the role of governance body for the project’s DLT solution. Should there be a demand to keep the project’s system running beyond the time of this project, this governance model will be reviewed.

2) The cooperation of all partners in a value chain environment is essential. Collaboration is necessary, not just with the first and second-tier business partners, but all the business partners along the entire value chain need to be sitting at the same table and sharing their data—a situation complicated by the constantly changing nature of business relationships with partners coming and leaving. This means everyone needs to speak the ‘same language’, which can be done by creating a unique, standardized data model that, in turn, creates a common understanding of value chain activities and practices.

3) A “digital twin” environment must be created, in which assets are given digital identities that can be securely maintained, easily tracked and monitored. The main challenge is to implement the most appropriate technology by considering the right trade-offs between cost and effectiveness. (Some niche cases can support expensive digital identity tools, but mass-market products must look at cheaper solutions, that are still widely accepted, to be sustainable in the market.)
4) The data transparency versus data confidentiality challenge is a topic that has been gaining more and more importance due to increased public attention and related legislation. A DLT-based solution can cover data confidentiality needs in an excellent manner by using cryptographic techniques, but the real challenge is how to provide appropriate levels of data accessibility and transparency to support product claims while maintaining their credibility.

52. These challenges also show some of the ways that a DLT based solution can bring benefits and advantages compared to standard ERP systems and proprietary IT solutions.

53. Last, but not least, much of the data and information flows shared in a DLT environment can be controlled by the system itself, in a neutral way, through the automation functionalities known as “smart contracts”. These are computer programs that are embedded in a blockchain and, like data on a blockchain, cannot be changed. These can support interoperability with machines (IoT) and other data sources based upon the respect of strict rules, controls and alerts that are programmed into a “smart contract”.

54. Blockchain technology is a type of distributed ledger technology—a decentralized, verified, trusted, secure transaction ledger which records data and, among other things, can be used for the verification of information. Most importantly, the blockchain records data in an immutable way, thereby making the information more easily accepted for verification and disclosure purposes.

55. Particularly in the garment and footwear industry, blockchains can register data about all stages of the production (raw material harvest, production, product use, end of life disposal), as well as sustainability certifications, vendor contracts, orders and shipments. Therefore, blockchain technology can boost information exchange by connecting all the actors in a commonly accessible, distributed data management system, while providing immutable data storage, which fits the needs of such a fragmented and opaque industry.

56. For this project, some key benefits of blockchain technology and automation have been taken into consideration. For instance, this technology can be used in an application to do the following:

- It can enable business partners to have more control over the production of raw materials and products, from A to Z, by providing a common source of information.
- It can smooth and streamline communications between all the business partners who are part of the value chain.
- It can make information more reliable and easily controlled due to its visibility, the fact that it is shared and the fact that it cannot be tampered with.
- It can support the building of trust between business partners, connecting them from a practical standpoint.
- It can root public information in verifiable facts so that consumers can make better purchasing decisions, building on more transparency.

57. At the same time, there are some drawbacks related to blockchain technology, such as its reputation for being energy intensive. The evolution of blockchain technologies is still in the early stages so the future will offer more and more sustainable solutions. This pilot framework uses the Ethereum testnet blockchain; for any future, larger-scale deployments other Ethereum-compatible chains can be evaluated, taking into consideration scalability, cost of transactions and energy consumption.

58. Since data cannot be changed once it is registered on a blockchain, the reliability of the data to be uploaded is a key concern. Blockchain technology becomes financially costly when a lot of transactions are involved since public (and many private) blockchains require payments for uploading data. Another key issue for companies is certainly that transparency and data sharing is sensitive due to competitiveness reasons.

59. While technology can play an instrumental role in addressing information issues in the garment and footwear industry, changing business and consumer behaviours towards more sustainable production and consumption practices is the real challenge.
60. The blockchain solution developed supports the technology-agnostic data model provided by the ECE working group according to UN/CEFACT standards, and specifically the standard data in the United Nations Core Component Library. The blockchain system provides end-to-end traceability and transparency within cotton and leather value chains and allows extensions to other industry sectors (wool, silk, etc.). SUPSI (the University of Applied Sciences and Arts of Southern Switzerland) developed the solution’s infrastructure and software between October 2020 and September 2021. The blockchain was developed based on a hybrid open-source web technology stack built upon the public Ethereum (testnet), allowing permissioned access to the system through which users (i.e. value chain actors) are onboarded by the project’s governance body (i.e. ECE).

61. Within the pilot framework, the access to data can be customized for each value chain actor. For example, brands may have visibility into data from their upstream partners, such as farmers, who may not, in turn, have access to data about downstream partners such as manufacturers. It is a web-based, desktop software (compatible with smartphone/tablet standards) that allows the exchange of data (input/output, read/write and store) among users. The three core functions provided by this blockchain-based system are (1) supply chain actors management and onboarding procedures; (2) B2B trade transactions management (i.e. contracts, orders, shipments) and certifications; and (3) supply chain visibility through traceability.

62. The solution handles on- and off-chain data\(^{38}\) (copies of the uploaded documents) and transactions and is a multi-claim solution enabling companies to visually check the different claim categories for their products in real time (origin, organic, social & environmental, use of chemicals). The users interact with the system by registering three types of events: (1) trade transaction events (incoming/outgoing contracts, orders, shipments); (2) transformation events (processes/materials internal to an organization); and (3) certification/assessment events. Trade transactions and certifications are controlled by a seller/consignor, checked by a buyer/consignee and verified by a certification/verification body or other party (e.g. second party). For instance, value chain actors upload B2B transaction documents (e.g. contracts, commercial invoice, orders, shipping notes, delivery notes) throughout the value chain to trace the origin of a product. After the registration of a trade transaction, an email is sent to the buyer/consignee to enter the system and confirm the registered trade transaction. The same process applies to certification/verification bodies that register certifications/licences/assessment reports by uploading certificates on the system. In addition, business partners are also able to register the certifications/verifications they self-assessed or have undergone. Different scenarios have been tested directly with companies during the so-called dry run test and training sessions. Overall, the pilot framework has been deployed as an effective and reliable stand-alone solution that functions independently. The relevant data collection points have been identified and implemented in the platform.

63. The blockchain platform is designed to guarantee data privacy and security. Data management in the platform is handled by each value chain partner entering their own information. Value chain partners are asked “from where” and “to where” they transfer materials in order to build piece by piece a complete value chain. To take into consideration the system implementation on a public blockchain, the system manages privacy and confidentiality using cryptographic technologies and companies’ related “wallets” (containing public/private keys). This allows users to dynamically assign different visibility/disclosure levels to different value chain partners, while hiding information from any other partner not allowed to read the data stored in the blockchain smart contracts. This enables, for example, disclosure of the country of suppliers without disclosing company names, thus restricting available traceability and transparency information.

64. The use of blockchain technology is a real asset for reducing the risk of fake documents and of the disclosure of fake information. The system is not controlled by any single authority and enables the real-time verification of the sustainability-related claims through links to referenced certification standards. The information is made available to value chain partners in a standardized way, which allows for a common understanding, accessibility, clarity and comparison.

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\(^{38}\) “On chain” data is recorded on a blockchain while “off-chain” data is not.
65. The end-to-end value chain visualization is the result of manual data entry by value chain actors and stored in a secure way in the immutable blockchain. The privacy is assured using “privacy by design”, based upon encryption technologies with public and private keys. Users have full control over which information to disclose to the next partner in the chain and to final customers. The solution shows the supply chain in an interactive graph that allows users to zoom in on individual partners, their different claims and other relevant information. The solution implements blockchain decentralization, a distributed ledger, and implements the standard functionalities found on a public permissionless blockchain architecture (Ethereum testnet).

66. More than 120 users were onboarded in the platform for the cotton and leather pilots, during which 104 trade transactions and 111 certificates were uploaded.

Figure 14: Distribution of shipping/trade transactions by type in the blockchain platform
VI. Deep dive into the use cases

67. The pilot use cases tested ECE-UN/CEFACT standards and approaches for traceability and transparency of product value chains, processes and facilities in a blockchain environment. Many companies seized the opportunity to pilot test a framework to support their transition towards sustainable and circular value chains.

68. In the project, 13 use cases including jeans, shirts, socks, handbags, shoes and semi-finished products etc. were traced across 20 countries (see Figure 16 and Figure 17).

69. The cotton pilots focused on 8 use cases across 13 countries. Four cotton use cases also explored the role of DNA markers to support the physical traceability of cotton’s provenance, quality and authenticity. A variety of sustainability claims formulated by companies were covered by the platform. A minimum requirement was the origin of the goods, for example the origin of cotton from field to shelf. Other product claims that were covered include those about fibre content (i.e. organic, recycled fibre), use of chemicals, social/environmental performance, processes and facilities—all based on the sustainability criteria identified in ECE Policy Recommendation No. 46. Half of the product use cases were traced forward, for example, following the real-life cycle of cotton from cultivation in September to retailing of consumer products in March/April. The other half of the product use cases were traced backward, meaning that the documentary evidence was collected ex-post from suppliers throughout the value chain when the final product was already on sale in stores or online.

70. The leather pilots focused on 5 use cases across 12 countries, tracing the products backward, using traceability-related documents such as shipping notes, delivery notes and commercial invoices to trace the origin of the product. Sustainability transparency-related documents were also identified and collected to cover specific risks in these value chains (mainly third-party certificates on animal welfare, use of chemicals and social/environmental performance). These documents were then used to substantiate the claims developed by pilot participants. Two certifiers, ICEC and LWG, were also involved and onboarded on the

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39 See Figure 16 and Figure 17 for the geographical coverage of the pilot
40 Minimum criteria are identified in ECE Recommendation No. 46 and aligned with the *OECD Due Diligence Guidance for Responsible Supply Chains in the Garment and Footwear Sector*, and the set of sustainability standards included in the ITC Sustainability Map.
41 International Cost Engineering Council (ICEC) and the Leather Working Group (LEG)
platform to provide a verification process which links the certifications uploaded by companies participating in the pilots to the relevant certifying entity.

Figure 16: Overview of product use cases and value chain coverage for cotton

Figure 17: Overview of product use cases and value chain coverage for leather

71. The principal sustainability risks have been identified in both the cotton and the leather value chain based on research conducted by internationally recognized institutions (e.g. OECD, UNEP, ITC, ECE internal research) and then cross mapped with organizations offering standards and certification programs to address those risks for both cotton and leather. This work was done in accordance with of the Business Process Analysis for

72. Hotspots for cotton and leather have been illustrated in the figures below, which represent the risks in each value chain stage. For example, hazardous chemical use in the cotton value chain would typically be a risk in the initial, middle and last value chain stages (i.e. plant harvesting, finishing and consumption, disposal, post-consumption and recycling). The same hazardous chemistry use risk in the leather value chain would typically apply to the central stages of the value chain (i.e. from hide/skin preservation throughout the manufacturing stage up to product assembly).

Figure 18:
Sustainability hotspots along the cotton value chain from the ECE Business Process Analysis for Sustainability and Circularity in Textile Value Chains

Figure 19:
Sustainability hotspots along the leather value chain from the ECE Business Process Analysis for Sustainability and Circularity in the Leather Value Chain

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The cotton textile industry has historically been associated with environmentally harmful (from farming to processing and producing) issues and complex social concerns such as child labour, workers’ rights and wages, as well as health and safety. Sustainability standards have therefore gained significant traction to ensure that the environmental, social and economic impacts of cotton farming and textile manufacturing and production are mitigated. Although each sustainability standard has its own primary goals, focus and verification systems, they largely share the same long-term ambitions and objectives and incorporate environmental, social and economic aspects. The main cotton textile standards presented below are among the ones used by the industry partners, as described in the use cases paragraph.

Among many, the primary sustainability standards in use for cotton farming and referenced in the pilot use cases are the Better Cotton (BC) based on a set of principles and criteria, and the IFOAM family of standards for the organic cotton; these both address the 3 dimensions of sustainability (environmental, social and economic).

The Global Organic Textile Standard (GOTS) (used for several use cases) and the Organic Content Standard (OCS) are adopted for certification of organic textiles. In addition to organic textiles, standards have been set for other sustainable approaches, such as those for textiles made using recycled materials. The two dominant sustainability standards for these textiles are the Recycled Claim Standard (RCS) and the Global Recycled Standard (GRS) (used in the pilots) both of which have also experienced significant growth in recent years.

The use of hazardous chemicals and their elimination is another important topic addressed by sustainability standards. The most accepted by the industry are the OEKO-TEX set of certifications and, more recently, the Zero Discharge of Hazardous (ZDHC) Chemicals guidelines and implementation protocols.

The Social compliance dimension is central to the cotton textile industry and has been under the spotlight since the 1990s, when outsourcing of production in the textile industry accelerated. This, along with an increased emphasis on labour and human rights, saw the multiplication of social standards and certifications, as well as the commissioning and request by international retailers for social audits as a precondition for a commercial relationship. The monitoring of the labour, health and safety situation at workplaces is frequently done by private audit firms and based on the United Nations Guiding Principles for Business and Human Rights and the OECD due diligence guidelines. Social compliance certification used in one of the pilot’s use cases is the WRAP (Worldwide Responsible Accredited Production), an independent, objective, non-profit team of global social compliance experts dedicated to promoting safe, lawful, humane, and ethical manufacturing around the world through certification and education.
Over the last two decades the leather industry has developed many voluntary audit and certification standards to support environmental and social improvement within its value chains and, particularly, in manufacturing. Many of these standards were created to address specific concerns that could affect consumer health and safety such as the use of harmful chemicals that remain present in a finished product or the discharge of harmful chemicals into waterways or onto land. More recently, brand reputation has suffered from reports of modern slavery or unfair pay, which has also led to a widening of the need for responsible sourcing through audited and certified suppliers.

Leather manufacturing is one of the best regulated industries for environmental pollution and chemistry, with chemical Restricted Substances Lists and Manufacturing Restricted Substances Lists now recognized globally.

Certification within the industry falls into three main categories: environmental compliance, social responsibility and, more recently, material composition. Most of these certifications are provided by private companies and associations, in line with recognized standards and/or regulations. Some certifications are based on cross-industry standards (such as ISO9001 Quality Management and ISO14001 Environmental Management Systems) where others are proprietary standards which are specific to the industry such as the Leather Working Group’s Audit Protocol or OEKO-TEX’s Step for Leather.

Most certification in the leather industry is facility based and involves a site-specific audit, although there are some self-assessment tools that can be used and these can then be verified by an external assessor. In addition, many brands have their own internal auditors who visit facilities and audit against a brand’s own requirements.
A. **Cotton use cases deep dive**

82. The boxes below provide an overview of the eight cotton use cases, detailing for each one the objective, product traced, claim formulated, business partners involved and documentation submitted, as well as a narrative description.

83. The following use cases are covered:

- Use case 1: Recycled pre-consumer waste and virgin denim (Turkish cotton)
- Use case 2: Organic shirt (United States cotton)
- Use case 3: Organic yarn (Egyptian cotton)
- Use case 4: Low environmental impact socks (Egyptian cotton/upcycled fibres from closed-loop processes)
- Use case 5: Organic Shirt (Egyptian cotton)
- Use case 6: Inclusive family farming pajama (Peruvian cotton)
- Use case 7: T-shirts (Uzbek cotton)
- Use case 8: Organic denim fabric (Indian cotton)
Cotton use case 1: Recycled pre-consumer waste and virgin denim (Turkish cotton)

Objective: Prove the fibre content (recycled and virgin cotton) and quality of a pair of jeans by involving value chain partners to provide documentary evidence of the quality of the cotton fibres (recycled and virgin %) and the use of chemicals.

Output: Claim substantiated by complete and relevant documentation

Main challenges: Onboarding of tier-4 suppliers at the planting and cultivation phases for the virgin cotton

Lead company: Vivienne Westwood SRL, brand

Product traced (backward tracing): Classic tapered jeans, indigo, season: spring/summer 2021

B2C claim: The fabric of this pair of jeans is made of 65% recycled cotton yarn coming from the pre-consumer waste of our Italian fabric supplier and 35% of virgin cotton sourced from Türkiye. From the yarn up to the finishing of the denim material the processing steps avoid the use of chemicals harmful for health and the environment

Onboarded supply chain partners: Marchi e Fildi Spa, spinner; Berto E.G. Industria Tessile SRL, dyer/weaver/finisher; Denim Service SRL, garment manufacturer; Vivienne Westwood SRL, brand/retailer

Documentation shared among supply chain partners: self-declarations, shipping notes, commercial invoices

Certifications made available to prove claim(s): GRS and OEKO-TEX 100

The use case aimed at tracing the supply chain of the classic tapered jeans of Vivienne Westwood by involving in the pilot suppliers operating in different tiers of the supply chain for them to share documentary evidence related to the monitored production stages of the traced jeans. To this end, Vivienne Westwood involved in the pilot its suppliers (all Italy-based) starting from the cotton spinner Marchi e Fildi, the weaver, finisher waste provider Berto E.G. Industria Tessile and the garment manufacturer, Denim Service. The denim fabric of the tapered jeans consist of a blend of Turkish virgin cotton (35%) and recycled cotton (65%) derived from pre-consumer waste (fabric scraps).
The goal of participating in the pilot was twofold:

- Achieve product traceability by involving supply chain partners who uploaded onto the blockchain system documents showing the origin of the cotton (for both virgin and recycled %) and the movement of the material/product along the different stages of the value chain.

- Identify how the partners along the supply chain mitigate sustainability hotspots (for this pilot the adoption of circular materials, i.e. recycled cotton and the reduced use of chemicals).

The brand’s suppliers responsible for cotton cultivation, harvesting and ginning were not directly involved in the pilot and did not test the methodology and blockchain-based system, but the needed documentary information was provided and managed by the spinner through a self-declaration where he stated the country of origin of the virgin cotton. The movement of the cotton along the different production stages was evidenced in the blockchain by the uploading of shipping notes among the manufacturers.

The same happened for the traceability of the recycled cotton which was evidenced in the blockchain platform by the uploading of shipping notes, starting with the shipment of Berto’s pre-consumer fabric scraps to Marchi and Fildi. The fabric scraps were then shredded and spun into recycled yarns at Marchi and Fildi, the fabric was woven and finished at Berto, then shipped to the Denim Service for garment manufacturing. Following manufacturing, the classic tapered jeans were shipped to the Vivienne Westwood logistic warehouse for retailing.

To prove and substantiate the sustainability claims along the supply chain and, in particular, the one related to the use of recycled cotton, a Global Recycled Standard (GRS) transaction certificate was uploaded at the spinning level, covering the yarn that was spun using virgin cotton and recovered textile waste at the factory level, and GRS scope certificates were uploaded whenever available along the manufacturing cycle (dyeing, weaving, fabric finishing at factory level). Moreover, to show compliance with a reduced chemical use of chemicals, OEKO-TEX 100 certificates were uploaded.
Cotton use case 2: Organic shirt (USA cotton)

Objective: Prove the fibre is of organic quality and the origin (USA) of the cotton used in the shirt by involving value chain partners to provide documentary evidence for both content/quality and origin of the cotton fibres and the use of chemicals.

Output: Claim substantiated by complete and relevant documentation

Main challenges: Onboarding of tier-4 suppliers at the farming and cultivation stage for virgin cotton

Lead companies: Cotonificio Albini S.p.A. (Albini Group) and Vivienne Westwood SRL

Product traced (backwards tracing): Slim shirt, season: spring/summer 2021

B2C claim: The material of this shirt is made of organic cotton sourced from the USA and totally traceable in its value chain. This cotton yarn is organic, produced without the use of pesticides and chemicals harmful for health and the environment

Onboarded supply chain partners: Jess Smith and Sons Cotton LLC and Allenberg cotton co. ginner/trader; Anhui Humao Textile Co. LTD, spinner; Cotonificio Albini S.p.A., dyer; Cotonificio Albini S.p.A. and Diefurt SRO, weaver; Brebbia Divisione del Cotonificio Albini S.p.A., finisher; Poletti SRL, garment manufacturer; Vivienne Westwood SRL, brand/retailer.

Documentation shared among supply chain partners: commercial invoices, shipping notes

Certifications made available to prove claim(s): GOTS transaction and scope certificates

The use case was led by Cotonificio Albini S.p.A. in Bergamo of the Albini Group (1400 employees), and Vivienne Westwood SRL (Milan, Italy) with the support of Cittadellarte - Fondazione Pistoletto.

The pilot aimed at tracing the supply chain of the slim shirt of Vivienne Westwood SRL by involving suppliers operating at different tiers in the supply chain in order to share the documentary evidence related to the production of the traced shirt. To this end, Cotonificio Albini, the fabric weaver, involved its suppliers in the pilot, starting with the cotton ginner/traders based in the United States (Smith and Sons Cotton LLC
and Allenberg cotton Co.); the spinner, based in China, Anhui Humao Textile Co. LTD; and Albini Group’s entities for the dyeing, weaving, and finishing (Cotonificio Albini S.p.A., Italy; Diefurt SRO, Czech Republic, Weaver; and Brebbia Divisione del Cotonificio Albini S.p.A.). Other participants included the garment manufacturer (Poletti SRL, Italy) and eventually the logistics warehouse of the brand Vivienne Westwood SRL (Italy) and Vivienne Westwood Ltd (United Kingdom).

The fabric of the shirt is made using 100% Supima cotton from the United States. The goal of participating in the pilot was twofold:

- Achieve end-to-end traceability of the product by involving the supply chain partners who uploaded into the blockchain system the documentary evidence for the origin of the organic cotton yarn and the movement of the material/product along the different stages of the value chain\(^44\).

- Identify how supply chain partners cope with sustainability hotspots (i.e. organic cotton production and GOTS compliant industrial processes).

Cotonificio Albini suppliers participating in the organic cotton cultivation, harvesting and spinning were not directly involved in the pilot, but the documentary information was collected and managed by Cotonificio Albini (the dyer, weaver, fabric finisher) through a self-declaration where they stated the country of origin of the organic cotton. Cotonificio Albini wove and finished the fabric in its industrial plants, which was then sent to Poletti for the garment manufacturing. Poletti transferred the final garment to the Vivienne Westwood Italian central logistics hub and from there the product was dispatched to the London shop. The movement of the cotton, yarn and fabric along the different production stages was evidenced in the blockchain by the uploading of shipping notes and commercial invoices from one supplier to another.

To prove and substantiate the sustainability claims along the supply chain, in particular the one related to the use of organic cotton, transaction and scope certificates for the Global Organic Textile Standard (GOTS) were uploaded to certify that the companies involved meet all the criteria to be allowed to process GOTS goods (social and environmental requirements) as well as the materials and products themselves meeting all GOTS product criteria.

\(^{44}\) The documents at the spinning stage were uploaded on behalf of Anhui Humao Textile CO. LTD by Cotonificio Albini S.p.A.
**Objective:** Prove the fibre yarn is of organic quality by having value chain partners provide documentary evidence for the cotton fibre content/quality and use of chemicals.

**Output:** Claim substantiated by complete and relevant documentation

**Main challenges:** Onboarding of ginners

**Lead company:** Filmar S.p.A.

**Product traced (backward tracing):** ZERO organic cotton yarn (“ZERO yarn” is a trademark)

**B2B claim:** The ZERO Yarn is made of Egyptian organic cotton. It has been produced in compliance with GOTS for environmentally and socially responsible processing, without the use of harmful substances according to STANDARD 100 by OEKO-TEX, and in compliance with ZDHC Cprogram, which supports the implementation of sustainable chemistry to protect workers, consumers and the environment

**Onboarded supply chain partners:** Nature Tex (SEKEM Group), Filmar Nile Textile, Filmar S.p.A.

**Documentation shared among supply chain partners:** Invoices, shipping notes, production orders, GOTS scope and transaction certificates, OEKO-TEX certificate, and ZDHC in-check reports

**Certifications made available to prove claim(s):** GOTS, OEKO-TEX 100, ZDHC

The pilot aimed at tracing the supply chain for ZERO organic cotton yarn by having suppliers in different supply chain tiers share documentary evidence related to the monitored production stages of the traced yarn. To this end, Filmar S.p.A., in its role of yarn manufacturer, involved in the pilot its suppliers (Egypt and Italy-based) starting from the cotton trader Nature Tex and the spinner Filmar Nile Textile. The yarn was selected as per its sustainability criteria and represents a best seller among the GOTS certified organic Egyptian cotton yarns. The goal of participating in the pilot, was threefold:

- Trace a bestselling yarn material using a cost and time-effective traceability and transparency methodology for which there is a high demand from customers.
• Achieve product traceability by involving the supply chain partners who uploaded onto the blockchain system documents about the origin of the cotton and the movement of the material/product along the different stages of the value chain.

• Identify how the partners along the supply chain mitigate sustainability hotspots (for this pilot the adoption of organic cotton produced without the use of hazardous chemicals).

The movement of the cotton along the different production stages was evidenced in the blockchain by the uploading of shipping notes and invoices from the trader, through the spinner, to the manufacturer.

To prove and substantiate the sustainability claims along the supply chain and, in particular, the one related to the use of organic cotton yarn, GOTS transaction certificate documents were uploaded in the platform for the ginning, spinning and dyeing phases. Moreover, to further ensure the compliance with reduced use of chemicals, the OEKO-TEX 100 and ZDHC in-check reports were also uploaded for the wet processes (spinning and dyeing).
Cotton use case 4: Low environmental impact socks
(Egyptian cotton/upcycled fibres from closed loop processes)

Objective: Prove the fibre quality (upcycled) of a pair of socks integrating digital and physical traceability

Output: Claim substantiated by complete and relevant documentation

Main challenges: NA

Lead company: Filmar S.p.A., Bonadei

Product traced (forward tracing): a new product Filmar is testing in the market, a blended yarn called Ecoloop.

B2C claim: This pair of sock is made of a blended yarn -Ecoloop- with 50% virgin cotton and 50% upcycled cotton from internal production waste. It uses dyeing processes that restrict the use of harmful substances and meet the requirements of the STANDARD 100 by OEKO-TEX and the ZDHC program for safer chemical management


Documentation shared among supply chain partners: Invoices, self-declarations, third parties’ certificates

Certifications made available to prove claim(s): Haelixa DNA marker, OEKO-TEX 100, ZDHC in-check report

The use case was led by Filmar S.p.A. (120 employees in Italy) in partnership with Calzificio Bonadei (Brescia, Italy)

The pilot aimed at tracing the supply chain of a pair of socks made by a blended yarn Ecoloop, made from a mixture of 50% virgin cotton and 50% upcycled cotton fibre from internal production waste. In order to provide evidence of the origin of the upcycled input, the fibre was sprayed with the Haelixa DNA marker before spinning. Tests were performed by Haelixa both on the yarn and the final socks. All the suppliers operating at the different tiers of the supply chain were involved, starting from the cotton trader, the spinner and the manufacturer Bonadei. They all shared the documentary evidence related to the monitored production stages of the traced socks. The goal of Filmar’s participation to the pilot was threefold:
• Achieve product traceability by having supply chain partners upload onto the blockchain system documents about the origin of the upcycled cotton fibre and the movement of the material/product along the different stages of the value chain.

• Identify how the partners along the supply chain mitigate sustainability hotspots, which for this pilot was reduced waste production as well as reduced use of chemicals and water for an overall reduced product environmental impact.

• Physically and digitally prove the origin of the 50% upcycled cotton input derived from waste from internal processes.

The origin of the cotton along the different production stages was evidenced in the blockchain by the uploading of manufacturer’s self-declarations for the upcycled fibres and by invoices from the trader for the virgin cotton.

Additionally, to prove and substantiate the sustainability claims along the supply chain and, in particular, the one related to the upcycled fibres, a certificate from Haelixa was uploaded, which certifies the physical origin of the recycled fibres. The recycled fibres were marked with unique DNA-based markers at the spinning mill in Egypt. Following the DNA application process, verification of the marking was carried out at different nodes of the supply chain on the yarn and on the knitted socks. The upload to the platform of the certificates provided by Haelixa enabled a connection between the physical product and the digital traceability claim associated with the DNA marker. One key outcome from this pilot was that physical markers are important tools for ensuring that fibre, yarn or fabric are not mixed or exchanged throughout textile processing stages. Ultimately, the use of DNA markers made the claim stronger since, as of now, there is no certification in the industry that proves the use of upcycled fibres from production waste. Lastly, to further ensure compliance with a reduced use of chemicals, the OEKO-TEX 100 and ZDHC in-check reports were also uploaded to the blockchain platform at the dyeing stages.
Cotton use case 5: Organic Shirt – (Egyptian Cotton)

Objective: Prove the fibre content is physically and digitally traceable and made from organic cotton by having value chain partners provide transparency and documentary evidence for the cotton fibre content/quality and use of chemicals.

Output: Claim substantiated by complete and relevant documentation

Main challenges: Onboarding of suppliers

Lead company: WEBA Weberei Appenzell AG

Product traced (forward tracing): Organic cotton (Giza 92) used in shirt.

B2B claim: This shirt is made of Egyptian organic cotton. It has been certified in compliance with GOTS and Standard 100 by OEKO TEX for consumer protection from harmful substances. The production facilities have been certified according to STEP by OEKO TEX for improving social and environmental conditions.

Onboarded supply chain partners: SEKEM S.A.E; Mediterranean Textile Company; Delta Dyeing; Elvy Weaving S.A.E; AG Cilander; WEBA Weberei Appenzell AG

Documentation shared among supply chain partners: Delivery notes, shipping notes, commercial invoice, HVI documents (Giza fibre quality and composition classification), certificate of origin

Certifications made available to prove claim(s): STeP by OEKO-TEX, GOTS, Haelixa DNA marker, OEKO-TEX Standard 100

This pilot use case aimed at tracing the supply chain of an organic cotton fabric sourced by WEBA Weberei Appenzell AG in Egypt and sold to producers of garments such as shirts. The pilot had suppliers in different supply chain tiers sharing documentary evidence related to the production stages of the traced shirt. To this end, WEBA involved its suppliers starting from the cotton trader based in Egypt (SEKEM S.A.E), the spinner (Mediterranean Textile Company, Egypt), the dyer (Delta Dyeing, Egypt), the weaver (Elvy Weaving, Egypt), the finisher (AG Cilander, Switzerland), and the fabric trader
(WEBA, Switzerland). The fabric of the shirt is made of 100% organic cotton from Egypt. The goal of participating in the pilot was threefold:

- Achieve end-to-end product traceability by having the supply chain partners upload onto the blockchain system documents about the origin of the organic cotton and the movement of the product along the different stages of the value chain.

- Identify how the partners, along the supply chain, cope with sustainability hotspots — i.e. organic cotton production, GOTS, OEKO-TEX Standard 100; and STeP by OEKO-TEX compliant industrial processes.

- Trace physically and digitally the organic cotton from Egypt.

All processing stages from cultivation, through spinning and dyeing, to fabric weaving happened in Egypt, while the finishing and the product manufacturing followed in Switzerland. In this pilot, with a scope of traceability from field to shop shelf, the origin and quality of the cotton were substantiated by the uploading of HVI (high volume instrument testing) documents certifying the classification of Giza fibre quality, composition and quantity for the lint cotton harvested. The movement of the cotton along the different production stages was evidenced by the uploading of delivery notes certifying the transfer of goods between suppliers. To prove and substantiate the sustainability claims along the supply chain, particularly the one related to the use of organic cotton and social and environmental performance, GOTS certificates for the fibre and the yarn were uploaded to certify that the ginning and spinning mills met all the criteria to be allowed to process GOTS goods (social and environmental requirements) as well as the materials and products themselves meeting all GOTS product criteria. Additionally, the OEKO-TEX Standard 100 and STeP by OEKO-TEX certificates were also uploaded in the blockchain platform to certify compliance of the fabric and product with STeP requirements, which are related to chemicals management, quality management, and environmental performance and management. In this pilot, the use of DNA markers on the cotton were also tested to physically trace the cotton and certify its provenance and authenticity. Following an application on the fibre material at the spinning mill, two tests of the DNA were carried out on the yarn and on the fabric, for which relevant certificates provided by Haelixa were uploaded to the blockchain platform.
Cotton use case 6: Inclusive family farming Pajama (Peruvian cotton)

**Objective:** Prove the fibre content is physically and digitally traceable and supports inclusive family farming in Peru by having value chain partners provide transparency and documentary evidence for the cotton fibre content/quality, social sustainability standards and use of chemicals in the industry

**Output:** Claim substantiated by complete and relevant documentation

**Main challenges:** (1) To involve all the actors of the value chain, generating trust during the whole process of traceability; (2) to communicate to the final clients through accurate marketing activities the added value of a sustainable product traced by leading edge technologies

**Lead organization:** FAO Regional Office for Latin America and the Caribbean

**Product traced (forward tracing):** Peruvian Pima seed and fibre, collection of pajamas April 2022

**B2C claim:** The cotton of this pajama is made in Peru by Piura family farmers at a WRAP certified facility for social compliance. It has been tested and certified according to the Standard 100 by OEKO-TEX for consumer protection from harmful substances.

**Onboarded supply chain partners:** COSTACH LTDA, small farmers (COSTACH associates), Creditex S.A.A, Cat’s Pajamas.

**Documentation shared among supply chain partners:** Commercial invoice, manufacturing instructions

**Certifications made available to prove claim(s):** Haelixa DNA, OEKO-TEX Standard 100, WRAP

The use case was led by FAO Regional Office for Latin America and the Caribbean (Santiago, Chile) in the context of FAO +Cotton Project, in partnerships with FAO country office in Peru, COSTACH (5200 family farmers, region of Piura, Peru), Creditex (1460 employees, Lima, Peru) and The Cat’s Pajamas (25 employees, California, United States).

FAO and the Brazilian Government through Brazilian Cooperation Agency (ABC/MRE) coordinate the +Cotton Project in Peru to mobilize and unite efforts to make the cotton value chain competitive, support family farmer access to markets and to increase their quality of

life and their livelihoods. One way they do this is by providing technical assistance to family farmers to produce and commercialize sustainable cotton.

The +Cotton Project works with the COSTACH cooperative (a group of more than 5,200 farming families) which participated in the ECE blockchain pilot with Creditex, one of the largest yarn producers in the region. The objectives of their participation were as follows:

- Trace the Peruvian PIMA cotton farmed by the COSTACH cooperative from field to shelf by onboarding Creditex as yarn, fabric and apparel producers and tracing the cotton onwards through all the weaving and garment manufacturing processes.

- Provide evidence of sustainability standards and certifications for the mitigation of sustainability hotspots. For this pilot use case these were certification of chemical use according to OEKO-TEX 100 and the social compliance of the garment manufacturer, certified by WRAP.

- Explore the supporting role of physical traceability with DNA markers for better tracking of the value chain processes for clothes and for providing incentives to the retail sector to develop sustainable and traceable collections.

- Test digital technologies for inclusive cotton value chains which integrate the cotton production phase in order to verify the importance of tracking primary materials from seed to garment and to show how this adds value to cotton production to the benefit of all actors.
Objective: Prove the fibre yarn is physically and digitally traceable to certified production practices by having value chain partners provide documentary and transparency evidence for the cotton fibre content/quality and use of chemicals

Output: Claim substantiated by complete and relevant documentation

Main challenges: Onboarding of weavers; complexities with documentation and in following sector-specific standardizations for partners

Lead organization: International Finance Corporation (IFC) World Bank (WB), Tashkent office (Uzbekistan)

Product traced (forward tracing): T-shirts

B2B claim: This shirt is made of Uzbek cotton. It has been tested for harmful substances and certified in accordance with the conditions of the Standard 100 by OEKO TEX for safer chemical management. It has been manufactured in compliance with ISO Standards (45001, 9001, 14001, 18001) for measuring and improving an organization’s health and safety and environmental impact

Onboarded supply chain partners: Indorama Agro, Indorama Kokand Fertilizers and Chemicals, Indorama Kokand Textile, Nil Granit (Samo)

Documentation shared among supply chain partners: Commercial invoice, delivery note

Certifications made available to prove claim(s): Haelixa DNA, OEKO-TEX Standard 100, ISO Certificates (45001, 9001, 14001, 18001)

The use case was led by the Tashkent office of the IFC-WB in collaboration with Indorama (around 2000 employees at Indorama Agro cluster, Uzbekistan)

In 2021, the World Bank Group-International Finance Corporation (WBG-IFC) invested in Indorama Agro, one of the country’s largest cotton farms, to promote sustainable cotton and improve livelihoods in rural areas in Uzbekistan through a 60 million dollar long-term loan. Additionally, Indorama Agro has been supported by the WBG-IFC to pilot a Better Cotton initiative.

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approach to promoting decent work and sustainable practices and standards in cotton farming.

Within this pilot, IFC worked with Indorama Agro in Tashkent, Uzbekistan to create and implement an example of a private sector-led cotton farming and ginning business based on accepted international environmental and social practices, such as the Better Cotton Initiative. IFC and Indorama Agro’s approach focused on introducing sustainable cotton farming and ensuring decent work practices within the company’s supply chain. IFC is therefore supporting Indorama Agro to test the Better Cotton program in order to promote sustainable and decent work practices and standards in cotton farming in Uzbekistan.

The Indorama group, which has vertically integrated operations from farm to spinning, also partnered with ECE to implement a pilot for traceability and transparency in Uzbek cotton supply chains. Indorama onboarded a weaver and a garment manufacturer to provide traceability from yarn up to the finished garment (i.e. t-shirts). Moreover, in order to integrate digital and physical traceability, Indorama explored the use of DNA markers on the fibre to trace it along the value chain to the finished garment phase. IFC and Indorama’s participation in the ECE cotton pilot had several objectives, in particular the following:

- Prove that the cotton is farmed in line with the standards and criteria set by Better Cotton and provide traceability for that proof from farm to garment.
- Provide evidence and a high level of disclosure on how sustainability hotspots are mitigated at the farming level and onwards.
- Show how a high level of integration in production and manufacturing activities can provide enhanced traceability and transparency.
- Explore the application of DNA markers and the use of laboratory testing to link physical cotton to a digital system and to help trace Indorama’s products in the market.

\[\text{Ibid.}\]
Objective: Prove the fibre content is made from Indian organic cotton by having value chain partners provide documentary evidence for the cotton fibre content/quality and use of chemicals.

Output: Claim substantiated by nearly complete and relevant documentation

Main challenges: Onboarding and alignment with tier-4 suppliers and ginners

Lead company: Candiani Denim

Product traced (forward tracing): Organic denim fabric

B2B claim: This denim is made of organic cotton sourced in India. It is manufactured in Italy in compliance with the GOTS and ISO standard 14001 for reducing environmental impacts and the ZDHC program for safer chemical management by restricting the use of harmful chemicals, at a facility that is annually assessed for its environmental and social performance through the HIGG FEM


Documentation shared among supply chain partners: Delivery notes, GOTS transaction certificates, sea waybill reports, dyeing reports, weaving reports, finishing reports

Certifications made available to prove claim(s): GOTS from ginning through fabric production, HIGG FEM, SA8000, ZDHC, IFOAM, NPOP+

Candiani’s pilot aims at tracing the supply chain for organic cotton used in denim fabric by having suppliers operating at different supply chain tiers share documentary evidence related to the monitored production stages of the traced yarn. To implement, Candiani, in its role as a vertically integrated denim manufacturer involved its suppliers in India and Italy in the pilot, starting from the cotton trader (Otto Stadtlander) and the ginner (Bafna and Gomtesh). This denim fabric was selected due to its sustainability criteria and because it represents a best seller among the GOTS certified organic cotton denim fabrics that Candiani produces. The goal of participating in the pilot, was as follows:

• Trace a best-selling fabric for which there is a high demand from customers using a cost and time-effective traceability and transparency methodology.
• Achieve traceability of the product by involving the partners in the supply chain who upload onto the blockchain system the documents about the origin of the cotton and the movement of the material/product along the various stages of the value chain.
• Identify how Candiani and its partners along the supply chain mitigate sustainability hotspots by using organic cotton and by adopting the ISO14001:2015 certification and HIGG FEM assessment as references and tools to evaluate environmental sustainability along the entire product production chain.

The movement of the cotton and the product through the different production stages is evidenced in the blockchain by the uploading of shipping notes and invoices from the cotton trader, through to the ginner, to the vertically integrated denim manufacturer.

To prove and substantiate the sustainability claims along the supply chain and, in particular, the one related to organic cotton yarn, GOTS certificate transaction documents are uploaded in the platform for the ginning and fabric manufacturing phases, which includes spinning, warping, dyeing, weaving, finishing, and warehousing. Environmental performance aimed at continual improvement was demonstrated by uploading ISO 14001:2015 certificates and HIGG FEM assessment reports while sustainable chemical management was verified using the submission of ZDHC certification, and the uptake of organic agriculture and similar approaches was certified by uploading IFOAM and NPOP standards conformance for the planting stage.

B. Leather use cases deep dive

84. The boxes below provide an overview of the five leather use cases, detailing for each one the objective, product traced, claim formulated, partners involved, documentation submitted and provides a narrative description.

• Use case 1: Handbag (Danish leather)
• Use case 2: two pairs of shoes (Brazilian leather)
• Use case 3: Shoe (American leather)
• Use case 4: Small calf leather for women’s shoes processed in Italy
• Use case 5: Finished goat leather (Uganda)
Leather use case 1: Handbag (Danish leather)

Objective: To prove that the leather used in a handbag has been processed according to chemical compliance and social and environmental standards by having value chain partners provide documentary proof

Output: substantiated claim through the provision of complete and relevant documentation

Main challenges: N/A

Lead company: Richard Hoffmans

Product traced (backward tracing): Lily Heavy Grain Handbag

B2C claim: The leather in this Mulberry product has been sourced from Denmark and it was manufactured in Germany in accordance with Leather Working Group, ISO and ZDHC standards which promote environmentally sustainable and responsible chemical use practices.

Onboarded supply chain partners: Danish Crown (farming and slaughter), Scan-Hide (tanning), Royal Smit & Zoon (chemical manufacturer), Richard Hoffmans (tanning and manufacturing), Mulberry (manufacturing, brand and retailer)

Documentation shared among supply chain partners: Orders, commercial invoices, delivery notes

Certifications made available to prove claim(s): LWG, ZDHC MRSL, ISO 14001:2015

DESCRIPTION OF USE CASE

The use case traced the supply chain for a Lily Heavy Grain Handbag and was led by Richard Hoffmans, who managed to involve it’s upstream and downstream partners, from farm to store.

The leather was sourced in Denmark from Danish Crown farms and then delivered to Scan-Hide, who covered the tanning, splitting, shaving and sorting phases, then the material was passed to Richard Hoffmans who covered the manufacturing stages in Germany, with chemical inputs shipped by Royal Smit & Zoon from the Netherlands. Afterward, it went to Mulberry for product assembly and retail.
The origin of the product was traced based on orders, delivery notes and shipping notes from Danish Crown farms, delivery notes from Scan-Hide, delivery and shipping notes from Royal Smit & Zoon and shipping notes from Richard Hoffmans to Mulberry.

For certifications uploaded onto the blockchain, Scan-Hide, Richard Hoffmans and Royal Smit & Zoon were all covered by LWG certification, while Smith & Zoon added an extra layer of certification with ZDHC ClearStream certificates for chemical compliance and ISO 14001:2015 compliance certification.

Mulberry use case
Leather use case 2: Two models of shoes (Brazilian leather)

Objective: to evidence that the leather used in two different models of shoes has been sourced according to animal welfare, chemical compliance and social and environmental standards, by involving value chain partners to provide documental proof.

Output: substantiated claim through provision of complete and relevant documentation

Main challenges: N/A

Leading company: PrimeAsia

Product traced (backwards tracing): Stan Smiths HQ 6747 Shoes

B2C claim: The leathers used in the manufacturing of this shoe originated in farms carrying strict organic practices – in line with the USDA National Organic Program – that foster the responsible use of resources, conserves biodiversity and promotes the humane handling of animals. The hides were carefully processed at LWG Gold Rated tanneries working with efficient and clean processes in safe work environments. All leathers were finished in facilities using responsible and safe chemicals compliant with ZDHC Guidelines.

Onboarded supply chain partners: Minerva, slaughter; Curtume Centro-Oeste/Minerva and PrimeAsia, manufacturing; Apache, product assembly and dispatch; Adidas, retailing

Documentation shared among supply chain partners: shipping notes, delivery notes

Certifications made available to prove claim(s): AWA\textsuperscript{48}, USDA Organic, LWG, ZDHC ClearStream, FSLM, IQNet SR10:2015

DESCRIPTION OF USE CASE

The use case traced the supply chain of two different models of Stan Smith shoes. It was initiated by PrimeAsia, who involved it’s upstream and downstream partners, from slaughter to retail.

The leather was sourced in Brazil from Minerva, who covered the cattle farms as well as slaughterhouses, and through Curtume Centro-Oeste/Minerva (a subcontractor) for the wet-blue processing of the raw-hides. It then passed to PrimeAsia who covered the manufacturing stages in Brazil, Vietnam and China, then to Apache in China to be assembled into two distinct final footwear products, and finally it reached Adidas for retail in Germany.

\textsuperscript{48} Certified animal welfare approved (AWA)
In terms of documents uploaded, the origin of the product was traced based on the list of farms provided from Minerva, delivery notes from Minerva’s slaughterhouse to Curtume Centro Oeste/Minerva, bill of lading and delivery note from Curtume Centro Oeste/Minerva to PrimeAsia, through shipping and delivery notes from PrimeAsia to Apache and through shipping notes from Apache to Adidas.

In terms certifications uploaded on the blockchain, Minerva provided documentary evidence through an animal welfare certificate issued by WQS (a PAACO accredited organization)\(^\text{49}\). It also provided an organic certificate, in accordance with USDA National Organic Program covering the slaughterhouse and group of organic farms supplying to the slaughterhouse, certifying the responsible use of resources, biodiversity conservation as well as dignified handling of animals at the farm level. Curtume Centro-Oeste/Minerva is covered by LWG certification; PrimeAsia is covered by both social and environmental standards through LWG certification concerning work safety and cleaner process in tanneries, as well as chemical compliance through both LWG and ZDHC ClearStream certificates. PrimeAsia also provided FSML, covering social labour practices and human rights, and an IQNet SR10:2015 certificate.

Adidas use case

\[\text{The leathers used in the manufacturing of this shoe were originated in farms carrying strict organic practices – in line with the USDA National Organic Program – that foster the responsible use of resources, conserves biodiversity and promotes the humane handling of animals. The hides were carefully processed on LWG Gold Rated tanneries working with efficient and cleaner processes, in safe work environments. All leathers were finished in facilities using responsible and safer chemicals compliant with ZDHC’s Guidelines.}\]

\(^{49}\) Professional Animal Auditor Certification Organization, Inc. (PAACO); Brazilian-based World Quality Services (WQS).
Leather use case 3: Citysole Court Sneaker shoes – American leather

Objective: to evidence that the leather used in a pair of Citysole Court Sneaker shoes has been processed according to chemical compliance and social and environmental standards by involving value chain partners to provide documented proof.

Output: substantiated claim through the provision of complete and relevant documentation

Main challenges: N/A

Leading company: Tapestry

Product traced (backwards tracing): Citysole Court Sneaker shoes

B2C claim:
- **ZDHC** - The leather in this product comes from a tannery (PrimeAsia) that is verified by ClearStream as conformant with the ZDHC MSRL Leather Wastewater Guidelines (v1.0)
- **Social Labour Practices and Human Rights** – The leather in this product comes from a tannery (PrimeAsia) verified and certified by Higg FSLM for its social labour and human rights practices. PrimeAsia’s social responsibility management system is certified by the China Quality Certification Centre.
- **LWG**: The leather in this product comes from LWG Gold Rated tanneries (PrimeAsia and Tyson) verified and certified by LWG under its methodology and criteria for evaluating environmental practices, including efficient use of resources, safe use of chemicals and health & safety measures.
- **U.S. Hides**: the leather used to produce these shoes comes from U.S. hides.

Onboarded supply chain partners: Tyson, farming, slaughter and tanning; PrimeAsia, tanning and manufacturing; Shinymark, product assembly and dispatch; Tapestry, brand and retailer

Documentation shared among supply chain partners: shipping notes, commercial invoices

Certifications made available to prove claim(s): LWG, ZDHC ClearStream, Higg FSLM

DESCRIPTION OF USE CASE

The use case traced the supply chain of a pair of Citysole Court Sneaker shoes and was initiated by Tapestry, who managed to involve its upstream partners from farm to store.
The leather was sourced in the United States from Tyson, who covered the cattle farms, slaughterhouses and wet-blue tanning. It was passed to PrimeAsia who covered the leather manufacturing stages in China; then it went to Shinymark in Indonesia to be assembled into a final footwear product and finally to the Tapestry global market/retailer.

The origin of the product was traced based on a commercial invoice from Tyson to PrimeAsia, a Shipping note from Prime Asia to Shinymark, and commercial invoices from Shinymark to Tapestry.

In terms of certifications uploaded on the blockchain, Tyson and PrimeAsia covered chemical compliance and environmental standards through LWG and ZDHC ClearStream certificates. Additionally, PrimeAsia provided an FSLM certificate covering social labour practices and human rights and an IQNet SR10:2015 certificate.

**Tapestry use case – Citysole Court Sneaker**

- **Claim**
  - The leather in this product comes from a tannery (Primark) that is certified by CrmHs and confirmed with the ZDHC, WRAP, Leather Working Group (LWG) standards.
  - Primark social responsibility management systems is verified by the Global Standard Certification Center.
  - The leather in this product comes from a tannery verified and certified by Higg HfP for its social labor and human rights practices. Primark's social responsibility management systems is verified by the Global Standard Certification Center.
  - The leather in this product comes from a tannery verified and certified by Higg HfP for its social labor and human rights practices. Primark's social responsibility management systems is verified by the Global Standard Certification Center.

- **Companies**
  - CrmHs
  - Primark
  - Shinymark
  - Tapestry

- **Value chain**
  - Farming/Hunting
  - Dyeing
  - Setting
  - Sammying
  - Out of scope

- **Sustainability risks covered**
  - Air Pollution
  - Water Pollution
  - Hazardous chemicals
  - Solid waste
  - Energy consumption
  - Health and safety/PPE
  - Water Use

- **Transparency evidences**
  - Commercial Invoice
  - Shipping note
  - Commercial Invoice

- **Transparency evidences**
  - ZDHC
  - LWG
  - ZDHC
  - LWG
  - ZDHC

**Note:** The numbers used to produce these shoes come from CrmHs, Tyson, and Primark.
Leather use case 4: Small Calf leather for women’s shoes

Objective: To prove that the calf leather produced has been processed according to compliance with good practices for chemicals as well as traceability and environmental standards

Output: Substantiated claim through the provision of complete and relevant documentation

Main challenges: N/A

Leading company: BCN Concerie

Product traced (backwards tracing): Seta Box - small calf leather for women’s shoes

B2C claim: Seta Box leather was supplied by an Italian facility, Sapa S.p.A., which used tanning, retanning and finishing processes that meet LWG and ICEC standards in order to be compliant with the industry standards for traceability and environmental practices

Onboarded supply chain partners: Sapa S.p.A, trader; BCN Concerie, manufacturing

Documentation shared among supply chain partners: shipping note

Certifications made available to prove claim(s): LWG, ICEC

DESCRIPTION OF USE CASE

This use case traced calf leather for women shoes and was initiated by BCN Concerie, who involved its upstream partner, Sapa.

The raw hide was provided by Sapa to BCN Concerie, who covered the tanning and manufacturing stages of the process.

The origin of the product was traced based on commercial invoices from Sapa. In terms certification, uploaded on the blockchain, BCN covered chemical compliance and environmental standards through LWG certification and traceability through an ICEC certificate.
BCN Use Case

**Claim**

Seta Box was supplied by an Italian facility, Sapa S.p.A., transformed by tanning, retanning and finishing in accordance with LWG and ICEC standards in order to be compliant with the industry standards for traceability and environmental practices.

**Value chain**

1. Farming/Hunting of Livestock
2. Slaughter
3. Hide/Skin
4. Dyeing, Setting, Sammying
5. Hoofing, Tanning
6. Bleaching, Freezing, & Drying
7. Tanning, Setting, & Freezing
8. Drying, Conditioning, & Tanning
9. Product Assembly/ Finishing
10. Emission and Metal

**Sustainability risks covered**

- Air Pollution
- Water Pollution
- Solid waste
- Hazardous Chemicals
- Health and safety/ PPE
- Energy consumption
- Water Use

**Transparency evidences**

- Shipping note

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Leather use case 5: Finished goat leather (Uganda)

**Objective:** To prove that the finished goat leather has been processed according to safer environmental standards by involving value chain partners who provide documented proof

**Output:** Substantiated claim through provision of complete and relevant documentation

**Main challenges:** N/A

**Leading company:** Leather Links

**Product traced (backwards tracing):** Finished goat leather

**B2C claim:** Finished goat leather, sourced and processed in Uganda. The skins are processed and finished in Italy afterwards according to the Leather Working Group environmental protocol and supplied to the end client.

**Onboarded supply chain partners:** Reserved, hide and skin preservation; Reserved, tanning to splitting; Reserved, trading; Leather Links, trading; DL Leather, from dyeing to finishing.

**Documentation shared among supply chain partners:** Delivery notes, bill of lading, commercial invoices

**Certifications made available to prove claim(s):** LWG

**DESCRIPTION OF USE CASE**

The use case traced the supply chain of finished goat skin and was initiated by Leather Links, who managed to involve it’s upstream and downstream partners, from skin preservation to finishing.

The hide was sourced in Uganda, covering the hide/skin preservation and sent for tanning and splitting; It was then passed to the UK to a trader and to Leather Links in Switzerland for trading, before finally reaching DL Leather in Italy for the rest of the manufacturing process, up to finishing.

The origin of the product has been traced based on delivery notes, bills of lading and commercial invoices.
In terms of certification uploaded on the blockchain, LWG certificates covering the tanning process from raw hide/skin to tanned and from raw hide/skin to finished leather have been provided.

Leather Links use case

VII. Challenges, opportunities and lessons learned

85. The ECE blockchain pilots project has provided companies with an opportunity to test, free of charge, a methodology and a system for tracking and tracing within their value chains and for creating the transparency needed in order to support value chain partners in complying with the requirements stemming from due diligence laws. The pilots are also an opportunity to benefit from training and from industry experts’ knowledge about value chain processes, actors, sustainability risks and associated mitigation measures. Altogether, this has allowed companies to learn how to implement a standardized methodology for traceability and sustainability transparency for their customers. Building on their experience in the pilots, companies can further internalize these processes and implement them in their internal strategies for traceability and transparency.

A. Lessons learned and challenges for successful implementation

86. Through the direct and active participation of industry representatives in the pilots project and its technology, important lessons were learned, and challenges identified, as described below. The difficulties encountered by the partners in this project were primarily business issues or issues that would arise in the implementation of any new digital system, regardless of the technology used in that system.

Areas of opportunities and challenges for harnessing the potential of blockchain technology for due diligence and sustainability in value chains

<table>
<thead>
<tr>
<th>Areas of opportunities and challenges for harnessing the potential of blockchain technology for due diligence and sustainability in value chains</th>
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<td>a) Engaging all value chain partners in end-to-end product traceability</td>
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<td>b) Building the knowledge for a standardized business approach</td>
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1. Engaging all value chain partners in this end-to-end product traceability: opportunities and challenges

87. Building on the experience of the companies engaged in the pilots, there are lessons learned and challenges for successful implementation of traceability and transparency goals. A whole value chain approach, vertical integration and inclusiveness are key to traceability and transparency in the initial upstream tiers of a value chain. The project developed a methodology where the value chain approach is one of the main pillars and a key condition for a successful pilot implementation in the blockchain-based system. Onboarding value chain partners proved to sometimes be a challenging process.

88. In the cotton pilots, companies with a high-level of integration, and with sister companies operating in the cotton farming sector, performed much better because they had to cope with very little fragmentation in their supply chain. Notwithstanding the difficulties of reaching the initial tiers of the cotton value chain (i.e. cotton farming) the majority of companies could prove the origin of the cotton by onboarding the cotton traders. Better performance in the pilots project was observed for companies that have direct operations in cotton-producing countries and special CSR programs, partnerships and participation in projects that involve cotton farmers cooperatives. It is critical to raise awareness about the benefits to be reaped from supply chain traceability using blockchain technology, especially with regard to managing the risk of sustainability impacts in the context of due diligence and responsible business conduct.

89. The alignment of value chain partners, commitment and strong collaboration in supply chains is key to collecting documentary evidence to support claims. The difficulty, and the time required to complete the onboarding process will vary depending upon the complexity of the value chain, its level of integration and the willingness of partners to implement a collaborative approach in order to achieve traceability in support of sustainability claims using a common data repository. Therefore, considering that the onboarding of value chain partners and the coordination of data collection requires significant effort and time, the early identification of value chain points where data needs to be collected (also referred to as “data points”) and the engagement of suppliers throughout the value chain from field to shelf, is critical, especially for upstream actors in the value chain (e.g. raw material providers, SMEs and smallholders), but also for downstream actors (e.g. manufacturers, retailers). The upstream part of the value chain is also where sustainability impacts (labour, social, environmental, health & safety related impacts) tend to be less visible and, therefore, where it is more difficult to carry out due diligence. Building trust, establishing a win-win cooperation, and empowering all actors with the opportunity to make their contribution is important for value chain alignment, should the value chain be vertically integrated, and it is even more relevant for complex and fragmented value chains.
2. Building the knowledge for a standardized business approach: opportunities and challenges

90. In the context of implementing traceability and transparency within a value chain, it is critical to define a common terminology and process understanding among the value chain participants.

91. Raising awareness and building knowledge about why traceability and transparency are key enablers to accelerate the shift toward more responsible business models is important, especially since they can put to rest the issues of false claims and “greenwashing”. Traceability and transparency systems are the stepping-stones for embarking on the sustainability journey, because they allow us to better measure and manage risks for workers and the environment, to strengthen long-lasting partnerships and meet consumer demand for sustainably produced products.

92. A full understanding of the documentary (data) evidence required in order to support claims is essential for setting up a traceability system because the system requires that the essential data needed from suppliers be identified upfront. Backwards tracing may be more difficult than forward tracing, particularly when there is a need to collect information ex-post and that information is not always available or can be hard to retrieve, especially if the right processes or technology are not available. Forward tracing follows the chronological decision-making process (development, sourcing, manufacturing, etc.) and product life cycle. At the “upstream beginning” of the value chain forward tracing depends upon the identification of characteristics of textile fibres or materials; however, these fibres may have been harvested/manufactured before the proof-of-concept project was initiated or even before the purchaser of the fibre/material was known. Therefore, implementing data collection in these circumstances may require more time, may require the combined implementation of backward and forward data collection within the same value chain and may not fit within the timeline of a proof-of-concept, hence the challenge.

93. Building knowledge about the methodology and the blockchain-based system requires partners to invest time in training and coaching sessions. These have been provided by the ECE team to build capacity to use the platform built upon the UN/CEFACT standard. These trainings showed how to identify the data and documents that need to be uploaded and the appropriate disclosure levels for partners in the supply chain. The ECE pilot team adopted an open-source approach to sharing guidance documents with partners. It is a critical success factor in aligning the terminology of UN/CEFACT standards with that of the industry and to provide a clear understanding of the standardized data and data collection points based on the UN/CEFACT standard and the EPCIS reporting system.

3. Data disclosure and legal issues in the blockchain platform: opportunities and challenges

94. Data sharing, privacy, confidentiality, security and immutability in the blockchain is a key concern for companies. Despite willingness to shift towards more responsible business models, companies face a dilemma between reaching transparency goals and disclosing competition-sensitive data in a blockchain. Due diligence requires that partners implement, even invest in, certifications, inspections and audits related to sustainability performance and share this information – but the sharing of related information may be greeted with scepticism by some value chain actors who fear that transparency could lead to the disclosure of business-critical information. The data shared with the ECE secretariat, expert team and the technology-solution provider was analysed from a business and a legal perspective. The purpose of this analysis was to guarantee the confidentiality and privacy of data, while also defining the level of supply chain visibility required for the data (see Figure 22).
Figure 22:  
**Identification of disclosure levels in the blockchain platform**

Figure 23:  
**Data disclosure levels of traceability information in the blockchain platform**

Figure 24:  
**Data disclosure levels of transparency information in the blockchain platform**
95. Under the project, work was undertaken to identify the legal aspects impacting the development and implementation of the blockchain-based solution, such as governing law and jurisdiction, the governance framework for an open-source software solution, intellectual property rights, liability, data protection and data privacy (e.g. EU GDPR and other laws concerning data privacy). The project team produced a rules book on data management for partners in the implementation of the project blockchain pilots and a memorandum of understanding to define and organize the collaboration, to understand the data collected (what, when, where, who, why and how), to protect the sharing of data, and to manage and coordinate the overall project run.

4. Governing digital systems: opportunities and challenges

96. The pilots project was coordinated by a neutral organization, the ECE secretariat, who facilitated the activities and provided a convening platform for sharing best practices and experiences. This sharing was crucial for building trust between the parties, all of whom are involved in complex value chains. Most of the companies involved preferred a self-coordination approach, rather than central coordination, for collecting the documentary evidence needed from their suppliers to back up their claims, and they were supported in this by regular contact and guidance from the project team.

97. Developing a blockchain-based system based on an open source approach to sharing information and managed by a university (SUPSI) was an asset in the context of this project involving 40+ organizations and companies. The university has the advantage of being a more neutral body than a private technology solution provider.

98. An important lesson learned is related to the consequences of working within a blockchain environment. Blockchain is an immutable decentralized storage, where information is kept inside smart contract elements. Manual entry always leads to mistakes and errors, an aspect that, due to the blockchain architecture, cannot be corrected and updated. Therefore, the integration of APIs (application programming interfaces) for data collection will be fundamental, not only to avoid manual data entry but also to avoid human induced mistakes.

5. Integrating blockchain technology and/or other digital solutions into existing company systems: opportunities and challenges

99. Transition from manual data entry to a fully automatic and programmable integration of data entry for a blockchain application is mandatory for industrial applications. The need to analyse the different ERP systems of all involved partners is fundamental. For this, the involvement of the IT departments of different partners is needed in order to undertake the analysis from a technical perspective. The design and implementation of APIs which can be used to extract and upload data without changing the underlying systems is also necessary in order to reduce the impact on each company's IT department. The correct involvement of company IT departments is an important issue which was not fully addressed during this project and requires coordination and incentives for partners to fund this work. To support this, the open source approach could lead to an open community working group collaborating in the development of the platform and related APIs. The analysis of the integration API layer is important for the transition from a pilot project to actual system implementation from a technical perspective.

6. Adding another layer of traceability with physical markers

100. Product markers are emerging as another technology that can support the connection between the physical and the digital world and their data flows. While these solutions can be costly, especially for an implementation on a wide industry scale, they are also an opportunity to consider. For companies who give a high priority to tracing the provenance of raw materials and to product authenticity and quality, product markers provide another level of assurance in terms of traceability, which is complementary to the digital traceability provided

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Available at: https://eur-lex.europa.eu/eli/reg/2016/679/oj
in the blockchain. In the ECE blockchain pilots some use cases, in Egypt, Peru and Uzbekistan, have explored the application of DNA markers, provided by the Swiss start-up Haelixa, to support the physical traceability of the cotton.

101. In the cotton pilots, the lint cotton fibre was marked and the DNA analysed after a transformation or a transaction event to ensure identity preservation. DNA technology proved to be very valuable in cases where multiple parties are involved in the production at one stage in the supply chain (e.g. when yarn or fabric has been sent to an external processor to dye it). In these cases, if the returned product, when tested, no longer contains DNA, this identifies that the material was mixed up or exchanged. The company can then identify the source of the issue and correct it. There have been cases where the authenticity from the raw material to the final product was verified seamlessly. In such cases, DNA traceability ensured that product claims could be made on a specific garment, building trust among all actors in the value chain. Therefore, a physical marking, like Haelixa DNA, is a tool to ensure identity preservation.

102. Another key opportunity provided by DNA markers is independent verification that complements environmental, social and governmental (ESG) guidelines followed by manufacturers. Buyers (brands, retailers) may be increasingly willing to request independent verification of product claims regarding origin, quality, social and environmental performance, especially for materials, such as Egyptian cotton, where there are elevated levels of cheating and greenwashing. Buyers are willing to look for solutions that prove the material’s authenticity, and physical traceability is in demand by companies involved in the manufacturing of premium material and products.

7. Onboarding of certifiers

103. Following the cotton pilots, the platform was fine tuned for the pilots on leather to allow third-party certifiers to verify directly the certificates uploaded by participants. Certification companies wanting to participate in the pilots agreed to provide email contact details to be listed in the platform. Value chain partners were thus enabled to upload relevant certificates and select corresponding certifiers from a drop-down menu. Once all information was completed and the certificates uploaded, the referent within the certifying company received an email notification to assess the authenticity of the certificate uploaded. Then, once they approved its authenticity, the certificate was cleared for inclusion in the platform.

B. The industry experience

104. The participating companies filled in a questionnaire developed by the ECE secretariat in order to collect feedback about their pilot project experience and notably to

- identify outcomes and key performance indicators (KPIs) to measure the impact of blockchain technology for traceability and transparency in support of due diligence and sustainability in cotton value chains; and
- build upon outcomes to identify additional traceability and transparency KPIs to be tested by industry actors involved in the ECE blockchain pilots for other fibre types and materials.

105. The questionnaire was divided in six sections as follows:

- Use case outcomes in the blockchain platform
- Commitment and training
- Technology cost-benefit evaluation by partners

51 This part builds upon the outcomes of a pilot evaluation and KPIs questionnaire completed by the lead working group partners for all the 13 use cases.
52 The questions in this survey refer often to blockchain technology, however the experiences and feedback received apply more generally to project implementation and the implementation of new digital systems. Therefore, in the questions copied below the references to blockchain have been deleted.
• ECE traceability and transparency methodology performance evaluation by partners
• Usefulness of the methodology within the partner’s wider supply chain sustainability efforts
• Communication and comments

106. This section is based on analysis of the results from 11 questionnaires. The questionnaires were completed by the lead partners for each use case in the cotton and leather pilots, i.e. brands (Vivienne Westwood, Tapestry), manufacturers (Cotonificio Albini, Filmar, WEBA Weberei Appenzell AG, Candiani Denim, Prime Asia, Richard Hoffmanns, BCN Concerie), international organizations and financial institutions (FAO RLC in Santiago, Chile, IFC Tashkent office, Uzbekistan). These lead partners’ answers also reflect the experience of the approximately 40 participating companies from the textile and leather industry.

1. **Cost-efficiency for data collection and exchange in the cotton pilots in comparison to internal data management systems**

107. Piloting companies reported that, overall, the cost-efficiency for data collection and exchange in the cotton and leather blockchain pilots in comparison to an internal data management system is medium to low, which is to be expected from a pilot project. Partners noted that the pilot requires higher manual data input at the moment since their suppliers do not have interfaces to link the pilot’s system with their internal systems. Additionally, the platform has been developed based on continuous feedback and input from the pilot partners regarding the set of criteria relevant to them such as certification types and standards used. Partners reported that the data collection, per se, was quite cost-effective and straightforward, requiring mostly dedicated man hours to complete. In some cases, the pilots revealed to companies some weaknesses in how data is organized and stored, which will require investments to remediate. The total workdays dedicated to the pilots varied between 5 and 30 days, with 15 days being the average. For the cotton pilots, partners who were involved in the development and setting up of the blockchain platform, including dry-run sessions dedicated up to 30 days. Finally, the level of cost-efficiency for data collection and exchange versus classic data management systems very much depended upon the internal availability of the needed documents for both cotton and leather.

Figure 25: **Level of cost efficiency for data collection and exchange in the cotton pilots in comparison to internal data management systems**

![Pie chart showing cost efficiency levels for data collection and exchange in the cotton pilots.](image)
2. Main challenges resulting from using digital traceability technology to manage supply chain data with all value chain actors

108. In the cotton pilots, and as highlighted earlier, the main challenge in using digital technology to manage supply chain data with all value chain actors is the commitment and alignment of all value chain actors. This is followed by the implementation with SMEs and small-scale actors and knowledge sharing, as described above. Also important is the need to educate partners about the operational aspects of digital technology and its implication for data sharing and storage. Perhaps because the leather value chains tend to be more vertically oriented, the leather use case partners have highlighted more technical concerns in terms of complexity and costs of data collection, together with privacy and security considerations.

109. The companies who started earlier in the pilot had to put more effort into supporting the ECE team as it worked to structure the pilot’s organization and data collection, which allowed the subsequent use cases to be developed and managed more smoothly. It was noted that training sessions were more effective when delivered in the local language of the partners and when real business data, rather than samples/dummy data were used. Moreover, partners noted that shifting to digital technology for traceability to manage supply chain data could entail major changes, especially in terms of the time commitment required to implement a system covering all the production steps and actors in the value chain. The cost of implementation presents a possible problem, so it is critical to invest resources to apply the right technology. SMEs would not have the capacity and internal resources to implement such a system. The engagement of value chain partners that are SMEs could be challenging depending upon their capacity and internal resources.

110. A further challenge identified by piloting partners is to create the necessary capacity for the actors to use the technology. In this sense, the interface of the platform could be improved, for example by adding pop up boxes on each feature that explain what the feature is and how to use it or by adding demo videos with mock use cases being built step by step. Moreover, it was noted that the system requires high level of organization for the collection and digitalization of the data, which is a challenge for farmers.

111. Some companies may have assigned a dedicated person to oversee the development and management of internal traceability based on the ECE platform technology. It was reported that the integration of the digital traceability system not only required companies to update their internal technology and hardware systems, but also required considerable time, thus resulting in high investment costs. Implementation could also present significant challenges for companies in terms of capacity building in their internal IT departments.

112. Additionally, partners have reported a pervasive level of scepticism and reluctancy along the supply chain to share information that has historically been private (e.g. dye recipes), which is an obstacle to transparency. Education was identified as key to helping partners better understand how a digital traceability system works and how important
strengthening supply chain monitoring and control is as a tool for supporting business continuity and mitigating sustainability hotspots.

113. In the future, interoperability will be critical, given the number of digital traceability systems and blockchain-based applications being developed. Without interoperability, there is a risk that supply chain participants may have significantly increased costs due to multiple partners using multiple digital traceability systems (which may use multiple blockchains or other technologies) or because they may have data that is on one system (for example for the transportation of goods) that needs to be transferred to another system (for traceability and transparency or some other purpose).

114. In addition, it is important to facilitate interoperability between digital traceability systems and the internal systems of companies. Since each company’s internal systems are different, it is not practical to think of having universal interoperability with them, but tools such as APIs can help, as well as the use of standardized data. Without such interface tools companies will have to input data by hand onto a digital traceability system, which is not practical and is prone to errors.

Figure 27: Main challenges of digital traceability technology for managing supply chain data with all value chain actors – cotton
3. Usefulness of the ECE traceability and transparency methodology and approach for accessing data on sustainability performance and supporting risk-informed decisions

115. Piloting partners assessed the usefulness of the ECE methodology and approach for accessing data on sustainability performance and supporting risk-informed decisions. The key benefits for the partners were the identification of a minimum set of information to be collected for traceability and transparency at key data collection points through the use of the T&T matrix, the identification of business processes, actors and sustainability risks resulting from the business process analysis (BPA), and additional benefits such as fostering data trustworthiness and facilitating the identification of evidence for traceability and transparency.

Figure 29:
Evaluation of the benefits of digital traceability technology for managing supply chain data with all actors – cotton
Figure 30:
Evaluation of the benefits of digital traceability technology for managing supply chain data with all actors – leather

Dimensions evaluated in the above chart
A1: Enhance due diligence, sustainability and responsible business conduct
A2: Efficiency improvements
A3: Monitoring energy consumption and material flows
A4: Enhanced decision-making
A5: Better waste management
A6: Improved logistics, inventory management and collection planning
A7: Transparency and instant tracking of material sources
A8: Speedier just-in-time production
A9: Cost effectiveness (staff, IT system) in managing data, documents, information
A10: Risk management (legal, reputational, operational risks)
A11: Digital and immutable document archiving
A12: Facilitated document sharing and exchange between actors through digitalization
A13: Reduced auditing
A14: Level playing field incentivizing “good players” and enhanced trust
A15: Secure green financing for investors promoting small and middle-sized actors
A16: Meeting consumer demand for sustainable consumption and production
A17: Better international market access for SMEs and MSMEs in producing countries
116. One company commented that digital technology for traceability enhanced sustainability and responsible business conduct by providing another level of assurance. At the same time, due diligence needs to take place prior to the actual transaction, so digital technology for traceability does little to further enable this. Digital technology for traceability was helpful for identifying information gaps that would support process improvement and has the potential to support the monitoring of material flows, depending upon the types of information being shared. For enhanced decision-making, digital technology for traceability can support the streamlining of processes and document storage. Transparency and instant tracking were noted as key benefits, as they enable partners to see, in real time, the release of a shipment. One of the biggest perceived benefits of blockchain is to provide another level of immutable assurance of data validity and to facilitate document sharing and exchange between actors through digitalization. However, an important caveat is that the assurance provided by blockchain is only as strong as the quality of the information being shared. Therefore, the largest value is attained only when the documents (information) shared have either originated from, or have been verified or certified by, a second or third party. The blockchain pilots project demonstrated that this type of supply chain cooperation has the potential to facilitate document sharing, especially when done automatically. With facilitated, potentially real-time, document sharing the potential to reduce audit fatigue is very high. By facilitating traceability this added value can be passed along to the end consumer. Also, with new legislation calling for verifiable green claims, digital traceability systems could be a valuable tool for helping to verify claims.

117. Piloting companies also mentioned alternative tracking technologies that were not used in the pilots but have the potential to enhance the level of assurance and verification in traceability and transparency systems. These included the use of product marking technologies such as RFIDs for downstream supply chain tracking, supplying information to consumers via QR codes and isotope tracking. These and other tracking technologies could contribute to the development of digital platforms where physical products are displayed and tracked in real time as digital twins. Cost efficiency will be an important factor in the selection of alternative technologies.

118. Pilot project partners evaluated the ECE traceability and transparency methodology, for providing the following benefits for their companies: increased awareness among stakeholders, the sharing and testing of the methodology with supply chain partners and in production lines with real-life scenarios and increased supply chain collaboration. The project was a learning journey that enabled partners to run and complete a pilot activity while experiencing, first hand, the complexity involved in implementing traceability and transparency. The development of reliable B2B and/or B2C claims in relation to sustainability risks has also been identified as a key benefit. Moreover, companies were happy with the increased knowledge and capacity they developed in their functional departments involved in the pilot, as well as the availability of tools and a methodology to start the learning and implementation journey toward traceability & transparency. One piloting company reported the development of an internal project related to traceability and transparency, to be integrated into other digital projects. The pilots have, in some cases, noticeably contributed to the digitalization of farm cooperatives. Another company noted that the ECE pilot provided a comprehensive overview of how traceability and transparency can be practically applied in operations. It also helped the company establish a baseline for how to improve internal processes in order to streamline data collection.
Figure 31:
ECE T&T methodology benefits for accessing data on sustainability performance and supporting risk-informed decisions – cotton

Figure 32:
ECE T&T methodology benefits for accessing data on sustainability performance and supporting risk-informed decisions – leather
Figure 33:
Usefulness of methodology within partners’ wider supply chain sustainability efforts – cotton

Dimensions evaluated in the above chart

Q1: Enable the establishment of a sustainable procurement policy that comprehensively covers relevant sustainability risks
Q2: Enable the company to increase visibility of its potential supply chain hotspots and related claims
Q3: Enable the establishment of relevant sustainability clauses as part of suppliers’ contracts
Q4: Enable the establishment of targeted sustainability questionnaires in requests for proposals
Q5: Establish clearer sustainable supply chain KPIs in your sustainability reporting
Q6: Enable more effective buyer training on category-specific sustainability hotspots
Q7: Enable stronger and more reliable partnerships with suppliers
Q8: Enable more effective due diligence on suppliers’ sustainability performance (e.g. through questionnaires, on-site audits, third-party audits, etc.)
Q9: Enable the company to de-risk its operations by being compliant and/or ahead of regulation
Q10: Enable the establishment of a supplier code of conduct that includes relevant sustainability risks
Figure 34: 
Usefulness of methodology within partners’ wider supply chain sustainability efforts – leather

Dimensions evaluated in the above chart

- Q1: Enable the establishment of a sustainable procurement policy that comprehensively covers relevant sustainability risks
- Q2: Enable the company to increase visibility of its potential supply chain hotspots and related claims
- Q3: Enable the establishment of relevant sustainability clauses as part of suppliers’ contracts
- Q4: Enable the establishment of targeted sustainability questionnaires in requests for proposals
- Q5: Establish of clearer sustainable supply chain KPIs in your sustainability reporting
- Q6: Enable more effective buyer training on category-specific sustainability hotspots
- Q7: Enable stronger and more reliable partnerships with suppliers
- Q8: Enable more effective due diligence on suppliers’ sustainability performance (e.g. through questionnaires, on-site audits, third-party audits, etc.)
- Q9: Enable the company to de-risk its operations by being compliant and/or ahead of regulation
- Q10: Enable the establishment of a supplier code of conduct that includes relevant sustainability risks

119. There is significant interest in developing pilot use cases for additional textile fibres (i.e. synthetic/polyester, wool, cashmere, cellulose, linen) and textile blends in order to assess the system’s adaptation to each type of material and its value chains.

120. Piloting companies also expressed interest in testing additional sustainability claims and KPIs in their upcoming seasons’ production; for instance CO2 emissions measurement
and circularity ranked high, water usage and reductions in chemical use were also reported as interesting KPIs to measure.

121. When asked about the requirements for scaling up the pilot, partners reported the need for the following:

- A digital traceability system that is integrated with companies’ existing digital management systems and does not require additional manual input
- Training videos for suppliers to support their data upload
- Clear guidelines for certification standards including for self-assessments
- A critical mass of brand participation
- Making the communication of the benefits easier
- For some partners it would be interesting to know whether the blockchain-based system would be approved for faster/paperless customs/shipping procedures
- An open-source app or blockchain platform with low transaction costs could help if it were provided to governments and the industry
- A higher involvement of international certifying organizations
- Eventually, to scale up, there should also be wider-scale cooperation between actors across the supply chain and updates to companies’ internal data collection processes

122. As part of the project’s training and coaching activities, over 120 people were trained to use the blockchain-based system, building on the ECE-UN/CEFACT methodology for traceability and transparency in cotton and leather value chains. The main functions/departments who participated in the training were sustainability, supply chain/operations (traders, farmers, ginners, spinners, dyers, weavers, finishers, brands) and procurement. Legal, IT or innovation departments also may have participated. The requirement for organizing a training session was to have all the value chain partners represented who were going to be users of the system. This meant the involvement of farmers, ginners, traders, spinners, yarn and fabric manufacturers, retailers and brands. Overall, an average of ten people participated in each training session. During the pilots, in addition to the one training session provided for each use case, additional coaching sessions were provided to facilitate users’ experience and support value chain partners as they navigated the uploading of data onto the blockchain-based platform. In total, around 60 training and coaching sessions were delivered by the ECE experts team for the cotton and leather pilots.

VIII. Future developments and recommendations

A. Possible future developments

123. In the near future, the blockchain-based system used in these pilots will be adapted to integrate supply chain traceability for animal-based materials and fibres (e.g. wool and cashmere) and synthetics by identifying the relevant business processes, actors, risks and mitigation measures. This will support assessing the scalability of the solution to additional value chains.

124. In addition, an API is currently being developed to support automation of the current manual data entry to the blockchain-based system. This is critical for supporting the scalability of the pilot platform and its interoperability with companies’ existing data management systems. The technical analysis, development and dissemination of generic APIs aligned with UN/CEFACT standards, EPCIS standards and authentication mechanisms for the blockchain platform will be developed during 2022.

125. The project will consider looking into aspects related to the governance of the blockchain-based system and transaction funding principles.

126. Moving forward ECE and the European Union, as the project donor and the pilot project participants, will have to define the future of the blockchain system developed under
the project. In particular, all concerned parties may need to explore how to create and maintain a governance body that will be responsible for defining and managing the governance rules for the blockchain system and related principles as well as their continuous application and improvement.

127. **Inter-platform interoperability.** The ECE platform is one of hundreds of traceability platforms that are in use across different global geographies and sectors. In general, supply chain information from finished product back to the primary producer is likely to exist in multiple platforms. As a non-commercial, non-competing platform, the ECE solution is well positioned to test interoperability standards between platforms to empower a future multi-platform, global traceability architecture. Therefore, this could be an interesting area for future work.

128. **Cost effectiveness and viability of blockchain applications.** Over the last few years there has been a significant increase in the cost of transactions over the Bitcoin and Ethereum blockchains. At the same time there are developments which should lower these costs, particularly in Ethereum, and there are other types of blockchains with much cheaper transaction costs, although they need to be carefully evaluated from the standpoint of security before use. This is a relatively new technology, so its evolution in the near future will be constant and not always predictable. In addition, some blockchains (those using proof-of-work algorithms) are very energy intensive and, therefore, reduce the sustainability footprint of any solution that builds upon them. Therefore, there is a need to explore and evaluate different technology solutions for cost effective and environmentally sound growth. Options include blockchains using different decision-making algorithms, blockchain side trees, hybrid systems that minimize writing to a blockchain by using it in combination with other technologies, and non-blockchain distributed ledgers.

129. Concerning viability, the management of new concepts related to wallets, key management, distributed data management and cryptographic tools need additional acceptance and adoption—as well as training to be fully understood by company management and IT department administrators.

130. **As an evolution, and in line with accepted reporting guidelines and directives, it would be relevant to integrate into the blockchain-based system the possibility of gathering environmental impact data from all value chain partners for a given unit of raw material and/or a final traced good.** This would raise the awareness of companies about the importance of life cycle assessment tools and give them experience with monitoring and evaluating the environmental impacts of products, as well as understanding how such impacts happen and how they can be measured depending upon their origin and the specific value chain. The training of value chain partners (upstream and downstream) on how to gather environmental data for registration on a digital platform should be aligned with the EU Ecodesign Proposal and other best practices in order to support full traceability and, within the context of the EU, the development of digital product passports (DPP) as envisaged by the EU Strategy for Sustainable and Circular Textiles. This strategy aims to have, by 2030, textile products on the EU market that are long-life and recyclable. Such products will be a cornerstone in the twin transition to circularity and digitalization in the textile sector.

### B. Recommendations

131. Blockchain and other IT solutions for traceability and transparency may be challenging for SMEs, small-scale actors and vulnerable groups due to the digital gap, implementation costs and the skills required. In the fragmented, globally scattered value chains found in the textile and leather sectors, SMEs account for more than half of the business partners. As result, solutions, in order to be viable, must be accessible to SMEs. Access should be supported through skills development programs, training and effective cost-distribution schemes. In this context, it is also critical to cut the cost of compliance stemming from new legislation that is intended to support sustainability (e.g. the upcoming EU mandatory due diligence law). Low-cost devices and user-friendly data collection tools must prevail to ensure that small-scale actors in producing countries can provide the
information needed, taking into consideration their constraints (e.g. language, access to technology, electricity and the Internet) as well as other implementation conditions on the ground.

132. Several benefits stem from using a blockchain-based solution to support supply chain traceability and sustainability. Blockchains offer immutable and trustworthy data storage with distributed access available to all partners (who have access permission). This can ensure trustworthy digital archiving of information in complex value chains, thus reducing the need for auditing (particularly when the archived information includes certificates, inspection reports, etc.). It can also facilitate document sharing and enhance cost efficiency. Interoperability with existing business data management systems using UN/CEFACT standards for information exchange, and implementation of ECE Recommendation No. 46 and its guidelines can also contribute to system effectiveness. Traceability, when combined with sustainability performance information, can create the transparency that consumers, investors, and financial operators increasingly need to make more sustainable purchasing and investment decisions.

133. Taking into account the above, the following are recommendations for consideration by those concerned.

1. **For policymakers (governments, international and intergovernmental organizations)**

134. **Open source, inclusive solutions and building capacity is essential for scaling up.** Policymakers and regulators have a role to play in spurring coordinated action, scaling up innovative and open solutions, and building capacity and inclusive partnerships to ensure that the digital transformation can support higher sustainability at a global scale while leaving no one behind. In particular, they should do the following:

- Create the necessary ecosystem for engaging all stakeholders in the use of technology for traceability and transparency
- Support technology transfer and market access for SMEs
- Devise tailored policies and regulations to support competition and facilitate the textile and leather industries’ connection to other key technological developments such as AI, IoT, big data and cloud computing
- Develop, in a concerted manner, the necessary supporting frameworks for data security, privacy and governance as preconditions for accelerating adoption
- Adopt standardized data models for inspection reports/certificates, credentials and distributed identity management based on international standards for information exchange such as the UN/CEFACT e-business standards
- Set up incentives, for example through public procurement policies, to support the development of cost-effective and interoperable applications
- Support investment in related education for entrepreneurs, civil servants and the general public

135. In order to support the implementation of blockchain solutions, governments could do the following:

- Develop policy initiatives promoting sustainable solutions through blockchain technology
- Create regulatory conditions to build digital solutions to accelerate the transition to a digital circular economy
- Provide financial incentives for brands and retailers to support SMEs in the implementation of technological solutions for traceability and transparency in alignment with sustainability goals (e.g. tax credit or funds for projects with a sustainability dimension, who can show how they have involved and supported SMEs)
• Set global ethical and sustainability guidelines for the use of blockchain technology that reflect the need to ensure access for SMEs, built upon similar work done by the EU on other advanced technologies (e.g. AI)

• Introduce standards for government procurement of blockchain systems that will encourage the development of reliable, interoperable and sustainable blockchain systems

• Support, through procurement and research funding, the development of more environmentally friendly blockchain technologies and strategies, including commissioning studies and reports on this topic

• Include blockchain technology solutions in national circular economy strategies or through bottom-up initiatives

• Introduce R&D and innovation programmes that encourage the use of blockchain technology

• Support projects, such as proofs of concept, that train companies on how to use and implement this technology in their businesses

• Give visibility and rewards to organizations that have developed successful blockchain projects, particularly those that improve access to the technology or develop innovative applications that support sustainability

136. In this project, international and intergovernmental organizations have played a key role in convening actors and providing the necessary financial and technical assistance, capacity building, skills development and technology transfer to support small-scale actors, who make up most of the textile and leather industries.

2. For industry

137. The commitment and collaboration of all stakeholders in the value chain is required for successful value chain traceability—i.e. to follow production flows from raw material to point of purchase and onward to reuse and recycling. Such traceability is increasingly becoming critical for due diligence and legal compliance. However, the deployment of shared and reliable technical solutions in different business environments is a key challenge that companies must address in their value chains. Therefore, it is imperative that companies incorporate these issues into their strategic priorities.

138. When developing a traceability and transparency system the pilot project experience shows that the most challenging aspect is the development of an integrated information ecosystem. Therefore, organizations that are planning to implement should give priority and assign adequate time and resources to this aspect of their systems.

139. Furthermore, once systems are in place and people are trained to use them, it is essential to define the right processes for ensuring the quality of data through verification, monitoring and validation mechanisms.

140. Investment in digital technology has a cost; however the benefits of establishing greater levels of traceability and transparency are worth it. For instance, blockchain technology for product traceability can support the conveyance of reliable product information to consumers, thus helping them to make better informed purchasing decisions, for instance on the characteristics and the provenance of materials and on the sustainability hotspots addressed in a value chain (labour, social, environmental, health & safety). Most importantly, technologies, such as blockchain solutions can support companies’ efforts to comply with social and environmental requirements and due diligence laws. It can also help them to better understand their value chains, build stronger relationships with their supplier base, and manage efficiency and reputational risks. Overall, companies who implement traceability and transparency systems will be more resilient in case of disruptions and better able to trace the status of goods across their supply chain network.

141. Within these considerations it is worth noting that many leading actors in the industry, especially on the brand and retailer side, are increasingly investing to build longer term partnerships with their suppliers as part of a trend to reduce their sourcing risks, including
through near-shoring activities, ensuring greater visibility and traceability of supply chains, and capacity building initiatives that aim to align suppliers with the long-term vision of the brand.

142. This is a welcomed development. Continuing and increasing the efforts of leading brands actors to upskill upstream value chain actors in terms of traceability, transparency and sustainability will be essential to bridge the technical and knowledge gap that many small suppliers still suffer while transitioning to digital technologies for traceability and sustainability. This cost is an investment that many brands are already undertaking for risk-management considerations, and this increased focus on transparency, traceability and sustainability will also allow firms to gain a first-mover advantage in the market. This will lead to several benefits, such as being ahead of legislation, having stronger compliance with existing legislation, ensuring visibility and supply chain resiliency in times of disruption and benefitting from a stronger brand image vis-à-vis a new generation of consumers who are ready to pay a premium for products that can solidly substantiate sustainability claims.

3. For civil society organizations

143. Civil society organizations (CSOs) have an important role in empowering consumers to make more informed purchasing decisions. This role can be enhanced by partnering in multi-stakeholder initiatives on traceability and transparency and enhancing communication and awareness campaigns. Moreover, CSOs should support small-scale businesses (that are normally engaged in global value chains), in getting together and developing the capacity to respond to the requests of big textile conglomerates, brands and retailers. CSOs should also support vulnerable groups to promote the use of product traceability in ways that will make business more accountable for actions that affect them.

4. For technology solution providers

144. Ensuring interoperability with other evolving technologies is important: Blockchain solutions must be able to exchange data and interact with other evolving technologies such as B2B platforms, artificial intelligence (AI), machine learning, the internet of things (IoT) and digital identity systems in order to keep abreast with the benefits provided by these digital developments.

5. For certifiers and inspection agencies

145. Certifiers and inspection agencies should build on their existing systems to develop the capacity for automated verification of certificates and inspection reports. This is still often done manually, and a digitally verifiable credential associated with each certificate would enable automated verification at scale, reduce fraud, and make the use of certification more attractive.

6. End note

146. This project directly contributes to a larger ECE project “Enhancing transparency and traceability of sustainable value chains in the garment and footwear industry” which is jointly implemented with ITC, in collaboration with the ILO, and is financially supported by the European Commission. Specifically, this activity supports project Activity A2.1, “Pilot the use of the transparency and traceability policy framework, standard and guidelines for one country and four companies”.


Annex A

Supporting publications and documents for reference


ECE (2021) Call to Action for Traceability, Transparency, Sustainability and Circularity of Value Chains in the Garment and Footwear Sector. Available at: https://unece.org/sites/default/files/2021-03/ECE_TRADE_C_CEFACT_2020_06_Rev1E_0.pdf


ECE (2022) Business Process Analysis for Sustainability and Circularity in Textile Value Chains

ECE (2022) Business Process Analysis for Sustainability and Circularity in the Leather Value Chain


UN/CEFACT Textile and leather data model

Product traceability message

Product transparency message

Mapping of polices, regulations, legislations:

Sustainability claims guidelines

Desk and field research

## Annex B

### Glossary for the blockchain pilots

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>User</td>
<td>Refers to the individual who accesses and uses the platform on behalf of the entity (ECE, SUPSI, blockchain pilot participants)</td>
</tr>
<tr>
<td>Claim</td>
<td>High-level statement about a characteristic of a product, or about a process or an organization associated with that product (traceable asset) (<em>ECE, Policy Recommendation n.46</em>). Message used to set apart and promote a product, process, business or service with reference to one or more of the pillars of sustainability: social, economic and/or environmental (ISEAL).</td>
</tr>
<tr>
<td>Sustainability claim</td>
<td>Claim that covers one or multiple sustainability dimensions (economic, environmental or social). (<em>UNEP, 2017</em>)</td>
</tr>
<tr>
<td>Product</td>
<td>Any good or service</td>
</tr>
<tr>
<td>Process</td>
<td>Set of interrelated or interacting activities which transform inputs into outputs. (<em>ISO/IEC 17020:2012</em>)</td>
</tr>
<tr>
<td>Business roles</td>
<td>The function or position that a person or an organization has or is expected to have in a business relationship.</td>
</tr>
<tr>
<td>Consumer</td>
<td>A person purchasing, using and or disposing of goods and services for private or commercial purpose.</td>
</tr>
<tr>
<td>Compliance</td>
<td>State of an organization that meets prescribed specifications, contract terms, regulations or standards. Compliance obligations can arise from mandatory requirements, such as applicable laws and regulations, or voluntary commitment. (<em>ASQ, ISO 37101</em>)</td>
</tr>
<tr>
<td>Assessment Procedure</td>
<td>A process for obtaining records, statements or other relevant information and assessing them objectively to determine the extent to which specified requirements are fulfilled. (<em>ISO 17000</em>)</td>
</tr>
<tr>
<td>Assessment</td>
<td>Demonstrable evidence that specified requirements relating to a product, process, facility are fulfilled. (<em>ISO 17000</em>)</td>
</tr>
<tr>
<td>Assessment Types</td>
<td>Self-declared</td>
</tr>
<tr>
<td></td>
<td>Self-assessed (first party verified)</td>
</tr>
</tbody>
</table>
Second-party verified

Third-party verified

See definitions below

Self-declared

The statement is issued by an entity, on behalf of itself, and is based on its own determination, that states its status against specified conformance requirements of a standard, guidance or other document. (ISEAL)

Self-assessed

The statement is issued by an entity, on behalf of itself, and is based on the sustainability performance of their products/processes evaluated through a self-assessment tool. (ISO)

Second-party verified

The assessment is carried out by a second party that can be related to the company and the statement of the entity is based on the second-party assessment. (ISEAL)

Third-party verified

The assessment is carried out by a third, independent party and the statement of the entity is based on the third-party assessment. (ISEAL)

Third-party certified

The assessment is carried out by a third, independent body that provides assurance that a product conforms to a specified standard. (ISEAL)

Certificate

Document that shows that the fulfilment of specified requirements has been demonstrated

Scope certificate

Document that proves compliance with a standard. The certification body declares that the company has been inspected and assessed according to the standard and that the products indicated in the certificate comply with the standard.

Or

(Document that proves the compliance with the relevant criteria in the relevant certification procedure done through a certification body confirming that the holder is able to produce goods in conformity with the standard). (Adapted from GOTS)

Transaction certificate

Document that indicates that the products received are actually certified to the standard. It includes product and shipment information.

Or

Document that lists the individual batches of products and relevant shipment details and
declares that all goods listed under the shipment are compliant with the standard.

(Adapted from GOTS)

**Accreditation**

A formal recognition (attestation) by an independent body to confirm that a certification body operates according to a standard. (UNEP, 2017)

**Standard**

Document that provides, for common and repeated use, rules, guidelines or characteristics for products or related processes and production methods with which compliance is not mandatory. (ISEAL Standard-Seng Code)

**Referenced standard**

A referenced norm or requirement that establishes uniform criteria, methods, processes and practices, such as in engineering or technical areas.

**Sustainability standard**

A standard that addresses the social, environmental or economic factors of a defined entity, or a combination of these. (ISEAL Credibility Principles, 2013)

**Standard owner/scheme owner**

The organization that determines the objectives and scope of the standards system, as well as the rules for how the scheme will operate and the standards against which conformance will be assessed. In most cases this is the standard seller, however it may also be an assurance provider, a governmental authority, trade association, group of assurance providers or other body. (Adapted from 'Standards system owner' in the ISEAL Assurance Code)

**Standards system**

The collective of organizations responsible for the activities involved in the implementation of a standard, including standard-setting, capacity building, assurance, labelling and monitoring. (ISEAL Assurance Code)

**Inspection**

Examination of product or process and determination of its conformity with specific requirements or, on the basis of professional judgement, with general requirements. (ISO/IEC 17020:2012)

**Audit**

Systematic, independent, documented process for obtaining records, statements of fact or other relevant information and assessing them objectively to determine the extent to which specified requirements are fulfilled. (ISO/IEC 17020:2012)
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Annex D

Blockchain pilots project governance

[Diagram with UNECE secretariat at the top, coordinating the project, and relationships between Pilot project partners, Pilot project team, Blockchain technology solution provider, and SUPSI.]
Annex E

Visualization of the supply chain in the blockchain platform

CASE 1: RECYCLED DENIM – CLAIM RECYCLED CONTENT

Example of GRS Transaction Certificate

During the project, two GRS Transaction Certificates and two GRS Scope Certificates were collected, referred to Berto Industria Tessile Srl and Marchi & Fildi SpA

CASE 1: RECYCLED DENIM – CLAIM ORIGIN

100% cotton yarn, is an unavoidable waste of the dyeing process that takes place in Berto. It is collected and shipped to Marchi & Fildi

Veneto, Italy

Cotton Fiber returns to thread at Marchi e Fildi, which combines the waste (65%) with virgin cotton (35%) from Turkey.

Piedmont, Italy (65%) + Turkey (35%)

After the Spinning phase in Biella it is returned to Berto for Dying, Weaving and Finishing

Veneto, Italy
CASE 1: RECYCLED DENIM - CLAIM ORIGIN

Finished Fabric is shipped to Denim Service for product manufacturing
Veneto, Italy

The finished Classic Tapered Jeans is ready for shipment to Vivienne Westwood Italian Warehouse
Piedmont, Italy

From central Logistic Hub it is dispatched to London Boutique
London, UK

CASE 1: RECYCLED DENIM - CLAIM USE OF CHEMICALS

During the project, three OEKO-TEX Standard 100 Scope Certificates were collected to support the claim.

The green nodes of supply chain indicate the verification of upload and validity of certificates.
CASE 2: ORGANIC COTTON SHIRT - CLAIM ORIGIN

Cotonificio Albini weaves and finishes the fabric in its industrial plants.
Lombardy, Italy + Lethorad, Czech Republic

POLETTI
The finished fabric is then sent to Poletti for the garment manufacturing.
Lombardy, Italy

Vivienne Westwood
Poletti transfers the final garment to Vivienne Westwood Italian Warehouse.
From central Logistic Hub it is dispatched to London Boutique.
Lombardy, Italy + London, UK

CASE 2: ORGANIC COTTON SHIRT - CLAIM ORGANIC CONTENT

Example of GOTS Transaction Certificate
Example of GOTS Scope Certificate

During the project, both GOTS Transaction Certificates and GOTS Scope Certificates were collected.

UNECE
SELECTION OF PRODUCTS AND CLAIMS TO BE TESTED

CLAIMS

TRACEABILITY
OF ORIGIN

WATER LOW

REDUCED USE
OF CHEMICALS

REDUCED
ENVIRONMENTAL
IMPACT

REPURPOSED COTTON
WASTE

CLAIM ON FIBER ORIGIN TRACED WITH PHYSICAL MARKER: the process

Spinner

DNA TEST LAB on yarn

Knitter

DNA TEST LAB on garment

Claim to consumer
Traceability of cotton fibers in final garment shown on the Block Chain platform

1. Repurposed fibers sprayed at spinning mill in Egypt
   Evidence: Manufacturer Self declaration

2. Mélange yarn spun with sprayed cotton tested by third party
   Evidence: Third party certificate

3. Final product knitted and tested by third party
   Evidence: Third party certificate

Documents uploaded on the Block Chain Platform to market a product with a traceable origin and with a verified sustainability claim
Annex F

List of certifier acronyms

<table>
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<th>Leather certifier acronyms</th>
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<tbody>
<tr>
<td>ZDHC                Zero Discharge of Hazardous Chemicals</td>
</tr>
<tr>
<td>MRLS                Manufacturing Restricted Substance List</td>
</tr>
<tr>
<td>FSLM                Facility Social &amp; Labor Module</td>
</tr>
<tr>
<td>SLCP                Social &amp; Labor Convergence Program</td>
</tr>
<tr>
<td>LWG                 Leather Working Group</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Cotton certifier acronyms</th>
</tr>
</thead>
<tbody>
<tr>
<td>BC                  Better Cotton</td>
</tr>
<tr>
<td>IFOAM               International Federation of Organic Agriculture Movements</td>
</tr>
<tr>
<td>GOTS                Global Organic Textile Standard</td>
</tr>
<tr>
<td>GRS                 Global Recycled Standard</td>
</tr>
<tr>
<td>RCS                 Recycled Claim Standard</td>
</tr>
<tr>
<td>WRAP                Worldwide Responsible Accredited Production</td>
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