THE FEASIBILITY OF BLOCKCHAIN SOLUTIONS IN THE MARITIME INDUSTRY

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ABSTRACT

Purpose / Value
The concept of Blockchain technology in supply chain management is well discussed, yet inadequately theorized in terms of its applicability, especially within the maritime industry, which forms a fundamental node of the entire supply chain network. More so, the assumptive grounds associated with the technology have not been openly articulated, leading to unclear ideas about its applicability.

Design/methodology/approach
The research is designed divided into two Stages. This paper (Stage one) enhanced literature review for data collection in order to gauge the properties of the Blockchain technology, and to understand and map those characteristics with the Bill of Lading process within maritime industry. In Stage two an online questionnaire is conducted to assess the feasibility of Blockchain technology for different maritime use-cases.

Findings
The research that was collected and analysed partly from deliverable in the Connect2SmallPort Project and from other literature suggests that Blockchain can be an enabler for improving maritime supply chain. The use-case presented in this paper highlights the practicality of the technology. It was identified that Blockchain possess characteristics suitable to mitigate the risks and issues pertaining to the paper-based Bill of Lading process.

Research limitations
The study would mature further after the execution of the Stage Two. By the end of both Stages, a framework for Blockchain adoption with a focus on the maritime industry would be proposed.

Practical implications
The proposed outcome indicated the practicality of technology, which could be beneficial for the port stakeholders that wish to use Blockchain in processing Bill of Lading or contracts.

Social implications
The study may influence the decision makers to consider the benefits of using the Blockchain technology, thereby, creating opportunities for the maritime industry to leverage the technology with government's support.

Keywords: Digitalization, Blockchain, Maritime, Bill of Lading, Feasibility study.

1. INTRODUCTION

The Blockchain technology can be an enabler for improved supply chain management. Various researchers have discussed different aspects of the technology in review papers. This study aims to present a feasibility study for a Blockchain based Bill of Lading (BoL) process, which is one of the main processes in the shipping industry. It will provide the base for developing a deeper understanding of the characteristics of Blockchain technology in the light of BoL process. The study reports findings from the related literature and applies them on a use-case from the shipping industry to establish the practicality of the use of technology.

1.1. What is Blockchain?

According to Harvard Business Review, *"Blockchain is an open and distributed ledger that can record transactions between two parties efficiently and in a verifiable and permanent way"* (Iansiti and R. Lakhani, 2017). In other words, the digitized transactional records are saved in a database which is distributed and transparent where no possibility of updates or fabrication or erasure.

1.2. Bill of Lading (BoL)

The Bill of Lading (BoL) is a legal document issued by an exporter to the shipowner that points the details about goods, vessel, freight, terms, and signature of the involved parties. There are 17 types and forms of BoL (Branch, 2014). In Shipped BoL document there are multiple parties involved. *Exporter* (E) or Shipper, is an individual or an entity, that owns the goods and wishes to transport them via ship. Shipowner or an authorized person called *Ship Agent* (SA) is an individual or an entity that transports goods and is accountable for any damage or loss of the goods during the transport. For both, import and export of the cargo, a *Custom Agent* (CA) checks the BOL and cargo. For financial settlement, the Bank (BA) reviews the document as well. Many a times, a *Freight Agent* (FA) is also part of the loop.

Some of the common issues with paper-based BoL are pointed out by (Branch, 2014):

- Delays in the arrival and overall process of BoL completion.
- Data is inconsistent or is unavailable (such as, freight details) when needed.
- Modifications in the BOL are not attested by the ship agent or the company.
- The endorsements regarding loss/damaged cargo are not sorted, hence, unacceptable to the banks.
- Discrepancies in between action and what is stipulated.

2. RESEARCH DESIGN

The research design is divided into two Stages. This paper (Stage One) is an enhanced literature review on data collection, to gauge the properties of the Blockchain technology, and to understand and map those characteristics with the Bill of Lading process in the maritime industry. Later, Stage One is complemented by an online questionnaire (Stage Two) that would be sent out to selected ports and terminals. This design was chosen because an online survey allows data to be collected on multiple variables easily and at once. The tool would run from June to August 2019. Based on the responses gathered, face to face interviews would be conducted to understand the possible scenarios where Blockchain could facilitate the information exchange at the port or terminal.

3. LITERATURE REVIEW

The literature review aims to unravel some of the common issues regarding the traditional paper-based Bill of Lading (BoL) document and mapped to the characteristics of Blockchain technology.

Multi-party Cooperation - As seen from Section 1.2, BoL involves multiple parties. Each party has their own purpose or utilization of the document. Often, due to multi-party cooperation the BoL is not presented within the prescribed time mentioned in the Letter of Credit (LoC), mostly 3 weeks from the shipment. Or it has incomplete data, such as rate of freight or total freight amount, or attestation of ship agent on the modifications. Blockchain formalizes the collaborations amongst all parties involved in the BoL by allowing them access to the ledger to view, update and authorize the modification of record when needed (Casado-Vara et al., 2018). No incomplete or incorrect entry is updated until all authorized parties endorse it through the consensus protocol. Once update is accepted by all parties a notification message is sent.

Process Optimization - There is a lot of documentation involved for the container, such as BoL receipt which may take up to 2 months. Having the BoL process digitized via a Blockchain, such as the main checkpoints: *Ship Agent, Custom Agent, Bank Agent*, etc., could reduce the time and effort spent on paper work and have the documentation prepared and shared with customs before the arrival of the container. Prospects of Blockchain for exchanging documentation in the shipping industry were presented in (Loklindt et al., 2018). One result is that the use of a distributed ledger technology could simplify the documentation efforts by eradicating the need to store and maintain multiple digital copies. The streamlining of entire BoL process will make the transaction speed close to real-time and would leverage digitization of sales transaction, in addition to monitoring of the cargo. Since, the record is unchangeable, hence, it acts as a permanent log as well.

Transparency and Auditability - Blockchain is a distributed ledger i.e. the database is available for all the parties involved. This transparency exemplifies the information to be available allowing shared ledger management, improving visibility and auditability (Francisco and Swanson, 2018).

Security - There is a general view about Blockchain being more secure than other alternatives (Siba et al., 2017). Each transaction or block in the ledger goes through the cryptographic hash function and a resultant hash value is formed. This hash value enables the block identification as well as integrity verification. Trust management in a port is essential to protect the data integrity and privacy of all involved stakeholders. In such a scenario Blockchain gets a meritorious position such as by having a distributed logistics transaction ledger that is irrefutable (Underwood, 2016; Zhao et al., 2016)

4. BLOCKCHAIN BASED BILL OF LADING: A USE-CASE

There is variation in terms of degrees of digitalization occurring at ports and terminals (Anwar et al., 2019), but nonetheless, the maritime industry is gradually progressing. The BoL process at most small-medium ports is paper-based. According to a recent EU project, Connect2SmallPorts, most of the small-medium ports rely on classical paper-based processes (Connect2SmallPorts, 2019).

To digitalize BoL with Blockchain let us first consider the following environment. The database is the foundation technology for Blockchain implementation. It stores and manages the entries of BoL such as name of the Exporter, name of the vessel, details of the cargo (type, package number, measurements, etc), freight details, date of goods received and etc. The database is distributed over peer-to-peer network. It is decentralized i.e. synchronized, stored, maintained and updated by different network nodes i.e. parties. Each party is a node in the network with

access to view, update and sign the transactions in the ledger or database. The involved parties in a typical BoL process are E, SA, CA, FA and BA as described in Section 1.2. Each party may or may not trust each other. In the background the consensus algorithm is running that governs who initiates the entry and who has the privileges to make and entry or to sign it. This means all parties in the network agree to work together on the distributed and transparent database.

All parties agree to the transaction before it is added to the ledger. In this case all parties endorse the transaction, but it may not always be the case. The protocol of who endorses what, and in what sequence is decided and agreed before allowing party's access to the system. This is coded in the endorsement algorithm.

Let us consider a common scenario where the BoL involves following parties: E, SA, CA, FA and BA, which are geographically divided via peer-to-peer network of computers. Each node has same rights and privileges to perform the transaction and no central administrator is deciding for each of them. Every resource in this network is shared with all the nodes equally. The concept of centralized party is void. Party SA wishes to initiate the BoL. Once written, it triggers other parties who can either accept or reject the new transaction. As no single administrator is involved, the collective action of all other parties will decide the acceptance or rejection of the newly created entry in the database.

The data shared by Party SA is the input to the cryptographic hash algorithm which creates a unique string of characters known as a hash which summarizes everything present in the plain text. This is known as digital fingerprint or hash. It can be 32 or 64 bits long and may appear meaningless in the sense that it cannot be reversed to create the original plain.

The CA and FA are notified about the creation of BoL and about the arrival of goods. If anything, pertaining to custom clearance or freight is missing, such as Freight information the FA may reject this transaction, hence indicating the SA to share complete information. This saves last minutes hassles and allows all parties to act proactively. Upon arrival of goods at the destination port, the CA is prepared to receive and perform clearance tasks. If an ambiguity is found, for example, merchandise is found to be different than what is stipulated in the BoL, CA may issue trigger. The transparency allows all parties to be notified about the discrepancy and to adjust accordingly.

It is not possible for CA to make changes in the BoL, such as type of goods. Firstly, because the protocol does not authorize CA to make change that SA is allocated to do. Secondly, due to immutability nature of the technology, doing so would trigger the amendment via a flag in the original data. This notifies the SA to make necessary amends. The BoL paper-documents would have to be taken to the SA as opposed to Blockchain based BoL, where SA instantly makes the needed correction and the CA is able to perform clearance. As the information is updated, another block of information is created. The hash value of the previous block of information is shared with the new block of information, and likewise a new hash for second block is also generated.

Similarly, when party FA signs the transaction, the hash for latest block is created and likewise the hash of previous block is shared with it. This forms blocks of information which are chained together with hash values, hence the term Blockchain. The Blockchain can have a new entry but it is not possible to go to an old entry and change it. The Blockchain network is hence, irrefutable and permanent. It is scalable (can add more parties) and hard to take down.

5. CONCLUSIONS

This study (Stage One and Stage Two) is set out to establish the what conditions and factors are required as a business case(s) for ports, in which Blockchain adoption could possibly be

advantageous. The Bill of Lading (BoL) use-case is designed to understand the practical dimensions in using Blockchain technology. The assumption made is that all parties involved are solely responsible to allow the right to participate in the Blockchain network and governance issues are ignored. Having Blockchain supported BoL could increase the overall time to complete a typical BoL transaction, to allow auditability and transparency, to allow immutability, and security in addition to maintaining information consistency. The proposed scenario shows the practicality of technology which could benefit the stakeholders in many ports that wish to make use of the Blockchain for BoL or similar processes. The study may influence the decision makers to consider the benefits of adopting this technology, thereby, creating opportunities for the maritime industry.

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