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TrainChain
Blockchain Training for Start Ups

PR1-T2 Programme

Blockchain in Supply Chain and Logistics

Author: MEAG

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1			
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1. Introduction

A blockchain supply chain can help participant's record price, date, location, quality, certification, and other relevant information to more effectively manage the supply chain. The availability of this information within blockchain can increase traceability of material supply chain, lower losses from counterfeit and gray market, improve visibility and compliance over outsourced contract manufacturing, and potentially enhance an organization's position as a leader in responsible manufacturing.

Blockchain driven innovations in the supply chain will have the potential to deliver tremendous business value by increasing supply chain transparency, reducing risk, and improving efficiency and overall supply chain management.

Blockchain can enable more transparent and accurate end-to-end tracking in the supply chain: Organizations can digitize physical assets and create a decentralized immutable record of all transactions, making it possible to track assets from production to delivery or use by end user. This increased supply chain transparency provides more visibility to both businesses and consumers.

Blockchain can drive increased supply chain transparency to help reduce fraud for high value goods such as diamonds and pharmaceutical drugs. Blockchain could help companies understand how ingredients and finished goods are passed through each subcontractor and reduce profit losses from counterfeit and gray market trading, as well as increase confidence in end-market users by reducing or eliminating the impact of counterfeit products.

Furthermore, businesses can maintain more control over outsourced contract manufacturing. Blockchain provides all parties within a respective supply chain with access to the same information, potentially reducing communication or transfer data errors. Less time can be spent validating data and more can be spent on delivering goods and services—either improving quality, reducing cost, or both.

1.1 Module Description

In this module you will learn about how blockchain technology can be applied to Supply Chain and Logistics, and is formatted as follows;

1. What is the current situation in the field and what problems do exist?
2. How can blockchain be utilized in the field? What problems would it address?
3. Real life implementations with details that the user can get inspiration from,
4. Proposed resources (where do I go from here).

1.2 Module Goals

1. Know the type of information blockchain can store and understand how this can improve Supply Chain & Logistics,
2. Understand the current obstacles to adoption,
3. Review current deployments and case studies,
4. Identify the next stages of development and roadmap for the technology,
5. Highlight emerging opportunities,
6. Refer the reader to further sources of information,
7. Estimate the time horizon for useful developments,
8. Identify the key players in the eco system,
9. Identify variations by sector, industry or geography.

1.3 Learning Objectives

Create awareness of the huge benefits using the technology and motivate learners to dig more, understand, design and apply such solutions, that will give them ways, first to survive, and then to beat unethical/illegal competition.

1. Create awareness of the benefits,
2. Highlight learnings from previous case studies,
3. Share information on the direction of the technology.

1.4 Learning Outcomes

Understand where these solutions fit in their business and what advantages they carry. To be able to analyze and design a roadmap for implementing a solution in their environment. To be able to understand the real-life scenarios vs over-promising proposals when implementing a solution with external experts.

To be able to evaluate the potential of emerging trends in this space.

2. Blockchain in Supply Chain and Logistics

2.1 State of the Art: Current situation and existing Problems

Supply Chain introduction

One of the key reference models for supply chain is the Supply Chain Operations Reference (SCOR) model developed by the Association for Supply Chain Management (APICS). This model identifies the six primary supply chain processes as:

Plan

The Plan processes describe the activities associated with developing plans to operate the supply chain. These include determining requirements, gathering information about available resources, balancing requirements and resources to determine planned capabilities and gaps in demand or resources, and identifying actions to correct these gaps.

Source

The Source processes describe the activities associated with ordering, delivery, receipt and transfer of raw material items, subassemblies, products or services. These include issuing purchase orders, scheduling deliveries, receiving orders, validating orders, storing goods and accepting suppliers' invoices. With the exception of sourcing engineer-to-order goods or services, all supplier identification, qualification and contract negotiation processes are not included in the Source process elements. Instead, see ASCM DCOR.

Make

The Make processes describe the activities associated with the conversion of materials or the creation of content for services. These include assembly, chemical processing, maintenance, repair, overhaul, recycling, refurbishment, manufacturing and other common types of material-conversion processes.

Deliver

The Deliver processes describe the activities associated with the creation, maintenance and fulfillment of customer orders. These include receiving, validating and creating customer orders; scheduling order deliveries; picking, packing and shipping; and invoicing customers.

Return

The Return processes describe the activities associated with the reverse flow of goods. These include identifying items that need to be returned, deciding on the proper method of disposition, scheduling the return, and shipping and receiving returned goods. Repair, recycling, refurbishment and remanufacturing processes are not described using Return process elements. Instead, see Make.

Enable

The Enable processes describe the activities associated with the management of the supply chain. These include business rules management, performance management, data management, resource management, facilities management, contract management, supply chain network management, regulatory compliance management, risk management and supply chain procurement.

Logistics introduction

Logistics is a fundamental part of supply chain management. It consists of the organisation and management of flows of goods related to purchasing,

production, warehousing, distribution and the disposal, reuse and exchange of products, as well as the provision of added value services.

Blockchain introduction

Blockchain is a distributed ledger technology. The updates to the ledger are applied by distributed nodes. When the updates in a block on the chain are accepted by a majority of all the nodes on the chain that block is committed to the chain and cannot be modified. The consensus algorithm that determines the majority of nodes varies from blockchain to blockchain.

The nodes are independent and therefore the control of the chain is decentralised.

There are two leading models for validating a block in the chain, proof of work and proof of stake, however a number of other models exist.

Blockchain technologies can be permissioned based or permissionless, a permissioned based blockchain provides additional controls over read and write access to data.

Emerging Trends in Blockchain

There is a trend towards proof of stake deployments in blockchain to reduce the carbon emissions associated with proof of work.

The concept of side chains has been adopted to provide flexibility for specific purposes that the supporting blockchain does not. A side chain consists of a blockchain which at various intervals is interleaved with a parent blockchain. This allows the parent blockchain to be used to validate all of the blocks on the side chain up to the point of each interleaf with the parent chain. The side chain will have its own validation nodes and consensus method.

Layer 2 blockchains, are being developed which interact with Layer 1 blockchains such as Bitcoin and Ethereum. The Layer 2 blockchains have channels or bridges to

the Layer 1 blockchains which allow the transactions (summary) on the Layer 2 blockchain to be validated by the Layer 1 blockchain.

Smart Contracts on the blockchain allow the issue of tokens from those contracts. Tokens differ from cryptocurrencies primarily because a cryptocurrency is built into the native protocol of the supporting blockchain, while tokens are dependent on the smart contracts running on the supporting blockchain.

Blockchain Standards

Progress with standards in the blockchain field as it applies to Supply Chain and logistics

Blockchain in Transport Alliance (BITA)

Barriers to the deployment of Blockchain in Supply Chain

The following issues are slowing down the adoption of blockchain for use in supply chains:

Environmental and Climate Impact.

There is a growing concern over the environmental and climate impact of blockchain technologies. The proof of work-based protocols requires nodes to execute complex mathematical operations to validate the blocks on the chain. The execution of the mathematical operations on the node consumes electrical energy which must be generated in the region that the node resides, in many cases this energy is from nonrenewable sources leading to blockchain contributing to climate change. The transition to proof of stake-based protocols is promoted as a solution to this problem.

Lack of standardization

There are many competing blockchain technologies and even more solutions based on some of the well-known Layer 1 blockchains. The fact that there is not a

clear leader in the field may slow down the adoption of the technologies by risk adverse organisations, who may wait until the market has matured.

Reputation of technology

The most widely known application of blockchain technology is the cryptocurrency called Bitcoin. There have been a number of widely reported issues related to bitcoin that have been damaging to the reputation of blockchain as a technology. The examples of the issues are:

Usage of bitcoin as a payment mechanism for criminal enterprises due to the lack of traceability. Most ransomware attacks request payment in bitcoin and internet based black markets such as the widely reported Silk Road market use bitcoin as a payment mechanism.

Pump and dump based investments. There have been numerous cases of new blockchains or blockchain tokens being launched with no clear function other than to attract investors at the initial launch and subsequent to the launch the founders have withdrawn the funds from the project.

Volatility of cryptocurrency investments. Cryptocurrencies based on blockchain technology have been the target of speculative investment worldwide for the past decade. These investments have been highly volatile with significant wins and losses being recorded by investors.

Stability of the technology

There have been a number of cases where technologies supporting the blockchains have been hacked leading to concerns over the security of blockchain. In particular cryptocurrency wallets and cryptocurrency exchanges have been the targets of these attacks. In most cases the underlying blockchain protocols have proven to be robust.

Legal certainty

Blockchain technologies have existed for the last decade, the legal frameworks and case law to support organisations who are adopting them for business processes is still taking shape. The lack of clear frameworks and legal precedent will reduce the adoption of the technology in certain fields and geographies.

Key Players

The case studies examined in this research indicate that the two prevalent solutions for blockchain based supply chain solutions are HyperLedger and Ethereum. This is consistent with other research finds such as *[Lohmer, da Silva, Lasch]*.

Industry / Sectoral Variations

Highlight industries or sectors that are at varying states of adoption.

2.2 How can blockchain be utilized in Supply Chain?

In this section we will examine the characteristics of blockchain that make it useful in Supply Chain and Logistic use cases. We will then explore how those characteristics enable functionality that is useful to supply chain and logistics processes.

Information Sharing

The distributed nature of blockchain technology acts as a mechanism to make the information on the blockchain available to all nodes with access to the blockchain. This is useful in supply chain and logistics as when a block containing information is committed to the chain that information is immediately available to all other nodes. This can allow verifiable information to be disseminated between parties participating in a supply chain or logistics process.

Traceability

One of the primary characteristics of blockchain technology is that when a block is committed to the chain, that block and the preceding blocks on the chain cannot be altered. This gives rise to the immutability of the information on the blockchain. The benefit of this in supply chain use cases is that once information is committed to the blockchain it is retained forever and can be verified in its original state. This is helpful in cases where traceability or verification of data is required.

Transparency

The accessibility of information that is stored on the blockchain to all parties brings transparency to processes that are built using blockchain. Each party can independently access the data and confirm the details of a transaction. This reduces the opportunity for a party in a supply chain or logistics process to hide

information that would have an adversely impact on them or compromise another party's interests. The accessibility of the information can be controlled on blockchains that provide a permissions model which determines who has access to what data.

Efficiency

As more and more processes are digitialised the fast and efficient flow of information between parties is becoming a necessity. Blockchain technologies support this by facilitating the transmission of data efficiently. When one party uploads information on the chain and the block containing that data is verified and committed to the chain the data is available to all other parties accessing the chain to feed into their digital processes.

Quick Updates

The online nature of the blockchain allows updates to be applied to the blockchain in near real time, subject to the consensus algorithm of the blockchain. This is a significant benefit over processes when a centralised party may need to accept data and perform a verification process before publishing it to all interested parties.

Disintermediation

The ability for participants on the blockchain to collaborate directly gives rise to the concept of disintermediation. This is where one or more intermediate parties are removed from a business process, for example if the blockchain is trusted to verify that a document is authentic then a third party is no longer required to validate this information. This allows processes in a supply chain to be more efficient as less parties are involved.

Trust

The decentralised control that the blockchain protocols provide allow all parties to trust the information stored on the blockchain. The information uploaded to the blockchain is the record that has been agreed by the consensus protocol that the blockchain uses to commit blocks to the chain. Any node using the blockchain can then download a block and be guaranteed that the information in that block is the verified record of transactions on the chain. This is of benefit to supply chain and logistics processes where otherwise a central third party may need to be consulted in order to verify information.

Security and Privacy

Confidentiality, integrity and availability of data are the three key tenets of information security. Blockchain protocols fundamental strength is in protecting the integrity of data stored on the blockchain, once a block is verified and committed to the chain it can no longer be changed or damaged in anyway, hence protecting the integrity of that data.

The availability of data on the blockchain is protected through the distributed nature of the nodes on the chain. The blockchain is not dependent on any single central point whose failure would make the data unavailable. If the nodes are distributed across the world than the blockchain would be resilient to even a large geographic outage of nodes.

Confidentiality can be maintained on blockchains which support permissions based models.

Immutability

The immutable nature of the data on the blockchain and the accessible record that it creates is of benefit in verifying compliance across supply chain and logistics processes. The data can be verified by each party in the process as well as any legal or regulatory body who has a need to verify and access that data.

Verified Transactions

In supply chain processes it is often necessary to verify that a party has completed a task at a particular time or to a particular standard. The blockchain protocols can support this by allowing the party to submit information to the blockchain that confirms the completion of an activity. This information is then distributed to all other nodes on the blockchain and cannot be repudiated by the original party.

Scalability

Most blockchain protocols are designed to support vast numbers of nodes attached to the chain. This allows for the processes supported by the blockchain to scale to hundreds of millions of nodes and billions of transactions. The fact that a centralised node is not responsible for validating each node or transaction means that the blockchain does not have an inherent bottle-neck that would limit the processes that are supported by it.

Smart Contracts

Certain blockchain technologies support smart contracts. Smart Contracts consist of software logic that is executed on the blockchain. Smart Contracts can complete tasks such as the transfer of cryptocurrency from one account to another when a particular trigger occurs. The use of Smart Contracts can automate tasks within a supply chain which previously would have required external intervention, for example triggering payment when a shipment arrives at a particular location.

2.3 What opportunities does blockchain provide in Supply Chain and Logistics?

The previous section examined how specific characteristics of blockchain enabled functionality that was of value in Supply Chain and Logistics processes. In this section examples will be provided of the opportunities created by this functionality and how it can be combined with other technologies to bring value to existing supply chain and logistics processes.

The supporting technologies to blockchain are, automatic identification, robotics, cloud computing, internet of things (IOT) and Artificial Intelligence. Each of these technologies brings a capability that when combined with blockchain can enhance the digitilisation of processes. These technologies are briefly introduced here.

Automatic Identification technologies allow a computer system to recognise an object in the physical world and trigger an action in the digital world. Examples of automatic identification technologies are barcodes, RFID (Radio Frequency Identification) tags, QR (Quick Response) codes.

Robots are automated machines capable of interacting with the physical world independently and performing complex actions. The capabilities and complexity of robots are continuously improving and are already deployed extensively throughout the Supply Chain and Logistics processes.

Cloud computing is a model of information processing where computing resources are pooled and their processing capabilities are shared between users accessing the system remotely over the internet. There are many types of cloud computing deployments, however one of the key benefits is the democratisation of access to complex computing capabilities such as artificial intelligence. This allows both small and large businesses to have access to advanced technologies at an affordable price.

The Internet of things (IOT) is the name applied to a computing model where devices of all types are provided with a network connection and attached to the internet. In effect this means that objects such as ships, robots, trucks, lights and sensors can be attached to the internet and send and receive information in real time. This facilitates automation of processes and speeds up the availability of reporting and consequent decision making.

The goal Artificial Intelligence is to create a machine capable of acting intelligently. There are many sub fields within artificial intelligence focused on areas such as computer vision and machine learning. While a general-purpose artificial intelligence has so far not been achieved, there have been significant successes in particular fields. The result of this is that computer systems now have very sophisticated pattern matching and prediction capabilities that can be deployed to improve business processes.

The following examples demonstrate where the capabilities of blockchain technologies can be applied to supply chain and logistics to create opportunities to add value or overcome existing challenges:

Opportunities for Compliance and Traceability Improvements:

Blockchain has the potential to improve compliance in industry by creating a shared, immutable database of transactions. A blockchain solution could be created where the movements of materials are automatically timestamped and recorded using RFID tracking and IOT devices and uploaded to the blockchain. It is conceivable that in more sophisticated industries that certificates of analysis or other relevant information could be attached to those records for later verification. This type of solution has value for proving environmental compliance, food traceability or forward tracing for disposal of waste material. The solution could also be deployed in circular economy use cases tracing the full life cycle of materials.

Opportunities for Reduced Transaction Costs:

Smart Contracts on the blockchain provide the opportunity for reduced transaction costs by eliminating manual intervention or processing during logistics activities. For example with the integration of IOT devices into the shipping process a carrier could be automatically penalised for transit delays. The IOT sensor in the shipping container could update its location and it a particular milestone is not met on the shipping journey a smart contract can be triggered to execute and incur a financial penalty on the carrier. Without the presence of an automated solution manual effort is required to invoice the carrier and seek settlement.

Opportunities for Collaboration, Transparency and Disintermediation

The distributed trust model of blockchain will create opportunities for parties to work directly where previously intermediate parties would have been required due to lack of trust or for verification. A blockchain solution could be created where parties are verified centrally and then given access to an industry wide blockchain. All further activity between the parties can be direct as the identity of the party uploading information to the blockchain can be trusted and the activities recorded by that party on the blockchain are verified and immutable. If the underlying blockchain technology supports smart contracts than the logic of the contracts can be automatically executed without any third-party involvement. The blockchain can also support making information widely available across this industry, for example a manufacturer's environmental compliance record.

Opportunities for Digitalisation and Automation of Processes

As the use of technology pervades Supply Chain and Logistics processes the blockchain can be used as bridge to link each stage in a supply chain. A solution could be derived where a raw material manufacturer uploads information to the blockchain on batches of raw materials as the robotic forklifts load the material onto autonomous trucks. While this shipment is transported to its destination the

laboratory analysis of the product during its manufacture is appended to the record of the material on the blockchain allowing the receiving party to adjust the planning system in the receiving factory. The shipment can be tracked on its journey to the factory and on delivery the product is received into stock and a smart contract executes to transfer the funds for the delivery. As more parts of the supply chain are automated with robotics the blockchain can provide a verifiable record and timestamp of activities.

2.4 Real life implementations with details.

Walmart Canada

Project	Walmart Canada
Lead Parties	Walmart DLTLabs
Industry	Retail / Logistics
Geography	Canada
Blockchain Technology	HyperLedger Fabric
Public / Private	Private
Active / Complete	Active
Summary	
Further Reading	https://www.hyperledger.org/learn/publications/dltlabs-case-study

Chronicled / Mediledger

Project	Chronicled / Mediledger
Lead Parties	
Industry	Medical
Geography	USA
Blockchain Technology	Parity Substrate
Consensus Algorithm	Zero Knowledge Proof
Public / Private	Private
Permissions Model	Permissioned
Active / Complete	Active

Summary	The MediLedger Network combines a secure peer-to-peer messaging network and a decentralized blockchain network to connect trading partners. MediLedger was launched in 2017 to understand how blockchain, emerging at the time for enterprise use, could benefit the US Life Science industry.
Further Reading	https://www.u4.no/publications/safeguarding-the-covid-19-vaccine-distribution-evaluating-the-role-of-blockchain.pdf https://substrate.io/ecosystem/projects/

PharmaLedger

Project	PharmaLedger
Lead Parties	Consortium of 29 leading Pharmaceutical Companies
Industry	Healthcare
Geography	Europe
Blockchain Technology	Multiple including HyperLedger Fabric and ConsenSys Quorum
Public / Private	Private
Permissions Model	Permissioned
Active / Complete	Active Research / Pilot
Summary	The vision for the PharmaLedger project is to create a scalable blockchain platform validated through reference use cases in supply chain, clinical trials and health data that will serve trendsetters in the industry, thus enabling early adopters.

	Sponsored by the Innovative Medicines Initiative (IMI) and the European Federation of Pharmaceutical Industries and Associations (EFPIA) under the Horizon 2020 programme, PharmaLedger is a 36 month project that brings together 12 global pharmaceutical companies and 17 public and private entities. The project is due to conclude at the end of 2022. The goal of the project is to provide a widely trusted platform that supports the design and adoption of blockchain-enabled healthcare solutions while accelerating delivery of innovation that benefits the entire ecosystem, from manufacturers to patients. One example use case is electronic product information (ePI), the objective is to digitise the product information sheets contained in medicine boxes. Patients could access ePI via a mobile app by scanning a medicine pack's barcode. The app can show valuable updates about batch recalls, the expiry date, or even counterfeit checks to verify that the given medicine is authentic.
Further Reading	https://pharmaledger.eu/

Project	Provenance.org
Lead Parties	
Industry	Sustainability Marketing Technology
Geography	Europe
Blockchain Technology	Ethereum
Consensus Algorithm	
Public / Private	
Membership	
Permissions Model	
Active / Complete	Active
Summary	
Further Reading	

SkuChain

Project	SkuChain
Lead Parties	
Industry	Supply Chain Finance
Geography	
Blockchain Technology	HyperLedger Fabric
Public / Private	
Permissions Model	
Active / Complete	
Summary	The SkuChain Currency Agnostic Blockchain links procurement and contract management, financing arrangements, direct enterprise control of corporate payments and inventory tracking in a buildable manner. SkuChain have deployed solutions across the aerospace, automotive, energy, electronics, mining

	and minerals, food and agriculture, financial services, insurance and commodities industries. SkuChain addresses supply chain problems including: Visibility: with secure data sharing with field-level encryption SkuChain customers have the ability to gather data and track inventory across multiple supply chain tiers, enhancing control over production schedules and the origin and quality of raw materials. Cash Flow: Scaling Inventory Control & Finance (ICF), marine and cargo insurance and credit insurance opportunities on the blockchain, SkuChain provides suppliers working capital relief and cash flow at the strongest cost of capital in the supply chain. Buyers in turn mitigate supplier risk, inject liquidity into their supply chain and lower the cost of goods. JIT Flexibility: SkuChain Popcodes and Brackets smart contracts application technologies are integrated through the blockchain to coordinate inventory movement and supply chain transactions, preventing buildup of excess inventory in warehouses and on balance sheets.
Further Reading	https://www.skuchain.com/

TradeLens

Project	TradeLens

Lead Parties	Maersk
Industry	Logistics
Geography	Global
Blockchain Technology	IBM Blockchain
Public / Private	
Permissions Model	Permissioned
Active / Complete	Active
Summary	The TradeLens platform has been jointly developed by Maersk and IBM and is supported by major carriers covering more than 60% of global containerized trade. TradeLens is an open and neutral industry platform underpinned by blockchain technology, supported by major players across the global shipping industry. The platform promotes the efficient, transparent and secure exchange of information in order to foster greater collaboration and trust across the global supply chain. TradeLens data is published directly from the source so the right people can securely manage their supply chain in real-time. TradeLens breaks down longstanding data and processing silos that exist among trading partners and simplifies the flow of documentation that accompanies every shipment TradeLens can be understood in three components: The Ecosystem, the Platform, and the Applications and Services Marketplace. Each part plays a distinct role in allowing

	TradeLens members to derive the most value for their businesses. An open Applications and Services Marketplace allows both TradeLens and third parties to publish fit-for-purpose services atop the TradeLens platform, fostering supply chain innovation and value creation. The TradeLens Platform is accessible via an open API and brings together the ecosystem through a set of open standards. Powered by Hyperledger Fabric blockchain technology and IBM Cloud, the platform enables the industry to share information and collaborate securely. The foundation of TradeLens is its business network: shippers, freight forwarders, ports and terminals, ocean carriers, government authorities, customs brokers and more. Each entity shares information that can be tracked, stored and actioned across the platform throughout a shipment's journey.
Further Reading	https://www.maersk.com/~/media_sc9/maersk/solutions/digital-solutions/global-tradelens/tradelens_solution_brief.pdf

Vinturas

Project	Vinturas
Lead Parties	Axess Logistics, NVD, Koopman Logistics Group and Autolink Group
Industry	Automotive
Geography	Europe
Blockchain Technology	IBM Blockchain

Public / Private	
Permissions Model	
Active / Complete	Active
Summary	Vinturas has developed a blockchain digital network solution for the global Finished Vehicle industry. It provides a solution for safe sharing of logistics and technical data within the global Finished Vehicle eco system. The benefit of the system is to bring transparency as the finished vehicle moves through the stages from manufacturer to customer such as logistics and customs. The customer benefits from real time information on tracking and manufacturers benefit through greater visibility on logistics which improves planning.
Further Reading	https://www.vinturas.com/ https://www.ibm.com/blogs/client-voices/blockchain-brings-visibility-to-finished-vehicle-supply-chain/

Origin Trail

Project	Origin Trail
Lead Parties	
Industry	
Geography	Europe

Blockchain Technology	
Public / Private	
Permissions Model	
Active / Complete	Active
Summary	Powered by various EU funding instruments, European agriculture is on its way to become smarter, more efficient, and more sustainable through continuous digital innovation and research. As part of this digital agricultural revolution, the OriginTrail protocol is supporting several trusted agri-food supply chain solutions within Europe-wide research and innovation consortia like SmartAgriHubs, DEMETER, and The Food Safety Market (TheFSM). SmartAgriHubs is a Europe-wide project aimed at the digital transformation of European agriculture through the fostering of an agricultural innovation ecosystem dedicated to excellence, sustainability, and success. It is funded by the European Union with EUR 20 million and brings together a consortium of more than 160 partners. The OriginTrail protocol is a part of the flagship innovation experiment for the traceability of organic dairy and poultry supply chains, bringing new digital solutions to the market. DEMETER is leading the digital transformation of Europe's agri-food sector through the rapid adoption of advanced IoT technologies, data science, and smart farming, ensuring its long-term viability and sustainability. It brings together 60 partners from 18 European countries and is funded by the European

	Union with EUR 15 million. The OriginTrail protocol is enabling trusted product passports for food products in poultry and wine supply chains and is supporting the Demeter platform interoperability. TheFSM project is developing an industrial data platform to give a digital boost to the way food certification takes place in Europe. It builds on the power of big data and state-of-the-art blockchain technologies to create an open and collaborative virtual environment that facilitates the exchange and connection of data between different food safety actors interested in sharing information that is critical to certification. Bringing together 11 partners from eight EU countries, the project will conduct extensive piloting with European providers of inspection and certification services. The project has a budget of EUR 6.5 million. The OriginTrail protocol is enabling trusted and secure data exchange within the platform to help create a transparent, data-powered certification ecosystem for safe food supply chains.
Further Reading	https://origintrail.io/ https://origintrail.io/case-studies/sustainable-agriculture

Project	EverLedger
Lead Parties	
Industry	Transparency in Global Supply Chains
Geography	
Blockchain Technology	IBM Blockchain (HyperLedger Fabric)
Public / Private	
Permissions Model	
Active / Complete	Active
Summary	Everledger is the digital transparency company, providing technology solutions to increase transparency in global supply chains. Everledger's platform is built on the fundamentals of private blockchains, where firms need the ability to share data securely and apply smart contracts, while also retaining privacy. Data is divided into privacy tiers, so a stakeholder can withhold sensitive data attributes, while allowing transparency on others. Everledger provides solutions for a number of industries including art, battery, fashion, wine, and the diamond industry. For example in the diamond industry Everledger,s capture solution leverages blockchain and IoT so that manufacturers, certification houses, and retailers can evidence the origin, ownership, and characteristics of the products and materials they trade. With access to an asset's provenance record from any device, Everledger Capture enables everyone along the supply chain to build more trust in their business. Today retailers use it to discover assets such as diamonds by origin,

	environmental performance, and legal chain-of-custody (criteria previously inaccessible at scale for diamond buyers).
Further Reading	https://everledger.io/

Banqu

Project	Banqu
Lead Parties	Coca Cola
Industry	Circular Economy
Geography	South Africa
Blockchain Technology	Ethereum
Public / Private	
Permissions Model	
Active / Complete	Active
Summary	BanQu provides a blockchain platform to enhance supply chain traceability and equitability. The platform has been deployed in a number of projects in Africa, Latin America and Asia. One specific example is a project in collaboration with Coca-Cola in South Africa to provide traceability for packaging. Waste collectors register with BanQu and have a verifiable record of their transactions with buy back centres when collecting waste packaging. The transparency and permanent record of the transaction benefits both the individual waste collectors and Coca-Cola. The benefit to the waste collector includes a verifiable record of their

	earnings as many of these individuals do not have a bank account. The benefit to Coca-Cola is the evidence of the source of the materials being recycled. In addition to this project Coca-Cola have other blockchain based Environmental,Social and Governance (ESG) initiatives including a project with Diginex to monitor working conditions in their supply chain.
Further Reading	https://banqu.co/use-cases/optimizing-the-circular-economy-coca-cola-and-banqu/ https://ellenmacarthurfoundation.org/tech-enablers-series/part-2

Circularise

Project	Circularise
Lead Parties	Porsche, Circularise
Industry	Supply Chain Transparency – Digital Twins
Geography	Europe
Blockchain Technology	Ethereum
Public / Private	
Permissions Model	
Active / Complete	Pilot
Summary	Circularise and Porsche collaborated on a proof of concept project for Supply Chain visibility. The project

	was able to provide traceability in a number of specific case for plastics from raw material production through to the final car. This contributes to allowing Porsche to provide certified sustainability information to the final customer for the car. The customer has access to a digital twin of the material int the car to know how it was produced and used. A digital twin is created on the blockchain for each sustainably produced batch of material produced by the suppliers who participated in the pilot. The digital twin stores the relevant information on the batch of material including its environmental footprint and origin. The digital twin is updated as the material passes through the manufacturing process.
Further reading	https://www.circularise.com/ https://ellenmacarthurfoundation.org/tech-enablers-series/part-2 https://www.youtube.com/watch?v=tvHD53zvyvM&t=2s

3. Knowledge Assessment

Quiz-like assessment based on the main content. Please mark the correct answer with bold when required. Include at least 5 questions for your module. Increase gradually the level of difficulty.

Examples:

Question 1(multiple choice or true/false): text
[answer 1] [**correct answer**] [answer 3]
[generic feedback]: text

Question 2 (multiple answers correct): text
[**correct answer**] [**correct answer**] [answer 3] [answer 4]
[generic feedback]: text
Question 3 (matching): Match the terms with their definitions.
Term 1 name: Definition
Term 2 name: Definition
Term 3 name: Definition
Term 4 name: Definition
Term 5 name: Definition
[generic feedback]: text

Question 4 (matching): Match the concepts with their explanations.
Concept 1 name: Explanation
Concept 2 name: Explanation
Concept 3 name: Explanation
Concept 4 name: Explanation
Concept 5 name: Explanation
[generic feedback]: text

Question 5 (matching): Match the problems with their solutions.
Problem 1 name: Solution
Problem 1 name: Solution
Problem 1 name: Solution
Problem 1 name: Solution
Problem 1 name: Solution
[generic feedback]: text

4. Module Summary

Write down a 5-line summary of your module. You can include bullet points with the key aspects of your main content.

5. References

Please use APA Style to write down your references. For example:

Friis Dam, R., & Yu Siang, T. (2021, January 2). 5 Stages in the Design Thinking Process. Retrieved from Interaction Design Foundation: https://www.interaction-design.org/literature/article/5-stages-in-the-design-thinking-process

MyComputerCareer. (2021, October). MyComputerCareer - Training for a better life. Retrieved from The Rise of Hybrid Jobs and Hybrid Skills: https://www.mycomputercareer.edu/news/the-rise-of-hybrid-jobs-and-hybrid-skills/