Background Note Blockchain for Due Diligence in the Garment and Footwear Sector

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Fashion companies are confronted with the rise of the conscientious consumer who questions the social conditions and the environmental footprint of clothes while calling for greater **transparency**. Indeed, garment and footwear manufacturing processes entail substantial environmental and reputational risks with the potential to affect corporate profitability, brand equity and operational capabilities. As one result, clothing manufacturers and retailers are increasingly motivated to change their business models and practices in order to ensure good practices throughout their supply chains and enforce these through solid traceability mechanisms.

Supply-chain traceability allows corporations to follow material and production flows from raw material extraction until the final product reaches the end-user. Supply-chain traceability is critical for legal compliance as well as for corporate social responsibility. Nonetheless, implementation is a complex issue because it requires the collaboration of all the stakeholders involved in the supply chain and the deployment of common and reliable technical solutions in widely different environments.

In the garment and footwear industry, until recently, supply chain traceability has been a lower priority than in other sectors (pharmaceutical, automobile, food and beverage, etc.) where regulations, audits and labelling standards make traceability a compulsory objective.

The Good Citizen Principles established by the Global Fashion Agenda and the Boston Consulting Group have as a minimum requirement for companies to identify 50 percent of their Tier 2 suppliers, while they define best practice as 100 percent identification (GFA and BCG 2017). In the context of sustainability, even this may not be adequate since, in many supply chains, much of the environmental and social risk lies with Tiers 3 and 4 (raw material supply and processing).

One of the key issues in the implementation of traceability is that existing databases are fragmented across a supply chain and, therefore, cannot provide a single picture of a product's provenance.

The most prevalent practice in the industry is to manage supply chain, product, sales and purchasing-related data through a web of solutions, such as Enterprise Resource Planning (ERP) packages, traditional databases and server applications – with each stakeholder keeping their own, separate, "solution web". In addition, most of the data collected across these "solution webs" refers to immediate suppliers and purchasers, without information about "the suppliers of a supplier" or the clients of a buyer.

As a result, these solutions have led to partial and unreliable data scattered among numerous parties. Moreover, the quality of data can be degraded when it is exchanged between stakeholders due to the lack of a standardised technological infrastructure (i.e. the data is subject to reinterpretation; manual reformatting or re-entry, lost data when transferred data contains information that is not collected by the destination system, misinterpretation due to differences in codes and a host of other issues).

Therefore, any work on new solutions needs to look at developing instruments for the exchange of information that can be used across the breadth and length of the entire supply-chain.

Distributed Ledger Technology (DLT) solutions can enable fashion companies and retailers to improve supply chain transparency across a variety of ecosystems by making available to relevant stakeholders all information on product origin and subsequent processing in a transparent and trustworthy manner, thus allowing companies to more effectively mitigate reputational and environmental risk. A study by Cognizant (2018) has demonstrated the possibility of **setting-up a blockchain-driven supply chain traceability framework** tailored to the garment and footwear industry.

Blockchain technology is a type of Distributed Ledger Technology (DLT) and is a distributed (decentralised), verified, trusted, secure transaction ledger which can record data that allows the verification of information. In the garment and footwear industry this could include, among others, data about raw material harvest, production, product use, end of life disposal, sustainability certifications and vendor contracts.

A blockchain records transactions on a ledger (immutable database) held by peers in a network. These transactions can be readily checked and are accessible equally to all parties if it is on a public blockchain, and, on a private/permissioned blockchain, equally to all parties who have read permission to read that data. Cybersecurity is managed by using separate public and private keys for cryptographically signing and accepting transactions, and the use of consensus mechanisms for validating transactions. These mechanisms require a majority consensus among all nodes that have copies of the blockchain database (which may be thousands) and often combine cryptographic algorithms with systems of reward and punishment that make cheating prohibitively expensive.

Blockchain networks provide an opportunity to increase traceability and, accordingly, sustainability through the creation of a common source of verifiable knowledge about transactions that is accessible to all stakeholders regardless of their location, so long as they have access to the Internet (which is the technology used for communicating with blockchain networks). This common source of knowledge can then be used by application developers to create a single framework that stakeholders can use to address comprehensively sustainability issues in supply chains.

As an example, a well-designed blockchain-based application has the potential to allow brand retailers to access the blockchain (via a user interface program) to verify the origin of each input used in manufacturing. Industry regulators will be able to check the data and examine the entire lifecycle process using the blockchain's digital ledger (including registered inspections made by authorities to identify occupational health and safety violations, unauthorised subcontracting and child labour). Consumers will be able to view a product's full journey and its certification from field to shelf via QR codes or apps. Accordingly, they will be able to make an informed decision before purchasing a product.

As the spotlight increases on the environmental and social consequences of the fashion trade, a key strategical objective for fashion companies has become to take action and lead the change by increasing supply chain transparency with the objective of:

- **Managing risks** (maintaining a full disclosure of material and process origins)
- **Realising efficiencies** (improving gross margins through better product design and processes with reduced lead times)
- **Creating sustainable products**
- **Improving brand equity**

Step 1 The Supply Chain Model

The very first step in creating traceability is to initiate a **supply chain mapping exercise** in order to capture all the points where data needs to be recorded, as well as what data needs to be recorded and by whom in order to create transparency, while also recording and verifying all the participants.

The critical prerequisites for a retailer to use blockchain are the capacity to map all the upstream organisations in the supply chain and get confirmation that all the actors along the chain have the necessary IT infrastructure to support the required data reporting.

There are four key process elements for mapping the supply chain:

1. **Identifying** the raw materials and downstream stakeholders (i.e. the Tier 1 final product manufacturing and assembly, Tier 2 Material manufacturing and Tier 3 Raw materials processing, Tier 4 Agriculture, farming and extraction);
2. **Creating** a map of the identified downstream stakeholders for each product type;
3. **Filtering and selecting** stakeholders to engage in a proof-of-concept pilot implementation;
4. **Defining** the best practices for the selected stakeholders.

Step 2 The Data/Information Model

For traceability to work, companies have to **capture the data** required by implementing globally unique persistent identification for all the relevant products and locations at either a batch or individual product level, depending upon what is being traced. Then, companies must establish a **common standardised data model** for capturing the physical supply-chain events that are needed for traceability. Business applications then need to be designed for recording these events on the blockchain and then, later, retrieving them.

Elements of the **data model** include:

1. The **business information**: party (e.g. farmer, trader, storage, transport, authority), facility, location (e.g. farm, field, treatment zone, crop, applied treatment, process) product/ material composition (used input, field, treatment, characteristics such as quantity, quality), production, trade (e.g. dispatch, invoice, order, catalogue)
    a. **Identifiers** of party, location and product batch
    b. **Codelist** for characteristics of party, location, product, process
2. The **sustainability requirements**: social/ethical/environmental for internal operations/suppliers/subcontractors
    a. **Relevant standard** and **KPIs**
3. **Certification** (e.g. party, farm, facility, product and process, storage and transport)

In addition, in order for companies to access and share the data on a blockchain, the data needs to be registered using **standard formats and definitions** so that everyone who can access the data knows exactly what form it is in and what it means. A blockchain application can then make available application programming interfaces (APIs which are small programs for exchanging data between different systems) and different supply-chain stakeholders can use these to retrieve data and move it into existing legacy computer systems, or new applications like an app on a consumer's mobile phone.

Step 3 The Technology Model

How to implement blockchain technology in the apparel supply chain?[1] The different steps to be completed range from agent onboarding & registration, to asset registration and certification, to transaction and certification tracking with smart contracts[2] and to audit.

Another key element is the identification of a digital identifier that can be used to trace each product element that is to be tracked. There are a number of ways to do this, the most important criteria being the close association of the digital id with the physical product. For example, digital ids can be developed by marking/tagging a product with bar codes, serial numbers, radio-frequency identification (RFID), near field communication (NFC) and Internet of Things (IoT) sensors.

Blockchain technology can be used as a traceability mechanism to facilitate closed-loop supply chains and a "**circular economy**". For example, when a retailer sells an apparel that can be registered on a blockchain and smart contracts could then be used to automatically encourage return of the used product or could be used by the consumer to prove that the item is genuine in a resale scenario. Supply chain stakeholders can also use the data generated via blockchain applications to evaluate lifecycle impacts and make strategic procurement decisions, being proactive rather than reactive.

There are a number of **types of blockchains**, which are categorised according to their governance structures. The three main types which have emerged are **public**, **private** or **consortium-led blockchain networks.** Which type should one use? This depends on the needs of a particular application and its stakeholders. Where stakeholders want to closely control who can participate and what kind of data the different parties are allowed to read or write onto a blockchain, blockchain application designers are most likely to select either a private or consortium-based blockchain configuration. An increasing number of blockchain networks are based on the consortium model because it can help to anchor trust between individual companies and bolster collaboration[3].

Private and Consortium based blockchains can also be designed to limit access to confidential information and control who is allowed to write what kind of information to the blockchain. Indeed, it is possible to allow for the segregation of certain transactions so that they can be accessed only by subsets of private parties within the larger supply chain network.

Overall, the use of standards and APIs should provide business application **interoperability**[4] as well as choices in the solutions that users want to develop. How can interoperability for an end-to-end traceability system be achieved?

1. **Agreement** on of the **use of existing standards** for the unique identification of the materials or products to be traced, on the visibility data models to be used (there are models that determine who has access to what data) and the methods to be used for the exchange of that data (for example APIs);
2. Development of **specific guidance** about how to apply standards consistently across an industry for a specific business problem;
3. Development of an **overarching governance policy** that each separate blockchain-based solution ecosystem will adhere to in order to be a part of a broader cross-ecosystem network.

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[1] For further reference, see the figure in the annex, 'Blockchaining the apparel supply chain' (Cognizant 2018).

[2] A smart contract is a computer program that is recorded on a blockchain, reflects the terms of an agreement, cannot be modified and executes automatically when the terms are met. In the context of apparel supply chains smart contracts could be related to payments based on deliveries and on criteria that must be met by the delivered products (for example, related to sustainability).

[3] Various industry organizations such as the Better Cotton Initiative (BCI) and Th Sustainable Apparel Coalition along with a number of start-ups (such as Provence, Sourcemap and Skuchain) are exploring ways to integrate and implement blockchain technology into the supply chain through Proof of Concept (POCs) implementations.

[4] Interoperability refers to the ability of different computerised systems to connect and communicate with one another easily, even when developed as part of different ecosystems.

Concluding remarks

- Although digital technology requires a significant investment, the benefits of establishing greater levels of traceability and transparency will outweigh the costs. Facilitating blockchain solutions will enable fashion companies to be more resilient in the face of disruptions as they will be able to trace the status of goods across their entire supply chain.

- The implementation of blockchain/DLT solutions must be able to exchange data and interact with other evolving technologies such as artificial intelligence, machine learning, IoT and other digital identity systems in order to keep abreast with the benefits provided by these digital developments.

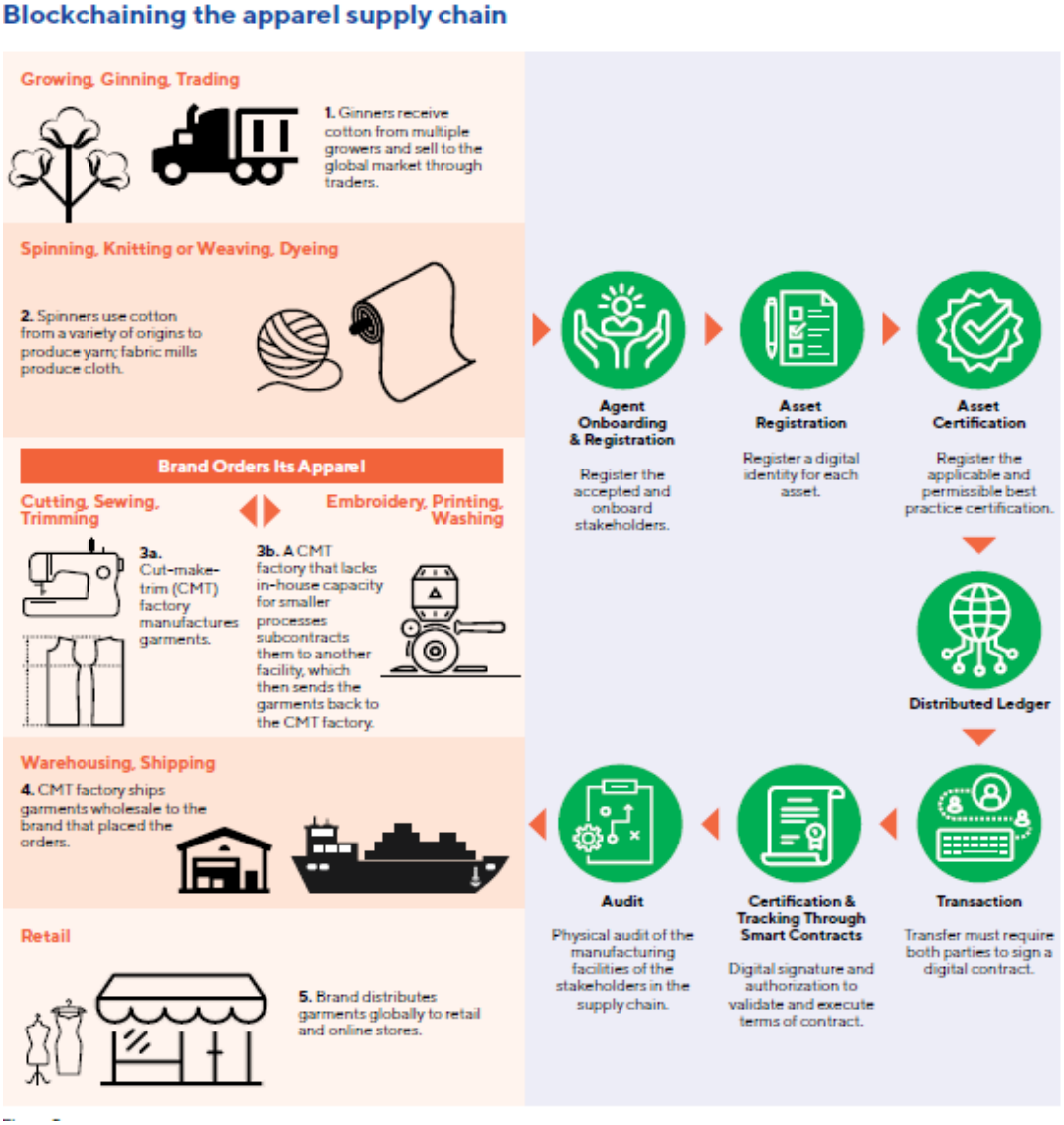
- For a local pilot project, it is advised to focus on using a blockchain network for tracing one single product type for testing purposes prior to expanding to gradually include other products.

Annexes

Blockchaining the apparel supply chain: using the example of cotton (Cognizant, 2018)

Process steps to integrate blockchain/DLT into the apparel supply chain

Process	Agent Onboarding & Registration	Asset Registration	Asset Certification	Transaction	Certification & Tracking Through Smart Contracts	Audit
Description	All participants are onboarded and registered. They will be provided with a public/private key to reflect their digital identity on the blockchain by a registry.[12] Records are now available for inspection on the blockchain by the entire community. It is this level of transparency which forms the trust element to enhance their reputation on the network.	This process creates a token or digital identity for the asset. This digital identity of the assets is the key to transacting on the network.	The onboarded certification authority will inspect and verify the asset and provide a certification for the asset in adherence to best practice standards. Specific attributes such as fair trade and fair labor certificates can be achieved.	Transaction of assets between parties takes place from one manufacturing process provider to another.	Smart contracts can help enforce the validation of certification.	Independent auditors can audit the flow of materials through manufacturing tiers. This additional layer provides a greater level of creditability and verification of the processes.
Example	All mapped raw material producers, process intermediaries and manufacturers are registered onto the network and assigned a digital signature to sign their transactions.	A farmer yarn spinner processes 10 tons of cotton fiber and registers it on the blockchain. The recorded information includes material grade along with the facility name, location, and membership ID of a standards and certifications body such as Better Cotton Initiative (BCI).	The cotton can be certified by standards and certifications bodies such as BCI.	Spinner sells yarn to fabric mill. The mill sells fabric to the trim provider. Each party records the transaction on the blockchain. A digital signature provides authenticity of the transaction between participants.	10 tons of certified cotton can be entered into a smart contract. A spinner's sale of six tons of cotton is updated to recalculate and record four tons of certified cotton remaining on the smart contract. If the spinner engages in malpractice and tries to merge a different batch of cotton, the smart contract triggers a red flag, indicating an attempt to sell uncertified cotton.	The auditor inspects the manufacturers' facilities and updates the results on the blockchain.



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