

Block-chain Implementation of Letter of Credit based Trading system in Supply Chain Domain

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Abstract: Supply-Chain Management (SCM) is a global network of facilities that manages various operations from the acquisition of raw materials to their storage and transportation, transformation into products, and delivery of finished goods to customers. Although all of these are straightforward in theory, effectively managing such a system in practice is difficult. Many technologies are being employed to address and overcome these inefficiencies and save the organization money. Among these, blockchain is rethinking how to alter the game as a whole. In order to solve the shortcomings that the conventional system was unable to fully address, this work suggests a new supply-chain system based on blockchain technology. Using a distributed, immutable, and extremely dependable ledger concept that documents a product's history from its origin to its consumer without the assistance of a third party, the suggested Blockchain system provides transparent record keeping and provenance tracking at a lower cost. This study demonstrates the effectiveness of the suggested approach and is implemented using Hyperledger fabric.

Supply chain management, smart contracts, blockchain technology, Hyperledger fabric, trade, permissioned networks, and letters of credit are some of the index terms.

Keyword: Supply chain Management, Smart Contract, Blockchain technology, Hyperledger Fabric, Permissioned network, trading, letter of Credit.

I. INTRODUCTION

Situations that highlight the inefficiencies and mistrust in the real world are part of international trade. The risks associated with trading goods or making purchases without a reliable middleman encouraged bank involvement and helped give rise to the concept of a "cash letter and lading bill." These procedures resulted in more than merely higher overhead or additional costs (banks charge commission to issue letters of credit). The turnaround time is also increased by applying for export permissions and waiting for them to be granted. The risks involved in sending goods or money without assurances (such as a reliable middleman) prompted banks to step in and helped create the principles of credit letters (LoC) and loading bills (BoL). These procedures resulted in more than just higher expenses (banks charge a commission to issue letters of credit) or extra overhead.

The turnaround time is further increased by applying and waiting for export licenses (LoE) to be granted. The communication process and actual shipping of the items take time in an ideal trading system. Though it hasn't fundamentally altered the system, the recent adoption of SWIFT messaging with manual communication has improved the efficiency of document application and collection procedures.

In contrast, a blockchain creates opportunities that weren't there before thanks to its (almost) instantaneous transaction obligations and guaranteed assurances. We will have a clear mutual basis of reality that can lessen vulnerability and simultaneously increase transparency by bringing all parties together in a global blockchain trading arrangement that enforces a particular smart contract. This is applied using the Composer platform's Hyperledger Fabric.

For instance, the straightforward fix we included in our use case was payment in increments, which is not possible with the old system since there is no reliable method for exchanging information regarding a shipment's progress. Such a departure would be deemed excessively risky in this case, which is why incentives are solely based on previous data. The Hyperledger Fabric framework is a distributed ledger

technology of blockchain that is used to create a permissioned network in which the Certification Authority controls network access, hence addressing privacy concerns for network users. The remainder of the document is structured as follows. The literature review is described in full in Section II. Details of the proposed model's implementation on the Hyperledger Fabric and Composer platforms are shown in Section IV. The analysis is presented in part v, and the study is concluded in section vi.

II. SURVEY OF LITERATURE

Muhammad Salek Ali, Raffaele Giaffreda, Miguel Pincheira Caro, and Massimo Vecchio [1] The suggested AgriBlockIoT and Blockchain, a fully decentralized and blockchain-based traceability solution for Agriculture-Food supply chain systems, provides a useful implementation approach for traceability in Agri-Food supply chain management by allowing for continuous IoT device simulation and consuming a lot of digital information throughout the chain. They demonstrated information traceability in this research through the use of the Ethereum blockchain.

Youness Tribis, Houssine Bouayad, and Abdelali El Bouchti [2] suggested a paper on a systematic mapping study of supply chain management with blockchain.

Their goal was to examine and assess the most recent developments in supply chain management applications using blockchain technology. By combining the available and current research, they have attempted to pinpoint the gaps in SCMs.

Dimosthenis Anagnostopoulos, Theodora Varvarigou, and Antonios Litke [3] suggested a thorough examination of how well blockchain technology fits within the supply chain sector. In examining the supply chain industry, this study focuses on the key blockchain components that will impact the supply chain, including performance, scalability, privacy issues, consensus process, cost and location evidence, and blockchain features.

By cutting out the middleman, Balaji Prabhu et al. [4] have also attempted to increase the transparency of the agricultural trading chain from farmer to customer.

According to the study, numerous authors have suggested a safe trading system that makes use of blockchain technology. Regarding the idea of a letter of credit (L/C), nothing has been done. This article's suggested model uses a blockchain implementation intended to construct a modular and permissioned architecture in supply chain management to try to guarantee trust, transparency, and traceability in trading with the concept of the letter of credit procedure. The Hyperledger Fabric Permissioned network offers greater security than the public Ethereum implementation, according to the study's findings. Thus, the necessary network is created using Hyperledger Fabric.

III. THE TPF-SCM MODEL AND THE PROPOSED METHODS

3.1. Objective: The key objective of this research is to develop a framework that promotes logistics traceability and consistency that can automate market transactions and business relationships through robustly protected import and export scenarios in global business networks by letter from the credit system without depending on third parties in the supply chain model.

3.2. LoC based SCM model:

The import export scenario, which will explain the straightforward transaction of selling items from one party to another, is part of the supply chain management model that is being examined here. The usefulness of blockchain technology in enabling this safe and transparent trade has been shown in this transaction. The importer's bank promises to pay the exporter bank in two installments. A clearance certificate is obtained by the exporter from the regulatory products to the transporter, after which a receipt is obtained. The first payment installment from the importer's bank to the exporter's bank is initiated by the receipt's production. The process is finished once the shipment has arrived at the target port and the second and last payment installments are made.

3.3. The algorithm and the LoC-SCM architecture:

The process diagram in Figure 1 clearly illustrates and explains the suggested LoC-based SCM

solution.

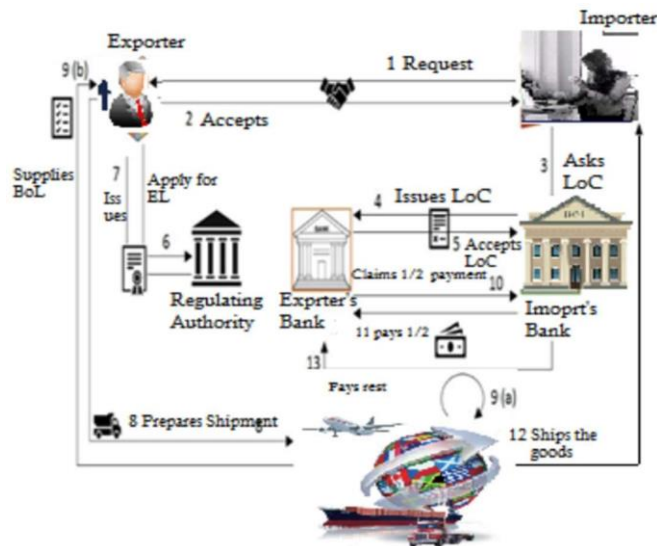


Fig 1 : Secure, transparent and cost effective SCM model proposed

In the trading situation under consideration, specific tools and artifacts are referred to by the following terminology. These tools are used in the produced application: The person who asks the exporter for the good or product and pays for it is known as the importer. The entity that provides the importer with the specified good or product for a certain price is known as the exporter. As asked by its client, the importer, the Bank of Importer provides a Letter of Credit in favour of the exporter. On behalf of the exporter, the Bank of Exporter accepts a Letter of Credit. Regulatory Authority: It grants LFE as permission to ship the specified goods within the exporter's country. When the carrier receives the consignment, it is the carrier that provides the exporter with the BoL document. Letter Credit: this refers to a bank's guarantee to reimburse an exporter upon presenting official documentation proving the shipment of the goods. This document, known as a letter of credit, is provided by the importer's bank upon request from the importer, who is its client. The LoC lists the documentation that prove shipment, the amount owed, and the recipient of that payment—in this example, the exporter. A license for export (LE) is the authorization granted by the exporter's nation's regulatory body to ship the designated items. Bill of Lading (BoL): After the shipment is in the carrier's hands, the exporter receives this document. It functions as a receipt, a contract requiring the carrier to deliver the items to a designated location in exchange for payment, and a title of ownership of the products all at once. This document, which acts as evidence of shipment and initiates an automatic payment clearing, is also included in the L-

C. Figure 1 depicts the transaction sequences between the aforementioned parties on the proposed blockchain network, which are explained in the steps that follow. These kinds of transactions are carried out in a way that cannot be undone. We assume a straightforward linear narrative in which the participants engage in dialogue and nothing undesirable happens; safeguards are put in place along the process just to record mistakes.

Algorithm: The exchanges between system participants to accomplish LoC-based SCM

1. In exchange for payment, the importer asks the exporter to provide the goods.
2. The exporter agrees to the agreement.
3. The importer requests an Exporter LoC from his bank.
4. An LOC for the exporter is issued by the importer's bank and is due to the exporter's bank.

5. On behalf of the exporter, the Bank of Exporter accepts the LoC.
6. The exporter is requesting an export license (EL) from the regulatory body.
7. The exporter will receive an EL from the regulatory body.
8. The exporter packages the shipment and delivers it to the carrier.
9. After the carrier verifies an EL, all products are accepted. b. An exporter is then given the BoL.
10. The exporter's bank requests that the importer's bank pay ½.
11. The importer's bank transfers half of the money to the exporter's bank.
12. The product is sent by the carrier to its intended location.
13. The remaining amount is charged to the exporter's bank by the importer's bank.

IV. EVALUATION OF EXPERIMENTATION PERFORMANCE

We have suggested and developed a trading system that uses Hyperledger fabric to create the permissioned ledger in order to improve the transparency, security, and cost-effectiveness of the current supply chain trading system. network of block chains. Four entities make up this network, each of which represents an importer, exporter, transporter, and regulator. The other two represent carrier and regulatory authorities, respectively. The exporting agency and its branch are part of the exporter's organization. However, the importing agency and its bank are involved in the importer department.

From a cost and protection standpoint, it then makes sense to combine the organizations and the groups they assist into a single body.

From its organizations, only the network agency has the ability to submit transactions or read the ledger state in the role of a client. Our network consists of one MSP in each of the four organizations, in addition to peers, and this ordering process runs in solo mode. Regarding MSP, an Order and operation belong to a different, autonomous entity.

V. RESULTS OF EXPERIMENTATION

The following scenarios were tested in this proposed work. Alice used the letter of credit procedure to make it easier for her to purchase computers from Bob. Although she paid in euros, she purchased the items in dollars. Before making the purchase, she was able to be sure that the products fulfilled her requirements. Bob sold Alice computers, but as he was an international client, he was unaware of the currency used for the transaction. He could be sure that, provided Alice was satisfied, he would be paid for his items in US dollars, his local currency, thanks to the letter of credit procedure with the products. Alice and Bob were able to rely on the system provided by Matias and Ella, who represent Dinero Bank and Eastwood Bank, respectively, that each would meet mutually acceptable requirements in order to be paid. Alice and Bob were able to receive a reasonable payment for their efforts. Every stage of the business process was visible to them in real time.

The Transaction steps for the Letter of Credit Process are as follows.

Step 1: Preparing to request a letter of credit

The buyer and seller agree on the trade terms, and the buyer prepares to apply for a Letter of Credit

through their issuing bank to secure payment for the seller.

Step 2: Requesting a letter of credit

The buyer applies to their issuing bank to request a Letter of Credit, providing all necessary details such as amount, payment terms, and required documentation. The issuing bank reviews the application and proceeds to issue the LC if everything is in order.

Step 3: Importing the bank approval. And accepting the same.

The advising bank reviews the issued Letter of Credit and confirms its authenticity to the seller. The seller examines the terms and accepts the LC to proceed with the transaction.

Step 4: Exporting the bank's approval

The exporter submits the required shipment documents to their presenting bank, which reviews them for compliance with the Letter of Credit terms. The presenting bank then seeks approval from the issuing bank for payment.

Step 5: Letter received by exporter.

The exporter receives the Letter of Credit from the advising bank and reviews its terms and conditions to ensure they align with the sales agreement. Upon acceptance, the exporter can proceed with the shipment of goods.

Step 6: Shipment.

The exporter ships the goods as per the terms and conditions outlined in the Letter of Credit. Shipment details are documented and prepared for submission to the presenting bank.

Step 7: Good's received

The buyer receives the goods shipped by the exporter as per the terms of the Letter of Credit. The buyer verifies the shipment and ensures it aligns with the agreed-upon specifications and delivery terms.

Step 8: Payment

The issuing bank reviews the documents submitted by the presenting bank. If all terms are met, the issuing bank processes the payment to the exporter, completing the transaction.

Step 9: Closing the letter.

Once payment is made and all conditions of the Letter of Credit are fulfilled, the issuing bank formally closes the LC. This marks the successful completion of the transaction between the buyer and seller.

Step 10: Bob receives the payment.

The issuing bank processes the payment to the buyer's bank as per the terms of the Letter of Credit. The buyer confirms the successful receipt of payment, completing the financial transaction.

V. CONCLUSION

In this paper, by using the Hyperledger Fabric of Blockchain technology built a Trading and Letter of credit process System that has implied trust. This trust system leads to reduced risks and various applied technology constructs such as a cryptography, encryption, smart contract and consensus essentially create gates to not only reduce risks, but also infuse added security in the Supply chain system.

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