

Block Trade:

A Revolutionary Duo Of Supply Chain And Blockchain Technology

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1. Abstract

Blockchain is a distributed, decentralized, immutable, public ledger. In simplest terms, Blockchain is a time-stamped series of immutable records of data that is managed by a cluster of computers not owned by any single entity. Each of these blocks are secured and bound to each other by using cryptographic principles (i.e chain). Logistics are the backbone of global trade with a significant number of stakeholders participating in a complex supply chain system. Furthermore, the shipping documents are valuable assets circulating in the supply chain system, creating bottlenecks in terms of cost, time, trust, and privacy [1]. Therefore, the distributed, immutable, and scalable nature of the blockchain technology solves the current flaws of the supply chain system. Block Trade aims to build an ecosystem which will bring all the authorities, organizations, carriers, banks and freight forwarders on a single platform. Our main goal is to develop automating processes, creating information pipelines, checkpoint tracking of shipment and building paperless trade. Through this secured ecosystem the concerned authorities will be able to view the documents and verify the authenticity of the document.

2. Motivation

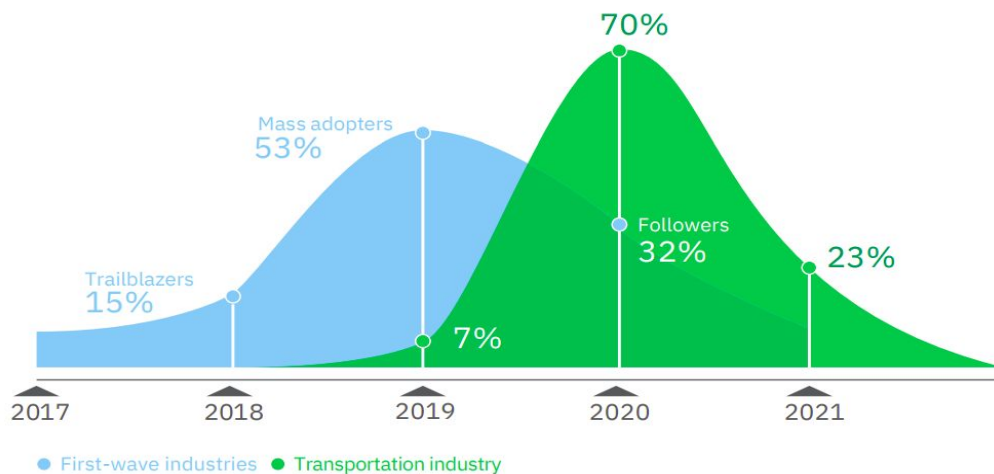
In the rapidly evolving environment of the international supply chain, the traditional network of manufacturers and suppliers has grown into a vast isolated system made of various products that move through multiple parties and require cooperation among stakeholders [3]. Current supply chain networks are bottlenecked due to their inability to simultaneously provide crucial data to all stakeholders. This leads to communication gaps and delays and extra costs for all parties involved in the system. Blockchain networks are inherently capable of combating this problem since they enable all participants to have access to the same information at all times.

Additionally, the demand for improved product visibility and source-to-store traceability has never been higher. However, traditional data sharing procedures in today's supply chain are inefficient, costly, insecure and unadaptable as compared to new and innovative technologies. The characteristics of blockchain architecture seem to be a good solution for many of the identified problems in the supply chain namely it's transparency, immutability, scalability.

Blockchain is the perfect solution to achieve authentic traceability of a supply chain, hence bringing about greater trust between stakeholders in an ecosystem [3]. At the same time they are a secure, incorruptible and immutable way to store information increasing the data integrity of a given supply chain. Furthermore, all data on a blockchain network is always accessible to anyone who has permission, and is within the blockchain network. In a nutshell, blockchain technology is equipped to overcome the inefficiencies of traditional supply chain networks, thereby incentivizing the existing supply chain networks to go fully digital.

3. Introduction

Our world has experienced four considerable industrial revolutions. Industry 4.0 is the transformation of the ways that goods are designed, produced, distributed, and the financial payment in the process. One of the most disruptive technologies of Industry 4.0 is Blockchain. In its most basic form, Blockchain is a chain of blocks that hold information, these blocks are linked by cryptography. It is a technique which intends to timestamp digital documents so that they are highly secure, verifiable and can't be tampered. Type of data which is stored in these blocks depends upon the blockchain and the goal it's trying to pursue. According to the World Economic Forum (WEF) prediction, 10% of the global GDP will be stored on blockchain technology by 2027. The following figure shows the timeline of blockchain adoption waves [1].



Timeline Of Blockchain Adoption

The supply chain management is a process of managing a chain or network of activities, individuals, procedures, organizations, and resources that are involved in the execution of the flow of materials from the supplier for its distribution to customers in the most economical way. The supply chain plays a crucial role in modern businesses by allowing them to achieve efficiency, responsiveness, and success. Over the past several decades, the scale of businesses has expanded, the number of geographic locales involved in the production process has grown, and product portfolios have diversified. As a result, the supply chain has grown from a traditional network of manufacturers and suppliers, to a vast ecosystem made of various products that move through multiple parties and require cooperation among stakeholders. Furthermore, shipping documents are significantly valuable in global trade. The old practice, which is an isolated system, might result in lack of agility, fraudulent activities, disputes, and intermediation. The inefficiency of data sharing in current supply chain networks has dramatically impacted the operations of retailers and manufacturers. Blockchain's three main properties; Transparency, Immutability, Scalability help supply chain management in numerous ways.

The transparency in supply chain management provides the companies with a clear view of all the information and data with manufacturers, vendors, retailers, and customers. The immutability of Blockchain technology eliminates the corruptible aspect in the supply chain, so no fragmented data or miscommunication can occur. Blockchain adds security to the system, by not letting any third party access the information entered by the workers of an organization. Blockchain technology has the potential to revolutionize traditional supply chain networks and thus helping to achieve greater friction-less commerce within an ecosystem.

4. Overview

There is no doubt that blockchain technology has started a new era in the internet and the online services. Blockchain has transformed the system of how we keep records. Our main motivation in this project is to create an ecosystem which will bring all the authorities, organizations, carriers, banks and freight forwarders on a single platform. Through this secured ecosystem, the concerned authorities will be able to view the documents and verify the authenticity of the document.

○ **Significance of the Project**

Block Trade is an interconnected ecosystem bringing all the supply chain participants on a single easy-to-use platform. It will help the exporter to connect with the most suitable carriers and agents in just a few clicks. It will also maintain a database for specific organization in which its authenticity is preserved. Our product will free its users from the legacy data systems and manual document handling.

○ **Description of the Project**

As told in the previous sections, Block Trade connects all the members of the supply chain on a single platform, provides checkpoint tracking of the shipment, also the authorized participant to upload the documents related to any event. It also gives the participants rights to update the planned and actual events of the shipment. Any exporter organization can find the suitable agent, freight forwarder, ocean carrier and even insurance company. All the records and customer reviews will be maintained to further help the exporter in selecting the best service provider.

○ **Background of the Project**

A review of background material that you found, or was provided for the problem. It should contain full citations of articles, books, software packages, www and other media.

A lot of information was gathered from various sources:

1. Books:

- a. Donald Waters - Logistics_ An Introduction to Supply Chain Management-Palgrave Macmillan (2003)
- b. Stadtler Hartmut - Supply Chain Management and Advanced Planning Concepts Models Software and Case Studies-Springer (2004)
- c. <https://www.intechopen.com/books/computer-security-threats/deploying-blockchain-technology-in-the-supply-chain>

2. Websites:

- a. <https://www.blumeglobal.com/learning/supply-chain-ecosystem/>
- b. <https://xord.one/blockchain-revamping-supplychain/>
- c. <https://www.intechopen.com/books/computer-security-threats/deploying-blockchain-technology-in-the-supply-chain>

3. Research Papers/ Articles:

- a. <https://hbr.org/2020/05/building-a-transparent-supply-chain>

○ **Project Category**

Our project is a product based project which would be delivered in the form of a web application.

5. Features / Scope / Modules

Our Product will have the following features:

- Registering your organization on the ecosystem
- Updating your organization type and services (with costs)
- Choosing the best/suitable service provider
- Choosing the insurance/funds provider
- Uploading/viewing documents.
- Setting the shipment plan
- Getting checkpoints update of the cargo
- Surrendering/discharging cargo on a single click
- Email notification
- Blockchain integration to preserve the integrity of the documents
- User rating

6. Literature review

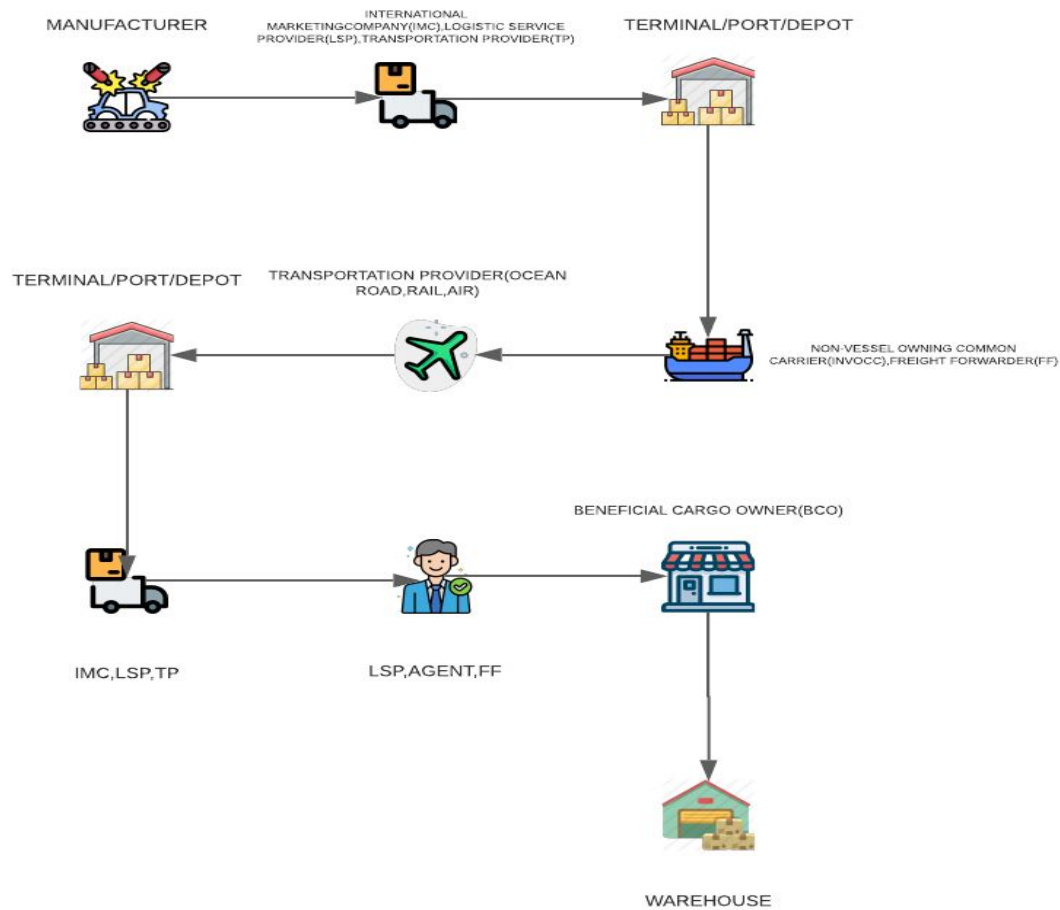
“Blockchain is a type of business transaction ledger. A blockchain network is a decentralized system for the exchange of assets. It uses a shared ledger (that is either public or private) for recording the history of electronic business transactions that take place in a peer-to-peer (P2P) business network. A blockchain network may use proof of work, or another consensus mechanism, as a basis of trust, accountability, and transparency, instead of relying on a third-party mediator financial institution or actor [4].”

Nowadays, The complexity of supply chains is increasing. Due to the misconception around supply chain management, many organizations cannot understand the overview of their supply chain management. Lack of transparency, agility, and traceability and problems in security and authenticity are among the challenges of supply chain mechanisms [5]. All the parties in the supply chain management have limited access to information across the supply chain which results in fraudulent activities, high cost, and time consumption [6]. According to the article published by Kshetri et al. (Kshetri, 2018) blockchain makes an effective contribution to reach the objectives of cost, risk reduction, sustainability, dependability, speed, and flexibility[7].

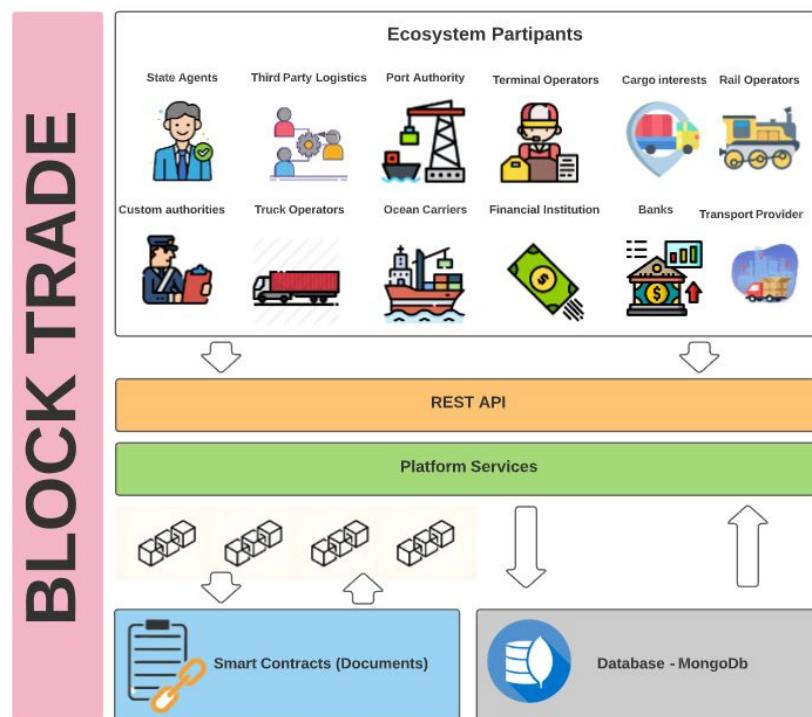
One of the main applications of blockchain technology is the ability to track and validate all the transactions and actions performed in the supply chain management system [5]. Furthermore, traditional information sharing frameworks like EDI or ERP are expensive and unrealistic due to time delays among agents [5]. Thus, blockchain uses another concept, every node in the network can have access to distributed ledger containing the past transactions. Besides, the consensus among nodes will be conducted on the current status of the ledger and this feature will pave the way for information consistency [8].

However, considering the above functionalities of blockchain in the supply chain management, blockchain is not a mature technology yet [5]. Hence, Shallow knowledge about blockchain in industry and new technology adaptation risks could be reasons for the gap between blockchain potential and supply chain realization [9].

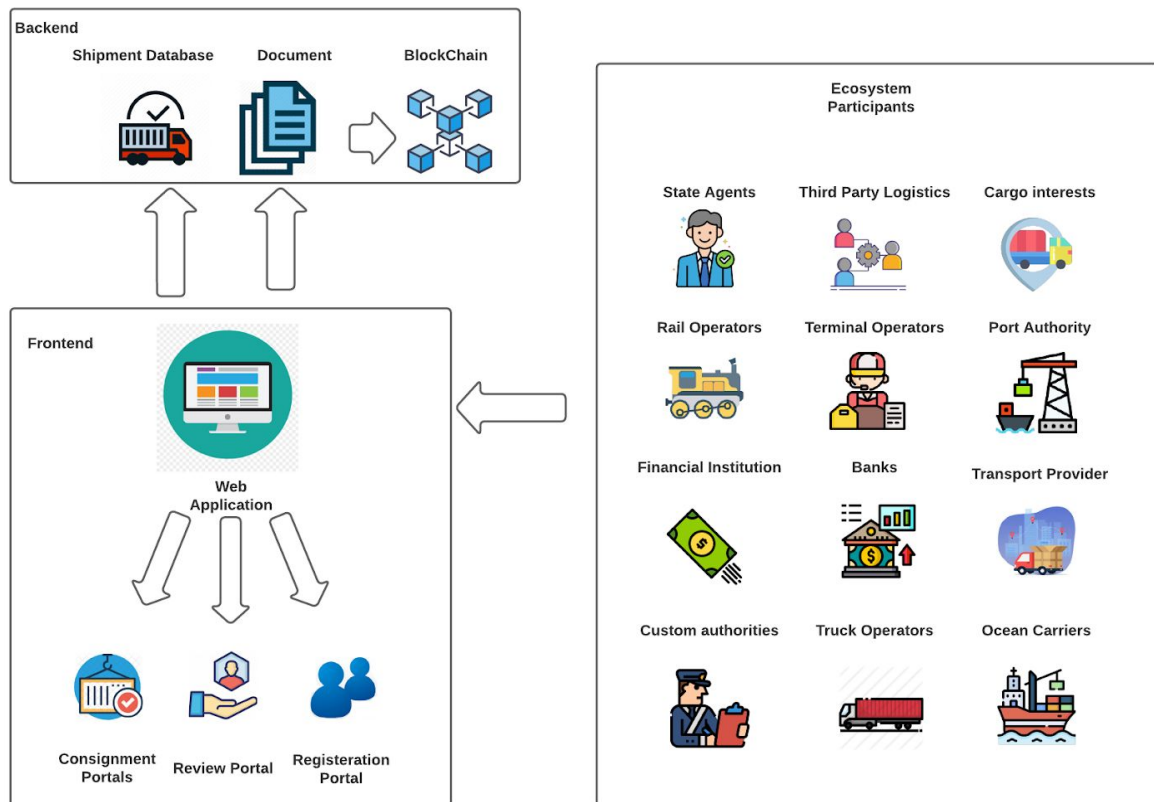
7. Product Lifecycle



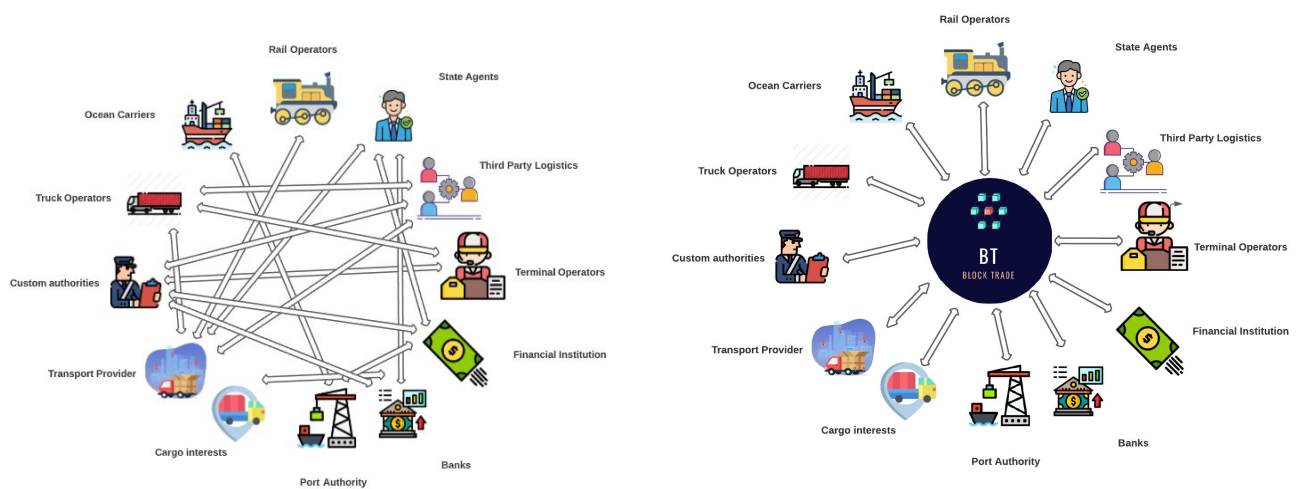
8. System Architecture:



9. System Model



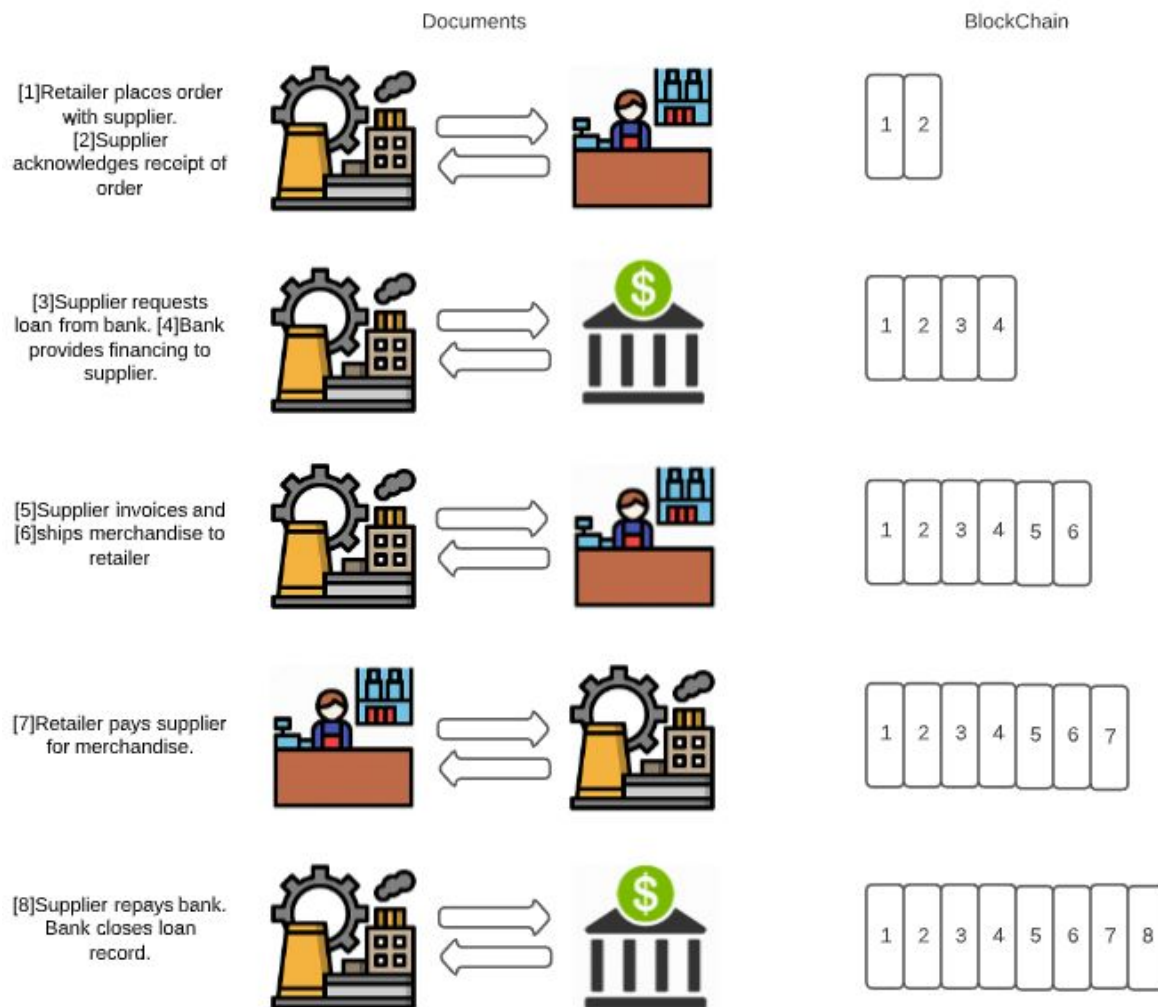
10. Ecosystem



11. Documents involved

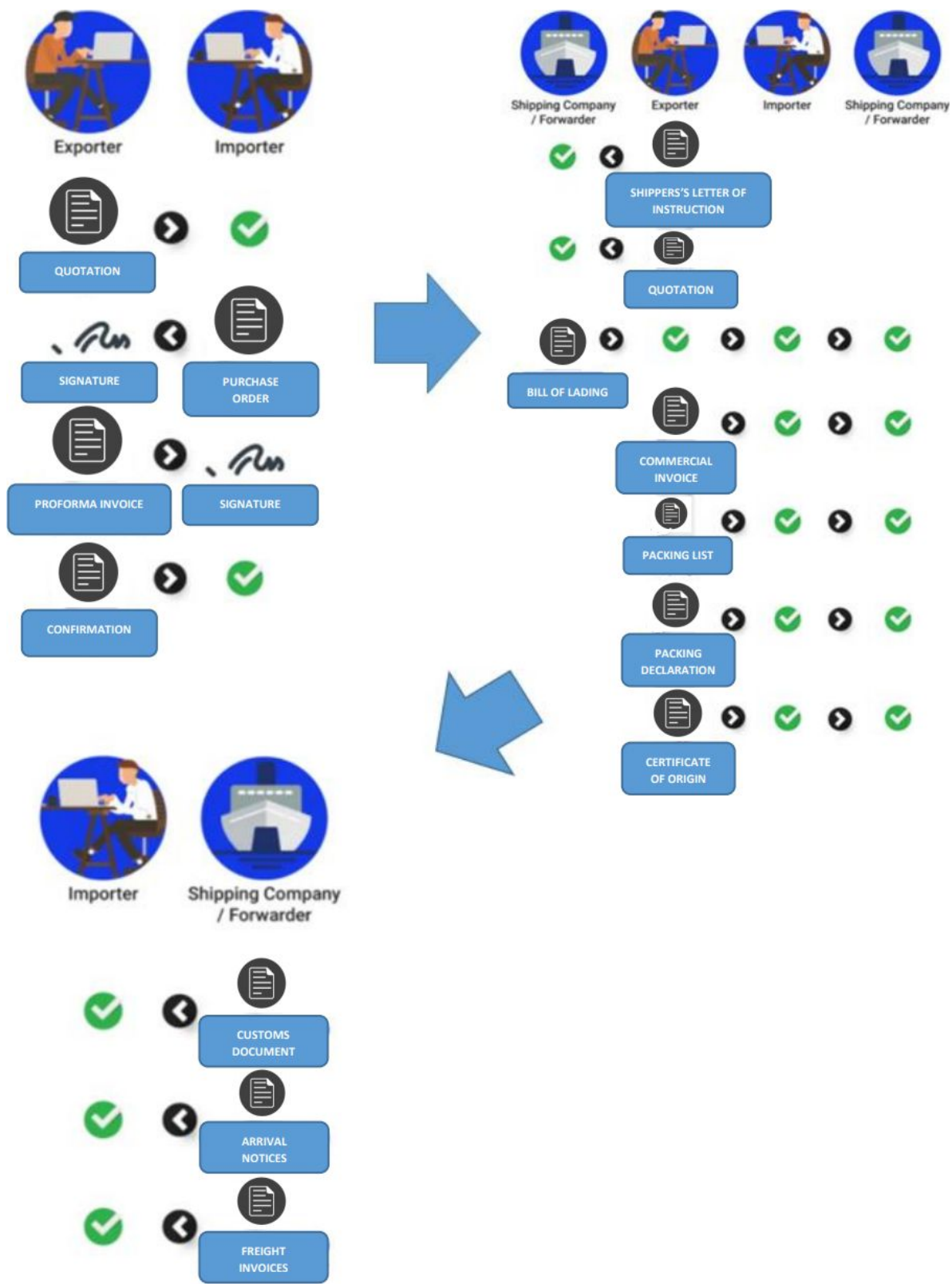
1. Packing list: Information needed for transportation process
 - a. Invoice
 - b. Buyer
 - c. Consignee
 - d. Country of Origin
 - e. Transport Date
 - f. Delivery Destination
 - g. Shipping and container marks
 - h. Weight
 - i. Volume
2. Original Bill of Lading: Versatile document recording the receipt of goods
 - a. Short description of cargo loaded
 - b. Name and Place of Business of Carrier
 - c. Name of Shipper
 - d. Consignee
 - e. Date and Name of Port of Loading
 - f. Port of discharge
3. Non-Negotiable Bill of Lading: Only the person named in this document can claim goods.
4. Advance Declaration
5. Pre-Paid Invoice: Document used to record advance payments from suppliers or clients.
6. Certificate of Origin: Document, certifying that goods are from a particular country.
7. Shipping Instructions: Document providing details needed to process your shipment.
8. Importer Security Filing: is a filing required by the CBP that documents importing information and details, as shipments pass from point to point.
 - a. From the importer or supplier:
 - i. Manufacturer (or supplier) name and address
 - ii. Seller (or owner) name and address
 - iii. Buyer (or owner) name and address
 - iv. Ship-to name and address
 - v. Container stuffing location
 - vi. Consolidator (stuffer) name and address
 - vii. Importer of record number / foreign trade zone applicant identification number
 - viii. Consignee number(s)
 - ix. Country of origin
 - x. Commodity Harmonized Tariff Schedule number for each product on the shipment
- b. From the carrier:
 - i. Vessel stow plan
 - ii. Container status messages
9. Cargo Specific Certificate
10. Custom Clearance
11. Commercial Invoice: Legal document between the supplier and the customer that clearly describes the sold goods, and the amount due on the customer.
12. Export Documentation: A document that states that permission has been given to export something legally
13. Import Documentation: A document that states that permission has been given to import something legally

12. Document addition in blockchain

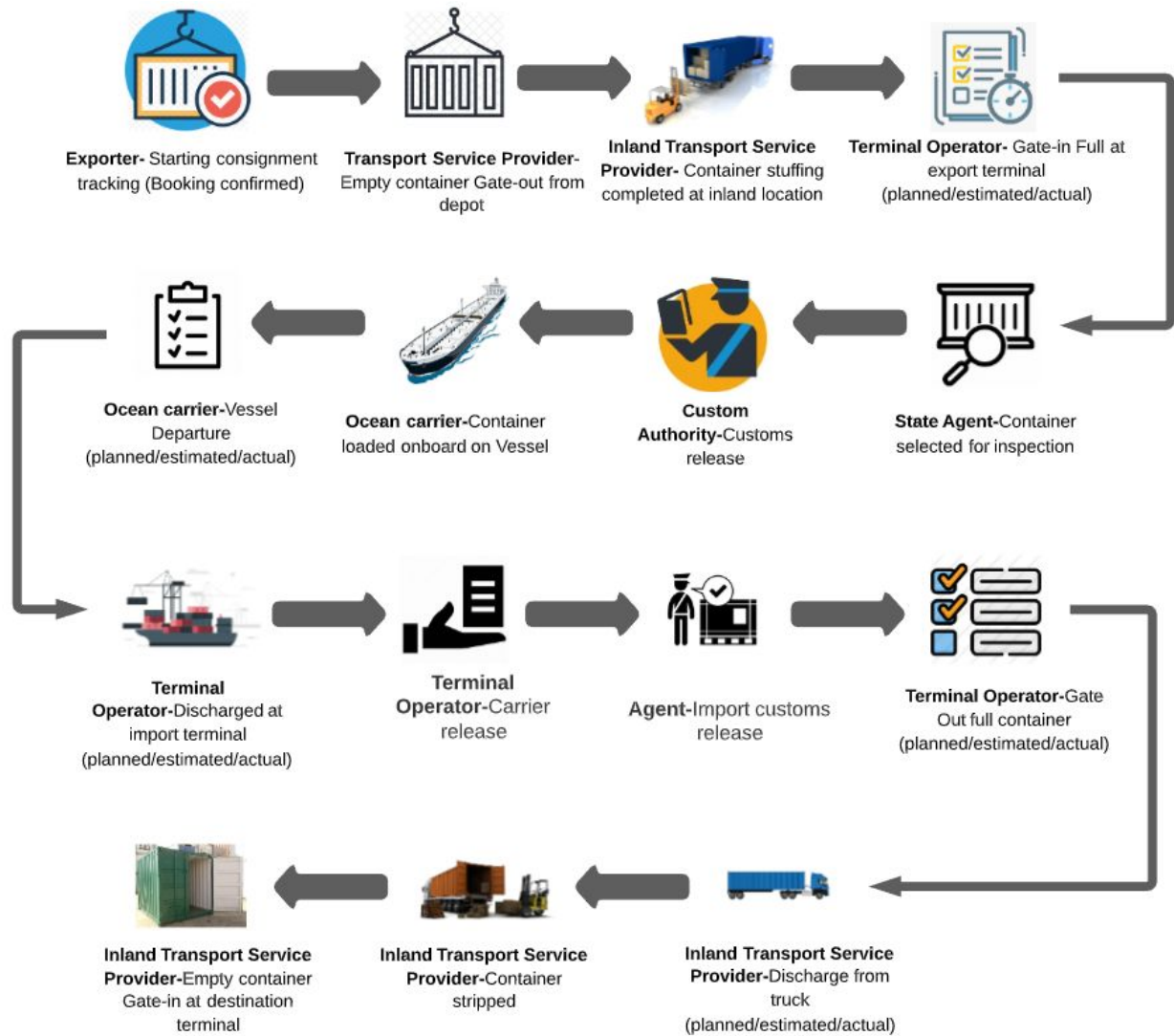


13. System flow diagram

System flow showing document interaction:



System flow diagram showing participant interaction:



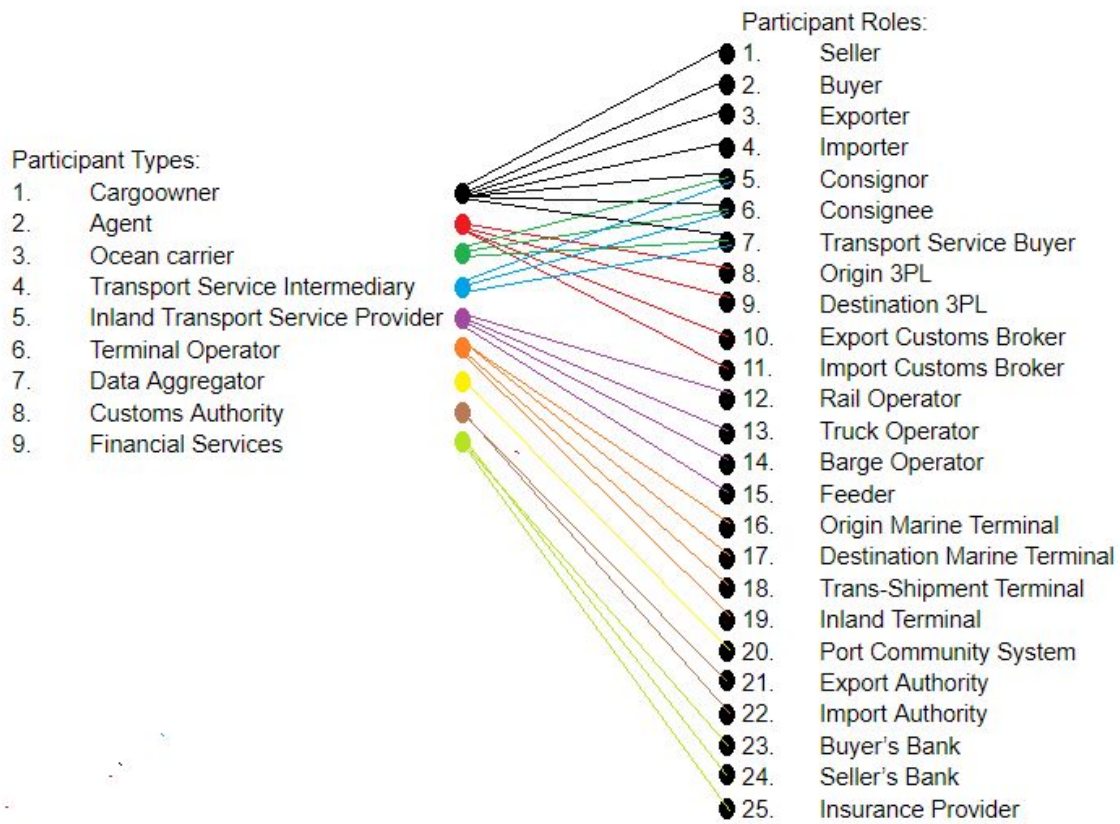
14. Registering a User

Selecting Participant Types:

1. **Cargo owner:** Party that is involved in transaction of consigned cargo.
2. **Agent:** Organization that acts on behalf of cargo owner for logistics, transport and clearance of cargo.
3. **Ocean carrier:** Operator that carries cargo from load port to discharge port.
4. **Transport Service Intermediary:** Provides transportation vy subcontracting.
5. **Inland Transport Service Provider:** Provides inland haulage services.
6. **Terminal Operator:** Party involved in loading and unloading consignment cargo.
7. **Data Aggregator:** Maintains and makes available supply chain related data.
8. **Customs Authority:** Party responsible for collecting tariff and for controlling flow of goods.
9. **Financial Services:** Institution that provides financial services related to consignment cargo.

Selecting Participant Roles:

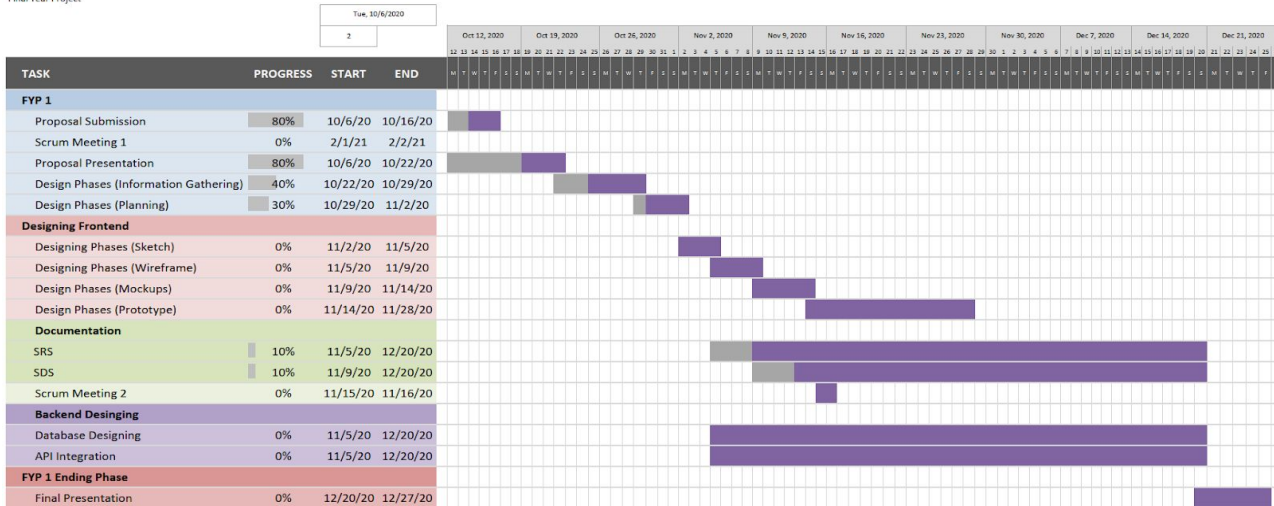
1. **Seller:** Party selling goods.
2. **Buyer:** Party buying goods.
3. **Exporter:** Party that makes export declaration mainly the owner of goods.
4. **Importer:** Party that makes import declaration.
5. **Consignor:** Party that provides consignment of goods.
6. **Consignee:** Party that receives consignment of goods.
7. **Transport Service Buyer:** Buyer of the transport services.
8. **Origin 3PL:** Party that provides 3PL services for cargo owners at origin.
9. **Destination 3PL:** Party that provides 3PL services for cargo owners at destination.
10. **Export Customs Broker:** Party that provides export customs brokerage services.
11. **Import Customs Broker:** Party that provides import customs brokerage services.
12. **Rail Operator:** Party that provides inland haulage via rail.
13. **Truck Operator:** Party that provides inland haulage via road.
14. **Barge Operator:** Party that provides inland haulage via barge.
15. **Feeder:** Party that provides feeder services.
16. **Origin Marine Terminal:** Marine terminal handler of cargo at origin.
17. **Destination Marine Terminal:** Marine terminal handler of cargo at destination.
18. **Trans-Shipment Terminal:** Marine terminal handler of cargo in the intermediate points of journey.
19. **Inland Terminal:** Inland terminal handler of cargo.
20. **Port Community System:** Parties responsible for information exchange.
21. **Export Authority:** Party that provides export authorization regulations.
22. **Import Authority:** Party that provides import authorization regulations.
23. **Buyer's Bank:** Issues letter of credit to buyer.
24. **Seller's Bank:** Pays seller if conditions of letters of credit are met.
25. **Insurance Provider:** Insures credit risks involved.



15. Project Planning

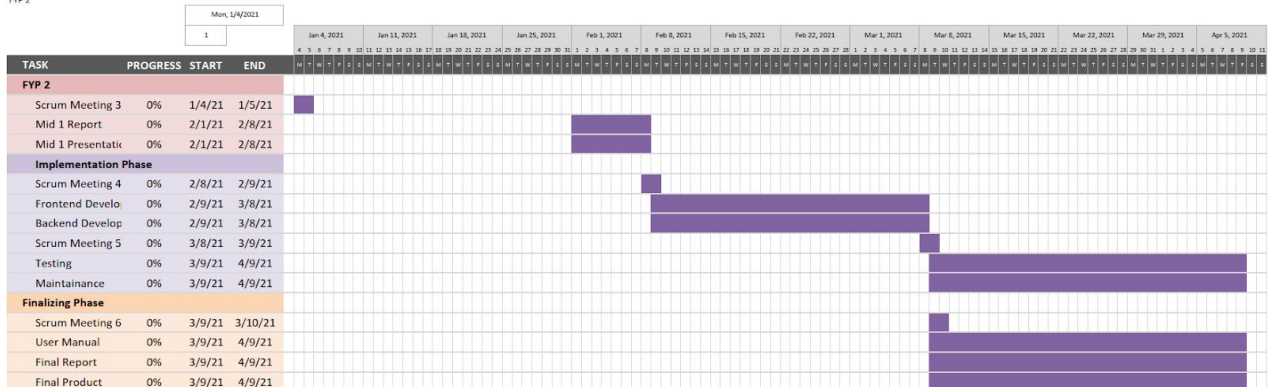
Trade Chain

Final Year Project



Trade Chain

FYP 2



16. Project Feasibility

- Technical Feasibility**

Our project is a complete web based responsive application made up of React JS, Node JS, Blockchain, REST APIs and MongoDB.

The diagram drawing tools used are Lucidchart and Eclipse.

- Economic Feasibility**

All of the resources required to complete this project is available to all the members of our team. Resources required include a laptop and some apps for the development.

- Schedule Feasibility**

We have two semesters to complete our project, which is enough for us to complete the product with the specified features. The time frame available to us is about 7-8 months.

17. Hardware and Software Requirements

Software requirements:

- HTML
- CSS
- Javascript
- Node JS
- REST APIs
- Blockchain
- MongoDB

Hardware requirements:

- A PC with 8GB RAM and internet connection.

18. Deliverables

- Project Proposal: This document consists of project ideas, scope, features and the outline of our product.
- Software Requirement and Specification Document: This document describes the nature of a project, software or application. In simple words, an SRS document is a manual of a project provided it is prepared before you kick-start a project/application.
- Software Design Specification: written description of a software product and the overall guidance to the architecture of the software project.
- Prototype: Overview of the system.
- Web frontend: User interface.
- Registration Portal: Registering Users with all the defined types and roles.
- Admin Web Application: Admin part of the web application.
- Demonstration of the Project: Presentation on how our system will work.
- User Manual: This document will consist of guidelines for the users explaining all the working of the project.
- Final Report: This report will be written after the product is completed and fully tested and will describe our product in detail.
- Finished Product: The final product will be presented at the end of 8th semester to the jury.

19. References

1. https://www.researchgate.net/publication/343417519_Blockchain_application_for_shipping_industry_documents
2. <https://hbr.org/2020/05/building-a-transparent-supply-chain>
3. <https://www.intechopen.com/books/computer-security-threats/deploying-blockchain-technology-in-the-supply-chain>
4. Blockchain For Dummies®, 2nd IBM Limited Edition (2nd ed.). John Wiley & Sons. <https://www.ibm.com/blockchain/what-is-blockchain>
5. Computers & Industrial Engineering Blockchains in operations and supply chains : A model and reference implementation. Computers & Industrial Engineering, 136(July), 242–251. https://www.researchgate.net/publication/334378419_Blockchains_in_operations_and_supply_chains_A_model_and_reference_implementation
6. Blockchain Ready Manufacturing Supply Chain Using Distributed Ledger. https://www.researchgate.net/publication/308163874_Blockchain_Ready_Manufacturing_Supply_Chain_Using_Distributed_Ledger
7. Blockchain's roles in meeting key supply chain management objectives. https://www.researchgate.net/publication/324139564_1_Blockchain's_roles_in_meeting_key_supply_chain_management_objectives
8. The All-Pervasiveness of the Blockchain Technology https://www.researchgate.net/publication/322912211_The_All-Pervasiveness_of_the_Blockchain_Technology
9. The application of supply chain management principles to emergency management logistics: An empirical study https://www.researchgate.net/publication/307511280_The_application_of_supply_chain_management_principles_to_emergency_management_logistics_An_empirical_study