Economic Commission for Europe
Executive Committee

Centre for Trade Facilitation and Electronic Business

Twenty-ninth session
Geneva, 9 and 10 November 2023
Item 6 (c) (ii) of the provisional agenda

Recommendations, standards, and deliverables supporting implementation:
Deliverables in support of implementation:
Deliverables in support of the outcomes of the seventieth Commission session

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

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

Submitted by the secretariat

Summary

This 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 textile and leather value chains. This project has engaged representatives from the global textile and leather industry to test the application of an ECE traceability and transparency standard which has been designed to trace products using a blockchain system. It uses a multistakeholder approach and covers global value chains. The report also provides recommendations regarding the key implementation challenges. This report contributes to the theme of the seventieth Commission session on “Digital and green transformations for sustainable development in the ECE region”. This report is an update of the Report on the Blockchain Pilots Project for the Garment and Footwear Sector (ECE/TRADE/C/CEFACT/2022/9).

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

Mention of specific names of companies does not imply endorsement of the United Nations.

Document ECE/TRADE/C/CEFACT/2023/19 is submitted to the twenty-ninth session for information.
# Contents

I. Summary ............................................................................................................................................. 3

II. Background ......................................................................................................................................... 5

III. The blockchain pilots project: scope and goals ................................................................................. 7
   A. The ecosystem of actors involved in the pilots ................................................................................. 12
   B. Definitions .......................................................................................................................................... 13

IV. Preparation: how to build a use case ............................................................................................... 15
   A. Step 1: Identification of the traceable asset, analysis of inputs and processes and onboarding of value chain partners ....................................................................................... 16
   B. Step 2: Evaluation of sustainability hotspots and mitigation measures in place ............................. 17
   C. Step 3: Identification of related claims ............................................................................................ 17
   D. Step 4: Data identification, training and data upload in the blockchain platform ............................ 18

V. The technology ..................................................................................................................................... 21

VI. Deep dive into the use cases ............................................................................................................ 26
   A. Cotton use cases deep dive .............................................................................................................. 34
   B. Leather use cases deep dive ............................................................................................................ 57
   C. Wool use cases deep dive ............................................................................................................... 67

VII. Challenges, opportunities and lessons learned ............................................................................... 70
   A. Lessons learned and challenges for successful implementation .................................................... 71
   B. The industry experience .................................................................................................................. 76

VIII. Future developments and recommendations ............................................................................... 86
   A. Ongoing and possible future developments .................................................................................... 86
   B. Recommendations ............................................................................................................................ 88

Annex A: Supporting publications and documents for reference ............................................................. 92
Annex B: Glossary for the blockchain pilots ............................................................................................ 93
Annex C: List of figures and tables ......................................................................................................... 96
Annex D: Blockchain pilots project governance ..................................................................................... 98
Annex E: Visualization of the supply chain in the blockchain platform .................................................. 99
Annex F: List of certifier acronyms ........................................................................................................ 104
I. Summary

1. Decades of unsustainable consumption and production practices in complex and fragmented garment and footwear value chains have resulted in serious environmental, labour and social impacts. Addressing these issues has become a priority for consumers, governments and industry. The garment and footwear sector carries 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 textile and leather value chains are needed to address these issues because global fragmentation in the production of textile and leather-based products and the 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 identify and make available information about a product’s origin and sustainability performance in a trustworthy way.

4. In support of United Nations Sustainable Development Goal (SDG) 12 for responsible consumption and production, since January 2020, the United Nations Economic Commission for Europe (ECE) has been engaged in a project to test a blockchain system to support companies in their efforts to comply with relevant norms and standards for traceability, transparency and sustainability in textile and leather value chains. The project participants include 95 entities from 23 countries (4 international organizations, 2 technology solution providers, 2 academia/think tanks, 6 standards and certification bodies, 10 brands/retailers, 53 manufacturers/suppliers, 12 farmers/raw material providers, 2 NGOs 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, pajamas, suits, 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, the project was set up with the following ambitious plan and milestones (see figure 1):

---

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, the Netherlands, New Zealand, Peru, Singapore, Switzerland, Türkiye, Uganda, the United Kingdom, the United States of America, 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</td>
<td>4</td>
<td>95</td>
</tr>
<tr>
<td>Number of countries</td>
<td>1</td>
<td>23</td>
</tr>
</tbody>
</table>

Source: ECE-UN/CEFACT, 2023

8. This 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 report then provides an overview of developments and recommendations regarding the key challenges, and identifies 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 about further testing and about how to enable the ECE framework on different technology platforms.

10. This report also provides recommendations to address the challenges facing SMEs, small-scale actors and vulnerable groups and explores the benefits of blockchain-based solutions to facilitate 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 2019 ECE-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. This initiative is also known as “The Sustainability Pledge”.

II. Background

12. Unsustainable practices in the garment and footwear industries have resulted in pressure from consumers and governments on these 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 this 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. 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.

---

Box 1: 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 families.6

Therefore, cotton is a key driver of economic growth and 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 use and release of hazardous chemicals), 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.

---

6 Ibid.
fertilizers, despite cotton accounting for only 2.5 per cent of arable land use. Cotton garment production, from field to shelf, involves a very complex supply chain where the lack of strict regulations can contribute to neglect of social criteria, resulting in poor health and safety measures and making workers vulnerable to poor working conditions. 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 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. Additionally, the volatility of market prices and uncertainty stemming from current purchasing and subcontracting practices have increased informality and precarity.

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

Box 2: 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 eradication of poverty in such countries, the potential for negative environmental impacts is significant.

The industry is not only characterized by excessive water use, but also by significant water pollution due to the chemicals used by tanneries to transform raw hides and skins into leather, that can harm the environment. In fact, more than 90 per cent of 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, are often released

---

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.
into waterways, affecting surrounding land and human communities. In addition, the leather manufacturing process creates high levels of solid waste, especially in tanneries\(^\text{16}\), resulting in 800 thousand tonnes of leather waste annually\(^\text{17}\). In 2020, in leather production globally, the hides and skins of around 1.4 billion animals were used, of which the most used types were cattle hides (8.6 million tonnes) and sheep hides (1.9 million tonnes)\(^\text{18}\).

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 per cent stemming from only ten countries, of which four currently dominate the industry (China, India, Italy, and the Republic of Korea)\(^\text{19}\). In some countries, the farming and slaughtering of livestock takes place in an environment that lacks animal welfare regulations, thus allowing for 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\(^\text{20}\). 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 who 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%)\(^\text{21}\). It is highly dependent on consumers, who are increasingly demanding sustainable and fairly produced leather goods. To combat the potential negative impacts of the industry on people and planet, and to locate, identify and reduce such risks, leaders and experts all agree that traceability and transparency need to be core elements of the leather industry value chains of the future.

### III. The blockchain pilots project: scope and goals

15. Since January 2020, the United Nations Economic Commission for Europe (ECE) has been engaged in a pilots project to test a blockchain system in textile and leather value chains. This system is intended to assist companies in their efforts to comply with relevant norms and standards for sustainability and circularity and to support SDG 12 for responsible consumption and production. The pilots presented in this report encompass the full spectrum of value chain tiers. They engaged 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 11 cotton, 1 wool, and

---


\(^{18}\) FAOSTAT (2020)

\(^{19}\) ILO, “Wages and Working Hours in the Textiles, Clothing, Leather and Footwear Industries” (GDFTCLI/2014).

\(^{20}\) Memedovic, Olga & Mattila, Heikki, “The global leather value chain: the industries, the main actors and prospects for upgrading in LDCs”, Int. J. Technological Learning, Innovation and Development, Vol. 1, No. 4, (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](https://www.researchgate.net/publication/23646324_The_global_leather_value_chain_the_industries_the_main_actors_and_prospects_for_upgrading_in_LDCs) (Accessed 3 October 2023.)

leather-based products which were traced represent some of the world’s most sold items in terms of volume, including jeans, shirts, T-shirts, pajamas, socks, shoes and handbags.

16. This proof of concept report presents key findings from the pilots project thus far, which has engaged representatives from the global textile and leather industries to test the application of an ECE textile and leather traceability and transparency information exchange standard, which uses a blockchain system and DNA markers to trace cotton products. It uses a multistakeholder approach and covers global value chains. The report also provides recommendations regarding the key implementation challenges as well as opportunities for expanding the project to cover additional textile fibres.

17. The project was implemented in the context of the 2019 ECE-UN/CEFACT initiative, “Enhancing traceability and transparency of sustainable value chains in the garment and footwear sector”, jointly with the International Trade Centre (ITC) and with funding from the European Union. 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 textile 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 to 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 participating 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.

22 The project website and key documents are available at: https://unece.org/trade/traceability-sustainable-garment-and-footwear.
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 standard 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 during the roll out. The pilots project was intended 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 provide a good understanding of the on-the-ground operating environments and constraints.

Figure 2
Breakdown of 95+ piloting companies & organizations

Source: ECE-UN/CEFACT, 2023

25. An ecosystem of actors from approximately 95 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 23 countries.\textsuperscript{24}

26. Over 179 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 the 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 period\textsuperscript{25}.

27. This project traced 11 cotton, 1 wool, 1 wool/lyocell, 1 wool/polyamide, 5 leather-based products and provided documentary evidence to substantiate related sustainability claims made by brands and retailers. It did so by using a blockchain-based platform to create backward and forward traceability and by registering documentary evidence. Two additional pilots have also begun, one tracing a recycled wool value chain and another a synthetic fibre. The intention is to apply the methodology and technology to new fibres.

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 the 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 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\textsuperscript{26}, 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 distribution of participants in the textile and leather blockchain pilots by country (for 19 use cases) and the corresponding stages in the value chain. For analytical purposes, the value chain participants were divided into four categories\textsuperscript{27}: (1) raw material suppliers, (2) fabric and fibre producers for cotton (3a) product manufacturers and traders for cotton and leather, and (4) retailers/brands. The level of fragmentation in the value chain use cases varied. Some use cases involved an integrated value chain embedded in a single country; the majority involved a value chain stretching across more than two countries. In textile and leather value chains, information exchange is usually

\textsuperscript{24} See Figure 3 – The geographic coverage of the pilot.
\textsuperscript{25} The pilot should have initially been started in 2020; however, due to the COVID-19 pandemic, activities slowed as they were scaled down to a fully virtual format.
\textsuperscript{26} Radio-frequency identification (RFID), near field communication (NFC) and quick-response (QR) codes.
\textsuperscript{27} Refer to the ECE “Mapping of the Garment and Footwear Sector Ecosystem” (3 April 2021). Available at: https://unece.org/sites/default/files/2021-05/Ecosystem_report-April2021.pdf.
fragmented across several countries, which eventually leads to complex data collection.

Figure 3
**Textile and leather blockchain pilots—geographic coverage**

*Source: ECE-UN/CEFACT, 2023*

*Source: ECE-UN/CEFACT, 2022*
A. The ecosystem of actors involved in the pilots

30. This section will map all the entities (+95) 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

Source: ECE-UN/CEFACT, 2023
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; to manufacturing garments or footwear; to 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.

Figure 5
Textile pilot participants

Source: ECE-UN/CEFACT, 2023
Figure 6
Leather pilot participants

Source: ECE-UN/CEFACT, 2022

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 7 and 8).

Figure 7
Standard cotton value chain considered in the pilot (business process analysis)

Source: ECE-UN/CEFACT, 2022

Figure 8
Standard leather value chain considered in the pilot (business process analysis)

Source: ECE-UN/CEFACT, 2022
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:
• 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\(^{28}\) on enhancing traceability and transparency of sustainable value chains in the garment and footwear sector;
   • The ECE business process analysis standards and business requirements specifications for the textile and leather sectors; and
   • The guidelines on the formulation of sustainability claims.\(^{29}\)

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

Figure 11
Steps in building a use case

Source: ECE-UN/CEFACT, 2022

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

38. In the first step, the product (intermediary or 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 is identified. Once the product is selected, the next step is to evaluate of the inputs used (e.g. cotton fibre quality, type of leather, water, chemicals etc.) and to analyse the production processes relevant to the identified traceable asset. Next, the value chain partners involved in all stages of the selected product value chain are mapped.

39. Once the 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 (2022) 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. They can also refer to their own past experiences and mitigation measures they already have in place, including auditing and third-party certification.

1. 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.

1. Tools:

- ECE (2022) 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

30 See Annex A: Supporting publications for links to these tools.
31 Document in draft form at the time of publication of this report – final version to be published in 2024.
Box 3: Sample of a multi-issue sustainability claim\textsuperscript{32}

**Cotton Example**

“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.”

**Leather example**

“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.”

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Focus of sustainability claims for the ECE blockchain pilots project</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Claim</strong></td>
<td><strong>Focus area</strong></td>
</tr>
</tbody>
</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, recycled and regenerative fibres (cotton)  
• Use of chemicals  
• Social/environmental performance of products, processes and facilities, based on a set of minimum sustainability criteria\textsuperscript{33} |
| Sustainability claim: A claim that covers one or multiple sustainability dimensions (economic, environmental, social) | |

*Source: ECE-UN/CEFACT, 2022*

**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 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\textsuperscript{34} and is based on the so-called “5Ws” model (who, what, where, why (how), when)\textsuperscript{35} 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.

---

\textsuperscript{32} A multi-issue claim covers multiple sustainability hotspots.

\textsuperscript{33} 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.

\textsuperscript{34} ISO/IEC 19987:2017 defines Version 1.2 of Electronic Product Code Information Services (EPCIS). The goal of EPCIS is to enable disparate applications to create and share visibility event data, both within and across enterprises. Available at https://www.iso.org/standard/72926.html.

\textsuperscript{35} See ECE Recommendation No. 46, Part II: Guidelines, Section C.6: Events.
1. Tools

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

Figure 12
Examples of “5W” information collected by value chain partners

<table>
<thead>
<tr>
<th>Data collection</th>
<th>Traceability event types</th>
</tr>
</thead>
<tbody>
<tr>
<td>e.g. cotton, yarn, pallet</td>
<td>Transaction</td>
</tr>
<tr>
<td>e.g. date/time occurrence</td>
<td></td>
</tr>
<tr>
<td>e.g. Italy, Prado</td>
<td></td>
</tr>
<tr>
<td>e.g. Weaver</td>
<td></td>
</tr>
<tr>
<td>e.g. Weaving yarn to fabric</td>
<td></td>
</tr>
<tr>
<td>e.g. Certificates/Reports</td>
<td></td>
</tr>
<tr>
<td>WHAT</td>
<td>Transaction</td>
</tr>
<tr>
<td>WHEN</td>
<td>Transformation</td>
</tr>
<tr>
<td>WHERE</td>
<td>Aggregation</td>
</tr>
<tr>
<td>WHO</td>
<td>Object</td>
</tr>
<tr>
<td>WHY</td>
<td></td>
</tr>
</tbody>
</table>

Source: ECE-UN/CEFACT, 2022

43. The five EPCIS dimensions\(^\text{36}\) (who, what, when, where 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). They involve 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.

\(^{36}\) 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.
(certificates, audit/inspection reports, laboratory test result reports, NGOs/civil society attestations, declarations).

Table 2

<table>
<thead>
<tr>
<th>Traceability-related documents</th>
<th>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>

Source: ECE-UN/CEFACT, 2022

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 do not need to interact directly with the blockchain used, as this is 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. Together, ECE and SUPSI (the University of Applied Sciences and Arts of Southern Switzerland) created a user manual to provide guidance to end users navigating and using the blockchain-based platform that was developed for the pilots. 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.
Table 3
The key data entities for collection in the TT matrix: cotton example

<table>
<thead>
<tr>
<th>General information applicable to all claims</th>
<th>WHY</th>
<th>Business step</th>
<th>1. Planting and cultivation of cotton</th>
<th>2. Cotton harvest identification &amp; transfer from farmer to ginner</th>
<th>Etc.</th>
</tr>
</thead>
<tbody>
<tr>
<td>WHO</td>
<td></td>
<td>Value chain partner</td>
<td>From</td>
<td></td>
<td>To</td>
</tr>
<tr>
<td>WHERE</td>
<td></td>
<td>Business location</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WHAT</td>
<td></td>
<td>Material/product name</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DNA marker</td>
<td>WHAT</td>
<td>Material/product quantity</td>
<td>Material/Product unit</td>
<td>DNA marker ID</td>
<td>Application/test</td>
</tr>
<tr>
<td>Origin</td>
<td>HOW</td>
<td>Verification criteria (evidence)</td>
<td>Assessment type</td>
<td>Event date and time</td>
<td></td>
</tr>
<tr>
<td>Fibre content</td>
<td>HOW</td>
<td>Verification criteria (evidence)</td>
<td>Standard</td>
<td>Event</td>
<td>Event date and time</td>
</tr>
<tr>
<td>Use of chemicals</td>
<td>HOW</td>
<td>Verification criteria (evidence)</td>
<td>Standard</td>
<td>Event</td>
<td>Event date and time</td>
</tr>
<tr>
<td>Social and environmental performance</td>
<td>HOW</td>
<td>Verification criteria (evidence)</td>
<td>Standard</td>
<td>Event</td>
<td>Event date and time</td>
</tr>
</tbody>
</table>

Source: ECE-UN/CEFACT, 2022

V. The technology

47. During the pilots, participating partners were asked to identify what data was needed, who had the right to access the data, and they were also asked to coordinate the collection of that data along their respective value chains. Their only interaction with “technology” was with the software tool 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
to the more traceable downstream part of the value chain.

50. This high business and geographic fragmentation, together with the large
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 enterprise resource planning (ERP) systems
are not capable of scaling up to that level of information volume 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
(e.g. 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 serve 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 a minimum, including only what
is essential. For those participating, a DLT system can become a 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. The challenges considered
in this project include the following:

- 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; however, the voice and needs of vulnerable
  stakeholders need to be considered. In many cases a governing body is needed
  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 timeframe of this project, this governance model will be
  reviewed.

- 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 to facilitate a common understanding of value chain activities and practices.

• 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, but widely accepted, solutions to be sustainable in the market.)

• The data transparency versus data confidentiality challenge is a topic that has been gaining 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.

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, due to 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 testnets 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 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 can be applied to other industry sectors as well (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 (testnets), 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 rights 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 data37 (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 invoices, 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

---

37 “On-chain” data is recorded on a blockchain while “off-chain” data is not.
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. Given that the system is using the testnet blockchain of Ethereum, it manages privacy and confidentiality using cryptographic technologies and through each company’s “wallet(s)” (containing their private keys). This allows users to dynamically assign different visibility/disclosure levels to different value chain partners, hiding information from any partners who are not allowed to read certain data stored in the blockchain smart contracts. For example, this enables disclosure of the country of suppliers without disclosing company names, thus restricting available traceability and transparency information.

Figure 13
The blockchain pilot landing page and interface

![Blockchain Pilot Landing Page and Interface](source.png)

Source: ECE-UN/CEFACT, 2022

64. The use of blockchain technology is a real asset in 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 the referenced certification standards. The information is made available to value chain partners in a standardized way, which allows for collective understanding, accessibility, clarity and comparison.

65. The end-to-end value chain visualization is the result of manual data entry by value chain actors and is 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 and view 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 testnets).

66. More than 255 users were onboarded in the platform for the cotton and leather pilots, during which 258 trade transactions and 220 certificates were uploaded.
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, 19 use cases, including jeans, shirts, socks, handbags, shoes and semi-finished products were traced across 23 countries.\(^{38}\)

69. The cotton pilots focused on 11 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.\(^{39}\) Half of the product use cases were traced forward; for example, following the real-time 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. As for wool, three use cases were completed in 2023 to trace a two-pieces suit made of a blend of wool and lyocell fibres, a recycled wool fabric and a fabric made of a blend of recycled polyamide synthetic fibres and recovered wool. to trace a dress made of a blend of wool and cellulose (Giorgio Armani Retail) and to trace a recycled wool value chain. Lastly, for synthetic, a use case was started to trace a synthetic fibres value chain.

70. The leather pilots focused on five 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. 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,\(^{40}\) were also involved and onboarded on the platform to provide a verification process which links the certifications uploaded by companies participating in the pilots to the relevant certifying entity.

---

\(^{38}\) See Figure 3 for the geographical coverage of the pilot.

\(^{39}\) 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.

\(^{40}\) These are the Institute of Quality Certification for the Leather Sector (ICEC) and the Leather Working Group (LWG).
Figure 16
Overview of product use cases and value chain coverage for cotton

Source: ECE-UN/CEFACT, 2022

Figure 17
Overview of additional product use cases and value chain coverage for cotton

Source: ECE-UN/CEFACT, 2023

Figure 18
Overview of product use cases and value chain coverage for leather

Source: ECE-UN/CEFACT, 2022
The principal sustainability risks have been identified in both the textile and the leather value chain based on research conducted by internationally recognized institutions (e.g. OECD, UNEP, ITC, and 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 has been done in accordance with the UN/CEFACT Business Process Analysis for Sustainability and Circularity in Textile Value Chains and their Business Process Analysis for Sustainability and Circularity in the Leather Value Chain.

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 20
Sustainability hotspots along the cotton value chain from the BPA for Sustainability and Circularity in Textile Value Chains

Source: ECE-UN/CEFACT, 2022

Figure 21
Sustainability hotspots along the leather value chain from the BPA for Sustainability and Circularity in the Leather Value Chain

Source: ECE-UN/CEFACT, 2022

Data in the following 4 figures has been compiled from the UN/CEFACT, Business Process Analysis for Sustainability and Circularity in Textile Value Chains (2022), the UN/CEFACT, Business Process Analysis for Sustainability and Circularity in the Leather Value Chain (2022) as well as from an analysis conducted based on inputs from use case participants, ECE and experts.
Figure 22
Sustainability hotspots along the wool value chain from the BPA for Sustainability and Circularity in Textile Value Chain

Source: ECE-UN/CEFACT, 2023

Figure 23
Sustainability hotspots along the cellulose value chain from the BPA for Sustainability and Circularity in Textile Value Chain

Source: ECE-UN/CEFACT, 2023

73. The cotton textile industry has historically been associated with environmentally harmful practices (related to farming, processing and producing) and complex social concerns related to child labour, workers’ rights and wages, 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 section.

74. Among many, the primary sustainability standards in use for cotton farming, as referenced in the pilot use cases, are the Better Cotton (BC) assurance programme, based on a set of principles and criteria, and the IFOAM42 family of standards for organic cotton. Both address the three dimensions of sustainability (environmental, social and economic).

---

42 International Federation of Organic Agriculture Movements (IFOAM)
75. 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.

76. 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.

Figure 24
Certification standards used by industry participants to address sustainability hotspots in the cotton pilots

77. 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. A 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.

78. 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, 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.

79. 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.

80. 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.

81. 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.

Figure 25
Certification standards used by industry participants to address sustainability hotspots in the leather pilots

Source: ECE-UN/CEFACT, 2022

82. Based on the ECE Business Process Analysis for Sustainability and Circularity in the Textile Value Chain, ECE project experts conducted research and consultation with partners involved in the project (e.g. Woolmark), to cross check and fine tune the existing ECE recommendations to ensure they were up to date and fit for purpose to meet reality on the ground. While value chain business steps and sub-steps identified differed in terms of naming and in terms of quantity, the group was able to reconcile most steps to the original business process analysis, except for the addition of a step for quality control and transfer to manufacturer. This process was necessary in order to update the ECE blockchain platform with the relevant steps for document upload and for definition of the roles of pilot participants.
83. According to this research, the certification standards used by industry participants to address sustainability hotspots in the wool pilot could be as follows: ZQ Merino Fibre; ZQRX; RWS; 4Sustainability Chem; B CORP; GRS; Supplier to Zero; AEO FULL; ISO14001; ISO45001; EMAS; Woolmark; SustainaWOOL; Authentico; EOY; NATIVA; ISO9001; FAIRTRADE Textile Production; SA8000; BlueAngel; Bluesign; Cradle to Cradle; EU Ecolabel; GOTS; ISCC; ISO50001; NORDIC SWAN; OCS; STEP by OEKO-TEX; Tessile e Salute.

84. As for the synthetic value chain, the following reference and sustainability certification standards have been identified by industry participants: 4Sustainability Chem, B CORP, GRS, Supplier to Zero, AEO FULL, ISO 14001, ISO45001, EMAS, Authentico, EOY, NATIVA, FAIRTRADE Textile Production, SA8000, BlueAngel, Bluesign, Cradle to Cradle, EU Ecolabel, ISCC, NORDIC SWAN, Step by OEKO-TEX, Tessile e Salute, OEKO-TEX Standard 100, LCA ISO 14050, LCA ISO 14044, GRI, ZDHC Supplier to Zero, EPD.

A. Cotton use cases deep dive

85. The boxes below provide an overview of the 11 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.

86. 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)
- Use case 9: Regenerative cotton T-shirt (Turkish cotton)
- Use case 10: Regenerative cotton shirt (Turkish cotton)
- Use case 11: Better Cotton - Samarkand cotton cluster (Uzbek segregated 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 to health and the environment

Onboarded supply chain partners: Marchi & Fildi S.p.A., 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 goal of this use case was to trace the supply chain of the Vivienne Westwood classic tapered jeans by involving suppliers operating in different tiers of the supply chain in the pilot and having them share documentary evidence related to the monitored production stages of the traced jeans. To this end, Vivienne Westwood involved its suppliers (all Italy based) starting from the cotton spinner Marchi & Fildi; the weaver, finisher and waste provider Berto E.G. Industria Tessile; and the garment manufacturer Denim Service. The denim fabric of the tapered jeans consisted 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 upload documents onto the blockchain system that show 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 it was the adoption of circular materials—i.e. recycled cotton and the reduced use of chemicals.)

The brand’s suppliers who were responsible for cotton cultivation, harvesting and ginning were not directly involved in the pilot and did not test the methodology and blockchain-based system, however 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 & Fildi. The fabric scraps were then shredded and spun into recycled yarns at Marchi & Fildi, the fabric was woven and finished at Berto, then shipped to 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. The 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 use of chemicals, OEKO-TEX 100 certificates were uploaded.

Source: ECE-UN/CEFACT, 2022
**Cotton use case 2: Organic shirt (USA cotton)**

**Objective:** Prove the fibre is of organic quality and prove the origin (USA) of the cotton used in the shirt by involving value chain partners to provide documentary evidence for the content/quality, 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 & Sons Cotton LLC and Allenberg Cotton Company, ginner/trader; Anhui Humao Textile Co. LTD, spinner; Cotonificio Albini S.p.A., dyer; Cotonificio Albini S.p.A. and Dietfurt 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 goal of the pilot was to trace 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 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 & 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; Dietfurt 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 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 into the blockchain system.
- 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 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.

43 The documents at the spinning stage were uploaded on behalf of Anhui Humao Textile CO. LTD by Cotonificio Albini S.p.A.
Vivienne Westwood use case

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.

Source: ECE-UN/CEFACT, 2022

Source: ITC, 2023
Cotton use case 3: Organic yarn (Egyptian cotton)

Source: ECE-UN/CEFACT, 2022

**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:** 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 the ZDHC program, which supports the implementation of sustainable chemistry to protect workers, consumers and the environment.

**Onboarded supply chain partners:** NatureTex (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 InCheck reports

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

The goal of the pilot was to trace 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 as yarn manufacturer, involved its suppliers (Egypt and Italy based) in the pilot starting with the cotton trader NatureTex and the spinner Filmar Nile Textile. The yarn was selected as per its sustainability criteria and represents a bestseller among the GOTS certified organic Egyptian cotton yarns. The goal of participating in the pilot was threefold:
• Trace a bestselling yarn material, for which there is a high demand from customers, using a cost- and time-effective traceability and transparency methodology.

• Achieve product traceability by involving the supply chain partners, who uploaded system documents about the origin of the cotton and the movement of the material/product along the different stages of the value chain to the blockchain.

• Identify how the partners along the supply chain mitigate sustainability hotspots (for this pilot it was 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, in particular the one related to the use of organic cotton yarn, GOTS transaction certificate documents were uploaded to the platform for the ginning, spinning and dyeing phases. Moreover, to further ensure compliance with reduced use of chemicals, the OEKO-TEX 100 and ZDHC InCheck reports were also uploaded for the wet processes (spinning and dyeing).

Source: ECE-UN/CEFACT, 2022
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 by integrating digital and physical traceability

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

**Main challenges:** N/A

**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 socks is made of a blended yarn—Ecoloop—with 50% virgin cotton and 50% upcycled cotton from internal production waste. It uses dying 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

**Onboarded supply chain partners:** Alkan Cotton Trading; Filmar Nile Textile, Filmar S.p.A.; Bonadei

**Documentation shared among supply chain partners:** Invoices, self-declarations, third-party certificates

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

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

The goal of the pilot was to trace 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
documentary evidence related to the monitored production stages of the traced socks. The goal of Filmar’s participation in 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 the 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, in particular the one related to the upcycled fibres, a certificate from Haelixa was uploaded which certified 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 of the certificates provided by Haelixa to the platform 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 to ensure 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 InCheck reports were also uploaded to the blockchain platform at the dyeing stages.

Source: ECE-UN/CEFACT, 2022
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 goal of this pilot was to trace 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 the organic cotton from Egypt both physically and digitally.

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 to 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.

Source: ECE-UN/CEFACT, 2022
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; the April 2022 collection of pajamas

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 the FAO +Cotton Project\textsuperscript{44}, in partnerships with the FAO country office in Peru; COSTACH (5200 family farmers, region of Piura,

\textsuperscript{44} More information about +Cotton Project Program of Brazil-FAO International Cooperation is available at: https://www.fao.org/in-action/program-brazil-fao/projects/cotton-sector/fr/.
Peru); Creditex (1460 employees, Lima, Peru); and The Cat’s Pajamas (25 employees, California, United States).

The FAO and the Brazilian Government through the 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 of 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.

Source: ECE-UN/CEFACT, 2022
Cotton use case 7: T-shirts (Uzbek cotton)

**Source:** ECE-UN/CEFACT, 2022

**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\textsuperscript{44}. Additionally, Indorama Agro has been supported by the WBG-IFC to pilot a Better Cotton approach to promoting decent work and sustainable practices and standards in cotton farming\textsuperscript{46}.

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. The IFC and Indorama Agro’s approach focused on introducing sustainable cotton farming and ensuring decent work practices within the company’s supply chain. The 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. -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. The 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 international standards and criteria 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.

It is vital to recognize the seminal role the IFC in Uzbekistan played, with its investment in Uzbekistan’s cotton sector in 2021\textsuperscript{47}, and its collaboration with the ECE in a 2021-2022 on a pilot project to fully trace T-shirts back to the cotton field in Uzbekistan in the ECE blockchain platform. This work played an important role in the scaling up of subsequent use cases to improve cotton traceability and transparency in Uzbekistan, such as the ECE-Better Cotton use case (see use case 11: Better Cotton - Samarkand Cotton Cluster Uzbek segregated cotton) in 2022-2023. The introduction of the Better Cotton programme in Uzbekistan in 2022\textsuperscript{48} was based on many years of piloting with the IFC and GIZ, which are also funding partners\textsuperscript{49} of the

\textsuperscript{44} See International Finance Corporation (IFC), “IFC invests in Indorama Agro to Promote Sustainable Cotton and Improve Livelihoods in Rural Areas in Uzbekistan”, 27 May 2021. Available at: https://pressroom.ifc.org/all/pages/PressDetail.aspx?ID=26373
\textsuperscript{46} Ibid.
\textsuperscript{47} Ibid.
\textsuperscript{49} Better Cotton, Our Funding Partners webpage: https://bettercotton.org/who-we-are/how-we-are-funded/funding-partners/
Better Cotton Initiative. Uzbekistan is attracting international attention for its cotton sector modernization and efforts to become a global leader in cotton sourcing.\(^5\)

Source: ECE-UN/CEFACT, 2022

Cotton use case 8: Organic denim fabric (Indian cotton)

Source: ECE-UN/CEFACT, 2022

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. This was done at a facility that is annually assessed for its environmental and social performance through the Higg FEM.

Onboarded supply chain partners: Bafna Ginning and Pressing Pvt Ltd, Gomtesh Ginning and Pressing Pvt. Ltd; Otto Stadtlander GmbH; Candiani Denim

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+

The goal of the Candiani pilot was to trace 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. 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 bestseller among the GOTS certified organic cotton denim fabrics that Candiani produces. The goal of participating in the pilot was as follows:

- Trace a bestselling 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 was 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 were uploaded to the platform for the ginning and fabric manufacturing phases, which included 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. The uptake of organic agriculture and similar approaches was certified by uploading IFOAM NPOP+ certificates for the planting stage.

Cotton use case 9: Regenerative cotton T-shirt (Turkish cotton)

Source: ECE-UN/CEFACT, 2023
Objective: Prove that the jersey fabric T-shirt has been traced to the origin from SÖKTAŞ regenerative agriculture fields and respects chemical compliance by having value chain partners provide documentary proof.

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

Lead company: SÖKTAŞ

Product traced: Jersey fabric T-shirt

B2C claim: This T-shirt is made using regenerative cotton grown in Söke, Türkiye, using regenerative agriculture principles including (but not limited to) cover cropping, no tillage, adaptive grazing, as well as precision-farming technologies which optimize the use of resources. The garment’s value chain has been traced, from fibre to the finishing of the fabric, based on the ECE methodology, and it has been produced without the use of harmful substances for human and planetary health according to STANDARD 100 by OEKO-TEX and in compliance with the ZDHC programme.

Onboarded supply chain partners: SÖKTAŞ; Birpas; Gulle; Ekoten Tekstil; Camac; Stella McCartney

Documentation shared among supply chain partners: commercial invoices

Certifications made available to prove claim(s): Better Cotton, OEKO-TEX 100, STeP by OEKO-TEX, ZDHC InCheck, Higg FSLM

The use case traced the supply chain of a regenerative cotton T-shirt and was initiated by SÖKTAŞ in Türkiye, which involved its partners throughout the value chain, from farming up to retailing.

The cotton was farmed in Türkiye from a plot of land converted to regenerative agricultural practices which SÖKTAŞ has been experimenting with since 2019. The upstream part of the value chain in Türkiye, from farming up to fabric making was controlled by SÖKTAŞ and manufacturers subcontracted by SÖKTAŞ. The farmed cotton was transferred to Birpas for ginning, going back to SÖKTAŞ for warehousing and moving to Gulle for the spinning process. The yarn then moved to SÖKTAŞ again for quality check, warehousing and packing and has been knitted and finished by Ekoten Tekstil. Final inspection, testing and packaging was carried out by SÖKTAŞ. Finally, the fabric was shipped to Camac in Italy for garment manufacturing and then shipped to Stella McCartney in Italy for retailing.

In terms of certifications, the upstream part of the value chain up to fabric making was covered by Better Cotton certificates. Use of chemicals for finishing processes was covered by ZDHC InCheck, while the spinning to the fabric making was covered by OEKO-TEX standard 100. Spinning and fabric production, including of knitting and finishing, was covered by the Higg Index FEM and Higg FSLM standards. Based on the soil testing laboratory results indicated by the “soil organic carbon” changes over the four previous years, in this regenerative, biologically enhanced agriculture management (BEAM) transition, approximately 27.63 tons C/ha was captured and sequestered over the four-year timeframe of the project (~ 6.91 tons C/ha/year or over 14 times the typical expected rate of normal carbon assimilation in the top 45 cm of the soil profile). Accompanying the increases in soil organic carbon, an extra 590 kg N/ha were added annually as a resource for future crops, through the activity of the free-living and symbiotic nitrogen fixing bacteria. A 35 per cent reduction in water application was achieved with regenerative practices, which helped to increase both soil water storage capacity and plant water use efficiency.
Cotton use case 10: Regenerative cotton boyfriend shirt (Turkish cotton)

Objective: Prove that the cotton shirt has been traced to its origin from SÖKTAŞ regenerative agriculture fields and respects chemical compliance by having value chain partners provide documentary proof.

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

Lead company: SÖKTAŞ
Product traced: Regenerative cotton shirt

B2C claim: This shirt is made using regenerative cotton grown in Söke, Türkiye, using regenerative agriculture principles including (but not limited to) cover cropping, no tillage, adaptive grazing, as well as precision-farming technologies which optimize the use of resources. The garment’s value chain has been traced, from fibre to the finishing of the fabric, based on ECE methodology, and it has been produced without the use of harmful substances for human and planetary health according to STANDARD 100 by OEKO-TEX and in compliance with the ZDHC programme.

Onboarded supply chain partners: SÖKTAŞ; Birpas; Burteks Tekstil; Fabula; Stella McCartney

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

Certifications made available to prove claim(s): Better Cotton, OEKO-TEX 100, OEKO-TEX Step, ZDHC InCheck, Higg FEM & Higg FSLM

The use case traced the supply chain of a regenerative cotton woven shirt and was initiated by SÖKTAŞ in Türkiye, which involved its partners throughout the value chain, from farming up to retailing.

The cotton was farmed in Türkiye from a plot of land converted to regenerative agricultural practices, which SÖKTAŞ has been experimenting with since 2019. The upstream part of the value chain in Türkiye, from farming up to fabric making, was controlled by SÖKTAŞ and manufacturers subcontracted by SÖKTAŞ. The farmed cotton was transferred to Birpas for ginning, going back to SÖKTAŞ for warehousing and moving to Burteks Tekstil for the spinning process. The yarn then moved to SÖKTAŞ again to be woven into fabric and for the dying & finishing processes. Eventually, the fabric was shipped to Fabula for the manufacturing of the shirt, and then shipped to Stella McCartney in Italy for retailing.

In terms of certifications, the upstream part of the value chain, up to fabric making was covered by Better Cotton certificates. Use of chemicals for SÖKTAŞ weaving, dyeing and finishing processes were covered by ZDHC InCheck, OEKO-TEX STeP, OEKO-TEX standard 100 and Higg FEM & Higg FSLM, while the spinning was covered by OEKO-TEX standard 100. Based on the soil testing laboratory results indicated by the “soil organic carbon” changes over the four previous years, in this regenerative, BEAM transition approximately 27.63 tons C/ha was captured and sequestered over the 4 year timeframe of the project (~ 6.91 tons C/ha/year or over 14 times the typical expected rate of normal C assimilation in the top 45 cm of the soil profile). Accompanying the increases in soil organic carbon, an extra 590 kg N/ha were added annually as a resource for future crops, through the activity of the free-living and symbiotic nitrogen fixing bacteria. A 35 per cent reduction in water application was achieved with regenerative practices which helped to increase both soil water storage capacity and plant water use efficiency.
Cotton use case 11: Better Cotton - Samarkand Cotton Cluster (Uzbek segregated cotton)

The objective of this use case was to run a pilot on traceability and transparency in Uzbekistan for local cotton-based producers. The cotton was produced according to Better Cotton’s Principles and Criteria, which includes social and environmental criteria related to soil health, water stewardship, biodiversity, crop protection, fibre quality, decent work and management systems. The cotton was traced following Better Cotton Chain of Custody Standard v0.3. In 2022/2023 Better Cotton tested the Chain of Custody Standard (v0.3) in conjunction with ECE traceability methodology at a pilot scale in the Samarkand Cotton Cluster.

The Samarkand Cotton Cluster use case was aimed at making the cotton value chain more traceable and transparent for cotton material, from the cotton farming and
growing phases to the spinning. The Samarkand Cotton Cluster is a vertically integrated business, managing farming operations through to end-product production.

The next step in the use case would be to produce a finished garment and sell it on the market to the end consumer.

**Output:** Cotton farmed and grown in the field, collected in a warehouse, ginned and spun. The Better Cotton in this pilot has been segregated following the segregation requirements from v.0.3 of the Chain of Custody Standard. Third-Party verifiers assessed the cluster’s cotton collection point and ginnery to ensure segregation requirements were being maintained as the Better Cotton moved through the cluster’s internal supply chain.

**Lead organization:** Better Cotton

**Product traced (forward tracing):** Seed cotton, cotton bales, ginned cotton

**B2B claim:** This Better Cotton has been grown in accordance to Better Cotton Principles and Criteria (and enhanced decent work monitoring) and the cotton follows the Chain of Custody Standard (v0.3) through the clusters internal supply chain.

**Onboarded supply chain partners:** Better Cotton, Navbahor tekstil paxta klasteri

**Documentation shared among supply chain partners:** Shipping notes and Better Cotton licensing decision

**Certifications made available to prove claim(s):** Better Cotton licensing decision

**Main challenges:** It has proven very helpful to run the activities with the support of a local translator and expert to overcome the language barriers in training a variety of actors in the value chain stages. Tailored training and coaching sessions were critical considering the variety of actors involved in the value chain stages. The training and coaching activities were conducted in three separate groups: 1. the local cluster team; 2. the translator-cotton business expert; and 3. the Better Cotton team. The time required for the data collection was another challenge, proportionate to the high volumes of cotton considered in this forward-tracing use case (tons of material, hundreds of bales, hundreds of shipping notes, etc).

### B. Leather use cases deep dive

87. 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)

Source: ECE-UN/CEFACT, 2022

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 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 the Lily Heavy Grain Handbag and was led by Richard Hoffmans, who managed to involve the 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. The material was then 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 Royal Smit & Zoon added an extra layer of certification with ZDHC ClearStream certificates for chemical compliance and ISO 14001:2015 compliance certification.

**Mulberry use case**

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

Note: *1 Royal Smith & Zoon provides chemicals to Richard Hoffman before step 6*

**Source:** ECE-UN/CEFACT, 2022

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

**Source:** ECE-UN/CEFACT, 2022
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 documented proof.

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

Main challenges: N/A

Leading company: PrimeAsia

Product traced (backwards tracing): Stan Smith 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, conserve biodiversity and promote 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, USDA Organic, LWG, ZDHC ClearStream; Higg 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. Finally, it was sent to Adidas for retail in Germany.

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). It also provided an organic certificate, in accordance with the 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 was covered by LWG certification; PrimeAsia was covered by both social and environmental standards through LWG certification concerning work safety and cleaner processes in tanneries, as well as chemical

51 Certified animal welfare approved (AWA)
52 Professional Animal Auditor Certification Organization, Inc. (PAACO); Brazilian-based World Quality Services (WQS).
compliance through both LWG and ZDHC ClearStream certificates. PrimeAsia also provided FSLM certification, covering social labour practices and human rights, and an IQNet SR10:2015 certificate.

**Adidas use case**

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.

**Source:** ECE-UN/CEFACT, 2022
Leather use case 3: Citysole Court Sneaker shoes – American Leather

**Source:** ECE-UN/CEFACT, 2022

**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 MRSL 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 and 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

This 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 brand/retailer.

The origin of the product was traced based on a commercial invoice from Tyson to PrimeAsia, a Shipping note from PrimeAsia 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.

Source: ECE-UN/CEFACT, 2022
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., to BCN Concerie, who 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

This use case traced calf leather for women’s 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.
Leather use case 5: Finished goat leather (Uganda)

Source: ECE-UN/CEFACT, 2022

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:** Not disclosed (hide and skin preservation); Not disclosed (tanning to splitting); Not disclosed (trading); Leather Links (trading); DL Leather (dyeing to finishing).

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

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

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

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

The origin of the product has been traced based on delivery notes, bills of lading and commercial invoices.

In terms of certifications uploaded on the blockchain, LWG certificates covering the tanning process from raw hide/skin to tanned and from raw hide/skin to finished leather were provided.

**Leather Links use case**

---

**Source:** ECE-UN/CEFACT, 2022
C. Wool use cases deep dive

88. The boxes below provide an overview of the 3 wool use cases (with blends of other fibres), detailing for each one the objective, product traced, claim formulated, business partners involved, and documentation submitted, as well as a narrative description.

89. The following use cases are covered:

- Use case 1: Armani wool/lyocell Italian men’s dress
- Use case 2: Manteco – MWool® recycled wool use case
- Use case 3: RadiciGroup & Manteco fibres use case

Wool use case 1: Armani wool/lyocell Italian men’s dress

Objective: Demonstrate the traceability and transparency of a men’s dress made of blended virgin wool and lyocell fibres, complying with animal welfare, social and environmental standards and chemical use best practices.

Output: The mapping and tracing of the value chain of the Armani men’s dress back to the origin, through raw materials processing to the point of purchase. The claim supporting the product is substantiated by the relevant documentary evidence.

Main challenges: The training and coaching phase required great effort due to the high number of stakeholders involved. This use case applied a backward traceability approach, meaning the data had to be recollected and retrieved by the value chain participants. Giorgio Armani’s sustainability department was the main driver of the use case, while the R&D and operations departments were active in the background.

Lead company: Giorgio Armani S.p.A.

Product traced: Men’s dress made of blended virgin wool and lyocell fibres

B2C claim: This garment is made from TENCEL™ Lyocell fibres and from certified wool sourced in New Zealand, obtained according to the ZQ Merino standard that ensures animal welfare and supports health and wellness of farmers, families, farm workers and the local community. The garment's value chain has been traced from fibre production to spinning for TENCEL™ Lyocell fibres, derived from the natural resource wood, which is harvested only from certified and controlled sources, and from combing for wool fibres through manufacturing to retailing, based on the ECE methodology.


Documentation shared among supply chain partners: Shipping documents and invoices

Certifications made available to prove claim(s): ZQ Natural Fibre, OEKO-TEX® Standard 100 (for lyocell fibres), ISO 14001:2015 - Environmental management systems

The Armani use case aims to demonstrate the traceability back to the origin of a men’s dress. The production of the finished product was carried out in 2022, therefore the pilot applied a backward traceability approach. The wool was collected in New Zealand against the ZQ practices to respect animal welfare. The fabric was a blend of wool (76%) and lyocell (24%), sourced in the United Kingdom, as per the evidence provided. The fabrics with TENCEL™ Lyocell fibres are certified by Lenzing and can be verified in the value chain by a unique fibre identification technology, guaranteeing fibre authenticity from fibre to final product. The fibres were mixed to
make a single yarn and a finished fabric, ready for garment manufacturing. After the fabric finishing, the operations department of Armani shipped the fabric to laboratories for the cutting and sewing processes, after which the men’s dress was shipped to Armani’s retail shops worldwide.

**Giorgio Armani’s use case**

The garment is made from SRL2C™ wool fibres and from certified wool sourced in New Zealand obtained according to ‘O’ Merino standard that ensures animal welfare and supports health and wellness of farmers, families, farm workers and local communities. The garment’s value chain has been traced, from fibre production to spinning for SRL2C™ wool fibres, and from combing for wool fibres, through manufacturing, to retailing, based on the ECE methodology.

**Wool use case 2: Manteco – MWool® recycled wool use case**

**Objective:** Run a pilot on traceability and transparency for fabrics made of MWool® recycled wool.

**Output:** Description of the transformation events for a recycled wool value chain at the sourcing, warehousing, spinning, winding, warping, weaving and finishing stages, based on the ECE Traceability and Transparency standard.

**Main challenges:** The Manteco System business model and the ‘try and learn’ approach entailed several training and coaching activities. The use case applied a backward traceability approach, which required more time for the collection of data throughout the value chain.

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

**Product traced:** Fabric made of MWool® Recycled Wool fabric

**Claim:** This fabric is made of 100% recycled MWool®, GRS certified, and completely manufactured in Tuscany, Italy in facilities part of the Manteco System, according to the Manteco Charter of Supply Chain Commitments, that defines the goals and the environmental and social standards to be followed by our partners. The fabric has been traced according to the ECE methodology.

**Onboarded supply chain partners:** Manteco System

**Documentation shared among supply chain partners:** Commercial invoice and delivery documents

**Certification available to substantiate the claim(s):** GRS certification, ZDHC MRSLS

The Manteco use case aimed to demonstrate the traceability of the recycled wool material, applying ECE standardized traceability methodology in the blockchain-
based platform. Manteco purchased recycled raw wool fibres from a supplier and stored them on their premises. Based on customer’s orders, Manteco shipped the material to subcontractors to process the recycled raw wool fibres over several transformation events (spinning, winding, warping, weaving and finishing) and received a finished fabric. The fabric is 100% GRS certified and the wet-processing has been carried-out without the use of harmful substances for human and planetary health according to the ZDHC MRSL.

Source: ECE-UN/CEFACT, 2023

Wool use case 3: RadiciGroup & Manteco fibres use case

Objective: Demonstrate the traceability, the transparency and the environmental impacts of a fabric produced with recycled synthetic polyamide (Renycle®) from the RadiciGroup and sold to Manteco S.p.A. The recycled polyamide was blended with recovered virgin wool (ReviWool®) material to produce a fabric fully made of blended synthetic and wool fibres.

Output: A fully traceable and transparent value chain from post-industrial waste collection to finished fabric, through the upload of relevant documentary evidence in the ECE blockchain platform.

Main challenges: This use case is complex by nature due to the blend of recovered wool and recycled polyamide fibres, for which relevant evidence had to be collected by relevant actors and uploaded in the blockchain.

Lead companies: RadiciGroup and Manteco

Product traced: Fabric produced with a blend of recycled polyamide (Renycle®) and recovered virgin wool (ReviWool®).

Claim: This fabric is produced with a blend of recycled polyamide Renycle® coming from post-industrial waste collection and from recovered virgin wool ReviWool®. The fabric is fully traceable based on the ECE methodology, from waste collection to the final fabric manufacturing, and it is certified according to the Environmental Product Declaration based on LCA analysis.

Onboarded supply chain partners: Radici Yarn, Radici Ecomaterials, Manteco S.p.A.
Documentation shared among supply chain partners: shipping documents and commercial invoices

Certification available to substantiate the claim(s): OEKO-TEX Standard 100, Global Recycled Standard (GRS), Responsible Wool Standard (RWS), ZDHC, Environmental Product Declaration (EPD) and ISO 9001, 14001, 14040, 14044, 50001.

Radici Yarn collected pre-consumer waste in its internal production facilities and sorted it for different quality levels. The material was shipped to Radici Ecomaterials to be recycled through thermo-mechanical recycling. The recycled material was shipped back to Radici Yarn to produce staple fibres through the melt-spinning process. This operation resulted in a “fiocco” (staple fibres), sold to Manteco S.p.A. for yarn and fabric production; the purpose is to combine the synthetic recycled fibres with the recovered virgin wool fibres to weave a new and fully circular fabric ready for garment production. The four steps (collection and sorting of industrial fibre production waste, recycling, spinning, weaving) will be tracked in the blockchain platform against ECE standardized traceability methodology.

Radici Group & Manteco fibres use case

Source: ECE-UN/CEFACT, 2023

VII. Challenges, opportunities and lessons learned

90. 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 to support value chain partners in complying with the requirements of due diligence laws. The pilots have also been an opportunity to benefit from training and from the knowledge of industry experts 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 experiences in the pilots, companies can further internalize these processes and implement them in their strategies for traceability and transparency.
A. Lessons learned and challenges for successful implementation

91. Through the direct and active participation of industry representatives in the pilots project and its technology, important lessons were learned and challenges were 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.

<table>
<thead>
<tr>
<th>Box 4: Opportunities and challenges in harnessing the potential of blockchain technology for due diligence and sustainability in value chains – areas to be discussed:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Engaging all value chain partners in end-to-end product traceability</td>
</tr>
<tr>
<td>2. Building the knowledge for a standardized business approach</td>
</tr>
<tr>
<td>3. Data disclosure and legal issues in the blockchain platform</td>
</tr>
<tr>
<td>4. Governing digital systems</td>
</tr>
<tr>
<td>5. Integrating blockchain technology and/or other digital solutions into existing company systems</td>
</tr>
<tr>
<td>6. Adding another layer of traceability with physical markers</td>
</tr>
<tr>
<td>7. Onboarding certifiers</td>
</tr>
</tbody>
</table>

1. Engaging all value chain partners in end-to-end product traceability: opportunities and challenges

92. Companies that participated in the pilots have gained valuable insights and identified challenges for successful implementation of traceability and transparency goals. A comprehensive 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 of the blockchain-based system. However, onboarding value chain partners has proven to be a challenging process at times.

93. In the cotton pilots, despite the difficulties in reaching the initial tiers of the cotton value chain (i.e. cotton farming) most companies could prove the origin of the cotton by onboarding the cotton traders. 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. Better performance was also observed for companies that have direct operations in cotton-producing countries, those that have special corporate social responsibility (CSR) programs, those that engage in partnerships, and those that participate in projects that involve cotton farmer cooperatives. Raising awareness about the benefits of supply chain traceability using blockchain technology is critical, especially in managing the risk of sustainability impacts related to due diligence and responsible business conduct.

94. 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 and use 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. This is especially true for upstream actors (e.g. raw material providers, SMEs and smallholders), but also for downstream actors (e.g. manufacturers and retailers). The upstream part of the value chain is where sustainability impacts (labour, social, environmental, health and safety-related impacts) tend to be less visible and is therefore where it is most difficult to carry out due diligence. Building trust, establishing win-win cooperation and empowering all actors with the opportunity to make their contribution is important for the alignment of vertically integrated value chains, but it is even more relevant for complex and fragmented value chains.

2. Building the knowledge for a standardized business approach: opportunities and challenges

95. When implementing traceability and transparency within a value chain, it is critical to define a common terminology and establish an understanding of the processes among value chain participants.

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

97. A full understanding of the documentary (data) evidence required to support claims is essential in setting up a traceability system because the system requires that this essential supplier data be identified up front. Backwards tracing may be more difficult than forward tracing, particularly when there is a need to collect information ex-post, because information is not always available or it may be hard to retrieve 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; it may require the combined implementation of backward and forward data collection within the same value chain, and it may not fit within the timeline of a proof of concept—hence the challenge.

98. Building knowledge about the methodology and the blockchain-based system also required partners to invest time in training and coaching sessions. These were provided by the ECE team in order to build capacity in using the platform, which was built upon the ECE textile and leather traceability and transparency information exchange standard. This training identified the data and documents 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. This has been a critical success factor in aligning the terminology of UN/CEFACT standards with that of the industry and in providing a clear understanding of the standardized data and data collection points, which are based on the UN/CEFACT standard and the EPCIS reporting system.

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

99. 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.

Figure 26
Identification of disclosure levels in the blockchain platform

![Identifying disclosure levels in the blockchain platform](source)

Figure 27
Data disclosure levels of traceability information in the blockchain platform

![Data disclosure levels](source)
100. 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\(^53\) and other laws concerning data privacy). The project team produced a rule book on data management for partners in the implementation of the project blockchain pilots. They also developed 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

101. 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 were involved in complex value chains. Most of the companies involved preferred a self-coordination approach, rather than central coordination, for collecting the needed documentary evidence from their suppliers to back up their claims, and they were supported in this by regular contact and guidance from the project team.

102. The fact that this blockchain-based system was developed taking an open-source approach to the sharing of information and managed by a university (SUPSI) was an asset in the context of this project, which involved 40+ organizations and companies. The university has the advantage of being a more neutral body than a private technology solution provider.

103. An important lesson learned is related to the consequences of working within a blockchain environment. Blockchain is an immutable, decentralized type of storage where information is kept inside smart contract elements. Manual entry often results in mistakes and errors, something that cannot be corrected or updated due to the blockchain architecture. Therefore, the integration of application programming interfaces (APIs) 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

104. The transition from manual to fully automatic and programmable entry of data into the blockchain application is mandatory for industrial applications. This will require the analysis of the different ERP systems used by all partners involved. For this, the IT departments of all the different partners need to be involved to undertake the technical analysis. APIs need to be designed and implemented to extract and upload data without changing the underlying company systems so that the impact on each company's IT department is reduced. The 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. The open-source approach could lead to an open community working group that could collaborate in the development of the platform and related APIs. The analysis of the integration the API layer is an important factor for the transition from a pilot project to actual system implementation from a technical perspective.

6. Adding another layer of traceability with physical markers

105. Product markers are emerging as another technology that can support the connection between the physical and the digital world and associated data flows. While these solutions can be costly, especially for implementation on an industry-wide scale, they are an opportunity to consider. For companies that highly prioritize tracing the provenance of raw materials and product authenticity and quality, product markers provide another level of assurance that is complementary to the digital traceability provided 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.

106. In the cotton pilots, the lint cotton fibre was marked and then, after a transformation or a transaction event, the DNA was analysed 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.

107. Another key opportunity provided by DNA markers is independent verification that complements the 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 materials and products.

7. Onboarding of certifiers

108. Following the cotton pilots, the platform was fine tuned for the pilots on leather to allow third-party certifiers to directly verify 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**

109. The participating companies filled out a questionnaire that was developed by the ECE secretariat to collect feedback about the 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.

110. 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
- 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

111. This section is based on analysis of the results from 12 questionnaires. The questionnaires were completed by the lead partners for each use case in the cotton and leather pilots: brands (Vivienne Westwood, Tapestry, Stella McCartney); manufacturers (Cotonificio Albini, Filmar, WEBA Weberei Appenzell AG, Candiani Denim, PrimeAsia, Richard Hoffmanns, BCN Concerie, SÖKTAŞ); international organization (FAO RLC in Santiago, Chile); financial institution (IFC Tashkent office, Uzbekistan) and industry sustainability programme (Better Cotton). These lead-partner answers also reflect the experience of the approximately 48 participating companies from the textile and leather industry.

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

112. Piloting companies reported that, overall, the cost-efficiency for data collection and exchange in the textile and leather blockchain pilots in comparison to an internal data management system was medium to low, which is to be expected from a pilot project. Partners noted that the pilot required higher manual data input (at the moment) since their suppliers did not have interfaces to link the pilot’s system with their internal systems. Additionally, the platform was 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

---

54 This section is based on the outcomes of a pilot evaluation and KPIs questionnaire completed by the lead working group partners of all 15 use cases.

55 The questions in this survey often referred to blockchain technology; however the experiences and feedback received applied 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.
the data collection, per se, was quite cost effective and straightforward, requiring mostly dedicated staff-hours to complete. In some cases, the pilots revealed some weaknesses in how data was organized and stored, which will require investments to remediate. The total workdays dedicated to the pilots ranged between 5 and 30 days, with 15 days being the average. For the cotton pilots, partners who were involved in the development and set 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 29

*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 cotton pilots.]

*Source: ECE-UN/CEFACT, 2023*

Figure 30

*Level of cost efficiency for data collection and exchange in the leather pilots in comparison to internal data management systems*

![Pie chart showing cost efficiency levels for leather pilots.]

*Source: ECE-UN/CEFACT, 2023*
2. Main challenges resulting from using digital traceability technology to manage supply chain data with all value chain actors

113. 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 highlighted more technical concerns in terms of complexity and costs of data collection, together with privacy and security considerations.

114. 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 SME value chain partners could be challenging, depending upon their capacity and internal resources.

115. A further challenge identified by piloting partners was in creating 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 a high level of organization for the collection and digitalization of the data, which is a challenge for farmers.

116. 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.

117. Additionally, partners reported a pervasive level of scepticism and reluctance 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.

118. 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 will 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).
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, along with the use of standardized data. Without such interface tools companies will need to input data by hand onto a digital traceability system, which is not practical and is prone to errors.

Figure 31
Main challenges of digital traceability technology for managing supply chain data with all value chain actors – cotton

Source: ECE-UN/CEFACT, 2023

Figure 32
Main challenges of digital traceability technology for managing supply chain data with all value chain actors – leather

Source: ECE-UN/CEFACT, 2023
3. **Usefulness of the ECE traceability and transparency methodology and approach for accessing data on sustainability performance and supporting risk-informed decisions**

120. Piloting partners assessed the usefulness of the ECE methodology and approach for accessing data on sustainability performance and for 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 and the identification of business processes, actors, and sustainability risks resulting from the business process analysis (BPA). Additional benefits included increased data trustworthiness and identification of evidence for traceability and transparency.

**Figure 33**

**Evaluation of the benefits of digital traceability technology for managing supply chain data with all actors – cotton**

**Box 5: 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

*Source: ECE-UN/CEFACT, 2023*
Figure 34
Evaluation of the benefits of digital traceability technology for managing supply chain data with all actors – leather

Box 6: 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

121. 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 shared documents (information) 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.

122. 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.

123. 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 and 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 35
ECE T&T methodology benefits for accessing data on sustainability performance and supporting risk-informed decisions – cotton

Source: ECE-UN/CEFACT, 2023
Figure 36
ECE T&T methodology benefits for accessing data on sustainability performance and supporting risk-informed decisions – leather

Source: ECE-UN/CEFACT, 2023

Figure 37
Usefulness of methodology within partners’ wider supply chain sustainability efforts – cotton

Source: ECE-UN/CEFACT, 2023
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 supplier 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 38
Usefulness of methodology within partners’ wider supply chain sustainability efforts – leather

Source: ECE-UN/CEFACT, 2023
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 supplier 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

124. 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.

125. 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.

126. 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;
   • A way to make communicating the benefits easier;
   • Some partners were interested to know whether the blockchain-based system would be applied for faster/paperless customs/shipping procedures.
   • An open-source app or blockchain platform with low transaction costs provided to governments and the industry;
   • A higher involvement of international certifying organizations; and
   • Wide-scale cooperation between actors across the supply chain.

127. As part of the project’s training and coaching activities, over 188 people were trained to use the blockchain-based system and 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 may also 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 109 training and coaching sessions were delivered by the ECE experts team for the textile and leather pilots.

VIII. Future developments and recommendations

A. Ongoing and possible future developments

128. The blockchain-based system used in these pilots has been adapted to integrate supply chain traceability for animal-based materials and fibres (e.g. wool and cashmere) and synthetics, and has identified the relevant business processes, actors, risks and mitigation measures. This has supported to assess the scalability of the solution to additional value chains.

129. In addition, an API is currently being developed to support the automation of data entry into 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 that are aligned with UN/CEFACT standards, EPCIS standards and authentication mechanisms for the blockchain platform will be developed.

130. The project will consider looking into aspects related to the governance of the blockchain-based system and transaction funding principles. Moving forward, ECE and the European Union, as the project donor and the pilot project participants, will need to define the future of the blockchain system developed under the project. All concerned parties will 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.

131. Regarding 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 multiplatform, global traceability architecture. Therefore, this could be an interesting area for future work.

132. Regarding the 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 have been 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 for the foreseeable 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

56 As mentioned earlier, wool and synthetic pilots have already begun.
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.

Concerning viability, new concepts related to wallets, key management, distributed data management and cryptographic tools need to be more understood, accepted and adopted, so training is needed to help company management and IT department administrators fully understand it.

As an evolution, and in line with accepted reporting guidelines and directives, it would be helpful to integrate the ability to gather environmental impact data from all value chain partners for a given unit of raw material and/or a final traced good into the blockchain-based system. This would raise awareness among companies about the importance of life cycle assessment tools, give them experience in monitoring and evaluating the environmental impacts of products, help them understand 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.

Regarding collaboration with the ITC to integrate the T&T matrix into the ITC Sustainability Map and visualization of the completed use cases, the ECE with its Centre for Trade Facilitation and e-Business (UN/CEFACT) in collaboration with International Trade Centre (ITC) and with funding from the European Union, have been working since 2019 on the establishment of set of complementary tools to enhance traceability and transparency of value chains in the garment and footwear industry. Following the adoption of a toolbox (policy recommendation, guidelines, standard), between 2020 and 2023, the ECE has been carrying out these pilot projects with more than 95 actors (brands, manufacturers, raw material producers, certifiers etc.) to implement its standard to track and trace clothing items from the raw material to the finished product. This has been done using a blockchain-based platform, though which traceability and transparency evidence has been uploaded and registered by relevant parties. Such pilot projects provided companies with a robust methodology to formulate and substantiate sustainability claims.

The results of these pilot projects evidence the feasibility of implementing the standard produced by the ECE in an industry with complex, opaque and scattered value chains.

With the goal of facilitating the visualization of the pilot projects and to gather information scattered in multiple sources in a user-friendly way, the ECE began working with the ITC, leveraging its Sustainability Map platform. This collaboration would enable the pilot projects’ onboarding materials to be gathered on a single website and would provide a way to visualize the ECE blockchain pilot projects, including the supply chains of the clothing items traced back to the origin and the geolocation of each partner company involved.

In a second phase, ECE and ITC took a first step forward to develop visual representation of the pilot use cases through a website, including information gathered through the ECE framework initiative, like the project’s outputs, the
geographical scope of the pilots, the sustainability claim, and an overview of the traceability and transparency data for each use case.

140. With the goal of assessing the scaling potential and compatibility of the ECE Traceability & Transparency Matrix with the Initiative for Compliance and Sustainability (ICS) data, ITC worked with supply chain data of selected ICS Members to apply the ECE traceability methodology for about 150 products.

141. On the backend, an additional transformation logic and storage layer was used, to adapt ICS Members’ data extracts for the purpose of ECE Traceability Matrix and its visualization on the ITC Sustainability Map. In the future, this process can be automated and scaled further.

142. This work explored applicability of the ECE methodology and ITC data transformation and visualization approach beyond the proof-of-concept stage. ITC is working on a technical document summarizing the efforts, findings, and development directions.

143. The website summarizing this ECE-ITC work and highlighting selected use cases is available at https://resources.sustainabilitymap.org/unece-homepage.

B. Recommendations

144. 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, the implementation costs and the skills required. In the fragmented, globally scattered value chains of the textile and leather sectors, SMEs account for more than half of the business partners. As result, viable solutions must be available for 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.

145. 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.

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

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

147. 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; and
- Support investment in related education for entrepreneurs, civil servants and the general public.

148. 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, or for those 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; and
- 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.

149. 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**

150. 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.

151. 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 do this should give priority and assign adequate time and resources to this aspect of their systems.

152. 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.

153. 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.

154. 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 through capacity-building initiatives that aim to align suppliers with the long-term vision of the brand.

155. This is a welcome development. Continuing and increasing the efforts of leading brand actors to upskill upstream value chain actors in terms of traceability, transparency and sustainability will be essential in bridging 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 making 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**

156. 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 multistakeholder 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**

157. 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**

158. 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**

159. This project directly contributes to the 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


UN/CEFACT Textile and leather data model (under the tab ‘Standard’)

Product traceability event message

Product transparency message

Mapping of polices, regulations, legislations:


Communication - The ECE Blockchain Pilots infographic (2021):
Annex B:

**Glossary for the blockchain pilots**

<table>
<thead>
<tr>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>User</strong></td>
</tr>
<tr>
<td><strong>Claim</strong></td>
</tr>
<tr>
<td><strong>Sustainability claim</strong></td>
</tr>
<tr>
<td><strong>Product</strong></td>
</tr>
<tr>
<td><strong>Process</strong></td>
</tr>
<tr>
<td><strong>Business roles</strong></td>
</tr>
<tr>
<td><strong>Consumer</strong></td>
</tr>
<tr>
<td><strong>Compliance</strong></td>
</tr>
<tr>
<td><strong>Assessment procedure</strong></td>
</tr>
<tr>
<td><strong>Assessment</strong></td>
</tr>
<tr>
<td><strong>Assessment types</strong></td>
</tr>
</tbody>
</table>

---

**57** ISEAL is a global membership organization for credible sustainability standards.  
**58** From the American Society for Quality (ASQ) *Glossary of Terms, Acronyms & Definitions* 2.
<table>
<thead>
<tr>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Self-declared</strong></td>
</tr>
<tr>
<td><strong>Self-assessed</strong></td>
</tr>
<tr>
<td><strong>Second-party verified</strong></td>
</tr>
<tr>
<td><strong>Third-party verified</strong></td>
</tr>
<tr>
<td><strong>Third-party certified</strong></td>
</tr>
<tr>
<td><strong>Certificate</strong></td>
</tr>
</tbody>
</table>
| **Scope certificate** | A 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  
A 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** | A document that indicates that the products received are actually certified to the standard. It includes product and shipment information.  
Or  
A 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) |
<p>| <strong>Accreditation</strong> | A formal recognition (attestation) by an independent body to confirm that a certification body operates according to a standard. (ISO 9001:2015) |
| <strong>Standard</strong> | A 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-setting code) |</p>
<table>
<thead>
<tr>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Referenced standard</strong></td>
</tr>
<tr>
<td><strong>Sustainability standard</strong></td>
</tr>
<tr>
<td><strong>Standard owner/scheme owner</strong></td>
</tr>
<tr>
<td><strong>Standards system</strong></td>
</tr>
<tr>
<td><strong>Inspection</strong></td>
</tr>
<tr>
<td><strong>Audit</strong></td>
</tr>
</tbody>
</table>
Annex C

List of figures and tables

List of figures

- Figure 1 Blockchain pilots project milestones .......................................................... 4
- Figure 2 Breakdown of 95+ piloting companies & organizations .................................. 9
- Figure 3 Textile and leather blockchain pilots—geographic coverage .......................... 11
- Figure 4 Ecosystem of actors involved in the pilots ...................................................... 12
- Figure 5 Textile pilot participants ........................................................................... 13
- Figure 6 Leather pilot participants ......................................................................... 14
- Figure 7 Standard cotton value chain considered in the pilot (business process analysis) ... 14
- Figure 8 Standard leather value chain considered in the pilot (business process analysis) ... 14
- Figure 9 Standard wool value chain considered in the pilot ...................................... 15
- Figure 10 Standard synthetic value chain considered in the pilot ................................ 15
- Figure 11 Steps in building a use case .................................................................... 16
- Figure 12 Examples of “5W” information collected by value chain partners ............ 19
- Figure 13 The blockchain pilot landing page and interface ........................................ 25
- Figure 14 Distribution of shipping/trade transactions by type in the blockchain platform .. 26
- Figure 15 Distribution of certificates by assurance type in the blockchain platform ....... 26
- Figure 16 Overview of product use cases and value chain coverage for cotton .......... 28
- Figure 17 Overview of additional product use cases and value chain coverage for cotton 28
- Figure 18 Overview of product use cases and value chain coverage for leather ........ 28
- Figure 19 Overview of product use cases and value chain coverage for wool with blended fibres 29
- Figure 20 Sustainability hotspots along the cotton value chain from the BPA for Sustainability and Circularity in Textile Value Chains ........................................................................... 30
- Figure 21 Sustainability hotspots along the leather value chain from the BPA for Sustainability and Circularity in the Leather Value Chain ................................................................... 30
- Figure 22 Sustainability hotspots along the wool value chain from the BPA for Sustainability and Circularity in Textile Value Chain .................................................................. 31
- Figure 23 Sustainability hotspots along the cellulose value chain from the BPA for Sustainability and Circularity in Textile Value Chain .................................................................. 31
- Figure 24 Certification standards used by industry participants to address sustainability hotspots in the cotton pilots .......................................................... 32
- Figure 25 Certification standards used by industry participants to address sustainability hotspots in the leather pilots .................................................. 33
- Figure 26 Identification of disclosure levels in the blockchain platform ...................... 73
- Figure 27 Data disclosure levels of traceability information in the blockchain platform .... 73
- Figure 28 Data disclosure levels of transparency information in the blockchain platform .... 74
- Figure 29 Level of cost efficiency for data collection and exchange in the cotton pilots in comparison to internal data management systems ...................................................................... 77
- Figure 30 Level of cost efficiency for data collection and exchange in the leather pilots in comparison to internal data management systems .................................................................... 77
- Figure 31 Main challenges of digital traceability technology for managing supply chain data with all value chain actors – cotton .................................................. 79
- Figure 32 Main challenges of digital traceability technology for managing supply chain data with all value chain actors – leather .................................................... 79
- Figure 33 Evaluation of the benefits of digital traceability technology for managing supply chain data with all actors – cotton .................................................. 80
- Figure 34 Evaluation of the benefits of digital traceability technology for managing supply chain data with all actors – leather .................................................... 81
- Figure 35 ECE T&T methodology benefits for accessing data on sustainability performance and supporting risk-informed decisions – cotton .................................................. 82
- Figure 36 ECE T&T methodology benefits for accessing data on sustainability performance and supporting risk-informed decisions – leather .................................................. 83
- Figure 37 Usefulness of methodology within partners’ wider supply chain sustainability efforts – cotton 83
Figure 38 Usefulness of methodology within partners’ wider supply chain sustainability efforts – leather

**List of tables**

<table>
<thead>
<tr>
<th>Table</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Table 1</td>
<td>Focus of sustainability claims for the ECE blockchain pilots project</td>
<td>18</td>
</tr>
<tr>
<td>Table 2</td>
<td>Traceability and transparency-related documents</td>
<td>20</td>
</tr>
<tr>
<td>Table 3</td>
<td>The key data entities for collection in the TT matrix: cotton example</td>
<td>21</td>
</tr>
</tbody>
</table>
Annex D

Blockchain pilots project governance

ECE Secretariat

Coordinates the project pilot implementation, reviews progress and ensures consistency with overall ECE project scope and activities

Pilot Project Partners

Provide in kind input for pilot project implementation (Webia, Filmar, Albini, OEKO-TEX, GOTS, ZDHC, Vivienne Westwood)

Pilot Project Team

Includes consultants that provide technical input and expertise for pilot implementation

Blockchain Technology Solution Provider

SUPSI
Annex E

Visualization of the supply chain in the blockchain platform

CASE 1: RECYCLED DENIM - CLAIM RECYCLED CONTENT

CASE 1: RECYCLED DENIM - CLAIM ORIGIN
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

Examples of Oeko-Tex Scope Certificate

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 + Letohrad, 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
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
- Knitter
- DNA Test Lab on yarn
- 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>
<thead>
<tr>
<th>Leather certifier acronyms</th>
<th>Meanings</th>
</tr>
</thead>
<tbody>
<tr>
<td>ZDHC</td>
<td>Zero Discharge of Hazardous Chemicals</td>
</tr>
<tr>
<td>MRLS</td>
<td>Manufacturing Restricted Substance List</td>
</tr>
<tr>
<td>FSLM</td>
<td>Facility Social &amp; Labor Module</td>
</tr>
<tr>
<td>SLCP</td>
<td>Social &amp; Labor Convergence Program</td>
</tr>
<tr>
<td>LWG</td>
<td>Leather Working Group</td>
</tr>
<tr>
<td>ICEC</td>
<td>Institute of Quality Certification for the</td>
</tr>
<tr>
<td></td>
<td>Leather Sector</td>
</tr>
</tbody>
</table>

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