"A STUDY ON UTILIZING BLOCKCHAIN FOR STREAMLINING LETTER OF CREDIT-BASED TRADING IN THE SUPPLY CHAIN SECTOR"

Abstract

Supply-Chain Management constitutes a network of facilities responsible for various operations, encompassing the acquisition of raw materials, storage, transportation, resource transformation into finished products, and the distribution of these goods to consumers. Despite being conceptually straightforward, effectively managing such a system in practice can present challenges. To tackle inefficiencies and cost-saving opportunities, different technologies are being explored. One promising contender in this regard is blockchain, which offers innovative solutions to transform the landscape.

This study proposes an inventive supply-chain system leveraging blockchain technology to address the limitations of conventional approaches. By employing a distributed, immutable, and highly reliable ledger concept, the suggested Blockchain system facilitates transparent record-keeping and provenance tracking at a reduced cost, all without the need for a third-party intermediary. The effectiveness of this approach is demonstrated using Hyperledger Fabric in the presented paper.

Keywords: Supply Chain Management, Smart Contracts, Blockchain Technology, Hyperledger Fabric, Permissioned Network, Trde, Letter of Credit.

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I. INTRODUCTION

The realities of international trade often expose inefficiencies and a lack of trust in the current world. To mitigate risks associated with trading goods or making purchases without a reliable intermediary, banks have historically played a role by introducing concepts like "cash letter and lading bill." These procedures, while providing security, also led to increased costs due to bank commissions for issuing letters of credit and additional overhead. Furthermore, the process of obtaining export licenses (Letter of Credit) adds significant turnaround time to trade transactions. Although some improvements have been made through SWIFT messaging integration, the overall system remained largely unchanged.

In contrast, blockchain technology offers unique advantages, such as nearly instant transaction processing and increased certainty. By implementing a global blockchain trading arrangement with a specific smart contract using the Hyperledger Fabric platform, all parties involved can have a transparent and mutually agreed-upon reality. This increased transparency and reduced vulnerability can address some of the limitations of the legacy system. For example, blockchain facilitates straightforward solutions like incremental payments, which were difficult to implement in the traditional system due to a lack of reliable shipment status information. The legacy system's reliance on historical evidence for decision-making often viewed deviations from the norm as excessively risky.

Blockchain's Hyperledger Fabric architecture creates permissioned networks, where access restrictions are managed by a Certification Authority, addressing privacy concerns for network users.

II. LITERATURE SURVEY

In a study by Massimo Vecchio, Muhammad Salek Ali, Miguel Pincheira Caro, and Raffaele Giaffreda [1], they introduced AgriBlockIoT and Blockchain, a fully decentralized and blockchain-based solution for traceability in the agriculture-food supply chain. This innovative system integrates IoT devices, efficiently handling vast amounts of digital data throughout the chain. Using the Ethereum blockchain, they demonstrated the traceability of information within this context.

Another research paper, authored by Abdelali El Bouchti, Houssine Bouayad, and Youness Tribis [2], conducted a systematic mapping study to explore the cutting-edge applications of blockchain technology in supply chain management. By consolidating existing research, their objective was to identify gaps and advancements in SCMs.

Antonios Litke, Theodora Varvarigou, and Dimosthenis Anagnostopoulos [3] also delved into the integration of blockchain into the supply chain business. Their comprehensive examination focused on key blockchain components impacting supply chain management, including performance, scalability, privacy concerns, consensus processes, cost, location evidence, and blockchain-specific features.

Balaji Prabhu et al. [4] aimed to enhance transparency in the agricultural trading system by eliminating intermediaries, facilitating direct transactions from farmers to customers.

Numerous authors have suggested secure trading systems using blockchain technology. However, the concept of a letter of credit has not been thoroughly explored. This article proposes a model that utilizes a modular and permissioned architecture in supply chain management to ensure trust, transparency, and traceability in trading. The study concludes that Hyperledger Fabric Permissioned network provides greater security compared to open Ethereum implementations, making it the suitable choice for building the required network.

III. PROPOSED METHODOLOGY

1. **Objective:** The primary objective of this research is to develop a comprehensive framework that enables logistics traceability and consistency. The aim is to automate market transactions and business relationships within global business networks, specifically focusing on secure import and export scenarios. This framework will be based on the letter of credit system, ensuring robust protection without the need for third-party intermediaries in the supply chain model.

2. **Letter of Credit based Supply Chain Management Model:** In this Supply Chain Management model, the import-export scenario involves a simple sale of items from one party to another. Blockchain technology proves to be valuable in facilitating this transaction by ensuring openness and security. The process begins with the importer's bank committing to make two payments to the exporter's bank. Once the exporter transfers the products to the carrier and obtains clearance from the regulatory body, they receive a receipt.

   The first payment installment from the importer's bank to the exporter's bank is initiated upon presenting the receipt. Upon the consignment's arrival at the target port, the second and final payment installments are made, completing the transaction. Throughout this process, blockchain technology plays a crucial role in maintaining transparency and safety in the trade.

3. **Letter of Credit-Supply Chain Management Architecture:** The workflow diagram presented in Fig. 3.3.1 clearly illustrates and explains the proposed Letter of Credit-based Supply Chain Management System.

   In the trading scenario under examination, various terminologies are used to describe specific tools and entities involved. The application employs the following tools:

   - **Importer:** The party that requests and pays for a good or service from the exporter.
   - **Exporter:** The party that provides the specified good or product to the importer in exchange for a predetermined payment.
   - **Bank of Importer:** This bank issues a Letter of Credit to the exporter upon the importer's request.
   - **Bank of Exporter:** The bank that holds the Letter of Credit on behalf of the exporter.

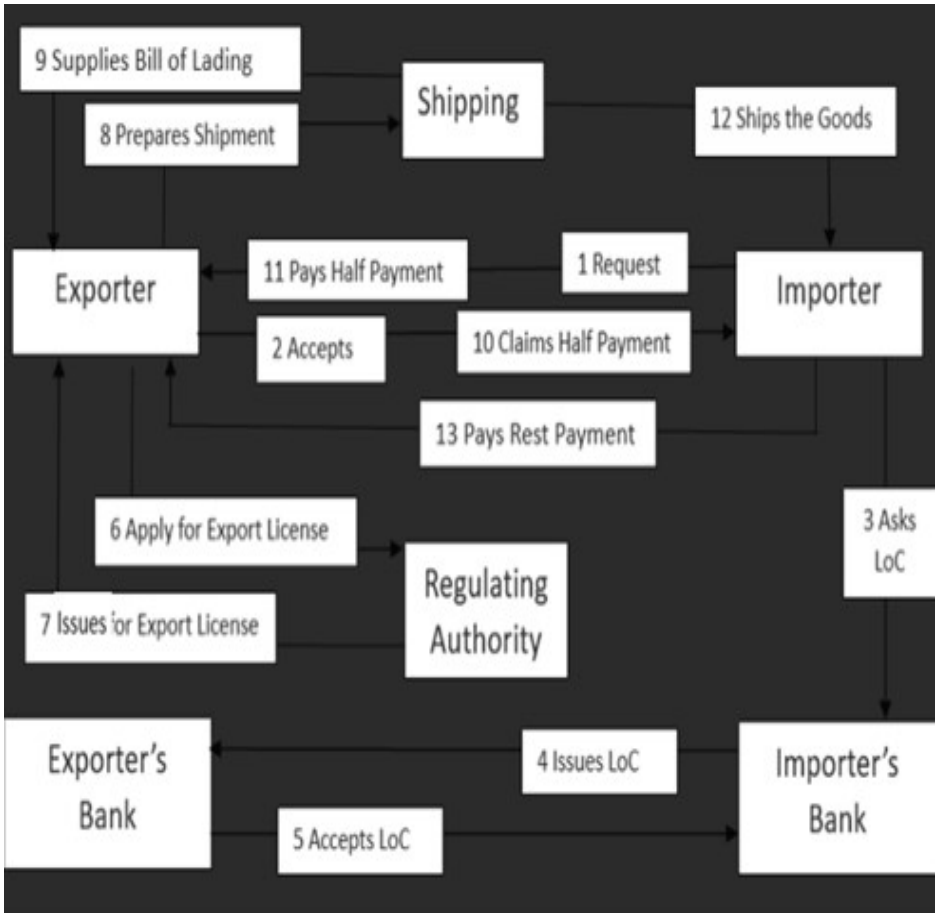

Figure 1: Streamlining Letter of Credit-based Trading in the Supply Chain

- **Authority:** The entity responsible for granting License for Export as permission for exporting certain products from the exporter's country.

- **Carrier:** The entity responsible for taking custody of the package and issuing the Bill of Lading document to the exporter.

- **Letter of Credit:** A bank's guarantee to pay the exporter upon receiving documentary evidence of the shipped items. It is issued by the importer's bank, specifying the payment amount, shipment proof documents, and the beneficiary (the exporter).

- **License for Export:** Permission granted by the exporter's country's regulatory body for the shipment of specific products.

- **Bill of Lading:** A document issued by the carrier to the exporter after delivering the shipment. It serves as a receipt, a contract for conveying the items to a particular location in exchange for payment, and a title to the commodities. This document is also referred to in the Letter of Credit, providing evidence of shipment and triggering payment clearance.

The proposed blockchain network facilitates transaction sequences among these parties, ensuring immutability and irrefutability. The process is presented in stages, depicted in Fig 3.3.1, where deals are conducted in a straightforward and linear manner. Built-in guards are in place solely to catch mistakes, assuming a seamless interaction between the parties without any unexpected occurrences.

4. **Algorithm:** The implementation of Letter of Credit-based Supply Chain Management involves various interactions among the parties in the system:

- The importer makes a payment to the exporter for the goods received.
- The exporter agrees to the terms of the contract.
- The importer requests an Exporter LoC from their bank.
- The importer's bank issues a Letter of Credit payable to the exporter's bank on behalf of the importer.
- The Bank of the Exporter accepts the LoC on behalf of the exporter.
- The exporter seeks an export license from the regulatory authorities.
- The exporter obtains the necessary Export License from the regulatory authority.
- The exporter packages the shipment and hands it over to the carrier.
- After validating the Export License and issuing a Bill of Lading, the carrier certifies the products.
- The exporter's bank requests a partial payment from the importer's bank.
- The importer's bank transfers half of the payment amount to the exporter's bank.
- The carrier delivers the products to the intended location.
- The importer's bank completes the transaction by charging the exporter's bank with the remaining payment amount.

5. **The Steps of Letter of Credit Process Transaction:** The transaction was facilitated through the letter of credit procedure, providing a sense of security to the parties involved. The seller knew they would receive payment in their home currency for the goods, thanks to the letter of credit. The entire business process was transparent and known to all parties. Below are the steps involved in the Letter of Credit Process Transaction:

Step 1: Preparation of a letter of credit request.
Step 2: Submission of the letter of credit request.
Step 3: Endorsement and approval of the letter of credit by the importer's bank.
Step 4: Transfer of the bank's approval to the exporter.
Step 5: The exporter receives the letter of credit.
Step 6: Shipment of the goods.
Step 7: Confirmation of the goods' arrival.
Step 8: Payment process.
Step 9: Conclusion of the letter of credit.
Step 10: The exporter receives the payment.

Through these sequential steps, the letter of credit process ensures a smooth and secure transaction for both parties involved.

IV. CONCLUSION

This study presents a trading and letter of credit process system that operates on the Hyperledger Fabric blockchain technology, aiming to establish implicit trust among participants. Key technological elements like cryptography, encryption, smart contracts, and consensus mechanisms are strategically integrated to create robust barriers that not only minimize risks but also enhance the overall security of the supply chain system. As a result, this trust system effectively reduces risks, making transactions more reliable and secure for all involved parties.

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