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Blockchain application in product quality assurance

Bachelor Thesis

by

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ABSTRACT

This thesis explores the implementation of blockchain technology in supply chain management, with a focus on its potential to enhance efficiency, transparency, and trust. The study begins with an overview of the current challenges in supply chain management and international trade, such as lack of visibility and trust, and how blockchain can address these challenges. The research specifically examines the potential applications in Free trade agreements including trade dispute settlement and issuance.

By using qualitative research method, the study is based on official documents, practical handouts, and empirical studies that recommend or focus on the application of blockchain in supply chain management and international trade. The findings and analysis recommended that the technology so called “blockchain” offers reducing supply chain flow time, trade disputes settlement simplicity, and amplify transparency and traceability in the supply chain and international trade.

However, given that blockchain may decrease the significance of many large global corporations, institutions, and power structures that have a keen interest in preserving established hierarchies, its potential may remain unexploited. Overall, this study helps to introduce the ongoing discourse on the transformative potential of blockchain technology in supply chain management and provides insights on how to leverage blockchain, including Certificate of Origin, to improve supply chain operations.

Keywords Blockchain • Distributed Ledger • Supply Chain • International Trade • Certificate of Origin

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I hereby affirm in lieu of an oath that I provided the submitted bachelor thesis

I did not use any sources other than those stated. In case that the work is additionally submitted on a data medium, I declare that the written and the electronic form are completely identical. The work was not submitted in the same or similar form to any examination authority.

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Place, Date	

LIST OF ABBREVIATIONS

COO - Certificate of Origin
RFID - Radio Frequency Identification Device
ROO - Rules of Origin
HS - Harmonized System
GS1 - Global Standards
WTO - World Trade Organization
EPA - Economic Partnership Agreement
FTA - Free Trade Agreement
GTIN - Global Trade Item Number
FOB - Free on Board
QVC - Qualifying Value Content

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1 INTRODUCTION

1.1 The objective of the study

The main aim of this study is to examine the application of blockchain technology, a novel advancement in supply chain management, with a specific focus on identifying opportunities for improvement and developing strategies to enhance the efficiency of its use, particularly in dispute management. This research combines two crucial and interdisciplinary subjects in modern business and the economy: supply chain management and blockchain technology.

From the very beginning of obtaining raw materials to the last customer connection, supply chain management includes the coordination of multiple actions and resources essential in the production and delivery of a product or service to the ultimate consumer. Supply chain management requires careful planning, coordination, and communication between all parties involved as well as the use of modern technology and analytical tools to increase operational effectiveness and decision-making quality.

Conversely, blockchain technology is a decentralized, distributed ledger technology that makes it possible to record and authenticate transactions without the need for a central authority. Supply chain management is one of the many applications that it is a good option for because to its inherent high security feature and resilience against fraud and hacking. The research reflects the potential application of the 'Certificate of Origin', a principal document proposed by the World Trade Organization (2013) for settling international trade disputes.

1.2 Research questions

The study aims to explore the potential of utilizing blockchain technology in supply chain management and seeks to provide answers to the following questions:

1. What could be the potential applications of the concept in supply chain management?
2. *How much time can be saved if one uses blockchain to reassure the origin of goods?*
3. *How can blockchain technology enhance the efficiency and security of the Certificate of Origin process?*

1.3 The theoretical background

This thesis's main goal is to give a comprehensive theoretical background on the use of blockchain technology in supply chain management, with a increased focus on the use of blockchain to enhance the Certificate of Origin process in supply chain and international trade. The theoretical framework of this study is based on the following three key concepts:

First and foremost, the concept "**supply chain**" refers to the entire network of organizations, people, actions, and assets used in the production and distribution of goods and services to clients. The supply chain encompasses processes from the extraction of raw materials to the manufacturing of products, to the transportation and delivery of finished goods. Effective supply chain management involves coordinating all the activities and resources involved in the process, from procurement and logistics to quality control and customer service, to maximize efficiency and minimize costs while still delivering high-quality products or services. Chopra and Meindl (2001) define a generic supply chain within the context of the total supply chain network, and it says that each firm belongs to at least one supply chain. Furthermore, Ashish Kumar Gautam and Dr. Raj Kiran Prabhakar (2019)[1] conducted the literature review on theories of supply chain and underlines that most of the researchers agree to define supply chain within theory of new technologies, management practices in terms of organizational supply chain and as a combination of various theories of economics, business, geography, optimization. The listed concepts include (1.) transaction cost economics (2.) resource-based view (3.) resource dependence theory (4.) network theory (5.) stakeholders benefit concept and et.,

Secondly, **blockchain technology** is a decentralized, distributed ledger technology that allows transactions to be recorded and verified without the need for a centralized authority. In a blockchain system, transactions are grouped together into blocks, which are linked to each other in chronological order, forming a chain of blocks that makes it difficult to modify or tamper with any of the transactions without invalidating the entire chain. This makes blockchain technology impossible to hack and manipulate it. Blockchain transactions are verified by a network of users known as nodes, who use complex algorithms to validate and record transactions on the blockchain. The blockchain technology generally has key characteristics of decentralization, persistence, anonymity, and auditability. There are numerous studies on blockchain from a variety of sources, including blogs, forum posts, conferences, and more. It seems that these studies are likely to be split into two main directions, with one group of researchers and practitioners focusing on IT technology, coding, and database structure and sharing while the others focus on applications of blockchain in various sectors, such as supply chain, decision making, and more.

[1] Ashish Kumar Gautam and Dr. Rajkiran Prabhakar (2019), "*Theories of Supply Chain management: A Literature review*" International Journal of Innovative Social Science & Humanities Research, *Vol (6), No.1 Jan-March, 2019*

"*An Overview of Blockchain Technology: Architecture, Consensus, and Future Trends*" study conducted by Zibin Zheng and others researchers (2017) reviews the blockchain from both technological and application perspectives and sees it big data and the basis of crypto currency and etc., This study focuses on blockchain as decentralized database where each database contains information about the product in various stages of its production: ledgers.

Certificate of Origin, on the other hand, it is a legal document that is used to certify the origin of goods being exported The 'Certificate of Origin' serves as a significant document, acting as a testament to the country of origin of goods, a requirement mandated by customs authorities across various nations for customs clearance. The World Trade Organization (WTO) has defined a set of principles that establish the country of origin of commodities for international trade purposes.

These Certificates of Origin stand as paramount documents in cross-border trade, serving as evidence that goods are entirely produced or manufactured in the country issuing the certificate. This certification entitles the goods to specific treatment, whether non-preferential (such as most-favored-nation treatment) or preferential (such as reduction or elimination of tariffs).

The procedure to procure a Certificate of Origin is predominantly manual and paper-based, rendering it time-intensive, expensive, and susceptible to errors and fraudulent practices. Documents necessary for processing the Certificate are provided by multiple parties, each submission potentially carrying the risk of falsification or fraudulent creation.

In an attempt to enhance security and transparency, in recent times, both governmental and private entities have initiated experiments with digitization of the entire procedure to simplify and facilitate the process. Nonetheless, even prospective projects incorporating digital Certificates have not wholly resolved the fundamental trust deficit among the parties involved in the process.

Certificate of origin is not only a crucial document for determining the origin of goods in international trade, but it also plays a significant role in tracing the movement of goods through the supply chain. In cases where there is a dispute about the origin of goods, the information or ledgers can be traced down to confirm or reject the information presented in the Certificate of Origin. Third-party participation can be used to verify and validate the process of issuance of Certificate of Origin, ensuring the integrity of the document and providing a clear record of its movement through the supply chain. To achieve this, various methods and technologies, such as digital signatures, barcodes, and blockchain, can be utilized. Implementing blockchain technology in the supply chain can help prevent fraud and ensure compliance with regulations related to international trade, thereby saving costs and improving efficiency. This study also highlights the possible use of blockchain in ensuring compliance with the Rules of Origin agreed upon between countries, as seen in the example of the EPA between Japan and Mongolia.

1.4 Limitations of the study

It is important to reflect on which topics are out of this thesis. The aspects located outside of the established scope are discussed in this segment.

1. *Detailed assessment of Blockchain's technological properties*
2. *Implications for other sectors*
3. *Practical based research*

On the other hand, this study is limited describe the supply chain and block chain in following context:

- Supply chain consists of sequences of operation and process that starts from raw material identification to final product. Thus, supply chain contains tangible (flow of goods and money), and intangible (information) goods.
- Blockchain consists of sequentially created ledgers that is created in each stage and the information flowing between the process and operation are based on the ledgers created. Thus, block chain is the decentralized database, where database has a ledger, a digital or physical log that records transactions and blockchain networks are a type of decentralized ledger system designed to store the ledgers. The code created within the blockchain through establishment of smart contract between the participants contains full information about the goods though out all stages of supply chain.
- The codes used in trade, for example HS, GTIN, GLN contains information about the goods, but they are largely limited in terms of information compared to the code generated by blockchain.

1.5 Organisation of the Study

The rest of the contents are organized as follows: Section 2 presents the existing literature on the application of blockchain technology in the supply chain. Section 3 presents the methodology I used for this work. Section 4 introduces the potential implication of the blockchain in Mongolia and illustrates real-world use cases. Finally, conclusions and recommendations are given in Section 5.

2 LITERATURE REVIEW

2.1 Brief about the general concepts

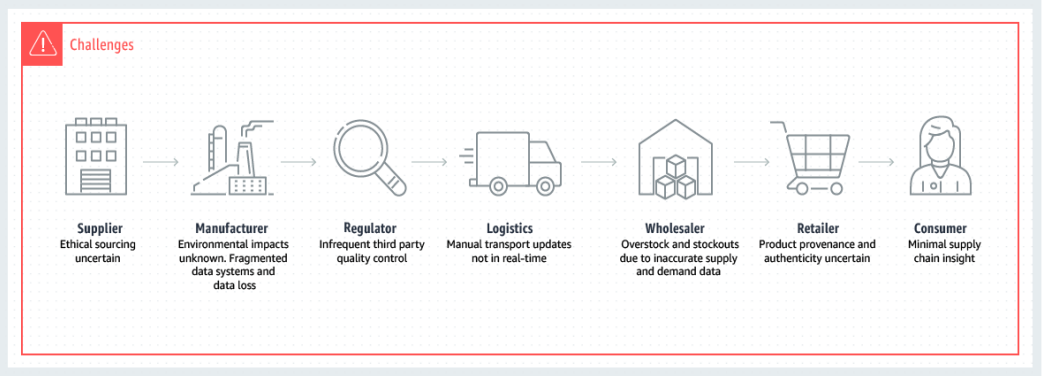
2.1.1 Supply chain with Block chain

In reference to the preceding information, a supply chain can be conceptualized as a comprehensive progression of processes. A traditional supply chain may be construed as an integrated network encompassing various entities such as organizations, individuals, and activities, all collaboratively responsible for a series of operations at multiple stages. This network also entails an amalgamation of vital information and resources imperative to the conception, creation, and eventual delivery of a product or service to the end consumers.

As depicted in Figure 2-1, the supply chain is an embodiment of all necessary undertakings essential for transporting a product or service from its initial conceptual stage to its final consumer destination. This journey includes procurement of raw materials, manufacturing, transportation, warehousing, distribution, and the final delivery process.

On a relevant note, Amazon Web Service (2023) characterizes the operations of a supply chain as particularly challenging. This complexity arises due to the lack of precise information concerning the location and the content of goods, among other factors.

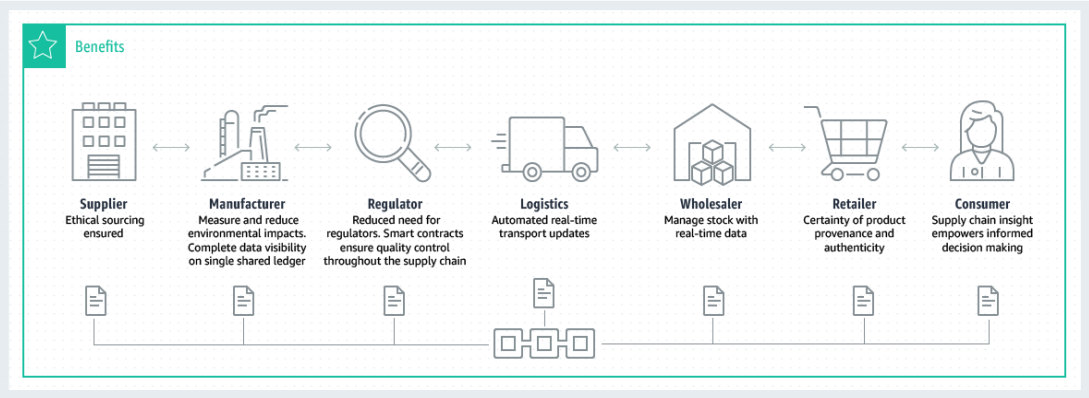
Figure 2-1 Traditional supply chain



Source: Diagram from Amazon Web Services (2023).
https://aws.amazon.com/blockchain/blockchain-for-supply-chain-track-and-trace/

When information flow in supply chain is activated or combined with block chain, the customers would be enabled to get full information about the goods at each node (Figure 2-2).

Figure 2-2 Supply chain with block chain



Source: Diagram from Amazon Web Services (2023).
https://aws.amazon.com/blockchain/blockchain-for-supply-chain-track-and-trace/

2.1.2 Tracing the Certificate of Origin

Tracing the information though-out the supply chain refers to the process of monitoring the movement of goods from their origin to customers. Effective and timely information exchange and monitoring is essential and benefits to increase transparency and visibility of the supply chain. The importance of information and its timeliness depends on the purpose why the parties in supply chain exchange the information. In traditional supply chain tracking and tracing helps to manage potential bottlenecks, delays, or other and address quality control issues or other concerns related to product safety or compliance. Various technologies and methods are being applied to collect and disseminate information about the location, status, and condition of the products as they move through the supply chain. For example, Barcoding and RFID technologies that allow to identify the products using unique identification codes; GPS technology – lets the companies to monitor the location of shipments in real time. Blockchain, the recent application, proposed to apply in various cases of supply chain and it expected to help to prevent fraud and improve accountability.

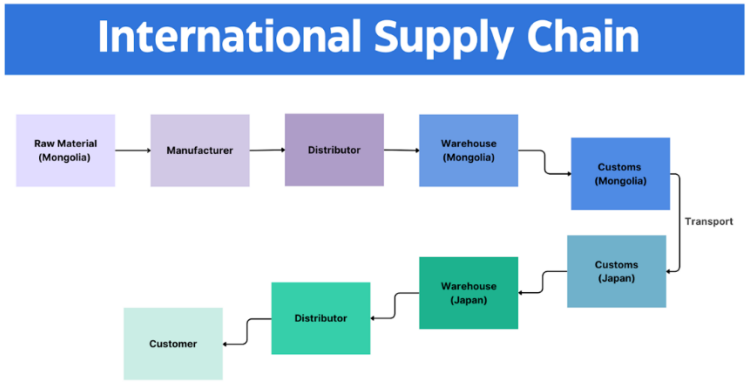
In modern practice, the Certificate of provenance is issued and used to confirm the provenance of goods and services transferred between countries. According to the WTO (2023) as well as WCO (2023) the issuing organization must follow the Rule of Origin Agreement. Thus, this study assumes that in case of dispute, all information used for making a conclusion on origin of goods can be traced. In other words, all the information or records kept at all stages of supply chain (ledgers) can be verified using the code generated by block chain technology.

2.1.3 International supply chain

International trade and supply chain are closely interconnected concepts. International trade involves the trading of goods and services between the trading countries, while supply chain refers to the process of producing and delivering goods and services from suppliers to customers. Accordingly, both international trade and the supply chain refers to all stages of business starting from producing and delivering goods, from obtaining raw materials and semi-produced goods to manufacturing, distribution, and final delivery to the customer. A well-managed supply chain is critical for the success of international trade, as it helps to ensure that goods are produced and delivered efficiently and cost-effectively. According to Waters (1) supply chain “consists of the series of activities and organizations that materials move through on their journey from initial suppliers to final customers”. Supply chain management can be described as the proactive administration of activities and relationships within the supply chain, undertaken by organizations with the aim of optimizing customer value and securing a sustainable competitive edge. This concept encompasses the deliberate attempts by firms within the supply chain to cultivate and operate supply chains in the most productive and efficient manner feasible, as detailed in Source (2), page 8, and elaborated by the Supply Chain Resource Cooperative at North Carolina State University (3).

The supply chain process typically starts with the supplier, who provides raw materials, components, or finished products to the manufacturer. The manufacturer then produces the goods and ships them to the distributor, who may be responsible for warehousing and transportation. The distributor subsequently markets the goods to the retailer, who in turn sells them to the ultimate consumer. Alternatively, this progression can also exemplify the stages of an international supply chain, commencing from the procurement of raw materials to the delivery to the end customer. Unlike a normal supply chain, an international supply chain involves additional movement of goods across borders and adds the complexity of cross-border customs regulations and international trades. Figure 2-3 presents a general diagram of the international supply chain. For example, in in this supply chain, the raw material supplier, manufacturer, distributors and warehouse are in Mongolia and goods are being exported. Export means the goods go through Customs inspection. Then the goods go through Japanese Customs and further distributed to the final customers through warehouses and distribution centers in Japan. Or it implies that in the international supply chain, suppliers and customers may be in different countries.

Figure 2-3 International Supply Chain Diagram



Source: Adapted by Khuslen. G

2.2 Block chain

2.2.1 Block chain as the decentralized database

Blockchain technology represents a reliable, shared database that spans across a network of participants, making instantaneous information accessibility a possibility for all members (4). This database type, characterized by its decentralization, employs cryptographic measures to validate private data without divulging the information itself, and/or to establish the genuineness of said information. As a technology fundamentally rooted in mathematical concepts, blockchain serves as a foundation for fostering mutual trust. The inherent clarity, accuracy, and transparency of algebraic systems provide no room for potential manipulation or unauthorized interferences.

Recently, the implementation of blockchain has been suggested across diverse sectors, including supply chain management. When applied to the supply chain, blockchain stands as a decentralized, distributed ledger technology, enabling the recording and validation of transactions devoid of any centralized governance. In a blockchain structure, transactions are gathered into blocks and are sequentially linked, forming a 'chain' of these blocks. Each block houses a cryptographic hash of the previous block, making it enormously challenging to alter or tamper with any individual transaction without causing a disruption in the entire chain. This characteristic makes blockchain a highly secure technology, offering robust resistance to fraudulent practices and potential hacking.

Within a blockchain, transactions are authenticated by a network of users, known as nodes, who employ sophisticated algorithms to confirm and log transactions onto the blockchain. This mechanism provides faster transactions, reduces associated costs, and bolsters security when compared with traditional methods.

In contrast to a traditional centralized database, which is regulated by a single entity or organization with the power to alter or remove data as needed, a decentralized blockchain

database presents no singular authority, no master node, and no controller of rogue activities. This means no single entity has control over the database. Rather, the database is spread out over a network of computers, or nodes, each holding an entire copy of the database. When a new transaction is initiated on a blockchain, it is confirmed and added to a block of transactions by multiple network nodes. These blocks are then connected in a chain, creating an enduring and transparent record of all blockchain transactions. Given its decentralized architecture and use of cryptographic safeguards, blockchain technology is highly secure and offers strong resistance to potential hacking or tampering. Moreover, the absence of a central authority ensures high levels of transparency and robust resistance to censorship.

Blockchain is a secure database shared across a network of participants, where up-to-date information is available to all participants at the same time. As a database, it is a type of decentralized database that uses cryptography to prove knowledge of confidential information without revealing that information, and/or to prove the authenticity of that information. It originates in mathematics, and as such it is employed as a foundation for establishing mutual trust because the clarity, transparency and precision of algebra leave no space for tampering or any interventions. Recently is being proposed to use supply chain in various industries, including supply chain. When it is taken within the supply chain, blockchain is a decentralized, distributed ledger technology that allows transactions to be recorded and verified without the need for a centralized authority. In a blockchain system, transactions are grouped into blocks, which are linked to each other in chronological order, forming a chain of blocks. Each block contains a cryptographic hash of the previous block, making it difficult to modify or tamper with any of the transactions without invalidating the entire chain. This makes blockchain technology highly secure and resistant to fraud and hacking. In blockchain, transactions are verified by a network of users known as nodes, who use complex algorithms to validate and record transactions on the blockchain. This makes transactions faster, cheaper, and more secure than traditional methods.

In a conventional centralized database, a single entity or organization controls the database and can modify or delete the data as they see fit. However, in a decentralized blockchain database, there is no single authoritative blockchain, no master-node (central server), and no one that controls rogue behavior. It means that there is no single entity that controls the database. Instead, the database is distributed across a network of computers, or nodes, and each node has a copy of the entire database. When a new transaction is made on a blockchain, it is verified and added to a block of transactions by multiple nodes on the network. These blocks are then linked together in a chain, creating a permanent and transparent record of all transactions that have occurred on the blockchain. Because of its decentralized nature and use of cryptography, blockchain technology is highly secure and resistant to hacking or tampering. Additionally,

because there is no central authority controlling the database, it is highly transparent and resistant to censorship.

2.2.2 Key elements of blockchain and how it works

The key elements of a blockchain include:

Decentralized technology: Instead of counting on a central authority or third person relation, blockchain uses a network of separate coordinated nodes that validate and confirm transactions. This decentralized approach ensures transparency and eliminates the need for a single governing entity.
(5)

Distributed ledger technology: All participants in the network have access to a distributed ledger that maintains an immutable record of transactions. This shared ledger prevents duplication of effort and provides a single source of truth for all network members.

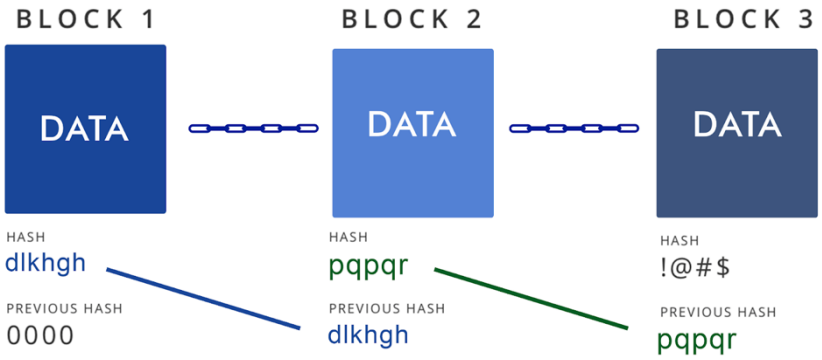
Immutable records: If a transaction is already added to the shared ledger, it can't be changed by anyone. If there's a mistake, a new transaction has to be made to fix it, and both transactions are kept visible. Nodes need to agree to make sure transactions are correct and valid.

Smart contracts: To speed transactions, a set of rules so called “smart contract” which is stored on the blockchain and executed automatically as a digital contract. A smart contract can define conditions for corporate bond transactions, include terms for travel insurance to be paid and much more. Blockchain uses techniques that is called cryptography whereby provide a possibility of secure transaction and privacy of the parties interconnected in the network nodes. Transactions are generally recorded using digital signatures and cryptographic hash, which makes it strenuous to alter or manipulate the data.

How it works: These transactions indicate the transfer of an asset, which could either be physical (such as a product or currency) or non-physical (like intellectual property). The data block can record the information which the blockchain member wants who, what, when, where, how much and even the condition.

Each block is connected to the ones before and after it. These blocks constitute a data chain, tracing the trajectory of an asset as it transitions between locations or shifts ownership (refer to Figure 2-4).. The blocks confirm the exact time and sequence of transactions, and the blocks link securely together to prevent any block from being altered or a block being inserted between two existing blocks. Upon the successful verification and integration of a new block into the blockchain, the transaction attains a state of permanence, making it invulnerable to alteration or deletion.

Figure 2-4 How the block chain work



Source: Diagram taken from https://www.blockchainexpert.uk/blog/how-does-blockchain-work

As each transaction occurs, it is recorded as a "block" of data: A blockchain is an irreversible chain formed by transactions. Each new block reinforces the prior block's verification, and by extension, the distributed ledger as an entire system. This gives the blockchain the essential strength of immutability and makes it tamper-evident. As a result , the probability of tampering can be reduced and a secure transaction ledger is produced.(5).

Who has access to the data kept on a blockchain?

Depending on the underlying ledger technology, different parties may be permitted to view the data that is kept on a blockchain ledger. Options here include:

- Public: In a public blockchain, all transactions are visible to everyone in the network. This approach ensures transparency and accountability.
- Permissioned: A permissioned blockchain includes a layer of permissions, allowing only approved parties to view transactions. This provides privacy and restricts access to sensitive information.

2.2.3 Smart contracts

The concept of smart contracts was first introduced by Szabo in 1994. A smart contract is a digital contract that defines the terms and conditions of a business transaction and is recorded on the blockchain (6). Being recorded on the blockchain, a smart contract becomes an inherent part of the event it represents, requiring no human intervention for its execution. Unlike traditional contracts, smart contracts prioritize cost-effective transfers and automated transactions within a decentralized global network.

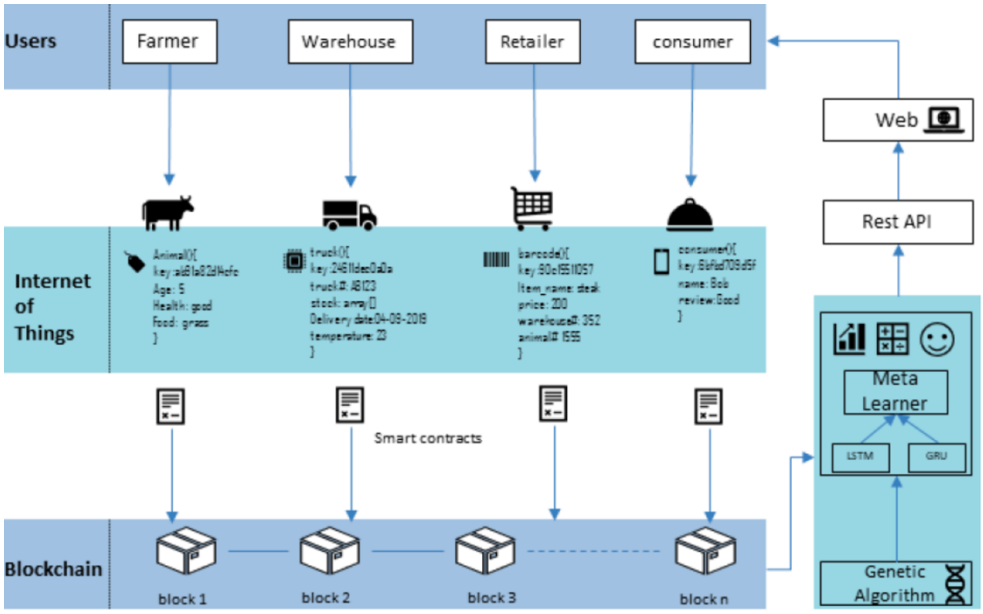
Compared to conventional contracts, smart contracts have a number of benefits, such as improved security, lower prices, and shorter delays. They can significantly improve scalability and enforceability, enabling automated payment flows. However, scaling smart contracts to a larger extent may necessitate more extensive information sharing, which raises concerns regarding its acceptance within the economic sector. Smart contracts are particularly suitable for temporary and fragmented supply chains that involve multiple levels of suppliers and contractors.

2.3 Value chain and ledgers in different nodes of supply chain

2.3.1 Decentralized databases created within international supply chain

Distributed ledgers are databases that authenticate assets or transactions by simultaneously preserving information in a number of cloud locations. A distributed ledger utilizes numerous nodes that must cooperate for authentication as opposed to traditional databases, which use centralized data storage. Since the data is encrypted, each node must independently confirm the authenticity of authorized users before they can access it. A member's nodes can each build their own ledgers. Any product can be given a distinctive identification that is protected by the distributed ledger system once the decentralized database is in place(7). Figure 2-5 illustrates the supply chain of the food industry and shows how to create a ledger at each node.

Figure 2-5 Blockchain implementation in Supply chain



Source: Diagram taken from Dujak, D., & Sajter, D. (2018). Blockchain Applications in Supply Chain. EcoProduction, 21-46. doi:10.1007/978-3-319-91668-2_2

Encrypted credentials are issued for each unit. It is possible to protect the identity of high-value products while still confirming the shipment because it is not essential to know the entire contents of the container in order to authenticate it. The distributed ledger system is used to create the identifiers, making it impossible to forge or counterfeit them. The decentralized database may create as many tracking numbers as necessary to track even individual parts, which can be helpful for inventory management and recalls.

Ledger contents: While the ledger itself maintains protection for its contents, it's worth noting that authorized members may have access to confidential documents pertaining to trade disputes and traceability. It is crucial to consider the sensitivity of traceability data that an organization might choose to disclose to external parties. Generally, a differentiation can be made between internal data, which is unsuitable for sharing with external parties due to commercial or privacy concerns, and external data, which can be shared with other parties under specific predefined conditions (8). For instances of data that an organization might treat as internal vs. external, see Table 2-1 below.

Table 2-1 Data across the ledger

Sensitivity of data	Master data		Transactional data	Visibility event data
External data	***Static data:*** Locations Catalogue items Assets …	***Relation data:*** Suppliers Customers 3rd party service providers …	Purchase orders Despatch notifications / Advance Ship Notice Transport instructions …	Producing Picking Packing Shipping Receiving …

Sensitivity of data	Master data		Transactional data	Visibility event data
Internal data	Product design Production Process Personnel …	Contracts …	Quality inspection data Lab analysiis results … …	Inspecting Collecting Holding …

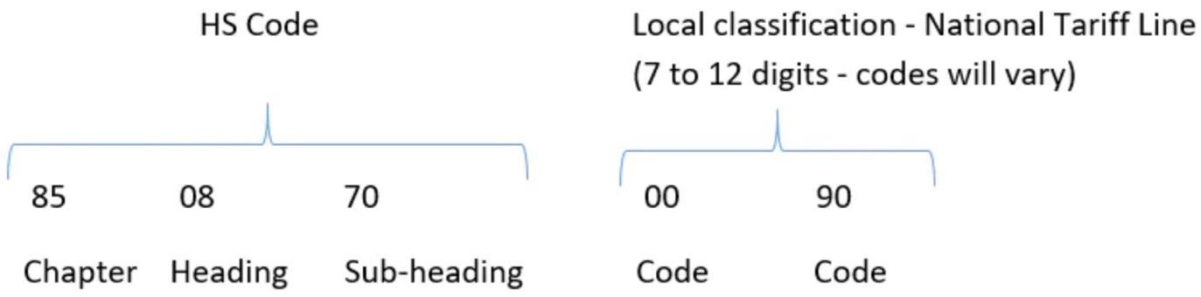
Source: Taken from: https://www.gs1.org/standards/fresh-fruit-and-vegetable-traceability-guideline/current-standard#1-Introduction+1-1-Purpose

2.3.2 Owners of the database and information in various coding system

HS code and contents:

The Harmonized System (HS) Classification is the World Customs Organization's Harmonized Commodity Description and Coding System. It is an international system for classifying goods for customs purposes that gives each category of goods a special 6-digit HS code. HS codes are used for several purposes. The HS code of a product is usually included in the Certificate of Origin to help customs authorities and other parties verify the origin of the goods and apply the appropriate tariffs and regulations. HS codes are composed of 6 digits and broken down into: Chapters (first 2 digits), Headings (first 4 digits) and Subheadings (full 6 digits). HS codes are 6 digits long and are divided into Chapters (first two digits), Headings (first four digits), and Subheadings (full six digits). Depending on the legal authority, the HS codes are further organized into 7- to 12-digit items (also known as commodity codes and national tariff lines). Figure 2-6 illustrates an example HS code and its division. HS code for "Vacuum Cleaners" is 85, while a more specific HS code for "Parts of Vacuum Cleaners" is 850870. The additional digits in the latter code (0090) provide more specific information about the product, such as its level of processing, packaging, and presentation(9). The contents of an HS code can vary depending on the product or product category it represents. Some products may have a more general HS code, while others may require a more specific code to accurately represent their characteristics and intended use. Decentralized databases can certainly be a valuable tool for identifying trade disputes, especially when combined with the use of HS codes in Certificate of Origin. By keeping a decentralized ledger of all transactions within a supply chain network, it becomes easier to trace the origin and processes of goods as they move through the network. This can help customs authorities to quickly identify any discrepancies or inconsistencies, which can then be investigated further.

Figure 2-6 HS Code Breakdown



Source: Taken from https://findrulesoforigin.org/en/glossary?id=XkjeoBMAACEAxFFh&returnto=gloscente

One of the benefits of using a decentralized database is that it can provide a more secure and transparent system for storing and sharing data. The database is less vulnerable to hacking or other forms of cyber-attack because it is dispersed among numerous nodes. Additionally, because all network members have access to the same information (external), it becomes more difficult for any one member to manipulate or withhold data.

GS1 Data bar and trade item identification:

GS1 is a multinational organization that creates and maintains supply chain management standards, such as the use of barcodes for product identification and tracking. (2015) (Dalmolen, Moonen, & Van Hillegersberg)

GS1 standards required the use of unique product identifiers, such as Global Trade Item Numbers (GTINs), to provide clear product identification across the supply chain. The GS1 system provides internationally identifiable identifying keys, allowing companies to exchange product information in an internationally recognized language. The GS1 Global Trade Item Number (GTIN) is the GS1 product identification key. For years, this GS1 identifying key has simplified the exchange and distribution of product information across supply chain partners, as well as providing the foundation for flexible supply chain management advances in numerous industries.

GS1 standards offer a possibility in terms of the granularity of trade item identification, resulting in varied degrees of precision in terms of traceability, as stated in table 2-2:

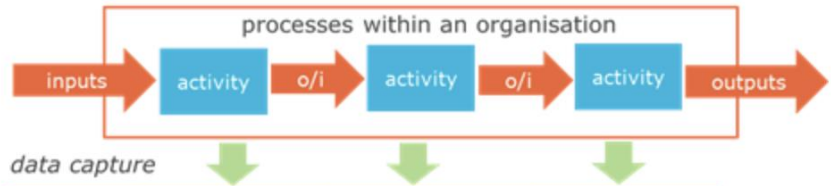
Table 2-2 GS1 Identification Number

GS1 Identification Number	GS1 Identification Number Title	Type of Supply Chain Information
GTIN	Global Trade Item Number	*trade item*
	Global Trade Item Number plus Lot Number	*specific lot of trade item*
	Serialized Global Trade Item Number (SGTIN)	*specific individual trade item*
GLN	Global Location Number	*location or trading partner*
SSCC	Serial Shipping Container Code	*specific logistics unit*

Source: Table taken from: https://www.gs1us.org/content/dam/gs1us/documents/industries-insights/by-industry/food/guideline-toolkit/White-PaperHow-GS1-Standards-Support-Product-Tracing-Critical-Tracking-Events-Key-Data-Elements.pdf

The GS1 standard includes several different types of identification codes (Table 2-2), including the Global Trade Item Number (GTIN), Global Location Number (GLN), and Serial Shipping Container Code (SSCC). These codes are used to differentiate between products, locations, and shipping. The food sector can monitor products from their origin to the final customer using these numbers, ensuring that they are safe and meet legal criteria. One of the key advantages of the GS1 standard is that it enables for complete product traceability across the supply chain. This implies that if a product has a problem, such as contamination, it can be immediately tracked down to its source. The food sector can identify and resolve the primary cause of the problem by tracking the product back to its source, preventing it from happening again in the future. GS1 has been actively working on blockchain implementation and has launched several pilot projects and collaborations with technology providers to implement blockchain solutions based on GS1 Standards(10).

Figure 2-7 Key Data Elements



KDE:	CTE 1	CTE 2	CTE 3
Who	gln	gln	gln
What	gtin+lot	gtin+lot	sscc
Where	gln	gln	gln
When	date+time	date+time	date+time
Why	business process	business process	business process

Source: Taken from https://www.gs1.org/standards/gs1-global-traceability-standard/current-standard#3-Traceability-data-and-traceability-systems+3-1-Traceability-data-within-an-organisation

Figure 2-7 illustrates how member organizations of GS1 process information divided (Who, What, Where When and Why). In this case, it makes the process easier to control and product tracing.

GS1 provides different code versions depending on the goods to improve the registration and control the good's traceability. The GS1-128 barcode (Figure 2-8), for example, is a type of barcode that has become well known in the food business due to its ability to store more information than regular barcodes. The GS1-128 barcode is based on the Code 128 symbology, which is a high-density linear barcode capable of encoding huge amounts of data in a little amount of space. All GS1 identifying keys (including the GTIN and SSCC) can be carried by GS1-128 barcodes, and they support Application Identifiers (GTIN key extensions such as batch/lot or serial

number number), which improves the ability to track and trace products moving through the supply chain.

Additional attributes, such as pack date or use by date, can be encoded in addition to the GTIN and batch/lot.

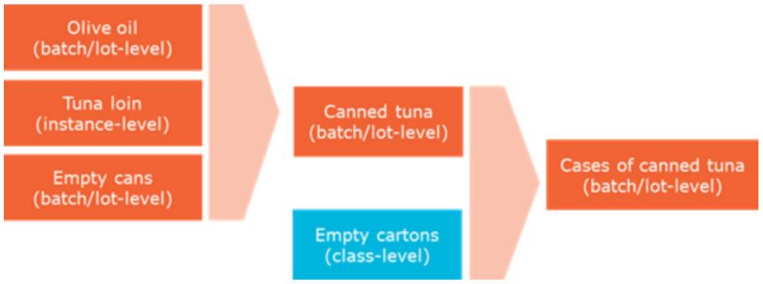
Figure 2-8 GS-128 Barcode Example

Source: taken from: https://www.gs1.org/standards/fresh-fruit-and-vegetable-traceability-guideline/current-standard#1-Introduction+1-1-Purpose:

How GS1 track the goods if problem occurs: Three primary degrees of identification can typically be utilized for the tangible identification of trackable items:

- Identification at the category level (GTIN), wherein the object is distinguished by its product or part ID. This allows differentiation from diverse product types or components. Additionally, it offers visibility into the application of different products within the supply chain and enables data aggregation through product counting.
- Identification at the batch or lot level (GTIN + batch/lot ID), where the product or part ID is supplemented with a batch or lot number. This confines the quantity of trackable objects sharing the same ID to a smaller group of instances (for example, items manufactured concurrently). Essentially, this level of identification differentiates products within one batch or lot from those in another.
- Identification at the instance level (GTIN + serial number), in which the trackable object is recognized with a serialized ID, restricting the number of trackable objects bearing the same ID to a singular instance. Instance level identification permits the individual identification of each product instance. This facilitates individual tracking or tracing of each product instance, thereby enabling precise correlation of observations at varying junctures within the supply chain (10).

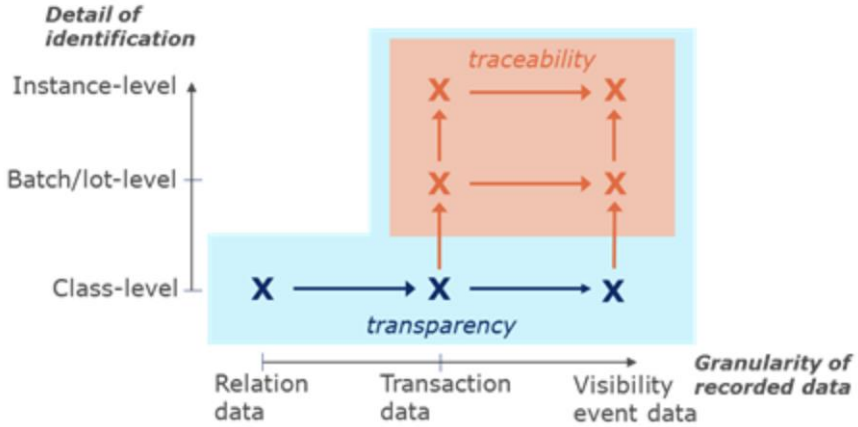
Figure 2-9 Example of combination of identification levels



Source: taken from https://www.gs1.org/standards/gs1-global-traceability-standard/current-standard#2-Traceability-and-the-importance-of-standards+2-2-The-need-for-unique-identification

If any case problem occurs, they check in detail according to Figure 2-9 identification types to find source of the problem occurrence.

Figure 2-10 Precision of traceability data



Source: Taken from https://www.gs1.org/standards/gs1-global-traceability-standard/current-standard#3-Traceability-data-and-traceability-systems+3-3-Managing-traceability-data

Instance-level (GTIN+Serial number) and Batch/lot-level (GTIN+batch/lot ID) are mainly for the traceability while the Class level is more general (Figure 2-10).

Overall, the similarity between the HS (Harmonized System) code and GS (Goods and Services) code is that they are both international classification systems used to categorize goods and services for trade-related purposes. The HS code is primarily used for customs and tariff reasons, to classify and identify commodities in order to charge customs duties, taxes, and restrictions under Free Trade Agreements. It is a standardized system used by customs officials around the world to facilitate international trade. On the other hand, the GS code is primarily used for statistical purposes, to collect and analyze data on international trade in services. While the HS code and the GS1 code are unrelated, they can be used in conjunction to provide a more

complete picture of a product's features and journey through the supply chain. For example, a business may use a GS1 code to track a specific product as it moves through the supply chain, while also using an HS code to classify the product for customs purposes.

2.4 Certification/Proof of origin in international trade

2.4.1 Key documents required in international trade and Certificate of Origin

Documents: The first point is about the documents required in doing international trade and shipment of goods. In international trade, several key documents are required by suppliers and buyers to ensure that goods are delivered, and payment is made properly to minimizing the risks associated with cross-border transactions. The key documents include:

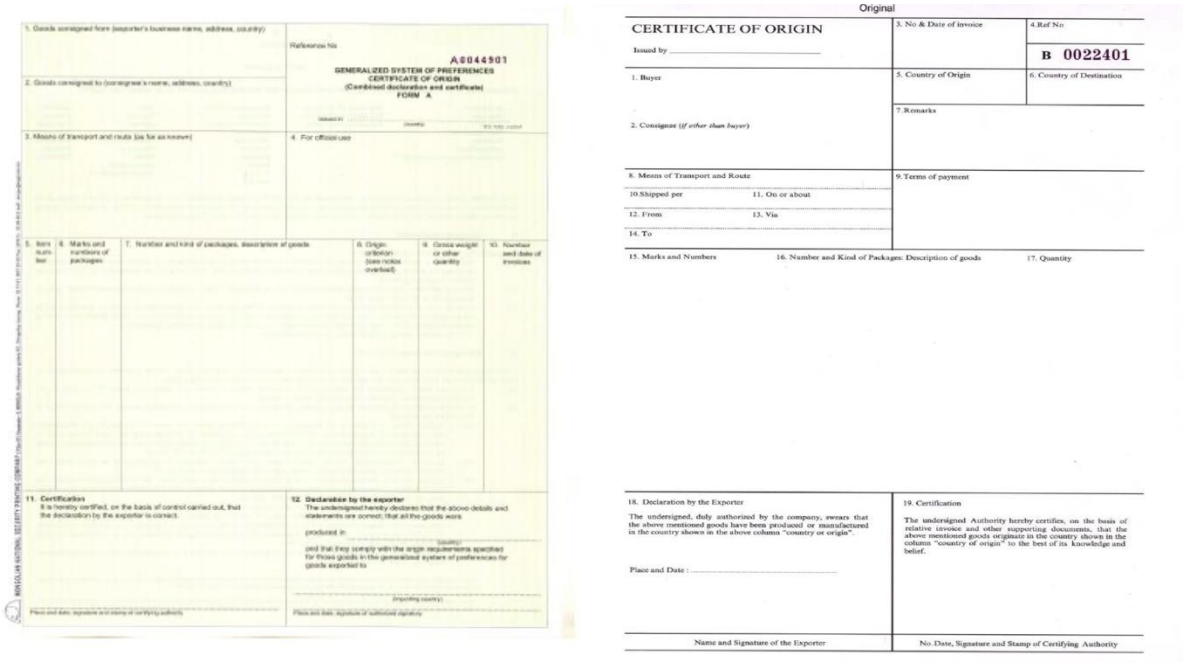
1. Purchase order
2. Invoice
3. Packing list
4. Bill of lading
5. **Certificate of Origin** (11)

This study refers only the documents: “Certificate of Origin” that typically includes information about the exporter, the importer, and the goods being exported, as well as a declaration that the goods originate from a specific country. The document is usually signed by the exporter or a designated authority and may also include a stamp or seal. For example, a certificate of origin is used to obtain preferential treatment under EPA agreements, reduced tariffs, when goods and services are being traded between Mongolia and Japan.

2.4.2 Content of certificate of origin

Certificates of Origin are crucial documents in the world of international trade, used to authenticate the origin of specific items. This confirmation aids in determining eligibility for preferential treatment under existing Free Trade Agreements, however some nations require it for verification of non-preferential treatment (12). The procedure of obtaining a Certificate of Origin is primarily traditional and paper-based (see Figure 2-11), making it labor-intensive, costly, and vulnerable to inaccuracies and fraudulent activities.

Figure 2-11 Certificate of Origin, Paper form



Original

CERTIFICATE OF ORIGIN

Issued by

3. No & Date of invoice

4.Ref No

B 0022401

1. Buyer

5. Country of Origin

6. Country of Destination

2. Consignee (*if other than buyer*)

7.Remarks

8. Means of Transport and Route

9.Terms of payment

10.Shipped per

11. On or about

12. From

13. Via

14. To

15. Marks and Numbers

16. Number and Kind of Packages: Description of goods

17. Quantity

18. Declaration by the Exporter

The undersigned, duly authorized by the company, swears that the above mentioned goods have been produced or manufactured in the country shown in the above column "country or origin".

Place and Date :

19. Certification

The undersigned Authority hereby certifies, on the basis of relative invoice and other supporting documents, that the above mentioned goods originate in the country shown in the column "country of origin" to the best of its knowledge and belief.

Name and Signature of the Exporter

No. Date, Signature and Stamp of Certifying Authority

Source: Taken from https://www.wcoomd.org/-/media/wco/public/global/pdf/topics/key-issues/revenue-package/guidelines-on-certification.pdf

In the process of issuing a Certificate of Origin, it has traditionally been common practice to utilize a document in written form that is physically signed by authorized personnel.

Basic information contents to be included in the Certificate of Origin

- Exporter's name, address and country
- Importer's name, address and country
- Certificate number
- Origin of the goods
- Price claim number and date
- Commodity code (Harmonized System (HS) code or tariff classification of the goods)
- Shipping information (where applicable)
- Packaging number, symbol, product name definition
- **Rules of Origin**
- Exporter’s customs declaration
- Verification information(13)

The Certificate of Origin shall contain the above information and, within this thesis, i elaborated on the Rules of origin which are the criteria used to determine the country of origin for a product.

2.4.3 Key players involved in certification of origin: issuers and users

2.4.3.1 Who needs a Certificate of origin?

In general, the exporter of the goods is responsible for obtaining the Certificate of origin. The Certificate of Origin may be required for various purposes, such as to claim preferential treatment under a free trade agreement, to comply with import regulations, or to satisfy requirements for payment under a letter of credit.

2.4.3.2 Who issues a proof of origin?

A Certificate of Origin is generally granted by the pertinent authorities in the country of export. In Mongolia, the Mongolian National Chamber of Commerce and Industry (MNCCI) holds the responsibility for issuing Certificates of Origin (COOs) in the context of Free Trade Agreements (FTAs). Operating as a non-governmental organization, the MNCCI advocates for the Mongolian business sector and fosters trade and economic advancement.

2.4.3.3 The obligations and the liability of the players

Multiple stakeholders are involved in the certification of origin within international commerce, including importers, exporters, and competent authorities. Each participant has distinct responsibilities and is accountable for specific aspects related to the certification of origin process.

Exporters bear the responsibility of ensuring that the goods being shipped out conform to the standards and regulations of the destination country. They must provide precise and comprehensive information on relevant paperwork, procure necessary licenses, permits, and certificates, and, if required, present a valid Certificate of Origin.

On the other hand, **importers** are obliged to adhere to the regulations and requirements of the country receiving the goods. They must remit payment for the purchased goods to the exporter and comply with any import restrictions or prohibitions.

The **competent authorities** are charged with the responsibility to authenticate the compliance of the traded goods with the relevant regulations and standards, issue necessary licenses, permits, and certificates, guarantee that the trade aligns with regulations and agreements, and impose penalties and fines on exporters or importers who breach regulations.

In case of breach of regulations or agreements, importers and exporters may face financial penalties or legal action, and competent authorities may also face liability for any failure to properly enforce regulations and agreements or for any negligence in their duties. It is essential for all parties to understand and comply with their obligations to avoid any legal or financial consequences.

2.4.4 Application of Certification of origin in Free trade agreement

Free trade agreements (FTA) are agreements between countries that aim to promote free trade by reducing or eliminating tariffs and other trade barriers on goods and services. To use a Certificate of Origin in an FTA, the exporter of the goods must obtain the certificate from the relevant authorities in their own country. The Certificate of Origin should provide information about the exporter, the importer, the goods being traded, and the origin of the goods. The Certificate of Origin must also include a declaration by the exporter certifying that the goods meet the rules of origin criteria specified in the FTA.

Once the Certificate of Origin has been obtained, the exporter should provide it to the importer, who can then use it to claim preferential treatment for the imported goods when clearing customs in the importing country. The customs authorities in the importing country will verify the information provided in the Certificate of Origin to determine whether the goods qualify for preferential treatment under the FTA.

2.4.5 Rules of origin

Rules of origin (ROOs) are used to determine if products are eligible for duty-free or reduced duties under the FTA rules even though they may contain non-originating (non-FTA) components. Determining the country of origin becomes simpler when a product is entirely grown or manufactured in one country. However, complications arise when the finished product incorporates components from multiple countries, making origin determination more intricate. Rules of origin vary in their level of detail and specificity, differing from one agreement and product to another.

In cases where uncertainty exists regarding a product's qualification or if previous shipments have faced scrutiny from the customs authority at the Free Trade Agreement (FTA) destination, an appeal can be made. Each FTA provides a means to request a binding advanced ruling from the destination customs authority regarding the goods in question.

According to the Rules of Origin, there are three type of goods:

- Originating goods
- Non-originating goods
- **Preferential goods**(9)

Originating goods is a wholly obtained or exclusively from originating materials while non-originating goods which are goods that are imported from another country, or they may be goods that are partially produced within a country but do not meet the necessary criteria.

Preferential goods are goods that qualify for preferential treatment under a trade agreement or free trade agreement. To qualify as preferential origin goods, the goods must meet specific rules of origin criteria, such as a certain percentage of value-added content produced within the participating countries. According to the Agreement between Japan and Mongolia for an Economic Partnership, the minimum percentage of a good that must be considered a Preferential Good is 40% for most goods, and 50% for some specific goods. In Chapter III of my thesis, I have detailed the methodology for calculating the Preferential Originated Goods.

2.4.6 Rules of Origin requirement for the preferential goods

As previously mentioned in the section, preferential goods are products that are eligible for preferential treatment under a particular trade agreement or arrangement. The determination of preferential origin for these goods can be a complex process, involving an assessment of the value-added content of the product, as well as the country in which that value was added. Qualifying Value Content (QVC) is used as a formula to identify origin of Preferential goods in Rules of Origin. In the Methodology section, an example was provided to illustrate how to evaluate the Qualifying Value Content.

Company X manufactures Leather purse in Mongolia and plans to export them to Japan under the Agreement.

HS Codes 42023120 : HS Classifications of Wallets and purses, of leather.

Company Y must demonstrate that the washing machine meets the 40% value-added rule (Build-down technique) or the 40% value-added rule (Build-up method) to qualify as an originating good of Japan.

(a) Method based on value of non-originating materials ("Build-down method")

Table 2-3 (Build down method)

Material/Parts	Sources	Originating Value Status	Value MNT ₮
Parts A	Mongolia	Originating good of Mongolia	50000
Parts B	Mongolia	Originating good of Mongolia	150000
Parts C	**China**	**Non-originating**	**80000**
Parts D	**Unknown**	**Undetermined**	**60000**
Other Costs	N/A[2]	N/A	30000
Transaction Value	- -	- -	320000

Source: Table taken from http://www.sice.oas.org/TPD/CHL_JPN/Implementation/appendix3.pdf

QVC is the qualifying value content of the good, expressed as a percentage;

$$QVC = \frac{FOB(TV) - VNM}{FOB(TV)} \times 100 \geq 40\%$$

V.N.M. is the value of non-originating materials used in the production of the good;

F.O.B. is the "free-on-board value" of a good is the price that the buyer pays to the seller of the good, not including any taxes that were reduced, exempted, or repaid when the good was exported. This price is not affected by the mode of shipment.

$$QVC = \frac{320000₮ - 140000₮(Parts\ C, D)}{320000₮} \times 100 = 56\% \geq 40\%$$

This calculation shows that the Leather purse qualifies as an originating good of Mongolia.

(b) Method based on value of originating materials ("Build-up method")

Table 2-4 QVC Build-up method

Material/Parts	Sources	Originating Value Status	Value MNT ₮
Parts A	Mongolia	Undetermined	10000
Parts B	**Mongolia**	**Originating good of Mongolia**	**150000**
Parts C	Unknown	Undetermined	40000
Parts D	Unknown	Undetermined	15000
Other Costs	N/A	N/A	30000
Transaction Value	- -	- -	320000

$$Q.V.C. = \frac{VOM}{FOB(TV)} \times 100$$

VOM is the value of originating materials used in the production of goods.

In some circumstances, the FOB value and the Transaction Value may be the same if the price paid for the items includes all costs involved with shipment and delivery to their destination.

Given that it is known that Parts B originate in Mongolia, Company X determined that it would be easier to utilize the Build-up approach because it is apparent that the QVC of the leather purse will be greater than 40% when only the value of Parts B is considered. Thus, the calculation of the QVC of the leather purse is:

$$QVC = \frac{150000₮}{320000₮} \times 100 = 47\% \geq 40\%$$

This calculation shows that the Leather purse qualifies as an originating good of Mongolia.

2.4.7 Customs tariff (Preferential and non-preferential origin)

Customs duties are taxes placed by governments on imports and exports, serving as a means of revenue generation and a protective measure for domestic industries against international competition. Broadly, these duties are classified into preferential and non-preferential origins.

Preferential tariffs are reduced duties levied on goods originating from countries sharing a Free Trade Agreement (FTA) or Preferential Trade Agreement (PTA) with the importing nation. These agreements aim to stimulate trade between countries by cutting down or eradicating tariffs on specific goods. To be eligible for preferential tariff treatment, goods must satisfy the rules of origin stipulated in the FTA or PTA. For instance, the commodity should be entirely obtained or produced within the country, or the good must be entirely produced in the Party exclusively from materials originating from the Party.

On the other hand, **non-preferential tariffs** apply to all imported goods into a country, irrespective of their source. These tariffs typically exceed preferential tariffs and are intended to shield domestic industries from international competition. Non-preferential tariffs are typically determined by the value or weight of the imported goods.

In the context of the Economic Partnership Agreement between Mongolia and Japan, a 5% import tax is levied on most imported goods, with certain items subjected to additional seasonal duties(14). Some export goods are also subjected to specific customs duties. Any individual or corporate entity engaged in foreign trade is liable to pay these customs duties, in addition to other taxes and fees, during importation or exportation.

2.4.8 Trade dispute settlement

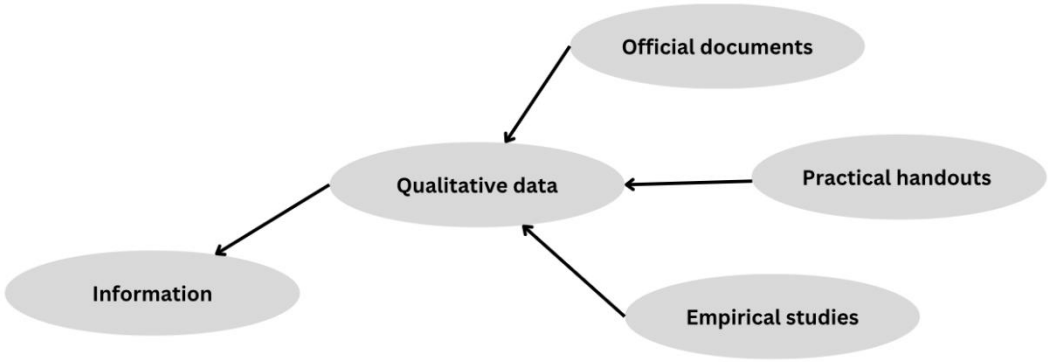
If issues or disputes appear in the Certificate of Origin, the Parties shall resolve the disputes through a Trade dispute settlement. If the customs authority of the importing Party finds that the certificate of origin provided by the exporting party does not meet the requirements, they can request clarification from the exporting Party for more detailed information. This is explained more in detail in section IV as a theoretical framework.

3 METHODOLOGY

3.1 Research design

The blockchain technology is still in its infancy and new research gaps evolve. As a result, there is a lack of available studies on the research topic and barriers during the implementation process of blockchain technology in the supply chain. That is why the qualitative research approach is more preferable to this study. In addition, a qualitative study can support the development of theories with the help of analysis, in-depth interpretations and the illumination of various aspects in this new research field. Therefore, when using a qualitative research approach, official documents, practical handouts as well as empirical studies on the application of blockchain in supply chain were used (Figure 3-1). Accordingly developed a conceptual framework, discussed in the chapter IV of this study.

Figure 3-1 Data Analysis



Source: Adapted by Khuslen.G

The blockchain provides improvements in various aspects of international trade and its application in dispute on origin of goods is the key point of my thesis. The direct and indirect impacts of blockchain as the part or as the key determinant of origins of goods could be multidimensional (i) transparency, (ii) information transmission, (iii) traceability, (iv) disintermediation and (v) cost of delay. Cost and time are the critical concerns of export and import processes and an accurate application of the advantages of free trade agreement, in my case EPA between Japan and Mongolia.

3.2 Data and data analysis (Comparative)

The fundamental explanation of blockchain application is that the cost of centralized administrative and legal services and providers is reduced. The elimination of paperwork compensates for significant savings in terms of global trade. With its immutable shared ledger, blockchain offers significant cost reductions. Manual paper-based operations are also greatly decreased, reducing the time and labor required for document processing. Blockchain applications frequently take advantage of their potential to reduce associated costs and time, such as those connected with complaints, confirmation, negotiation, auditing, validation, and so on.

The regulatory landscape was researched by myself to understand the laws, regulations, and customs procedures related to the Certificate of Origin in the international trade. In the next section, I take EPA as an example and conduct overall estimation. However, there is no publicly available dispute case within EPA framework, yet many exporting companies of Mongolia are in search to facilitate their trade with Japan and take advantage of EPA. In this sense Certificate of Origin is the key document and application of blockchain in the supply chain of the products for export is the key facilitating factor or innovative approach to ease the process. Therefore, several case studies were included, to prove the point of the blockchain's necessity.

3.3 Data sources and collection procedure

The Agreement between Japan and Mongolia for an Economic Partnership (EPA) is the primary data source for my thesis. The data gathered about the issuance of the Certificate of Origin, time period, and trade dispute settlement was primarily obtained from Chapter III of the EPA, which concentrates on Certificate of Origin. To clarify further, a thorough examination of the time of each step involved in the issue of a Certificate of Origin, the numerous phases that the certificate goes through, and the processes that are in place for the resolution of any trade disputes that may occur was conducted. By breaking down each step of the process and assessing the time and resources required, it was possible to gain a clearer understanding of the challenges and limitations of the current system. Additionally, by examining the various stages that the certificate must go through, from initial application to final approval, it was possible to identify areas where delays and inefficiencies might occur. Finally, by assessing the processes in place to resolve trade disputes, it was possible to obtain insight into the various risks and obstacles that could arise over the course of international trade. These findings provide an extensive overview of the present state of Certificate of Origin issuing and suggest areas where blockchain technology might be used to improve the process.

4 CONCEPT TO APPLY BLOCK CHAIN IN MONGOLIAN EXPORT AND IMPORT

4.1 Economic and trade relationship between Mongolia and Japan

4.1.1 Trade and Investment

Mongolia and Japan have had a long history of diplomatic and economic relations, dating back to 1972 when Japan became one of the first countries to establish diplomatic relations with Mongolia after its democratization. The two countries have since maintained close ties, particularly in trade and investment.

In 2016, Mongolia and Japan signed the Economic Partnership Agreement (EPA), which has further strengthened their economic partnership. The EPA is a comprehensive free trade agreement that includes a wide range of topics such as goods and services trade, investment, intellectual property, and government procurement.

Under the EPA, Japan has granted tariff concessions on a wide range of Mongolian goods, including beef, cashmere, and copper, which are key exports for Mongolia. In return, Mongolia has committed to liberalizing its market and creating a more business-friendly environment for Japanese investors.

The EPA has had a positive impact on trade and investment between Mongolia and Japan. In 2019, Japan was Mongolia's second-largest trading partner, with bilateral trade reaching $611 million. Japanese companies have also invested heavily in Mongolia, particularly in the mining sector, where they have helped to develop some of the country's largest mining projects.

However, there are still issues to solve in the Mongolia-Japan economic partnership. These include improving infrastructure and logistics, enhancing regulatory transparency and predictability, and promoting greater people-to-people exchanges.

4.1.2 Most traded goods and trade balance

Under the Economic Partnership Agreement (EPA) between Mongolia and Japan, the two countries have seen an increase in bilateral trade and investment. According to the Japan External Trade Organization (JETRO), Mongolia's exports to Japan mainly consist of mineral resources such as copper, coal, and iron ore. In contrast, Japan's exports to Mongolia include machinery, equipment, and electronic goods.

In terms of trade balance, Japan has traditionally maintained a surplus with Mongolia due to its large imports of mineral resources. However, under the EPA, the two countries are working towards achieving a more balanced trade relationship. The agreement has led to the elimination or reduction of tariffs on a wide range of products, including agricultural goods, industrial products, and textiles.

4.2 Economic partnership agreement between Mongolia and Japan: 2015 agreement

4.2.1 Goal

“The Economic Partnership Agreement” (EPA), a contract between Japan and Mongolia, aims to strengthen economic relationships through increased trade and investment. The EPA aims to reduce or eliminate trade and investment barriers, facilitate the flow of products and services, and create a more business-friendly environment. By lowering or eliminating tariffs on a wide range of goods and services, it aims to boost trade between Japan and Mongolia. As a result, it aims to stimulate Mongolia's economy by encouraging new company endeavors and job possibilities.

4.2.2 Free trade and customs tariff decrease

According to the EPA, goods and products which are in free trade and tariff decrease classified as follows (Table 4-1):

- If the goods of appropriate origin are marked “A” in the tariff line, the customs duties imposed on those goods shall be completely canceled on the date of entry into the EPA.
- If the goods of appropriate origin are marked “B10” in the tariff line, the basic custom duty imposed on such goods shall be reduced by the same amount every year for 11 years, and then zero.
- Assume that the Base tariff is 5% and the Tariff line is B10, it means that it will decrease by one percent every year for 10 years and will become 0% from the 11th year
- If the goods of appropriate origin are marked “R” in the tariff line, the Parties shall conduct negotiations on issues such as market entry in the exact year mutually agreed upon by the parties.

Table 4-1 Tariff

Tariff item code	Goods registration	Base tariff	Tariff line
HS 84	Machinery mechanical appliances, & parts	5%	B15
HS 95	Toys, games, & sports	5%	B10
HS 37	Photo & Movie and Goods	5%	B10
HS 54	Man-made filaments	5%	B5
HS 61	Knitted clothing accessories	5%	B5
HS 72	Iron & Steel	5%	B5
HS 42	Furniture of other materials	N/A	A
HS 94	Wooden furniture		R

Source: Adapted by Khuslen.G

4.2.3 Agreement on Certificate of Origin and how MNCCI issues it

EPA between Mongolia and Japan includes provisions for an Agreement on the Certificate of Origin. A Certificate of Origin, which confirms the origin of the items and entitles exporters to preferential tariffs under various trade agreements, is a requirement of the agreement for exporters. The items being exported are described in the certificate of origin, together with their place of origin, the exporter's name and address, and the country to which they are being shipped.

The Mongolian National Chamber of Commerce and Industry (MNCCI) has been issuing certificates of origin since 1990. According to the Law on the Mongolian National Chamber of Commerce and Industry (MNCCI), the MNCCI's responsibility to authenticate the origin of export goods includes the issuance of the Certificate of Origin. The Chamber verifies the origin of the goods and issues the certificate to the exporter, which can then be presented to the importing country's customs authorities to claim preferential treatment.

The Economic Partnership Agreement requires that the exporting Party's competent governmental authority issue a Certificate of Origin upon request from the exporter or its authorized agent. Additionally, the competent governmental authority of the exporting Party may designate other entities or bodies to issue Certificates of Origin under authorization given in accordance with applicable laws and regulations.

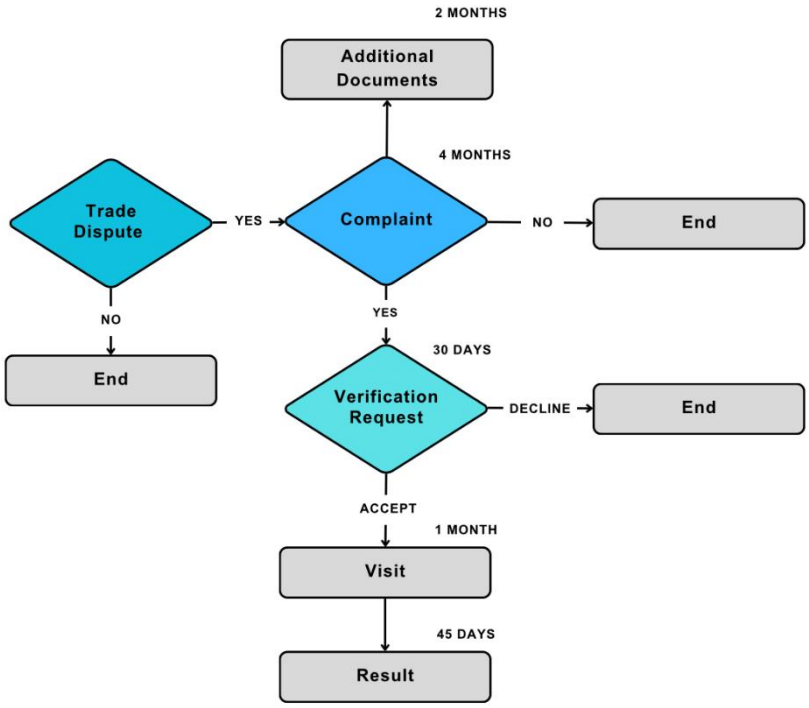
The Certificate of Origin is valid for **12 months** from the date of issuance and applies to a single importation of originating goods from the exporting Party into the importing Party. Before granting the Certificate of Origin, the responsible governmental entity or its designees must verify that the products to be exported qualify as originating goods of the exporting Party. The exporting Party must give the importing Party with specimen signatures and impressions of stamps used in the offices of the relevant governmental authority or its designees. The responsible governmental authority or its designees shall preserve a record of issued Certificates of Origin for **five years**, including any supporting documentation given to substantiate the exporting Party's qualification as an originating good. If the decision to issue a Certificate of Origin is canceled, the exporting Party's competent governmental authority must notify the exporter and the customs authority of the importing Party, except when the Certificate of Origin has been returned to the competent governmental authority.

4.2.4 Agreement on the Certificate of Origin related trade dispute settlement

In EPA, it includes provisions related to the settlement of disputes related to the issuance and verification of Certificates of Origin. In line with this Agreement and their respective laws and regulations, both Parties will help each other in verifying the information on a Certificate of Origin. For the purposes of determining whether a good imported from the exporting Party under preferential tariff treatment qualifies as an originating good of the exporting Party, the customs authority of the importing Party may request information related to the origin of the good from the competent governmental authority of the exporting Party on the basis of a Certificate of Origin.

4.2.4.1 Procedure

Figure 4-1 Trade Dispute Settlement Diagram



Source: Adapted by Khuslen.G

Figure 4-1 illustrates the overall schematic procedure of resolving the disputes in EPA. The Trade dispute settlement diagram explained as follows:

Pursuant to Article 18 of Chapter 3 of the EPA, to ascertain whether a good qualifies for preferential treatment, the customs authority of the importing Party may request information pertaining to the Certificate of Origin from the competent governmental authority of the exporting Party. Within four months of the request's receipt, the relevant authority of the exporting Party is required to provide this information.

If the customs authority of the importing Party requires additional information, they may request such information, and the government of the exporting Party is allotted a period of two months within which to furnish it. The exporting Party may request the exporter or producer of the goods to provide the information requested. If the customs authority of the importing Party remains unsatisfied with the outcome of the request, they may request further information from the exporting Party regarding the location and way the product was manufactured. A visit to the manufacturing site may be made to gather information and inspect the facilities by a representative from the relevant governmental authority of the exporting Party and the customs authority of the importing Party. The customs authority of the importing Party may request that the exporting Party undertake such a visit by sending a written communication to the exporting Party at least 40 days before the scheduled visit. The exporting Party is required to confirm receipt of the letter. The exporting Party shall respond in writing to the importing Party within 30 days of receipt of the communication. The competent governmental authority of the exporting Party is required, in accordance with the laws and regulations of the exporting Party, to provide the customs authority of the importing Party with the requested information within 45 days of the conclusion of the visit or any other mutually agreed period.

4.2.4.2. Time

Table 4-2 Dispute Resolution period

Trade dispute settlement			
Customs authority (i) to	Competent authority (e)	Request for CO	4 months
Customs authority (i) to	Competent authority (e)	Request for additional information	2 months
Customs authority (i) to	Competent authority (e)	Request for checking through visit, Deliver written communication	40 days
Competent authority (e) to	Customs authority (i)	Respond whether accept or refuse the visit	30 days
Customs authority (i) to	Competent authority (e)	Visiting and checking procedure	1 month
Competent authority (e) to	Customs authority (i)	Conclude information and provide results	45 days
			328 days

Source: Adapted by Khuslen.G

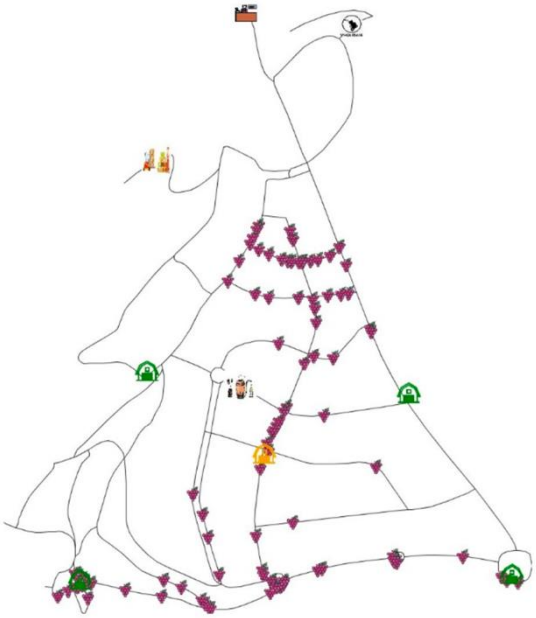
Taking into consideration all of these time periods, it has been observed that the resolution of a dispute regarding the origin of a single product may take a maximum of 328 days and a minimum of 180 days to solve (Table 4-2).

4.3 Current cases:

4.3.1 Supply chain case using blockchain

The case study provided in the Blockchain-Based Wine Supply Chain for the Industry Advancement paper[2] and it is a qualitative analysis of the wine supply chain, comparing traditional and blockchain-based supply chains, and uses two embedded units to provide a more precise understanding of the actors and their relationships. The ABMS tool, specifically the open-source GAMA software, is used to simulate complicated interactions among stakeholders and illustrate case study outcomes. The ABMS tool is selected based on its ability to model complex systems and to visualize simulation results, making it suitable for studying the wine supply chain. The simulation and model of the wine supply chain were developed using the results of the ABMS study and the software GAMA.

Figure 4-2 Supply Chain Simulation Model



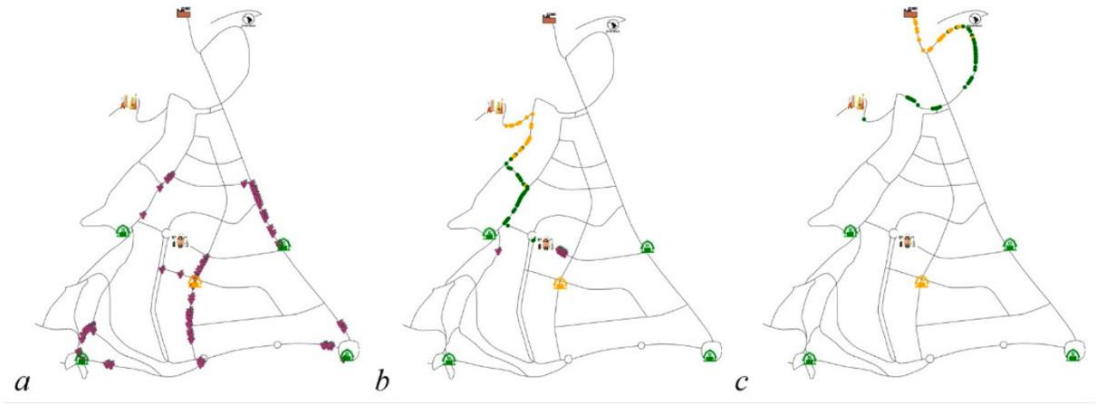
Source: Taken from Adamashvili N, State R, Tricase C, Fiore M. Blockchain-Based Wine Supply Chain for the Industry Advancement. Sustainability. 2021 Dec;13(23):13070. doi: 10.3390/su132313070.

The supply chain simulation model (illustrated in Figure 4-2) takes into account various participants such as farmers, processors, distributors, wholesalers, and retailers. Each has particular roles in logging information pertaining to grape variety, conversion processes, packaging, and internal operations. When a blockchain is utilized in the supply chain, every participant documents or associates all relevant details on a decentralized ledger. This includes

2 Adamashvili N, State R, Tricase C, Fiore M. Blockchain-Based Wine Supply Chain for the Industry Advancement. Sustainability. 2021 Dec;13(23):13070. doi: 10.3390/su132313070.

unique identifiers like QR codes for the finished product, containers, and boxes to facilitate efficient product tracking and tracing in the event of substandard goods. The simulation indicates that tracing a product back to its initial provider is time-consuming, however, a supply chain built on blockchain demonstrates a more proficient and effectual method for recalling products of inferior quality (as seen in Figure 4-3). The simulation considers factors such as the availability of grapes, quantity of produced wines, and wine quality, as well as the time units for each scenario. According to the result, the time units needed to recall the low-quality products using blockchain-based system is about 1/300,000 of the time it takes using the traditional system.

Figure 4-3 Tracking Errors



The path from vineyard to retailer (a) path from wineyards to grape growers, producer company and distributor; (b) path from producer company from distributor; (c) path from distributor to wholesaler and retailer.

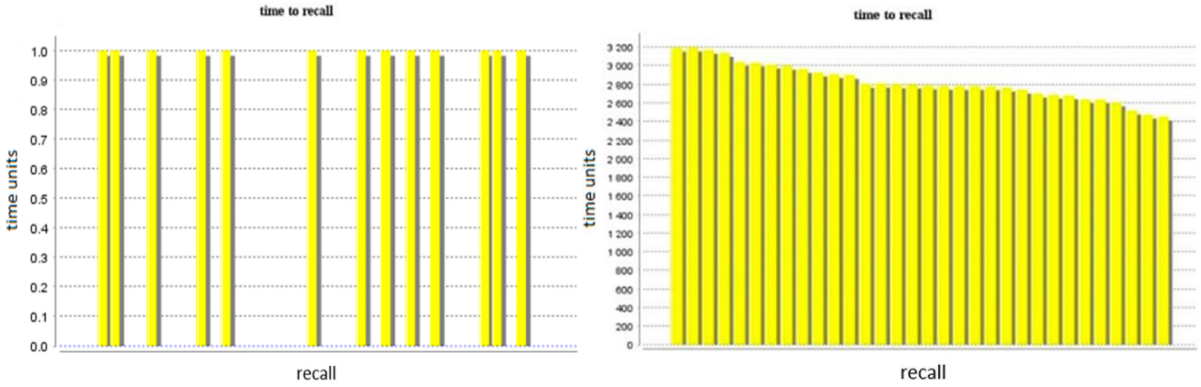
Source: Taken from Adamashvili N, State R, Tricase C, Fiore M. Blockchain-Based Wine Supply Chain for the Industry Advancement. Sustainability. 2021 Dec;13(23):13070. doi: 10.3390/su132313070.

Figure 4-3 shows the typical process of the supply chain. A processor/manufacturer receives grapes and turns them into wine, which is sold to a distributor, then a wholesaler, and finally a retailer who sells it to consumers. If a customer complains about low-quality wine, the retailer returns it. To avoid having to recall all the wine from the same batch, the company needs to identify which farmer provided the low-quality grapes. By doing so, they can remove only the bad wine from the market.

As a result (Figure 4-4), the time units needed to recall the low-quality products using blockchain-based system is about 1/300,000 of the time it takes using the traditional system.

Figure 4-4 Recall Time Comparison

(a) Traditional Suppy chain **(b)** Blockchain-Based Supply chain



Source: Taken from Adamashvili N, State R, Tricase C, Fiore M. Blockchain-Based Wine Supply Chain for the Industry Advancement. Sustainability. 2021 Dec;13(23):13070. doi: 10.3390/su132313070.

What blockchain does is that it gathers all the information in the ledger. It ensures the transparency of all processes and allows the product to be tracked and traced across numerous tiers.

4.3.2 Block chains and ledger creation needs

Maersk and IBM have been collaborating on developing cargo tracking and digitalization applications for international trade. This collaboration, together with the participation of other industry players, has enabled the development of a blockchain-based platform that provides real-time visibility and tracking of container shipments to all supply chain members, enhancing dispute management.

By integrating all participants into the blockchain application and digitizing document workflows, Maersk and IBM have ensured that all documents and activities in the supply chain are visible to every partner. This has resulted in reduced direct communication, disputes, waiting times, and faster information transactions. In addition, because this system is decentralized, all information is accessible at any time, decreasing delays and different sorts of fraud.

According to Marine Transport International, blockchain could save up to $300 per container in labor and document processing costs. Given that approximately 70 million containers are shipped worldwide every year, these savings could be substantial.

By the end of 2017, Maersk and IBM planned to obtain data from 10 million containers. Additionally, blockchain could optimize the use of empty containers by providing wider access to their availability at nearby ships or ports. The potential of blockchain has also been recognized by two of the biggest European ports, Rotterdam and Antwerp.

Blockchain technology is projected to spread widely to other modes of transportation in the future, where it can be combined with existing telemetry technology to facilitate secure and transparent information exchange for fleet management in the long term.

4.3.3 Blockchain-based Certificate of Origin

A blockchain-based Certification of Origin would involve creating a digital Certificate of Origin that is securely stored on a blockchain network. As for my understanding, this digital Certificate of Origin would contain all the necessary information about the origin of the goods, HS codes, the exporter, the importer, and other relevant details expressed as codes and stored in the distributed ledger (Figure 4-5). This results that the blockchain-based certification process would make the processing faster by paperless, and less costly. Additionally, it can contain relevant information about supply chain members such as Distributors to Raw material which could be added as a code in this barcode. In this case, when dispute occurs, blockchain technology can enhance the ability to trace and track the errors by combining and encoding international trade and supply chain network information.

Figure 4-5 Tracing goods by 256 digits encryption

- (Harmonized System (HS) code or tariff classification of the goods)-8508700090
- GTIN (GLN and SSCC)-012345678905
- Exporter's name, address and country-05
- Importer's name, address and country-06
- Price claim number, date-456257
- Packaging, number, product name definition-547895
- Certificate number-556456
- Origin of goods-953256
- Criteria of origin-458756
- Distributor-4521
- Retailer-5433
- Manufacturer 1-7877
- Manufacturer 2-6541
- Raw Material-768531

4.3.4 How can blockchain technology impact preferential goods in FTAs

Blockchain technology can play a significant role in improving the tracking and tracing of preferential goods under the Mongolia and Japan EPA. Let’s take an example. Let's say that a Mongolian company produces felted wool products, such as blankets and rugs, using Mongolian sheep wool. These felted wool products might be eligible for preferential treatment under the Mongolia-Japan EPA, as they are produced in Mongolia and contain Mongolian wool, which is a key input. To qualify for lower tariffs, the felted wool products must meet certain rules of origin criteria, such as a minimum 40% (This is determined by the Qualifying Value Content mentioned above in the Literature Review) of Mongolian content and value added in Mongolia. All parties concerned can have a shared and transparent understanding of the product's path from Mongolia to Japan by using blockchain technology to track and trace the transportation of these felted wool products. This can help to ensure that the felted wool products are authentically preferential commodities that are eligible for lower tariffs under the FTA and that they satisfy the rules of origin requirements. Additionally, blockchain can provide enhanced security and auditability, which can help to prevent fraud and ensure compliance with the rules of origin and other requirements of the agreement. Importers can be more confident in the product's origin by using blockchain technology to track and trace the shipment of these felted wool items, and exporters could benefit from lower tariffs, more efficiency, and compliance improvements.

4.3.5 Blockchain-Based GS1 supply chain system

GS1 has been examining the potential use of blockchain technology in supply chain management and participated in a number of projects and initiatives that have used blockchain to improve supply chain visibility and traceability.

The Food Trust Framework, established by GS1 Australia in collaboration with IBM and other industry stakeholders, is one illustration. The framework enables end-to-end traceability and visibility of food products throughout the supply chain, from farm to table, using blockchain technology and GS1 standards. The system improves transparency and confidence in the food supply chain by enabling consumers to access information about the production, processing, and distribution of food products.

How Blockchain can benefit GS1

Even though GS1 usually track goods with product key identifiers (GTINs, GLNs and SSCCs) and barcodes, which is enough for the normal processes but when it concerns quality goods and pharmaceuticals and health issues, there are a limitation to these technologies that blockchain could resolve.

One disadvantage could be that the data connected to these identifiers is frequently corrupted and manipulated, making it challenging to have an in-depth comprehension of the complete supply chain. This can lead to inefficiencies, and delays in the supply chain's operation and make it more difficult to identify and solve problems such product recalls and counterfeiting.

By offering a platform for securely storing and exchanging data along the whole supply chain, blockchain technology can overcome these restrictions. With blockchain, all participants may instantly access the same accurate information and can use a consensus process to confirm the accuracy of the data.

Depending on the demands of the supply chain system, GS1 can be integrated into blockchain technology in a variety of ways. One approach is to encode GS1 identifiers such as GTINs, GLNs and SSCCs (Mentioned in Chapter II and Fi) on the blockchain, which can be accomplished using smart contracts that trigger transactions and record data in a secure and immutable way.

4.4 Implication of Block chain for trade dispute settlement and expected benefits

4.4.1 Ease for using blockchain in international supply chain

Blockchain has the potential to revolutionize international trade. Blockchain can streamline the trade dispute resolution process and bring several benefits for multinational supply chains by providing a decentralized, secure, and transparent log of transactions.

Through the shared ledger that contains all important information about a transaction, blockchain technology can help parties resolve trade disputes more quickly and efficiently. Parties can assess the data to help discover the source of the issue.This can help avoid costly legal proceedings and lead to faster resolution. Blockchain technology can help automate compliance processes, reducing the administrative burden and costs associated with complying with international trade regulations.

4.4.2 Efforts saving

In addition to the fact that blockchain technology can resolve trade disputes quickly and effectively, reduce human intervention, time waste, and prevent illegal activities.

4.4.3 Time saving

According to my calculations in EPA, it appears it takes a maximum 328 days and a minimum of 180 days to resolve a dispute by checking the Certificate of Origin of just one item. However, by using a decentralized database, we can reduce this time by several times from 328 days to 30 days, and even within 7 days.

4.4.4 Clarity and consistency

In the event of a dispute, the original ledger document can be retrieved from the decentralized database, because the relevant nodes are always active, and the data is unable to be deleted or changed. This is because each node in the network has a complete copy of the ledger records, and the consensus mechanism ensures that any changes to the ledger are recorded in a transparent and verifiable manner.

Retrieving the original ledger document from the blockchain database may require the use of specialized software tools and technical expertise, as the ledger records are stored in a specific format and may require decryption or other processing to access.

4.4.5 Smart contract

Another option when solving dispute is Smart contract. It is Blockchain's fundamental feature which automate and enforce the terms of agreement between the parties involved. Smart contracts are self-executing contracts with the terms of the agreement between the parties directly written into code and are therefore automated and enforceable without the need for intermediaries. For our case, assume that dispute arises over the origin of goods or quality. When a dispute is raised, the smart contract can be programmed to immediately activate a quality verification process, in which a customs authority receives notice to check the products in concern. The responsible authority would afterwards submit a report detailing the results of the smart contract. The smart contract might then automatically enforce the conditions of the agreement based on the findings of the inspection report. For instance, if the items are deemed to meet the EPA's quality standards, the smart contract could release payment to the exporter's side. There is no need to check in person and speed up the process.

4.5 Analysis and findings

Based on my observations, it is clear that verifying the origin of commodities and resolving issues in the **Economic Partnership Agreement** requires a significant amount of time, approximately 12 months. This can result in inefficiencies, delays, and cost increases for all parties involved. However, by implementing blockchain technology, it is feasible to dramatically minimize this time and increase supply chain management efficiency. Furthermore, higher duties and taxes are paid in the EPA due to the uncertainty regarding the provenance of commodities. Blockchain can fix this by fully determining the originating items, whether they are preferential or non-originating, and so on.

In terms of **international trade**, blockchain could digitalize Certificates of Origin by creating a secure and tamper-proof digital ledger of Certificates of Origin data. Blockchain can also streamline the process of verifying product origin, reduce paperwork, and reduce the risk of fraud or errors in documentation.

As for **Supply chain**, integration of GS1 and blockchain technology has the potential to transform the supply chain industry by providing improved transparency, traceability, and authenticity of products. By leveraging GS1 identifiers like GTINs and blockchain's secure, decentralized ledger, companies and organizations can track products from origin to destination, ensuring that products are authentic, safe, and compliant with regulatory requirements.

In contrast, a **ledger** can provide a comprehensive and dependable record of a product journey. In the event of a dispute, a ledger can help to resolve it. By using complex code, it is possible to trace the product's journey and determine its origin, identify any discrepancies or issues, and pinpoint where they occurred. This can help to facilitate prompt resolution of the dispute and ensure that the product's journey is accurately recorded.

5 CONCLUSION AND RECOMMENDATION

5.1 Conclusion

In conclusion, this thesis has demonstrated the transformative potential of blockchain technology in supply chain management by addressing trade disputes, streamlining the process of obtaining and verifying origin of goods. Thus, I have established the relevance and usefulness of blockchain in increasing transparency, time savings, and traceability across supply chains in international trade through a thorough review of numerous case studies, real-world implementations, and theoretical frameworks.

The use of blockchain technology has shown to be an effective method for resolving trade disputes, which often come on by limited access to information and miscommunication in the Free Trade Agreements. Blockchain technology has the potential to reduce the incidence and severity of trade disputes in international trade by providing a decentralized, open, and secure system for data storage and administration. This is accomplished through facilitating the communication of necessary data in real-time between stakeholders, raising accountability, and encouraging cooperation across various supply chain participants. Additionally, this thesis has made clear the significance of identifying the country of origin of commodities in global trade as well as the difficulties in collecting and confirming vital documents. Blockchain technology can digitalize the Certificate of Origin, offering an efficient and secure means of issuing, storing, and verifying the authenticity of these documents.

Blockchain technology provides a promising result for streamlining supply chain procedures, reducing trade disputes, and assuring the authenticity of Certificates of Origin at a time when the world is still struggling to deal with trade dynamics that are becoming more complex and the need for sustainable business practices. Businesses, governments, and other stakeholders must work together and invest in the required infrastructure, learning, and legal frameworks to enable a successful transition into the future of supply chain management in order to fully exploit the potential of this "blockchain" technology.

5.2 Recommendation

5.2.1 Supply chain mapping

In this thesis, I illustrated overview of the supply chain and general understanding of the product tracing and tracking by using Innovative technology “Blockchain”. Although practical research is necessary it is suggested that the impact of supply chain mapping on supply chain performance be studied. Case studies and survey data could be utilized by research to examine how blockchain-based supply chain mapping can improve supply chain performance by detecting bottlenecks, lowering lead times, and increasing transparency.

Additionally, the research could explore the potential barriers and challenges in implementing supply chain mapping, including data collection and analysis, stakeholder collaboration, and resource allocation using Blockchain. By addressing these issues, the study could provide practical recommendations for organizations seeking to improve their supply chain performance through blockchain-based supply chain mapping.

5.2.2 Ledger decentralized database creation

To effectively utilize blockchain, organizations must establish a well-structured data architecture that accommodates the unique requirements of decentralized ledger databases. A robust data architecture offers efficient data storage and retrieval, effective access control, and facilitates data management, providing the foundation for successful implementation of a decentralized ledger database. However, there is a still unsolved question for blockchain platforms. Organizations will all need to join into a decentralized database to be a permissioned member. Also, if all companies exchange information through blockchain, what will happen to companies and SMEs that cannot implement blockchain. Personally, I believe that further research and studies could explore the practical implementation of a decentralized database in different industries and real-life use cases.

Another potential problem for research could be the legislative and legal consequences of decentralized ledger databases, including the development of regulatory frameworks that support innovation while protecting consumers and stakeholders. Especially, in Mongolia, lacks strict regulations on blockchain, and cryptocurrencies.

5.2.3 Organizational issues

The potential impact of blockchain technology in disrupting established power structures is a significant issue that must be considered. Many large global corporations and institutions have a keen interest in preserving their established hierarchies and may resist the implementation of blockchain technology, which could threaten their existing business models. Moreover, the decentralized nature of blockchain technology challenges the traditional centralized power structures and raises concerns about the potential loss of control over the data and processes. This resistance and fear of disruption may prevent organizations from fully exploring and exploiting the potential benefits of blockchain technology in their supply chain management systems in Mongolia. Therefore, it is crucial for organizations to carefully consider the potential implications of implementing blockchain technology and take steps to address any concerns and challenges that may arise during the adoption process.

Another significant organizational issue that organizations may face when adopting blockchain technology is resistance to change. This resistance can stem from employees and stakeholders who may lack understanding or have a fear of the unknown. Such resistance can create roadblocks in the adoption and implementation of blockchain technology, affecting the organization's ability to benefit from its potential advantages. Change management is necessary to reduce the resistance of the employees and the barriers resulting from the human origin. Based on this analyzation, further research suggestion can be proposed. Since, this topic is a considerably new one, especially in Mongolia. In my perspective, it is important to do practical research on employees' reaction on implementation of "Blockchain" based on experts' interviews and studies.

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