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

Rajashekaragouda G S,
M Dakshayini, Dept of ISE,
B.M.S. College of Engg., Bengaluru, Affiliated to V.T.U Belagavi.
S Balaji, Centre for Incubation, Innovation, Research and Consultancy,
Jyothy Institute of Technology, Tataguni, Off Kanakapura Road, Bengaluru-560082

Abstract— **On a global scale, Supply-Chain Management(SCM) is a network of amenities that runs through different processes involving procurement of raw materials, storage and movement of these materials and converting them into products to the distribution of final products to consumers. All these seems simple in theory, practically efficient management of such a system is challenging. In order to resolve and overcome these inefficiencies and save Organization's money, various technologies are being used. Amongst these, blockchain is reconnoitering new ways to change the overall game. This work proposes a BlockChain based revolutionary Supply-chain system addressing the deficiencies that the traditional system could not address in its entirety. The proposed Blockchain system achieves transparent record keeping and provenance tracking with reduced cost using a distributed, immutable and highly reliable ledger concept that records the history of products right from its origination to its buyer without the need of a third trusted party. This work is implemented using Hyperledger fabric and proves the efficiency of the proposed system.**

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

I. INTRODUCTION

International trade includes the kinds of situations that illustrate the inefficiencies and distrust in real world. The dangers involved with exchanging commodities or making purchases in the absence of a trustworthy mediator motivated bank participation and contributed to the development of the idea of "cash letter and lading bill". A consequence of these processes was not just additional cost (banks charge commission to issue letters of credit) or additional overhead. Applying and waiting for export licenses to be awarded also increases the turnaround time.

The dangers inherent in the transport of products or payments in the absence of guarantees (like a trustworthy middleman) inspired banks' intervention and contributed to the development of credit letter(LoC) and lading bill(BoL) principles. An effect of these processes was not just the additional cost (banks charges the commission to issue LoC or additional overhead.

Applying and waiting for licenses for export(LoE) to be issued also increases the turn-around time. In a scenario of ideal trading system, the process of communicating and shipment of the goods itself takes time. Recently, the implementation of SWIFT messaging with manual communication has made the collection processes and document application more effective, but it has not essentially changed the system.

By comparison, a blockchain with its (almost) prompt transaction responsibilities and assured assurances opens up opportunity that was not previously present. Through bringing all parties in a global blockchain trading arrangement enforcing a specific smart contract, we will have a clear mutual basis of reality that can reduce vulnerability and at the same time improve transparency and that is applied utilizing the Composer platform's Hyperledger Fabric.

For example, the simple solution we added in our use case was payment by increments which can not be applied in the legacy system as there is no assured way to learn and exchange details about the status of a shipment. In this situation, such a deviation will be considered too dangerous, which is why rewards are strictly related to historical evidence.

Hyperledger Fabric framework is an distributed ledger technology of blockchain which is used to establish the permissioned network such that access control to network is governed by the Certification Authority and there by providing the privacy concerns to the participants of the network.

The rest of the paper is arranged according to the following manner. Section ii outlines the Literature survey in detail. In Section iv details have been demonstrated that, how the proposed model is implemented on the Hyperledger Fabric and Composer platforms. Section v displays the analysis, and section vi finishes the paper.

II. LITERATURE SURVEY

Massimo Vecchio, Miguel Pincheira Caro, Raffaele Giaffreda and Muhammad Salek Ali [1] Proposed A practical implementation approach of traceability in Agri-Food supply chain management using AgriBlockIoT and Blockchain that is a completely decentralized and blockchain-based traceability solution for Agriculture-Food supply chain system, enable to continuously assimilate IoT devices generating and consuming lot of

digital data along the chain. In this paper, they proved the traceability of information by ethereum blockchain implementation.

Abdelali El Bouchti, Houssine Bouayad and Youness Tribis [2] proposed a Paper on A Systematic Mapping Study of Management of Supply Chain using Blockchain. Their effort was aims to analyze and explore the state-of-the-art on the BlockChain Technology applications for Supply Chain Management. They have tried to identify the gaps available in SCMs by blending the existing and available evidence.

Dimosthenis Anagnostopoulos, Theodora Varvarigou, Antonios Litke [3] Proposed, a detailed analysis of the fit of blockchain in the industry of Supply Chain. This paper emphasize focus on the important blockchain elements that will affect supply chain such as performance, scalability, privacy considerations, consensus mechanism, cost and location proof, and details on the blockchain in exploring the supply chain industry.

Balaji Prabhu, et.al.[4] has also worked on making the trading system of agriculture more transparent from farmer to consumer by avoiding the middleman.

The study made reveals that, many authors have proposed the secure trading system using block chain technology. No work has been done on the concept of letter of Credit(L/C). Proposed model in this article attempts to ensure the trust, transparency, traceability in trading with the idea of letter of credit process of Supply chain model by blockchain implementation that is designed for deploying a modular and permissioned architecture in Supply Chain Management. The results of the study indicates that Hyperledger Fabric Permissioned network provide more security than the public ethereum implementation. Hence, Hyperledger Fabric is used to create the required network.

III. PROPOSED METHODOLOGY AND TPF-SCM MODEL

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 Supply Chain Management model considered here consists of the import export scenario that will describe the simple transaction the sale of goods from one party to another. In this transaction, the value of block-chain has been demonstrated in facilitating this transparent and secure trade. A payment promise is made by the bank of importer to exported bank in two installments. The exporter obtains a clearance certificate from the regulatory authority, hands off the goods to the

carrier, and then obtains a receipt. The production of the receipt triggers the first payment installment from the bank of importer to the bank of exporter. When the shipment has reached the destination port, the second and final payment installments are made, and the process concludes.

3.3. LoC-SCM Architecture and the algorithm:

The proposed LoC based SCM system is well shown and explained from the workflow diagram given in Fig 1.
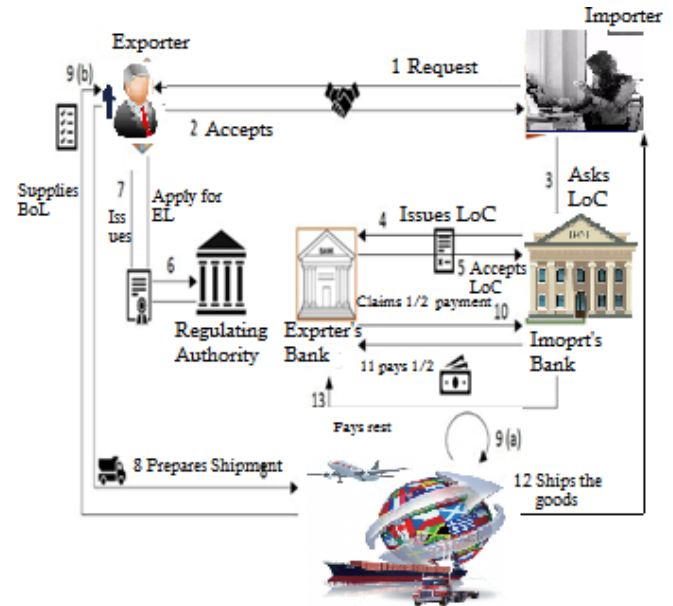

Fig 1. : Secure, transparent and cost effective SCM model proposed

The following are the terms used to refer to certain tools and artefacts plays in the trading scenario considered here. The application developed uses these tools:

- Importer- is the one who requests for the good/product from exporter and pays for the same
- Exporter- is the party who supplies the requested good/product to the importer for a specific amount
- Bank of Importer- It supplies an LoC in favour of the exporter as requested by its client i.e Importer.
- Bank of Exporter- It accepts an LoC on behalf of the exporter.
- Regulatory Authority- It issues LfE as an authorization for the shipping of the specific products in the nation of the exporter.
- Carrier- is the one, which issues BoL document to exporter once it takes possession of the shipment.
- Letter Credit - this applies to a pledge to pay by a bank's promise to pay an exporter upon presentation of documentary proof of goods having been shipped. Called Letter of credit, this document is issued by the bank of importer at the request of its customer: the importer The LoC states the list of documents that constitute proof of shipment, the amount to be paid, and the beneficiary (the exporter in this case) of that amount.

- License for Export (LE): This refers to the approval given by the regulatory authority in the exporter's country for the shipment of the specified goods.
- BillofLading(BoL): This is a document issued to the exporter by the carrier once the shipment is in possession. It simultaneously serves as a receipt, a contract obliging the carrier to transport the goods to a specified destination in return for a fee, and a title of ownership of the goods. This document is also listed in the L-C and serves as proof of shipment that will automatically trigger a payment clearance.

The sequences of transactions made in the proposed blockchain network among the above mentioned parties are described in the following steps and illustrated in the fig 1. Such transactions are done in an irrevocable and unrepudiable manner. In this chain of events, we presume a simple linear story in which the parties negotiate with each other and nothing untoward occurs, guards are created in the process just to capture errors.

Algorithm: The transactions made among the parties of the system to achieve LoC based SCM

1. Importer requests the exporter for the goods in return of money.
2. Exporter commits to the deal.
3. Importer asks his bank for an Exporter LoC.
4. The bank of the importer issues an LoC for the exporter which is payable to bank of latter.
5. Bank of Exporter accepts the LoC on the exporter's behalf.
6. Exporter is seeking from the regulatory authority for an export licence(EL).
7. Regulatory authority shall provide the exporter with an EL.
8. Exporter packs and passes the shipment to the carrier.
   9. a. All the products are approved once the carrier validates an EL and then
   b. Provides an exporter with BoL.
10. The bank of exporter demands ½ payment from the bank of Importer.
11. The bank of the Importer passes half the sum to the Bank of exporter.
12. The carrier sends the produc towars their target destination.
13. The bank of the Importer charges the residual balance to the Bank of Exporter.

IV. EXPERIMENTATION PERFORMANCE EVALUATION

In order to make the present trading system in the supply chain domain more transparent, secure and cost effective, we have proposed and implemented the trading system using Hyperledger fabric for creating the permissioned

Block chain network. This network consists of four organizations representing respectively the importer, exporter, carrier and regulator. The other two respectively reflect regulator and carrier agencies. The organisation of the exporter includes both the exporting agency and their branch. The importer department, however, involves the importing agency and its bank. Then integrating the organizations with the groups they support in a single entity makes sense from both a protection and a cost perspective.

Only the network agency obtains access to send transactions or reads the ledger state in the position of a customer from its organizations. In each of the four organisations aside from peers, our network comprises of one MSP, which involves an ordering process operating in solo mode. In relation to MSP an Order, operation belongs separately to its own independent entity.
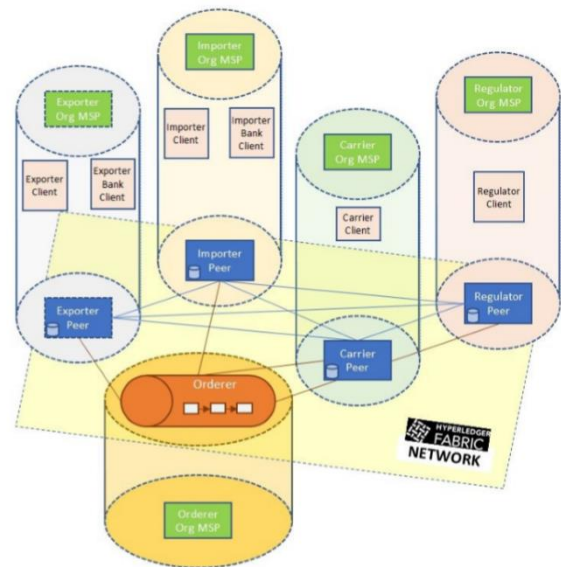
Design of network:

Figure 2: A blockchain network in their specific organizations with an orderer, a peer and clients.

V. EXPERIMENTATION RESULTS

This proposed work experimented with the following scenario. Alice wanted to buy computers from Bob, and used the letter of credit process to facilitate this transaction. She bought goods in dollars, but was charged in Euros. She was able to be confident that the goods met her terms and conditions before she paid for them. Bob sold computers to Alice, as an overseas customer he has no idea about the type of currency with which transaction is done. The letter of credit process allowed him to be confident that he would receive payment for his goods in his local currency, US dollars, as long as Alice was happy

with the goods. Matias and Ella, representatives of Dinero Bank and Eastwood Bank respectively, provide a system that allowed Alice and Bob to trust that each would fulfill mutually agreeable conditions in order to receive payment. They were able to charge Alice and Bob a fair price for their services. They were aware in real-time of every step in the business process.

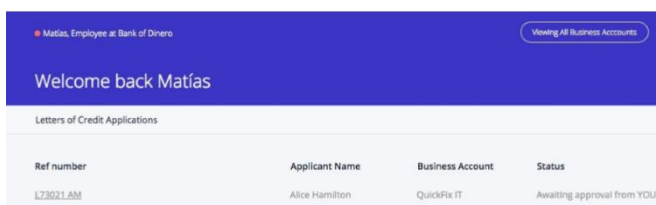The Transaction steps for the Letter of Credit Process are as follows.
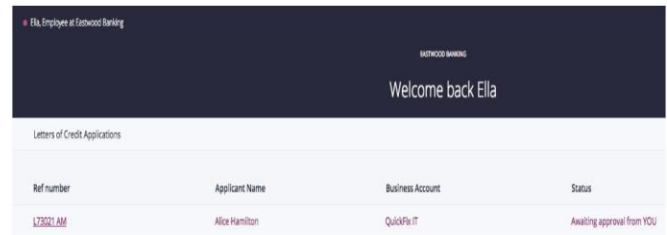
Step 1: Preparing to request a letter of credit.
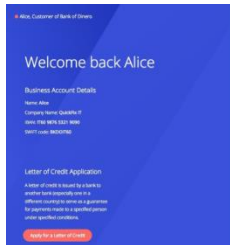
Step 2: Requesting a letter of credit.
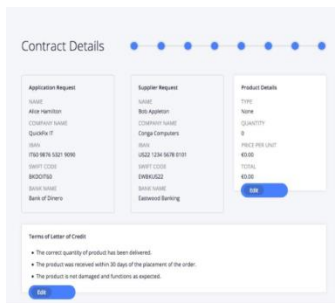
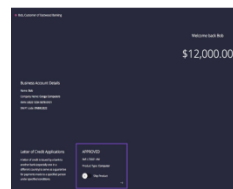Step 3: Importing the bank approval. And accepting the same.
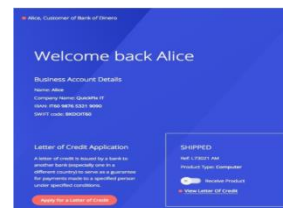
Step 4: Exporting the bank's approval.

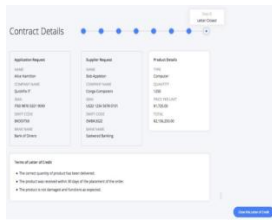Step 5: Letter received by exporter.

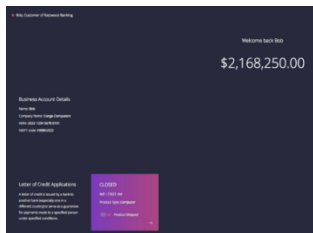Step 6: Shipment.

Step 7: Good's received.

Step 8: Payment

Step 9: Closing the letter.

Step 10: Bob receives the payment.

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.

REFERENCES

[1] Massimo Vecchio, Miguel Pincheira Caro, Raffaele Giaffreda and Muhammad Salek Ali "A practical implementation: Blockchain-based traceability in Agriculture-Food supply chain management" Proceedings of the International Conference on IoT Vertical and topical Summit on Agriculture Tuscany, Italy, 8-9 May, 2018.

[2] Abdelali El Bouchti, Houssine Bouayad and Youness Tribis "A Systematic Mapping Study on Supply Chain Management based on Blockchain" International workshop on Transportation and supply chain-2018.

[3] Dimosthenis Anagnostopoulos, Theodora Varvarigou, Antonios Litke "Architectural Elements and Challenges Towards a Global Scale Deployment: Blockchains for Supply Chain Management" Multidisciplinary Digital Publishing Institute (MDPI), Jan-2019.

[4] M Dakshayini, Balaji Prabhu B V, "An Effective Big-Data and Blockchain [BD-BC] based decision support model for Sustainable Agriculture system", published as chapter 8 in Springer Sustainable Cognitive Computing, EAI/Springer Innovations in Communication book Series, pp 77-86, https://doi.org/10.1007/978-3-030-19562-5_8

[5] Luc Desrosiers, Nitin Gaur, Venkatraman Ramakrishna, Petr Novotny 'Hands-On Blockchain with Hyperledger'

[6] https://www.ibm.com/blockchain/industries/supply-chain.