

BLOCKCHAIN TECHNOLOGY IN MARITIME TRANSPORT

Software tools in project planning of innovative ports

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Abstract

The application of blockchain technology in maritime logistics is one of the key current challenges for both cargo and passenger ships. The maritime industry lacks innovation related to operational procedures and logistics, which is also a challenge, which makes one of the most promising areas of maritime innovation related to digitization, including the development of smart ships, the smart fleet and smart global logistics. In the absence of academic research on this topic, the intention is to point out the need to connect these two areas which, due to different starting points, are centralized in one and decentralized in another, that is, due the existence of a regulatory framework in maritime transport and the absence of any form of regulation code blockchain technology, are so far revised through completely separate studies.



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1. INTRODUCTION

The application of blockchain technology in maritime logistics is one of the key current challenges for both cargo and passenger ships, since its strengths in other industries shows the possibility of eliminating the crucial problems that are common in shipping. The first one and so far, the only research on this subject was published by the Danish maritime conglomerate *A.P. Moller – Maersk (Maersk Group)* in collaboration with *IBM* technology company. After several pilot projects preceding this survey, Maersk Line, a shipping company within the same name group, involved in global container transport, announced that the implementation of a blockchain, referring to the fact that 90 percent of goods worldwide are transported by sea, while the costs of administrative processing commercial documents account for 20 percent of total shipping costs.

2. PURPOSE

The main purpose of this paper is to take into account the increasingly widespread introduction of blockchain technology into modern business, pointing to the benefits of its use in maritime logistics, identifying, on the one hand, key drivers and, on the other hand, pointing at the existing constraints that slow down the process its application.

Primary data for the purpose of this paper were collected by analyzing the report published through the joint activities of the companies A.P. Moller – Maersk and IBM. Moller – Maersk (<https://maersk.com/>) is an integrated container logistics company that works to connect and simplify customer supply chains around the world, which, as a global leader in shipping, operates in 130 countries.

IBM (<https://www.ibm.com/blockchain>) is a technology company that is the world leader in open-source company blockchain solutions, dedicated to enhancing inter-industry blockchain technologies that support the development of transactional business networks with open access management. Secondary data were collected by analyzing company reports and international media publications.



3. THE CONCEPT OF BLOCKCHAIN TECHNOLOGY

Innovative blockchain technology is designed to transfer and store data, and thanks to its decentralized nature, transparency and speed of transactions, it is applied in various industries. Blockchain is a platform without a central control or control body, which makes it a significant place in modern access to all forms of financial operations. France is the first member state of the European Union that has provided a legal definition of the blockchain as "a common electronic data storage device that allows the authentication of these operations to be checked" (Order No. 2016-520, April 28th 2016).

Blockchain is a specific technology that allows instant data synchronization, so that transactions are not reduced to consolidating accounting data, which requires a certain number of tests to be carried out in order to authenticate specific conditions that would allow this process to be in accordance with applicable regulations, that is, what indicates the necessity to unveil actions that technology does not launch from itself.

In addition to this, it is required to provide all the necessary prerequisites for the transformation of the payment industry, since the way transactions are now carried out through the blockchain platform is not adapted to the mass payment performances that make it take place in an extremely short period of time, such as is the case with payment cards. Blockchain technology is currently expanding its boundaries and expectations due to the characteristics of immutability, decentralization and keeping track of time¹.

¹ Kharchenko, Vyacheslav, Kondratenko, Yuriy, Kacprzyk, Janusz "Green IT Engineering: Concepts, Models, Complex Systems Architectures. Studies in Systems, Decision and Control", vol. 74. Springer, Cham (2017)



3.1 KEY CHALLENGES

In order to understand the change in the paradigm that blockchain brings to finance, it is necessary to have an insight into the dynamics of the development of technological innovations and to understand the need to enable a better connection of related parameters in order to facilitate faster, simpler execution of financial transactions and all the accompanying data and at the same time, within the databases involved in the business.

The challenge that blockchain technology represents for the maritime industry is grounded on three basic factors:

1. estimated benefits in order to reduce operational costs within the supply chain;
2. a clearer insight into the databases through a record that is distributed to all entities involved in the supply chain;
3. inability to change or remove content once it is added.

3.2 SCOPE OF ACTION

Blockchain-based maritime management involves cargo carriers, ships, carriers, freight forwarders, customs and port authorities. To work on an open platform in such a system, IBM and Maersk use a system that provides an accelerated process of digitizing the supply chain of international maritime supply chain.

One of the key reasons that led to the need to create solutions that would allow a better insight into the basis of all relevant data in the supply chain is the need to eliminate the risks of fraud by increasing transparency and providing visible evidence of authenticity in the raw materials sector, which is a prerequisite for insurance market confidence in traded goods.



A special reason for such a step forward is the effort to prevent a similar risky situation such as the scandal hit China's Qingdao port in 2014² when the global banking sector faced huge losses caused by the fraud of trade companies engaged in transporting goods.

Companies in this case used one and the same stock of raw materials to be able to provide guarantees for multiple credit lines, without the knowledge of commercial banks that approved such loans.

Thanks to this extension, blockchain signifies secure and distributed information shared by different users, which contains a set of procedures, each of which can verify its validity. Blockchain can thus be assimilated to a large public anonymous book that cannot be forged, and these parallel statistics are simplified and, in reality, data does not appear in plain text in a blockchain.

3.3 THE IMPORTANCE OF BLOCKCHAIN

Blockchain is significant in that it combines a distributed database and a decentralized book, completely eliminating the need to verify any central controlling authority. The initial feature of the blockchain platform is most easily seen on the example of the digital bitcoin currency, although crypto-traffic is not the main purpose of this technology.

However, in the example of the digital currency, it is noticeable how the dual spending problem that is commonly occurring in financial transactions is resolved, and at the same time the concept of monetary networks is redefined by providing a peer-to-peer payment system and eliminating the need for intermediary banks, including central banks, thanks to smart contracts.

² Home, Andy "Qingdao scandal casts a long shadow over metal markets", Reuters, London (2014) retrieved from <https://www.reuters.com/article/us-qingdao-metals-ahome/qingdao-scandal-casts-a-long-shadow-over-metal-markets-andy-home-idUSKBN0JW18620141218>



4. SMART CONTRACTS

Smart contracts³ are sections that are programmed to perform specific actions by standard contracts that define client's obligations and their modalities are linked to a computer program that automatically checks if conditions are met and accordingly executes the terms of the agreement, making each of the blocks inside chain indicates the transaction register page. Smart contracts therefore consist of code lines in the block of blocks that are activated as a result of transactions. In this way, a distributed database with parts stored in multiple locations and processed distributed among multiple database nodes is introduced into a decentralized system of logging of economic activities that are separated rather than relying on a third-party system, such as a financial institution. This eliminates the problem of the occurrence of double expenditure, especially when exchanging a digital currency in a way that it can be sent simultaneously to two different bases. The need for applying such a set of opportunities is becoming more noticeable in a number of spheres of business, where it is still unclear how much the potential of the overall spectrum of impacts and the effects of blockchain technology, for which only a small part of the moment is starting to be used in a dynamic business environment.

5. THE APPLICATION IN MARITIME TRANSPORT

The maritime industry is part of the complex and information-rich maritime supply chain, which consists of a number of organizations that are globally connected and distributed⁴, including other key infrastructures that support global trade, with transport and port structures. Although the maritime industry is technologically advanced, innovations in the maritime sector are primarily related to shipbuilding, exploration of oil and gas, seabed exploitation technology and others, mainly engineering innovations. However, the maritime industry lacks innovation related to operational procedures and logistics, that is also a challenge, which makes one of the areas of maritime innovation with the biggest

³ Braendgaard, Pelle "Unpacking the term 'Smart Contract'", ConsenSys Media, Managua (2016)

⁴ Kharchenko, V., Kondratenko, Y., Kacprzyk, J. „Green IT Engineering: Components, Networks and Systems Implementation. Studies in Systems, Decision and Control“, vol. 105. Springer, Cham (2017)



potential related to digitization, including the development of smart ships, the smart fleet and smart global logistics.

5.1 LACK OF DATA ANALYSIS

Regardless the growing number of subjects in the maritime industry that adopt blockchain technology, this subject has not been accessed through academic studies yet. One of the key reasons for which the extensive analysis of the application of blockchain technology in the maritime industry is still lacking is that the basic drivers of such a process are not identified and defined, since at the academic level blockchain is being studied in parallel as a decentralized system that is not subject to any form of external regulation, on the other hand, is one of the most influential drivers of innovation linked to existing foreign industry regulations in line with the policies of international organizations⁵.

It is a basic instrument for improving the performance of the supply chain, providing companies with several benefits, including the improvement of statistics when it comes to the time within which the client responds, reducing inventory levels, more advanced decision-making processes, and visibility across the entire chain⁶. For example, TradeLens⁷ uses IBM Blockchain technology that is the basis for digital supply chains, encouraging a growing number of trading partners to collaborate by establishing a unified common view of the transaction without compromising detail, privacy or confidentiality. Senders, shipping companies, freight forwarders, port operators and terminals, internal traffic and customs authorities are able to communicate more efficiently via real-time data access, including data on the Internet of things and sensors, from temperature control to weight of containers.

⁵ Crosby, M., Pattanayak, P., Verma, S., Kalyanaraman, V. „Blockchain technology: beyond bitcoin“ Appl. Innov. 2(6), 6–10 (2016)

⁶ Solesvik, M.: Partner selection in green innovation projects. In: Berger-Vachon, C., Gil, L.A., Kacprzyk, J., Kondratenko, Y., Merigó, J., Morabito, C. (eds.) Complex Systems: Solutions and Challenges in Economics, Management and Engineering, vol. 125, pp. 471–480. Springer, Cham (2018)

⁷ World maritime News <https://worldmaritimeneews.com/archives/258600/maersk-ibm-unveil-blockchain-shipping-solution/>



5.2 ADVANTAGES OF APPLICATION

The key benefits of using blockchain technology that apply to ports and port terminals is to provide information on the disposition of shipments within the port or terminal. In this case, the advantage of embedded connections with ship lines and other actors is that it allows full visibility through the transport corridor, as well as access to more information in real time in order to strengthen port cooperation and improve terminal planning. Shipping companies provide a better insight into the details of overseas shipments, relying on establishing connections with customers and ports, i.e. terminals around the world, and accessing real-time supply chain events.

The application of this technology to customs authorities enables insight into information on the export and import status of customs clearance for shipments entering or exiting the country. Maritime transport is an area of business that is well networked with other industries and allows lower prices in relation to the use of other forms of transport, such as air, rail or road, but one of the key challenges is to reduce the duration of the transport cycle⁸, which in a significantly larger achieved by using blockchain technology.

The significance of the application of the blockchain within the supply chain to freight forwarders is in the secured transport plan, the insight into the events in internal traffic and information on transfers, as well as the overview of the complete documentation accompanying the shipment. In this way, it is possible to use the benefits of embedded ecosystem connections, enhanced customs clearance tools and access to supply chain data in real time, not only in maritime but also in intermodal transport, as an insight is given on shipments to be forwarded transported by trucks or by rail. An additional advantage of using a blockchain in the supply chain is to provide greater predictability, early notification of all issues, as well as complete transparency for verifying fees and additional costs.

⁸ Finextra: Marine Transport International Applies Blockchain to Shipping Supply Chain (2016). Retrieved from <https://www.finextra.com/pressarticle/66223/marine-transportinternational-applies-blockchain-to-shipping-supply-chain/>



6. CONCLUSION

Maritime transport data stored on the blockchain platform contains a list of transactions and other metadata in a process where there is no central arbiter, which means that it is stored on user servers. Enabling a clear insight into all the details of a particular supply chain is a key advantage that the application of blockchain technology will bring to the maritime industry, eliminating the accumulation of operating costs caused by duplicate bookkeeping and shortening the duration of the procedures, especially when it comes to approving transactions. The application of smart contracts in communication between shipping operators, freight forwarders, customs and port authorities would ensure greater visibility of all relevant information for any member within the supply chain without the need to increase operating costs. The application dynamics will be conditioned by the comprehensiveness and precision of new data analysis derived from the direct experience of Maersk and IBM cooperation, as well as by monitoring future implementation examples.



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