BLOCKCHAIN POTENTIAL FOR LOGISTICS AND MARITIME TRANSPORT

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ABSTRACT: The contemporary business environment has recently witnessed a lot of innovations that promise to change the way of doing business while bringing more value to various business stakeholders. One of the emerging technologies is blockchain. Blockchain technology enables the decentralized storage and the secure exchange of verified data. Blockchain has gained growing interest in the recent years. Meanwhile, the logistics industry in general and ports specifically require the collaboration of different stakeholders necessitating a high degree of integration and synchronization. This paper examines the potential of blockchain implementations in the port logistics industry. The paper reviews the latest blockchain research especially in the supply chain and logistics industry. The paper starts by shedding the light on blockchain technology, then moves to exploring the potential uses and benefits in logistics and supply chain. The paper focuses on applications of blockchain in the maritime industry.

INTRODUCTION

The contemporary business environment is witnessing a lot of changes. The continuously growing demand in addition to competition have maximized the importance of efficiency and optimization. At the heart of economic and business environment is the logistics and supply chain industry. Data sharing has gained a lot of importance in recent years[1]. Meanwhile, the shipping industry is characterized by having many stakeholders and various legacy systems. Such systems generate lots of data in isolated silos which in turn impacts the efficiency and cost of operations.

There is a lot of talk today about blockchain technology and its potential to create new business models for the logistics and supply chain industry. Many efforts are underway to demonstrate the capabilities of this distributed ledger technology and its associated potential value. Focusing on the shipping industry, blockchain technology has set out to profoundly change the shipping industry landscape and its ecosystem.

WHY BLOCKCHAIN

While blockchain technology can be considered as a combination of technologies, it is the way in which these technologies are used together that defines the main characteristics of blockchain.

Blockchain concept is so broad to the extent that there is no common agreed upon definition for it. Blockchain was first introduced in 2008 when bitcoin was first introduced by Nakamoto[2]. It can be

defined as a ledger or database where all the transactions can be stored sequentially. Thus it can be considered as a digital register of transactions [3]. Another concise definition of block chain is:

"A blockchain is a distributed database, which is shared among and agreed upon a peer-to-peer network. It consists of a linked sequence of blocks, holding timestamped transactions that are secured by cryptography and verified by the network community. Once an element is appended to the blockchain, it cannot be altered, turning a blockchain into an immutable record of past activity." [4]

For a transactions to take place, it has to have a sender, transaction information, and a receiver and it has to be time-stamped by the involved members [5]. Transactions are exchanged between members of a peer-to-peer network. In order to secure the blockchain and ensure the correctness of what is being recorded, processes are performed involving both cryptography and user verification [2]. Furthermore, new blocks are added to the block chain based on verification by the prescribed blockchain protocol [5].

In this sense, a block represents a storage unit with a reference to the previously verified chain of blocks. The contents of the block cannot be seen except by those who hold the permission [6]. Moreover, blocks added to the blockchain cannot be changed or modified [3].

Nodes in the network can identify each other by IP addresses where each node can send transactions to any of the other nodes if they know the receiver's public key. This communication is performed without any central authority intermediating in between which in turn adds to the security of the blockchain [7].

Blockchain framework

To understand the blockchain technology, it is important to understand the framework of its working mechanism. Figure 1 shows the framework provided by Brenig et al. [8]

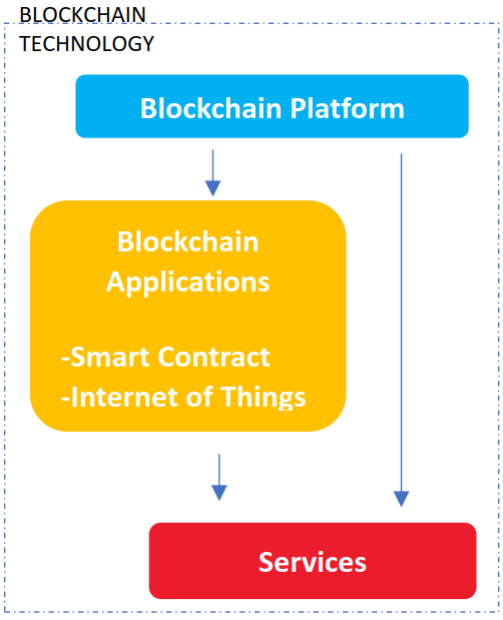

Figure 1: Framework for blockchain analysis [8]

The framework consists of three layers. The first layer is the blockchain platform that serves as the backbone of the applications and services layers. It can be identified as the protocol of the technology and serves as a decentralized consensus system [5, 9]. There are many standards for blockchain frameworks. The second layer is the application layer that is implemented on top of the blockchain platform to provide new functionalities that were not otherwise available. Finally, the third layer is the services layer that makes use of blockchain platform and applications functionalities to provide new services [8].

Benefits

Blockchain comes with a lot of promises of new business models and higher efficiency. From one side, blockchain improves trust between network members because the technology is based on shared consensus among different parties. This in turn makes the information more reliable and builds trust. Meanwhile, since there is no need for an intermediary to organize transaction exchange between parties, the involvement of parties in this exchange is built on transparency and trust [9]. On the other hand, blockchain increases visibility as information is shared accurately and on timely manner. Nonetheless, security is much higher thanks to the distributed nature of the blockchain technology compared to the centralized hub model. Contrary to the blockchain technology, the centralized hub model is vulnerable to server attacks. Contributing more to security, immutability is another important blockchain advantage which means that blocks cannot be changed or altered after being added to the chain [3].

Barriers

Despite the potential positive outcomes of blockchain implementation, the technology still faces some barriers. On top of these barriers are regulatory issues. For block chain to be fully utilized, it needs to be blessed by the regulator and many regulatory changes are required to accommodate for the use of this new technology[10]. Also, the fact that the technology is still in its early stages of adoption is another important barrier. A recent study showed that lack of trust in the technology and the reluctance to adopt it are among the current barriers [11].

BLOCKCHAIN FOR LOGISTICS AND SUPPLYCHAIN

The logistics and supply chain industry is characterized by many players. While efficiency is crucial to this industry, having many players represents a challenge. Blockchain represents many opportunities for this industry. What makes blockchain different is its characteristics of transparency, immutability, and integrity, which result to be appealing for shipping industry actors [12].
Despite the wide adoption of information technology in the shipping industry, the industry still faces some problems. Port logistics has three main important flows which are the physical flow, the financial flow and the information flow. The interdependency between the different flows makes the integration and synchronization between these flows crucial. However due to insufficient data sharing, this can result in bottlenecks, delays and accordingly higher cost [9]. The use of blockchain can provide innovative solutions to such problems. The technology brings forth a shift from technical

infrastructure to ecosystem-enabling platforms [3]. Meanwhile, to realize the full benefit of blockchain, there must be a large network of users which is the case in port logistics [12]. The next sections show potential application areas where blockchain can bring value to the industry.

Port community system (PCS) and cargo documentation

The shipping industry includes a lot of cargo and shipping documentation. A lot of these documentation are exchanged in a paper-based format. Moreover, missing information in the documentation is completed through bilateral communication. The updates to these documentations are stored in the updating company database or records creating more silos and mismatching data. This in turn causes delays and incurs more cost. Port logistics processes are executed among various players and require a high level of synchronization [9]. Using blockchain essential feature of "guarantee of uniqueness", blockchain technology can serve as the new PCS. With use of blockchain technology, port community members can exchange information on timely basis where the owner of the document can create a unique documentation. The transactions are then executed within the port community where each party contributes based on their permissions and their roles in the chain. This creates a basis of trust and security minimizing fraudulent data and costs due to delays, bottlenecks or inconsistent data [6].

Process traceability

One of the main processes within a port or terminal is moving cargo or containers from vessel to hinterland. This main process involves many sub-processes and is handled via many stakeholders. One of the major issues in port logistics is the lack of a realtime one image of the whole process [13]. This lack of visibility in turn hinders the coordination among the different process stakeholders thus increasing the process time. This can result in many bottlenecks and higher costs.

Blockchain technology can be used as an immutable ledger to store process timestamps. Process steps can be stored in the chain in an immutable and chronological order where each step is stored in the chain by the party performing it. In addition, blockchain provides transparency where each node in the network has a copy of the ledger that can be inspected in realtime. Meanwhile, the transactions are immutable since changing any block requires validation by the other nodes in the network which is practically impossible [7].

IOT and smart contract automation

IoT technology is gaining increased interest in the logistics and supply chain industry. The use of embedded sensors in physical objects and connecting these sensors to the network so that they can monitor their environment, communicate their status and even take actions based on the received information is opening the way to new business models and higher efficiency in port logistics. Combining the use of IoT and Smart Contracts in port Logistics may have a large potential in terms of process automatization. Smart contracts are electronic rules than can be applied once certain conditions are validated. There are lots of use cases in port logistics where IoT and smart contracts can make a difference [14]. Assets and infrastructure monitoring, optimization of capacity usage, storage and warehouse control, cargo monitoring are only some of the areas where IoT and smart contracts can bring value. However, many competing firms in the port community are often hesitant to share

information with a central intermediary that will aggregate this information with that of competitors. Figure 2 shows the main concerns when it comes to data sharing.

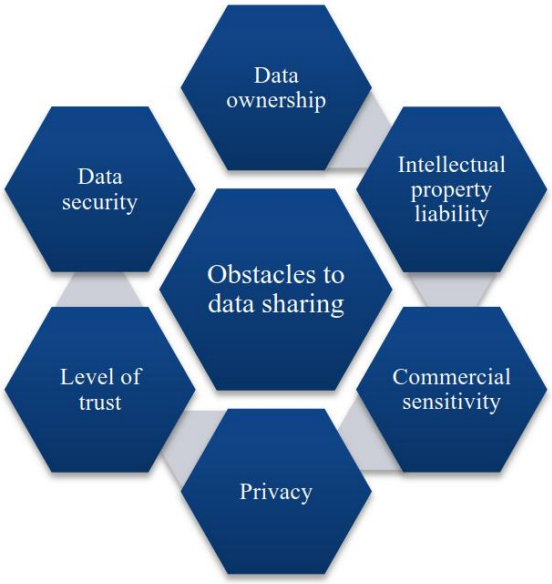

Figure 2: Key concerns of supply chain actors with regards to data sharing [15]

Therefore, blockchain technology represents a secure data management system that only shares relevant data with the concerning parties through an encrypted approach, backed up by confidentiality agreement. In this sense, blockchain solves the problem of data security with respect to the information generated by the smart devices.

Trade finance

Major losses have been accounted for during the past years in trade financing due to large inefficiencies and high chances of frauds [16]. One of the most common and standardized forms of bank-intermediated trade finance is a letter of credit (L/C), which is used for financing the international trade. Unfortunately, this document has been at the heart of several fraudulent attacks in last decades. There are many forms of fraud when it comes to this document. Whether the goods doesn't exist, the document is tampered, the cargo is of poor quality or the goods are sold more than once, these are all types of fraud [17]. Preventing such fraud requires lengthy validation processes thus impacting the port operations and causing delays. Meanwhile, containers are held in the terminal until a proof of commercial viability is received. Also, some parties that are not part of the port community system such as banks do not receive realtime information about the cargo within the port thus causing more delays and lack of coordination.

Blockchain technology can contribute to trade finance by guarding against frauds and saving reconciliation costs. Through blockchain technology, banks can be included in the blockchain network, while the transaction mechanism of blockchain can help prevent fraud thus leading to

smoother operations.

CONCLUSIONS

Blockchain has a lot of potential when it comes to port logistics. However, the technology is in its early adoption phases and faces some barriers that require attention. Port logistics is a very suitable industry for blockchain implementation. Some of the areas that can benefit out of blockchain in port logistics are as follows.

(1) Cargo documentation.
(2) Process traceability.
(3) IoT and smart contract automation.
(4) Trade financing.

REFERENCES

1. M. Oude Weernink, W. Van Den Engh, M. Francisconi, and F. Thorborg, "The Blockchain Potential for Port Logistics," Erasmus Univ. Delft Univ. Technol., no. 2 January 2018, p. 16, 2017.

2. I. Britchenko, T. Cherniavska, and B. Cherniavskyi, "Blockchain technology into the logistics supply chain implementation effectiveness," Dev. small.

3. L. Xu, L. Chen, Z. Gao, Y. Chang, E. Iakovou, and W. Shi, "Binding the Physical and Cyber Worlds: A Blockchain Approach for Cargo Supply Chain Security Enhancement," in 2018 IEEE International Symposium on Technologies for Homeland Security (HST), 2018, pp. 1–5.

4. H. H. Abbas and A. E. H. O. Abd El Halim, "The Role of Suez Canal Development in Logistics Chain," in Global Supply Chain Security: Emerging Topics in Research, Practice and Policy, A. R. Thomas and S. Vaduva, Eds. New York, NY: Springer New York, 2015, pp. 163–180.

5. S. Seebacher and R. Schüritz, "Blockchain technology as an enabler of service systems: A structured literature review," in International Conference on Exploring Services Science, 2017, pp. 12–23.

6. V. Morabito, "Business innovation through blockchain," Cham Springer Int. Publ., 2017.

7. F. Glaser, "Pervasive decentralisation of digital infrastructures: a framework for blockchain enabled system and use case analysis," 2017.

8. C. Brenig, J. Schwarz, and N. Rückeshäuser, "Value of Decentralized consensus Systems-Evaluation Framework.," in ECIS, 2016, p. ResearchPaper75.

9. L. Kirstein, "Information sharing for efficient maritime logistics," 2018.

10. B. Carson, G. Romanelli, P. Walsh, and A. Zhumaev, "Blockchain beyond the hype: What is the strategic business value?," McKinsey Co., 2018.

11. N. Hackius and M. Petersen, "Blockchain in logistics and supply chain: trick or treat?," in Proceedings of the Hamburg International Conference of Logistics (HICL), 2017, pp. 3–18.

12. M. Dobrovnik, D. Herold, E. Fürst, and S. Kummer, "Blockchain for and in Logistics: What to Adopt and Where to Start," Logistics, vol. 2, no. 3, p. 18, 2018.

13. I. Haq, R. Monfared, R. Harrison, L. Lee, and A. West, "A new vision for the automation systems engineering for automotive powertrain assembly," Int. J. Comput. Integr. Manuf., vol. 23, no. 4, pp. 308–324, 2010.

14. E. Hofmann and M. Rüsch, "Industry 4.0 and the current status as well as future prospects on logistics," Comput. Ind., vol. 89, pp. 23–34, 2017.

15. V. Kupriyanovsky, S. Sinyagov, A. Klimov, A. Petrov, and D. Namiot, "Digital supply chains and blockchain-based technologies in a shared economy," Int. J. Open Inf. Technol., vol. 5, no. 8, pp. 80–95, 2017.

16. Y. Zhang, Approaches to Resolving the International Documentary Letters of Credit Fraud Issue. University of Eastern Finland, 2011.

17. L. Rutten and others, "A primer on new techniques used by the sophisticated financial fraudster, with special reference to commodity market instruments," 2003.

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