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Supply Chain Traceability in the Digital Age

Dr. Wafaa Ahmed

What will I cover today?

- Supply chain traceability – why is it needed?
- Blockchain-enabled supply chain traceability
- Blockchain case studies

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Supply chain traceability – why is it needed?

GOV.UK

Home › Crime, justice and law › Crime prevention

Collection

Modern Slavery Act 2015

European Commission

English (en)

Search

Home › Press corner › Corporate sustainability due diligence

Available languages: English

Press release | 23 February 2022 | Brussels

Just and sustainable economy: Commission lays down rules for companies to respect human rights and environment in global value chains

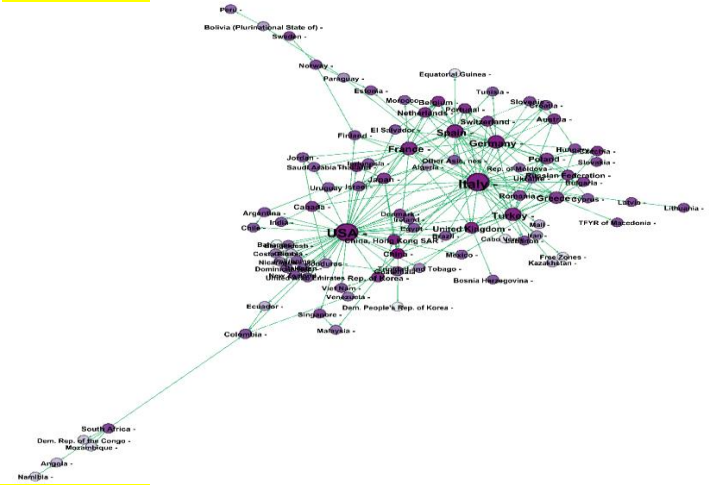
2007

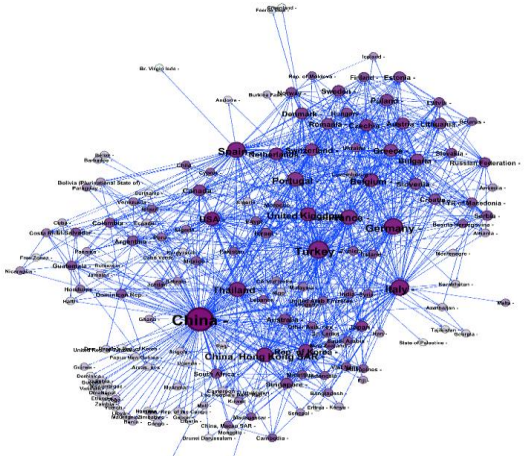
Combed and carded Cotton Network

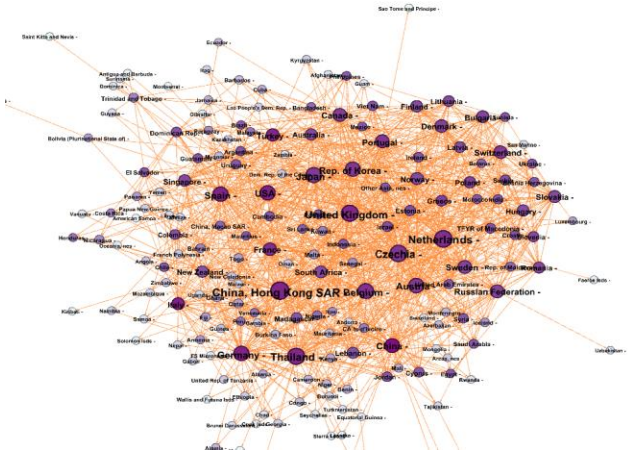
Yarn Cotton Network

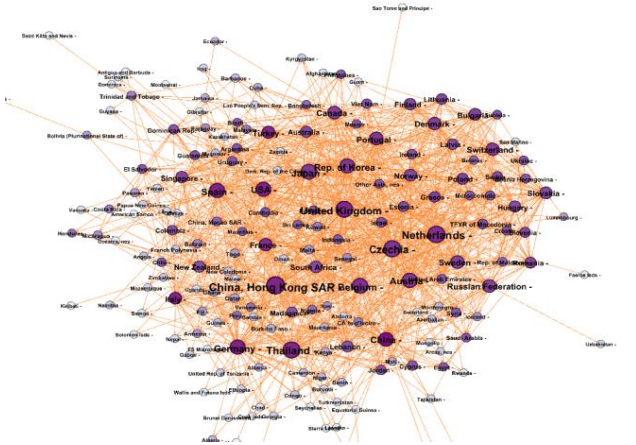
Fabric Cotton Network

Cotton Network

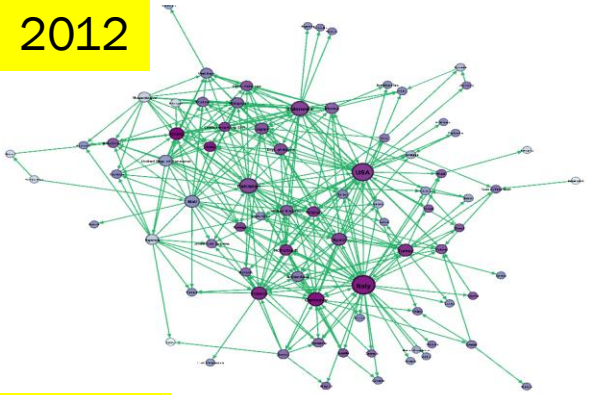


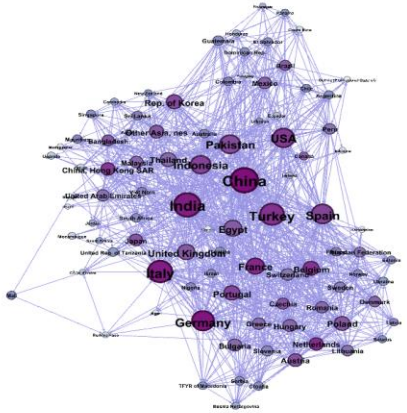


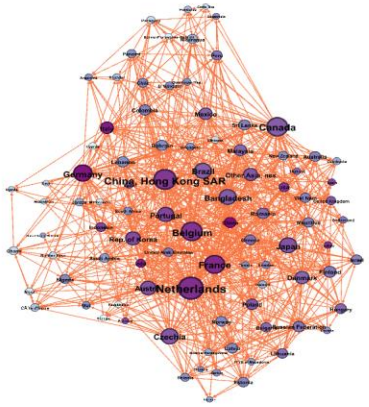


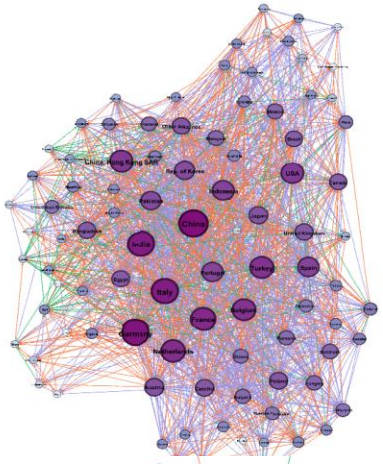


2012

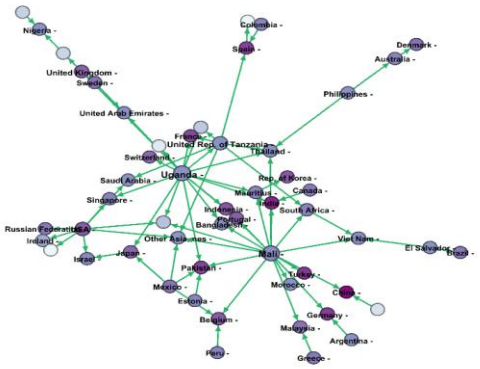


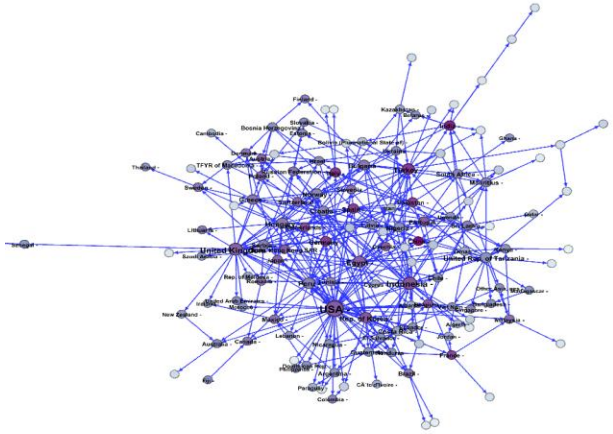


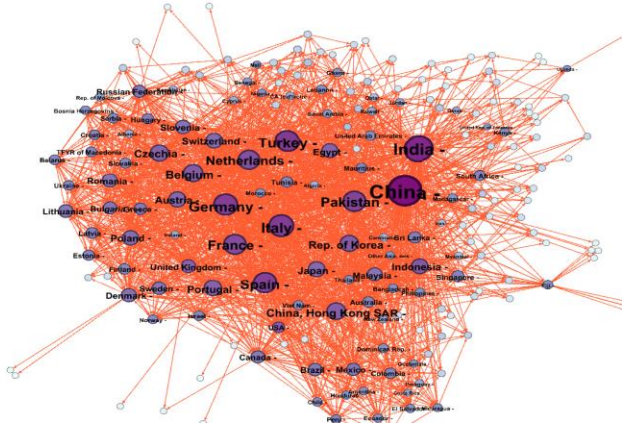


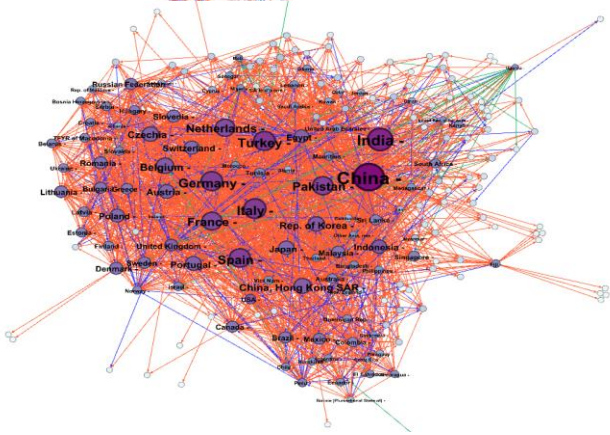


2017

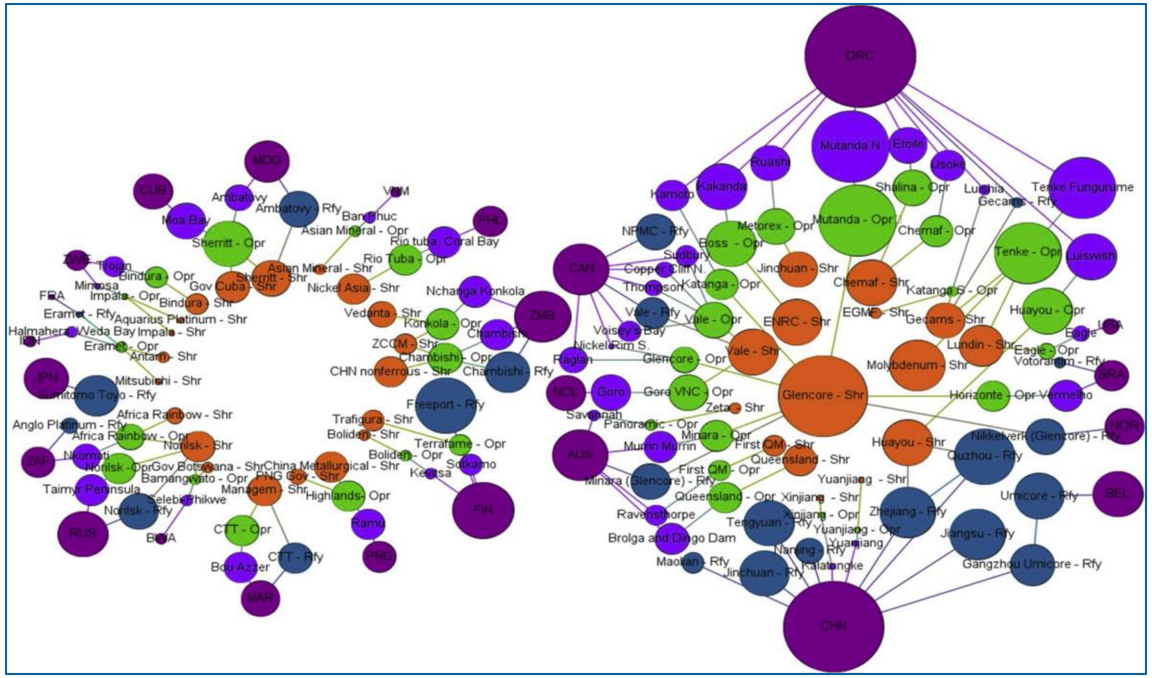


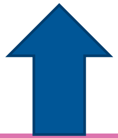






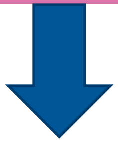
Cobalt supply chain - two views

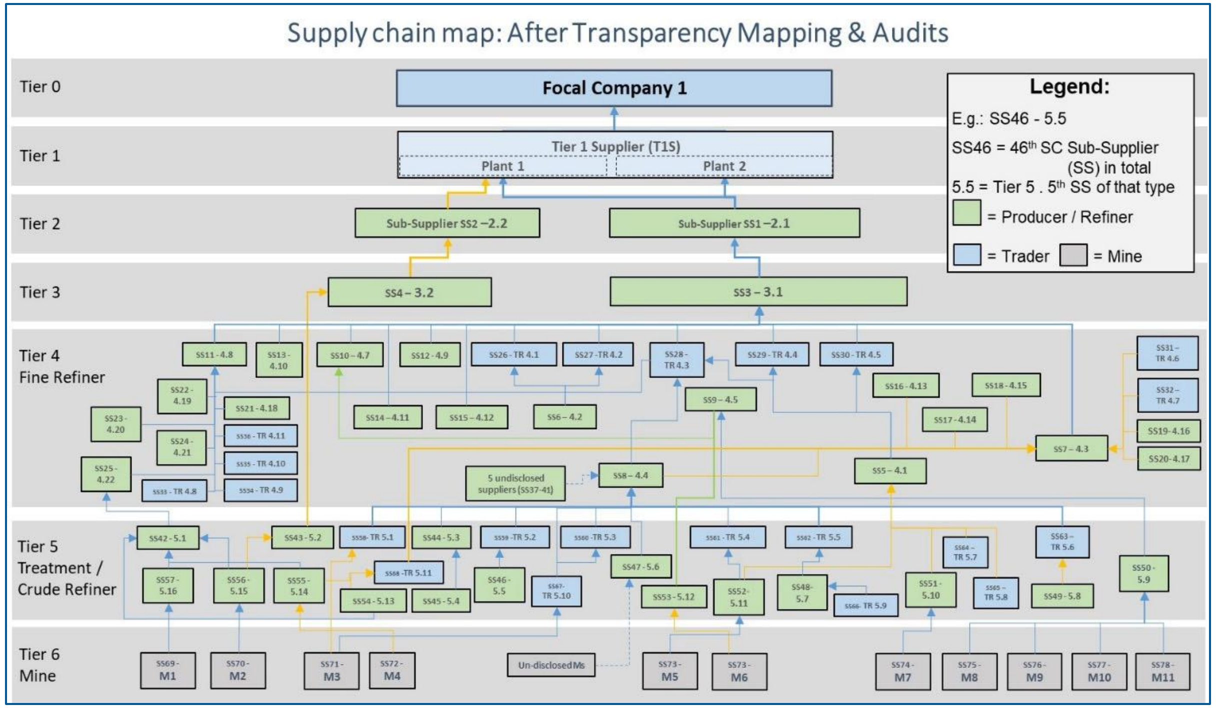




Supply Network
van den Brink et al., (2020)


Supply Chain
Fraser et al., (2020)





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Can digital technologies help?

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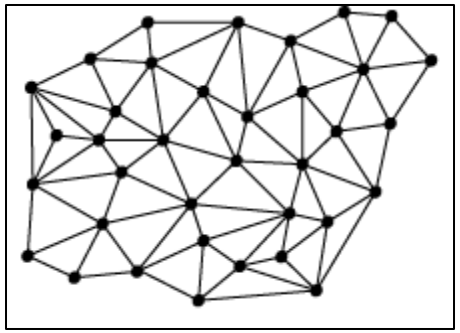
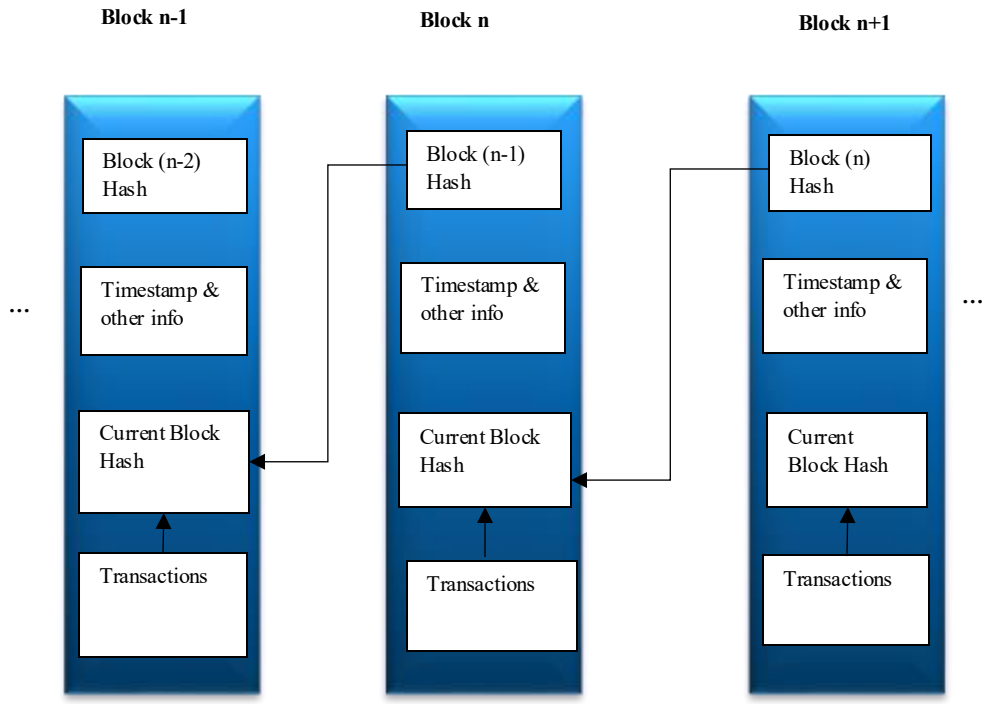
Blockchain technology for supply chain traceability

What is Blockchain Technology?

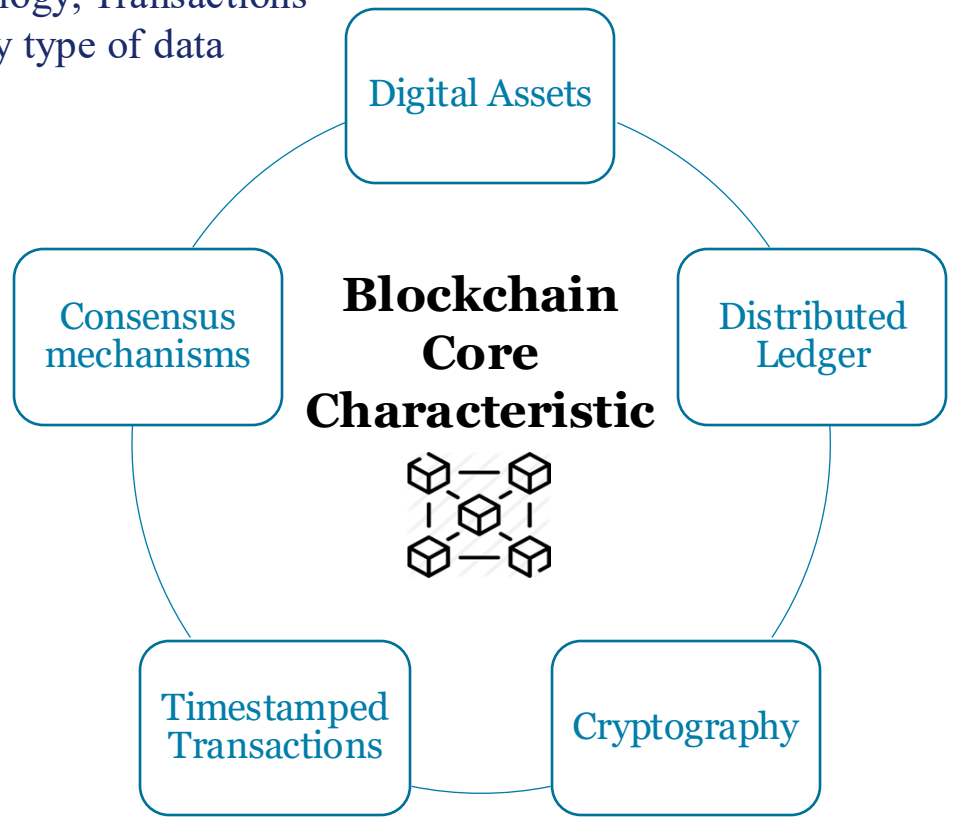
- Blockchain ≠ Bitcoin
- Blockchain is a combination of technologies comprising a **digital** chain of records that are **time-stamped**, uniquely identified using **cryptography**, and stored in a chronological order on a **distributed ledger**. Each block refer to the block that precedes it in the network and blocks are validated based on the **consensus mechanism** of the network to establish agreement on the ledger history.
- Blockchain networks can be **public/permissionless, private/permissioned** or **Hybrid**, allowing different access, read and write rights to the network participants





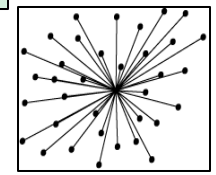
Blockchain Technology Core Characteristics

Digital Technology, Transactions can include any type of data

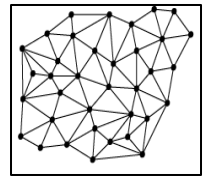


All participants have to agree on single truth, i.e., the current status of the ledger

Centralised ledger - owned/controlled by one participant in a network

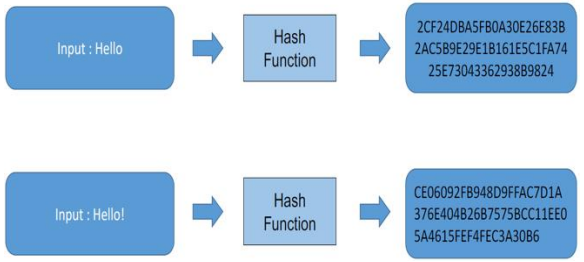


No central authority. Data is distributed and broadcasted to all the nodes in the network in real time



Each Transaction is timestamped, and blocks are linked in a chronological order

Use of complex mathematical and computational algorithms to create unique digital signatures for the blocks based on its data (i.e., hash)



Blockchain in the Supply Chain – Why?

- Blockchain provides an immutable digital ledger promising a 'single source of truth' for a supply chain
  - May contain information on supply chain products, processes, operations, and transactions
  - Each block is time-stamped, can be traced and may contain any type of data, e.g., geo-location information

- Many potential supply chain applications
  - **Provenance** - where has this product come from?
  - **Traceability** – where has it been?
  - **Authenticity** – is this a genuine product?
  - **Sustainability** – has this product been produced in a sustainable way?
  - + many other claimed applications (e.g. **smart contracts**)

Blockchain in Practice

- Increasing number of **organizations** are implementing blockchain projects in the different sectors

- Increasing number of **blockchain consortia** focusing on business and supply chain applications

- Increasing number of **blockchain providers**

Ahmed and MacCarthy (2022). Blockchain technology in the supply chain: learning from emerging ecosystems and industry consortia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Blockchain
Supply Chain
Applications -
Case Studies

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Textile Supply Chain

Lenzing
Innovative by nature

Ahmed, W.A. and MacCarthy, B.L., 2021. Blockchain-enabled supply chain traceability in the textile and apparel supply chain: A case study of the fiber producer, Lenzing. *Sustainability*, *13*(19), p.10496.

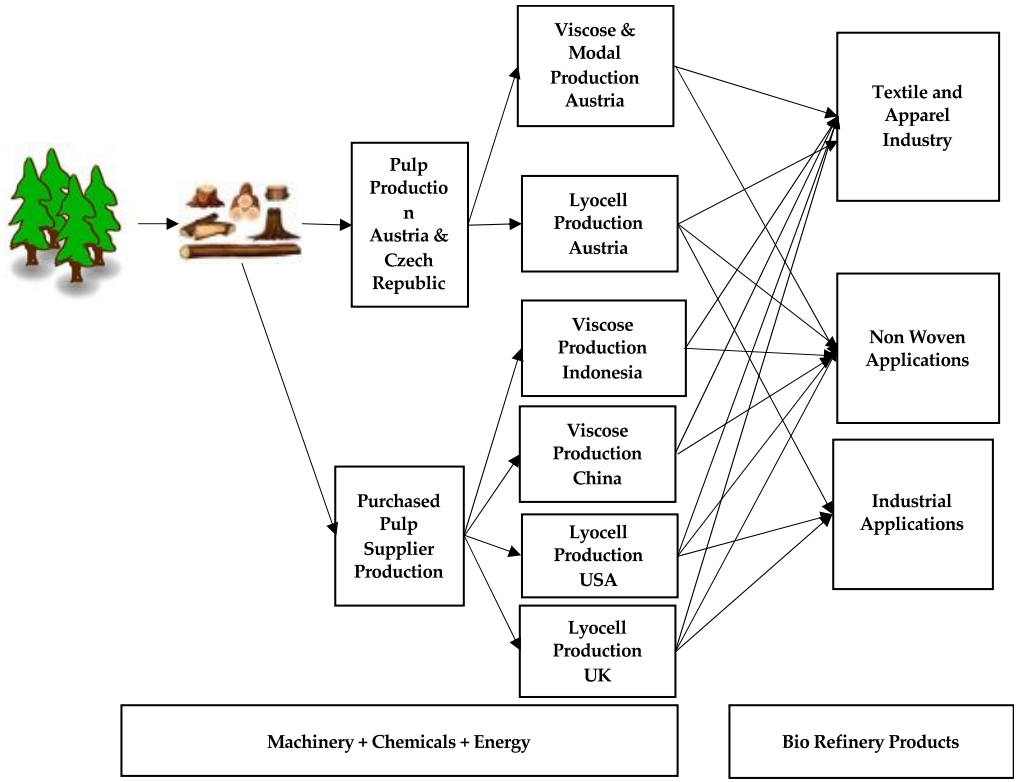
Lenzing Group Products Offering

1. TENCIL Fibers
- Lyocell fibers
- Mainly for Textile
- Use of REFIBRA technology – recycling cotton waste and own lyocell fibers.
- Partners: ASOS, Levi's, H&M, Guess, TED Baker, etc.

2. Eco Vero Fibers
- Viscose fibers.
- Certified renewable wood sources.
- 50% less emissions and water impact.
- Partners: J.Crew, MONSOON, ESPRIT, etc.

3. VEOCEL Fibers
- Lyocell fibers.
- Mainly for nonwoven applications.
- Great water absorption and smoothness.
- Ideally used for sanitary and baby care products, wipes, facial sheets, etc.

4. LENZING Fibers
- Lyocell Fibers.
- Hi-Tech fibers for industry and agriculture solutions.
- Provides sustainable packaging solutions.
- Provides strong fibers ideal for industrial uniforms.



Innovative by nature

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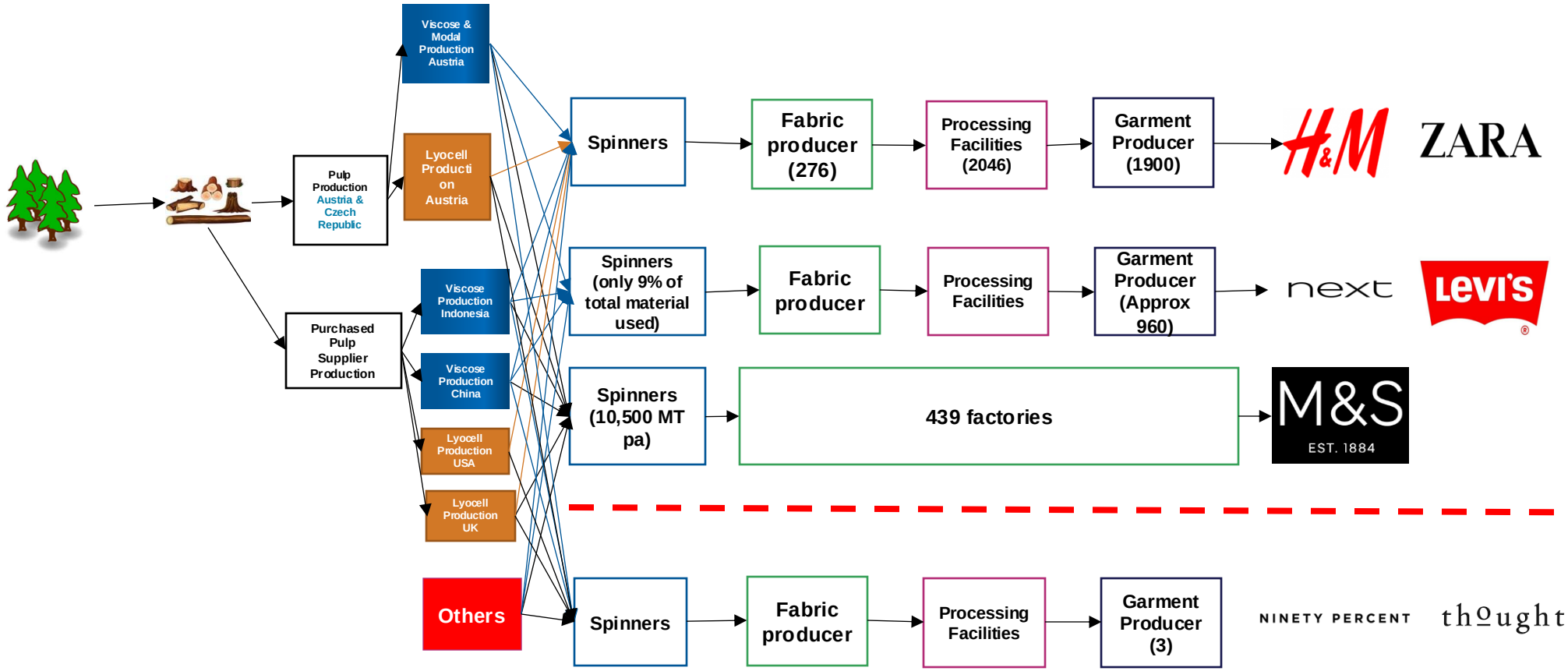
Lenzing – Textile Supply Network Configuration



- ✓ Big Brands
- ✓ Complex and Large Supply networks
- ✓ Low % of Lenzing fibre
- ✓ Keen on achieving sustainability
- ✓ Harder to implement traceability solution

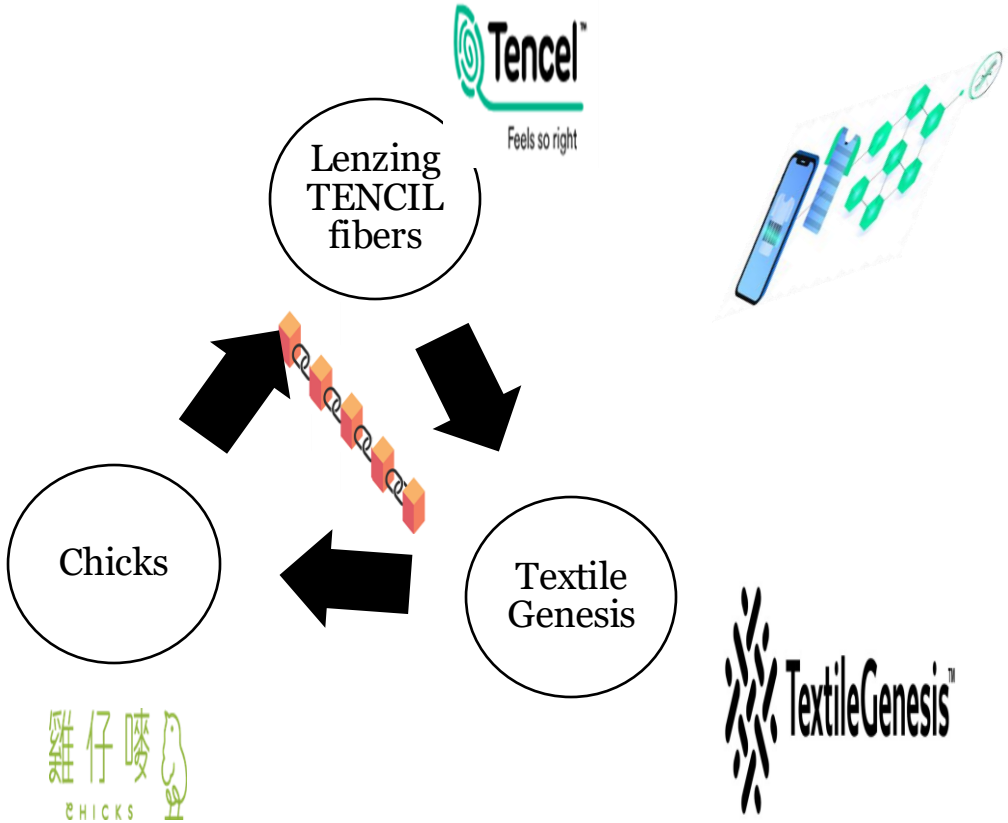
- ✓ Relatively smaller brands
- ✓ Small-Medium Supply networks
- ✓ Higher % of Lenzing fibre
- ✓ Based on sustainable materials (e.g. 90% , thought clothing)
- ✓ Easier to implement traceability solution

Lenzing
Innovative by nature

Ahmed and MacCarthy (2021)

Main motivations for blockchain adoption

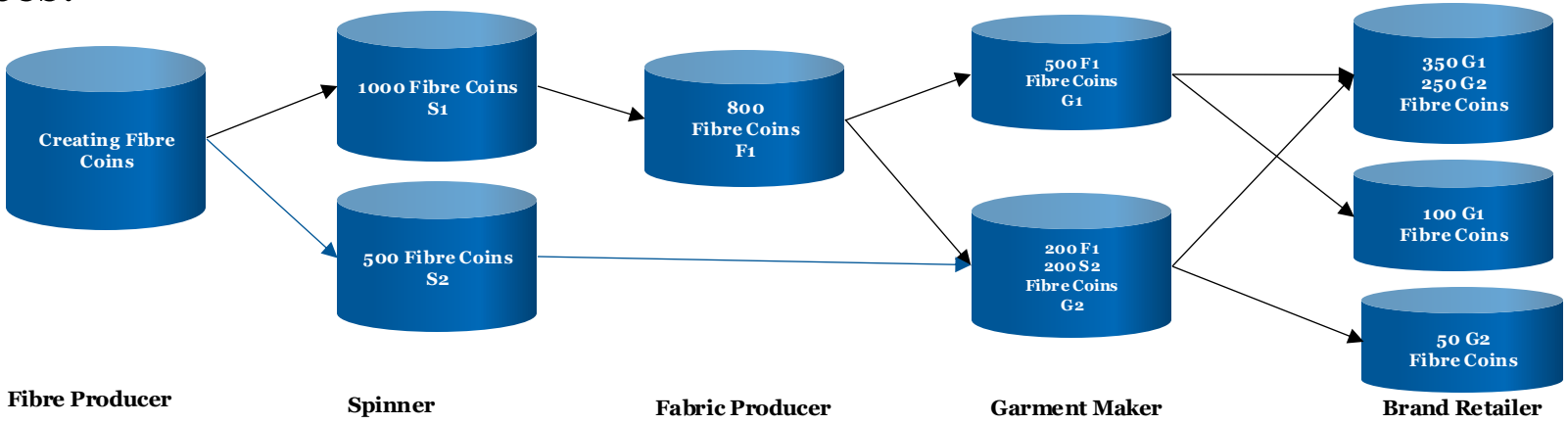
Fight counterfeiting	• Ensure product authenticity • Verify the use of sustainable fibers
Lack of traceability	• Fiber traceability • Knowledge of material flows
Lack of visibility	• Supply chain visibility and mapping
Misleading information	• Educate the customers about Lenzing sustainable fibers.



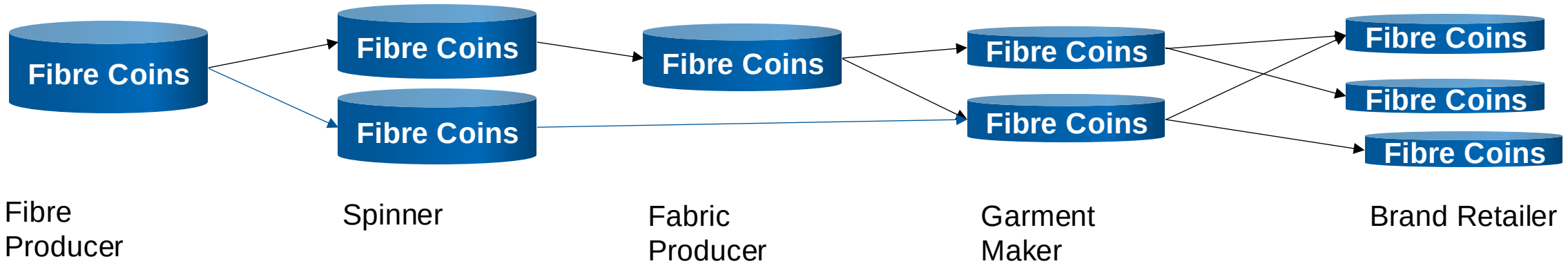
Ahmed and MacCarthy (2021)

Textile Genesis Platform – Key Features

- **Private Permissioned** Blockchain Network
- Provides **fibre-to-retail** transparency with the use of **blockchain technology** and **Fiber coins**.
- Fibre coins are only created at the fibre sources and transferred across the supply chain.
- **1 TG Fibre coin = 1 kg Lenzing fibre**.
- Fibre coins are linked to volume in invoices, purchase orders and shipment references.



Textile Genesis Platform – Key features



Example

Fibre producer produced 10 ton of fibre and created 10,000 fibercoins

6000 transferred to S1
4000 transferred to S2

S1 Received 6000 coins of fibre
S1 Inventory 2500 yarn

TG Platform also capture yarn ID, Blend ratio, waste %

Assumption: Yarn ID- 1, Blend ratio 40% of Lenzing fiber, Average waste 3%.

S1 sent 10 Ton of yarn to F1:
No of fiber coins that would be transferred = 10,000*0.4= 4000 fibercoins

Fibercoin production balance= 6000*0.97 = 5820

S1 new inventory balance = 5820+2500-4000=4320 fibercoins

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Textile Genesis Platform – Example of Platform Information

	Provided Information	Received Information
Fibre Producer	• All **outgoing** transactions (shipment ref, PO, invoice, customer name). • Fibre Type • Volume	• **All supply chain partners' name, location, and certifications.** • **Audits result across the supply chain.** • **Fibre coins inventory across the supply chain.**
Spinner	• **Incoming and Outgoing** Transactions (shipment ref, PO, invoice, customer/supplier name). • **Yarn ID.** • **Blend Ratio.** • **Volume**.	• Incoming transactions from their suppliers. • Their audit information.
Fabric Maker	• **Incoming and Outgoing** Transactions (shipment ref, PO, invoice, customer/supplier name). • **Fabric ID.** • **Blend Ratio.** • **Volume and Dimensions**.	• Incoming transactions from their suppliers. • Their audit information.
Garment Maker	• **Incoming and Outgoing** Transactions (shipment ref, PO, invoice, customer/supplier name). • **Garment ID.** • **Blend Ratio.** • **Volume and Dimensions.**	• Incoming transactions from their suppliers. • Their audit information.
Brand Retailer	• All **Incoming** Transactions (shipment ref, PO, invoice, supplier name). • **Garment ID.** • **Blend Ratio.** • **Volume and Dimensions**.	• **All network members' name, location, and certifications.** • **Materials flows in the upstream supply chain.** • **Audits result across the supply chain.**

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Key Capabilities of TG Platform

- ✓ Provides a **robust and unified** platform for all Lenzing SC partners to manage their inventory and ordering and shipment transactions.
- ✓ **Ensure Fibre Authenticity:** With the use of fibre coins, brand retailers will be assigned fibre coins for every garment product that include Lenzing fibres. Without the possession of fibre coins, brand retailers cannot claim that they provide Lenzing sustainable fibres.
- ✓ Provide Lenzing and brand retailers with **knowledge** about their supply network.
- ✓ Provide Lenzing with **Inventory Information** across the supply chain.
- ✓ Provide **an integrated** platform capturing the required **certifications** across the supply chain.

Textile Genesis Meeting Lenzing Business Needs

1. Ensure Product Authenticity

- End brands using co-branded swing tickets.
-Claiming the use of sustainable fibers

Fully Addressed

2. Fibre Supply Chain Traceability and Visibility

-Supply chain mapping.
- Materials Flows

Partially Addressed (No access to material flows).

3. Customers Education and Awareness about sustainable fibres

-Educate the customers about Lenzing sustainable fibres.

Out of Scope

Any other limitations ?

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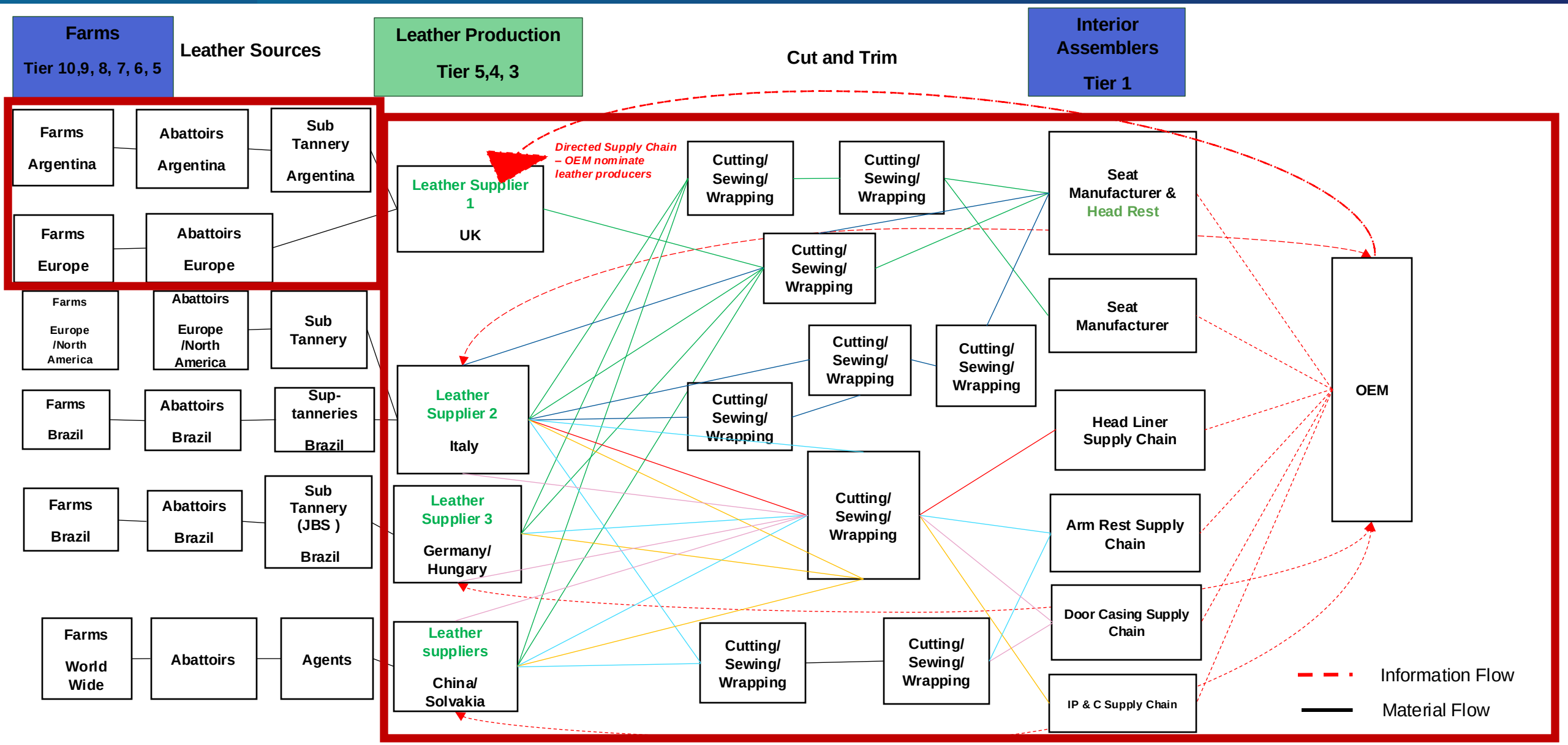
JAGUAR LAND ROVER AUTOMOTIVE PLC ANNUAL REPORT 2021/22

Automotive Leather Supply Chain

Automotive OEM Global Leather Supply Chain Map – The Traceability Challenge



Ahmed and MacCarthy (2023)

Main motivations for blockchain adoption

Identifying leather provenance	▪ Identifying the provenance of leather used in the OEM vehicles.
Compliance and sustainability	▪ Ensure leather compliance and sustainability.
Lack of visibility	▪ SC visibility and optimisation.
Customer Service	▪ Provide customers with improved options.

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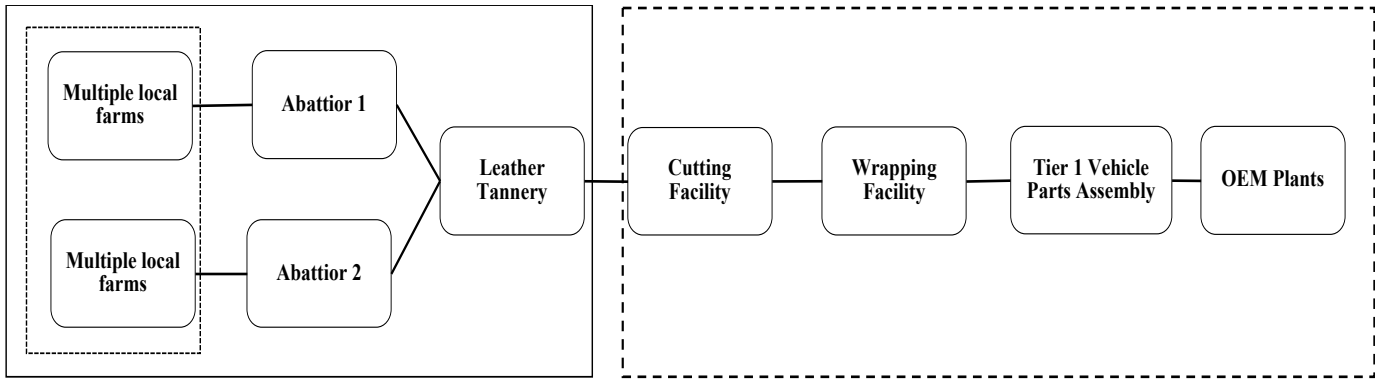
Global Automotive Leather Supply – Pilot Project

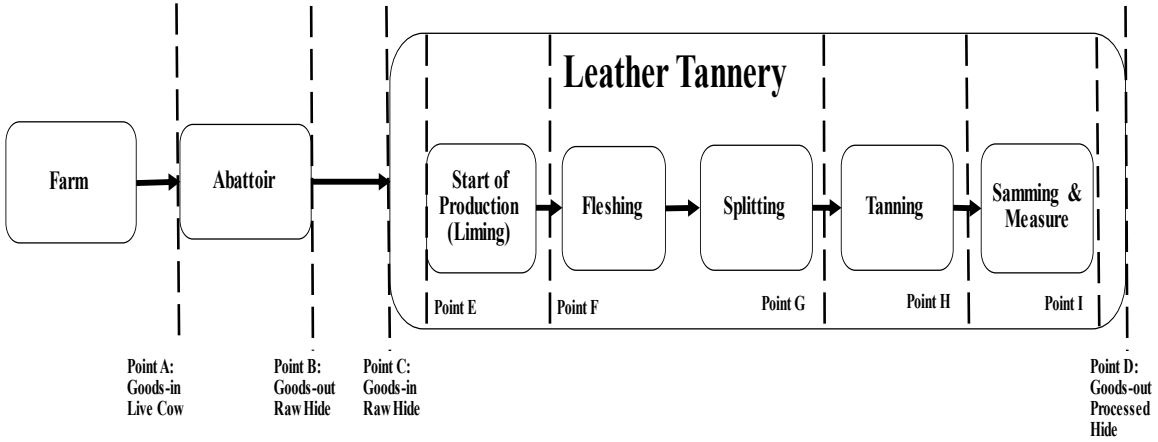


Cattle Traceability System data fed into the blockchain solution (Investigated for global leather supply chain)

Blockchain Application Area - Deployed

Blockchain Application Area - Investigated

- Engage the required SC partners
- Map the supply chain
- Identify data capture points
- Define product identification methods and linkage between the different data capture points
- Identify data requirements at each data capture point
- Identify data upload methods at the different data capture points
- Configure the blockchain platform



A

B

C

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Global Automotive Leather Supply – Pilot Project

Data Capture Point	Data Capture Identifier	Captured Information (Attributes)
1. Abattoir – Goods-in (Point A)	CTS Passport Number	Farms CTS Data including: - Producer code - Location (Area code) - Breed - Date of birth - Age - Origin - Number of movements - CO_2 emissions
2. Abattoir – Goods-out (Point B)	CTS Passport Number Slaughter Tag number	- Kill date - Kill number - Net weight - Grade - Transport ID (CO_2 emissions) -Energy use in process (CO_2 emissions)
3. Tannery – Goods-in (Point C)	CTS Passport Number Slaughter Tag number	- Date - Pack Number Market - Weight Range - Type - Origin - Preservation Method (Iced, salted, etc.) - Contracting tanning (Yes/No)
4. Tannery – Liming, Fleshing, splitting, and tanning processes (Point E, F, G & H)	Tannery Ear Tag number	- Date - Pack Number Market - Weight Range - Type - Origin - Preservation Method (Iced, salted, etc.) - Contracting tanning (Yes/No)
5. Tannery – Samming and measure (Point I)	Laser Engraving with the ear tag number	- Size (Square meter) - Grade - Weight
6. Tannery – Goods-out (Point D)	Laser engraved ID	- Transport ID (CO_2 emissions) - Customer ID - Energy use in processes (CO_2 emissions)

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Global Automotive Leather Supply – Pilot Project

Scan

Scan ID: 2839873	Scan Code: UKS83530102043
Scan Date: 13-AUG-2021 11:37:53	Scan Point: AB_100500 - Goods-in

Material Flow

Attributes

Name	Value
Age (months)	22
Breed	SMX
Date of birth	16/06/2019
Number of movements	2
Origin	SCOTCH
Postcode	PK

Scan Location

Images

Attachments

No attachments

Global Automotive Leather Supply – Argentinian Case

1. Limited / variable regulation and trusted data upstream eg no cattle passport in South America
2. Could adopt '**Trust Points**' from Tannery (ie aggregators of upstream data).... But relies on Tannery verifying and maintaining upstream provenance
3. Direction of travel towards improved traceability driven by export driven pressure
4. Would require specific technologies and Trust Point focus on key risks eg Deforestation / Animal Welfare

Leather Sources

Cutting / Sewing / Wrapping

Interior Assemblers

Other Global Leather Supply Chain

Other Leather Suppliers

Trust Point

Cutting/Sewing/Wrapping Facilities

Seat Manufacturer

Head Liner Supply Chain

Arm Rest Supply Chain

Door Casing Supply Chain

IP & C Supply Chain

Risks

- Gran Chaco Deforestation
- Animal welfare

Farms Europe

Abattiors Europe

Farms Argentina

Abattiors Argentina

Sub Tannery Las Toscas -Santa Fe Chrome (Automotive) - Argentina Crust Leather

Leather Supplier 1 UK

Trust Point

Exec Bolster Semi-Aniline

Germany Seating Semi-Aniline

Morocco Facility(90%) Seating Semi-Aniline / Tauruas

Outsourced Wrapping Facility - UK

Serbia Headrests Semi-Aniline

Poland Headrests Semi-Aniline

Seat Manufacturer & Head Rest

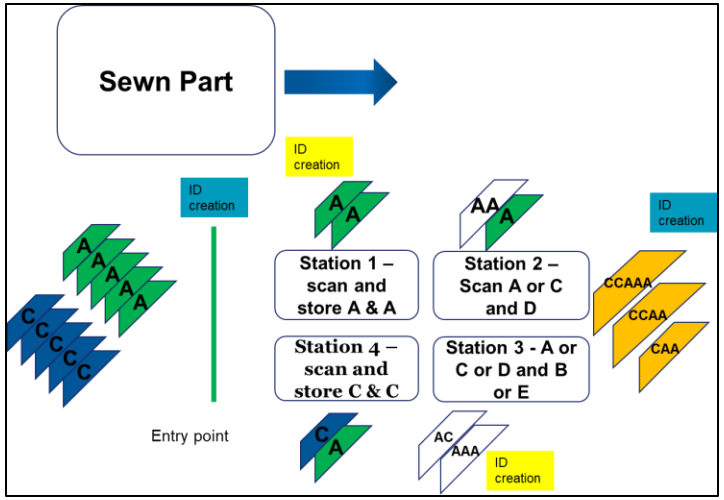
OEM

Three levels of Downstream Traceability – What is feasible?

1. Tannery level traceability is feasible with some further controls
2. Batch level traceability **requires significant control** but is feasible and *may* be beneficial
3. Hide level is **infeasible** - technologically and costs

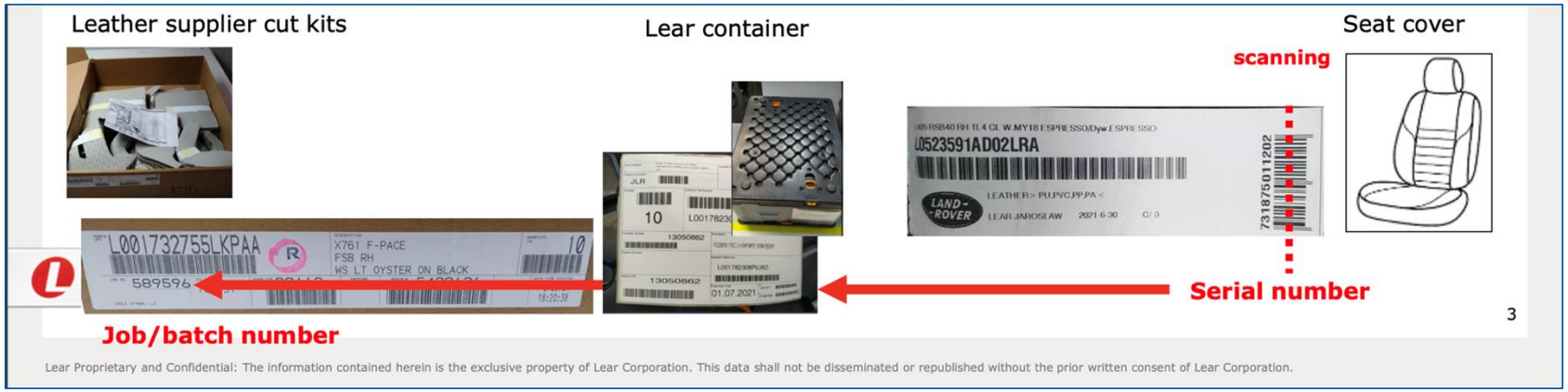
	Potential Technologies	Upstream Traceability Reqs	Downstream Traceability Req	Data Capture
Level 1: Tannery Level	Commercial Batch ID + DNA Technology	Individual hides or batches can be linked to the commercial batch ID	**Low:** More control on material flow & batch mixing. Integration with existing systems.	• Commercial Batch ID + DNA Technology • Identified check points
Level 2: Batch Level	Unique Batch ID + several DNA Technology / Laser etching/ Dot Peening etc.	Batch Traceability must be maintained from farm to finished hides	**Medium:** Require investment in scanners in each **sewing line** and more restricted material flow.	• Unique Batch ID • Beginning and end of Sewing line
Level 3: Individual Hide	Unique Hide ID + several DNA Technology / Laser etching/ Dot Peening etc.	Individual hide traceability must be maintained from farm to finished hides and cut parts	**High:** Require investment in scanners in each **sewing station** and physical examination of each hide/cut parts.	• Unique Hide ID • Each sewing station

Mixing of parts downstream significantly increases complexity for piece part tracking



Wrapped Part

1) Need to have a physical ID in the leather.
2) Scan cut/sewn part ID (QR codes/COMID)
3) Create another barcode that can be temporally attached in a visible part of the wrapped part (until the next stage).
4) Transmit data to the final seat ID and VIN



Noted in JLR's Annual Report – May 2022

HARNESSING BLOCKCHAIN TO TRACE OUR SUPPLY CHAIN

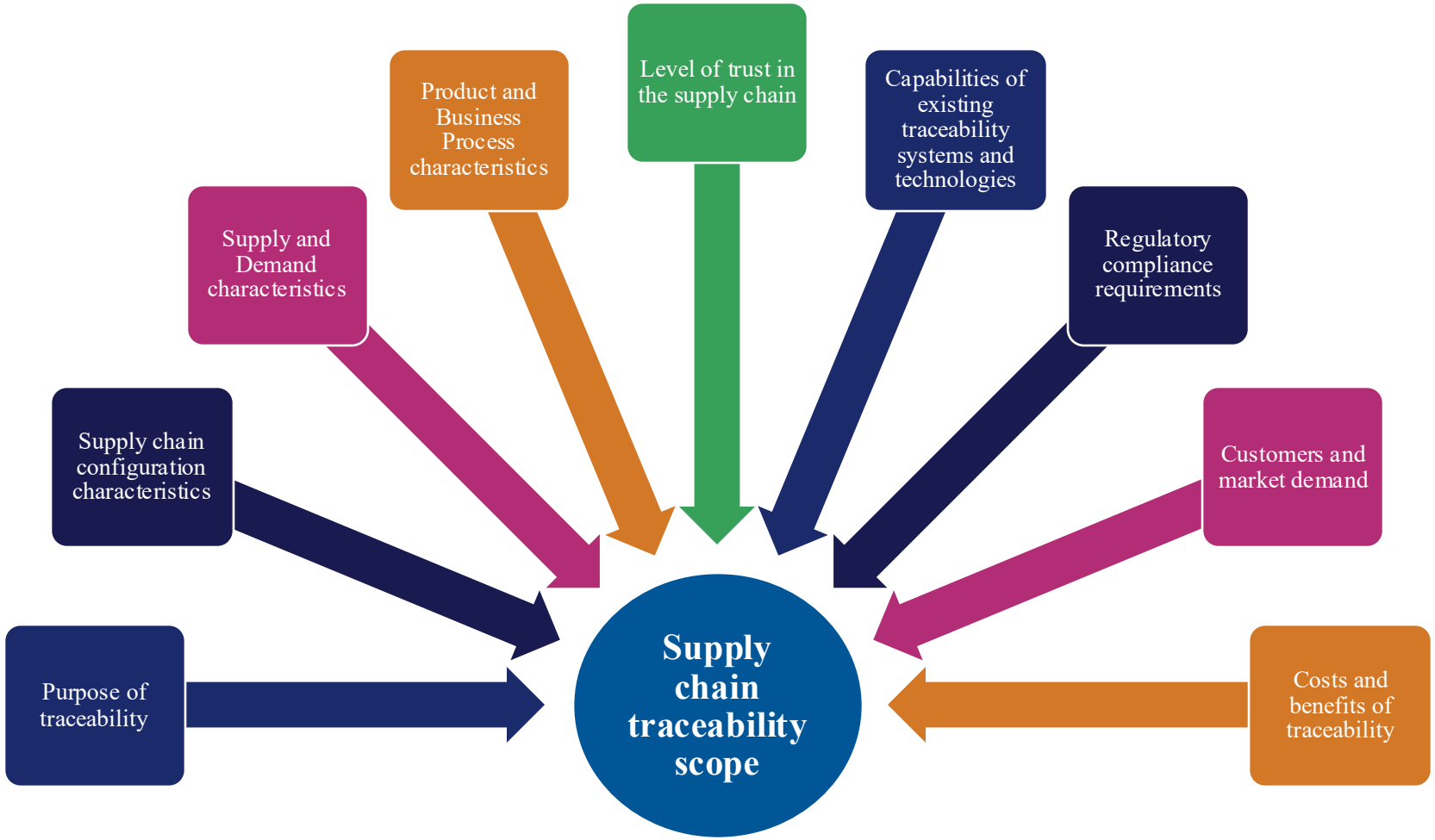
In understanding the provenance of material through our supply chain, we have partnered with blockchain technology firm Circulor, leading UK leather manufacturer Bridge of Weir Leather Company and the University of Nottingham, to prove the use of traceability technology in the leather supply chain.

A combination of GPS data, biometrics and QR codes were used to digitally verify the movement of leather at every step of the process, from farm to our own facilities.

As well as tracking compliance, the secure digital process can assess the carbon footprint of supplied materials and could be deployed to trace a range of commodities. Circulor is already using blockchain to improve the traceability of minerals used for electric vehicle batteries.

This is a key step in our journey to achieving net zero carbon across our supply chain, products and operations by 2039, enabled by leading-edge digital capabilities.

Factors influencing the scope of traceability



Ahmed and MacCarthy (2023)

Thank you for listening

Q&A