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Offering Patterns Used for Block chain in International Transportation Industry

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Abstract

This article Is a comprehensive review of the current growing trend of using blockchain technology in the transportation industry. The definition and features of blockchain technology, as well as its potential benefits in various fields, such as financial, internet of things, medical, government services, etc. is represented for a better understanding of its complexity and application. Besides, blockchain technology main challenges, and the most prominent patterns and uses of blockchain technology in international transport have been illustrated. Its advantages and applications are also presented through numerous examples.

Keywords: blockchain technology, international transport (shipping), seaports

1. Introduction:

International transfer is one of the most essential international sections, which has long been noted by business people, and through the tax of which the economy of cities and countries were maintained. International transportation has transformed along with the changes in technology, among which one of the most important contracts was the Incoterms that has focused on an extremely significant section of trade. Businessmen and salespeople's risks, their costs and benefits, and new methods led to more attention to transportation documents. One of those subjects that is highly emphasized on is business portfolios; whoever has such a portfolio is regarded as the merchandise owner. However, countless hardships may occur for goods transport and documents that change. For instance, when a company does not want its rivals to learn about the whereabouts of purchase, or during sanctions, or when they do not intend to clarify the

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destination of the transported goods, they may as well change the documents. To avoid forgery in transport documents, block chain technology was introduced; unfortunately, nonetheless, it could not be properly used in this field.

In the meantime, maritime transportation was a major means of International transport for world trade in past centuries, and was regarded as one of the basic principles of globalization (Halim et al., 2018). Around 90% of world trade is carried by the transportation industry (IMO, International Maritime Organization, 2019). Maritime transportation has an important role in the integrated transportation system, especially in the area of international trade (Caban, Ignaciuk & Misztal, 2017).

Blockchain, as a relatively new technology, can positively affect international shipping, and can make a large number of innovative changes in the obsolete industry today. Blockchain is a digital, decentralized, distributed ledger in which transactions are recorded and added in chronological order, creating permanent, anti-tampering records (Treiblmaier, 2019). To achieve decentralization, concurrent peer performance, anonymity, transparency, irreversibility, and integration, blockchain is designated in a fully functional way (Tijan, Aksentijević & et al, 2019).

Furthermore, it can have a positive impact on international shipping, as well as logistic processes, from storage to delivery and payment (Tijan, Aksentijević & et al, 2019). Through blockchain, it is feasible to accelerate the physical flow of goods, in addition to rising clarity and security (Lindman, Rossi &Tuunainen, 2017). For example, Maersk and IBM have decided to jointly create their own blockchain solution in order to decrease international shipping costs, improve visibility across the supply chain and eliminate inefficiencies caused by bureaucracy (IBM, 2018).

This article explores its role by drawing upon and especially emphasizing on blockchain technology in international transport for a better understanding. The subject revolves around rising costs and losing time as a result of insufficient or traditional implementation and monitoring of business processes.

The aim of this article is to present the effect of blockchain technology in the development of international shipping, and to indicate the facilities of blockchain in international shipping. This research has been conducted to show a set of the most destructive innovations of DigLogs, project D3.1.1. that can affect the area in the next five years; this project is a collaboration of Italy and Croatia for the purpose of creating the necessary concepts, technological solutions, and models

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and of planning to create the most advanced digital logistics processes for freight traffic and passenger service program in this area is running.

2. Blockchain Technology

Blockchain technology is based on the way in which previously unknown parties can jointly generate and maintain any fully distributed database in which the correctness and completeness of the transaction is confirmed using the consensus of independent verifications (Tijan, Aksentijević & et al, 2019). Blockchain is made up of two terms: "block" and "chain". A "block" represents a transaction, while a "chain" links these transactions to a chain. Block is the main unit of blockchain. Each block contains a list of transactions and links of the previous block in the chain. The principle of blockchain technology is realized through a decentralized peer-to-peer network. Peer-to-peer network is defined as a data sharing network between many work units (Peer-to-Peer Networks, 2009).

The first blockchain was used as the basis for Bitcoin cryptocurrency in the financial sector. It uses peer-to-peer technology and works without any credible trusted third party that may appear as a bank, chartered accountant, notary or any other centralized service (Maersk and IBM, to create joint ventures using blockchain to improve global trade and digitize supply chains, 2018). Bitcoin is open source; its design is public; no one owns or controls it (BitCoin, 2019). In addition, it is an encrypted electronic payment system and provides the possibility of trading virtual currencies in the form of digital tokens called Bitcoin (BTC or Bitcoin) (Conti et al., 2018).

In the transportation industry, blockchain was initially used to enable confidential financial transactions between shareholders without relying on "third parties". However, there is a difference between public blockchain networks and solutions in the transportation industry. Public blockchain allows anyone to become a member, no one has control over networks and so on (Public Vs Private Blockchain In A Nutshell, 2018). While the latter is usually based on authorized blockchains which have very different properties and look more like traditional information systems or databases.

A blockchain-based smart contract represents a distributed operating system (Uvod u blockchain — Ethereum i pametni ugovori – startit, 2017). A smart contract can be defined as a pre-evaluated contract that executes itself (Allam, 2019). Blockchain technology includes several

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prevention mechanisms (for instance, distributed agreement and cryptography) to lower the risk of cyber-attacks.

Blockchain can be implemented in public and social services in a wide range of applications from financial assets, payment systems, smart contracts, operational risk in the financial market, risk management, Internet of Things (IoT) (Tijan, Aksentijević, et al, 2019). IoT technology may be improved by blockchain technologies. IoT represents digital or "smart" connection of objects using RFID sensors, Wi-Fi, Bluetooth and other "smart" protocols to accelerate business processes (Jović et al, 2019). Typical IoT applications consist of logistics management with radio frequency identification (RFID) technology, smart homes, e-health, smart grids, maritime industry, and more (Tijan, Aksentijević, et al, 2019).

There is a distinction between blockchain and other smart technologies. For example, blockchain is designed as a basis for applications that cover transactions and interactions. These can include smart contracts (smart contracts are automatically executed when a certain condition is fulfilled, for instance in the case of product conditions or environmental conditions) or other smart applications which support specific IoT processes. As a result, blockchain technology can adapt not only to the Internet of Things but also improve IoT features and cost-effectiveness (i-SCOOP, 2018).

3. Blockchain Challenges

Blockchain technology is still very immature, there is no basic standard, Concepts are difficult to master, and even the simplest forms of implementation require programming intervention (Tijan, Aksentijević, et al., 2019). Besides, failure to regulate creates insecurity, Because some aspects of smart contract technology may be accepted by the logistics market, just to be over-regulated, or even to be taken as illegal (Gatteschi, et al., 2018).

Blockchain technology suffers from scalability and performance issues: all nodes in the chain must process all transactions, and this issue is presented on a large scale, especially globally (Tijan, Aksentijević, et al., 2019). Therefore, "this technology is very energy-consuming and the proven calculations consume a significant amount of CPU. What's more, users' privacy may become more limited, because all nodes contain a complete copy of the ledger and there is no central authority to contact them in cases of obvious security breaches (Tijan, Aksentijević, et al., 2019). Distributed trust, and therefore security and privacy, is at the core of blockchain

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technologies and it has the potential to help them succeed or cause failure (Karame & Capkun, 2018). Personal information and sensitive data in general should not be trusted to third parties if they are susceptible to attack and abuse (Zyskind, Nathan & Sandy' Pentland, 2015).

Instead, users should control their data without ownership, without compromising security or restricting the ability of companies and authorities to provide personalized services. One solution is a platform that targets blockchain, the aim of which is again to act as an access controller and a silent blockchain storage solution (Laurent et al., 2018). Users do not require to trust third parties and are always aware of the data collected about them and how it is used. Furthermore, blockchain identifies users as the holders of their personal data. Companies, in turn, can focus on data usage without having to be too concerned about proper security and segmentation.

The United States ordered the Deloitte Blockchain Global Poll in March and April 2018, primarily as a research tool for gaining more insight into general attitudes and investing in blockchain as a technology (Deloitte, 2018). According to the survey, despite the security challenges mentioned, the majority of respondents (1053 on the global level) believe that blockchain is more secure than conventional IT systems.

4. Application of blockchain technology in the transportation industry

The maritime industry is part of a complex and intensive offshore supply chain holding information which includes a set of organizations that are connected and distributed across the globe, namely other vital infrastructure that supports global trade, such as transportation and ports (Gosdal, Chacharovsky and Solswick, 2018). The maritime industry lacks innovation in operational procedures and procurement, and is one of the most promising areas of maritime innovation in digitalization, such as the development of smart ships, smart fleets, and smart global logistics in international transportation (Tijan, Aksentijević, et al., 2019) (Wang et al., 2016).

Even though the maritime industry is technically advanced, innovations in the maritime sector have been primarily related to ship-building and propulsion, oil and gas exploration, seabed exploitation technologies, and other innovations (mostly based on engineering) (Tijan, Aksentijević, et al., 2019). There are some of the most prominent examples of blockchain applications in the maritime industry with an emphasis on maritime transport mentioned below.

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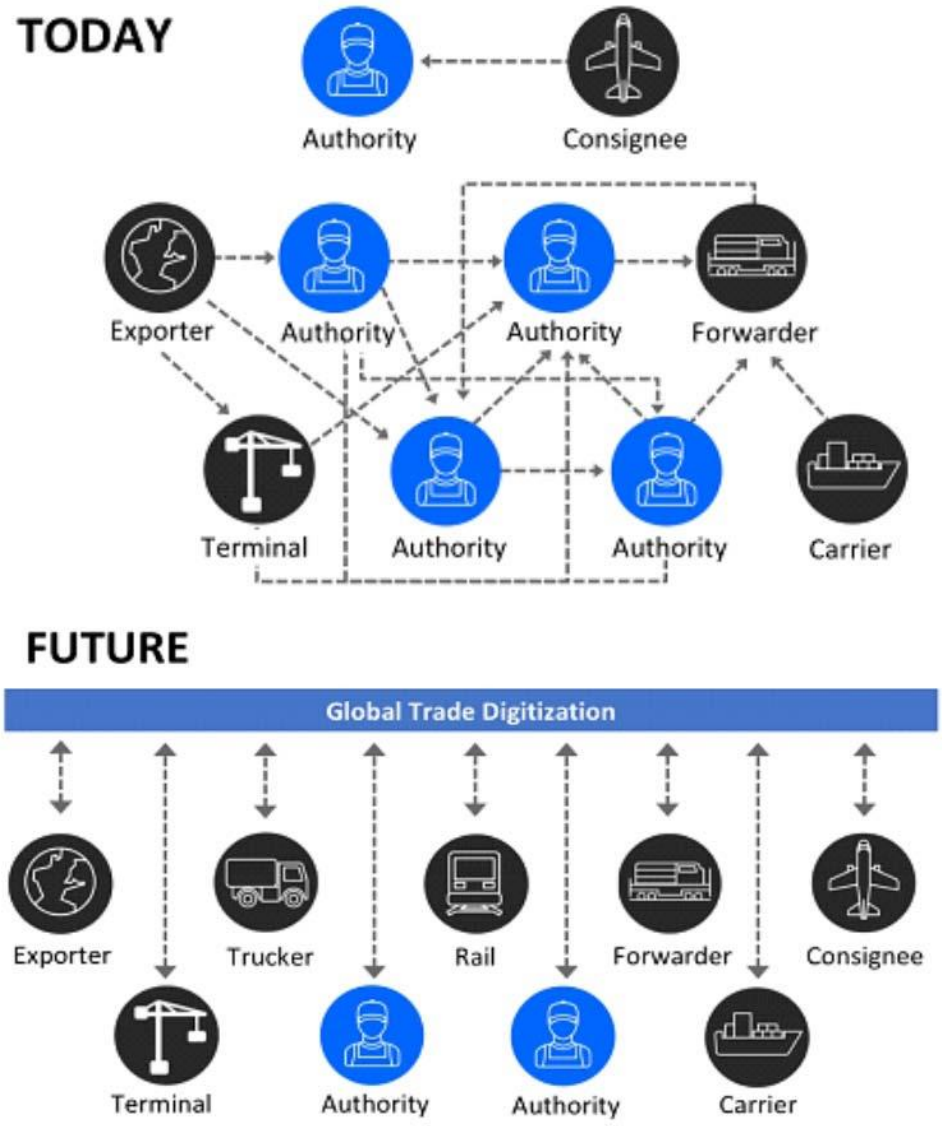
TradeLens - Maersk and IBM blockchain

Maersk and IBM joined together to create a blockchain solution with the purpose of digitizing global trade called "Tradelens". Inspired by the initiative, other international transport industry actors have also begun to partner or join industry-wide consortia hoping to reap the promised benefits of blockchain technology. According to IBM, the Joint Blockchain Initiative had the potential to "greatly reduce the cost and complexity of business" (cross-border and large-scale supply chain solution between Maersk and IBM in Blockchain, 2017). Figure 1 illustrates Maersk-IBM blockchain solution for digital Global Trade Show (IBM Blockchain, 2018).



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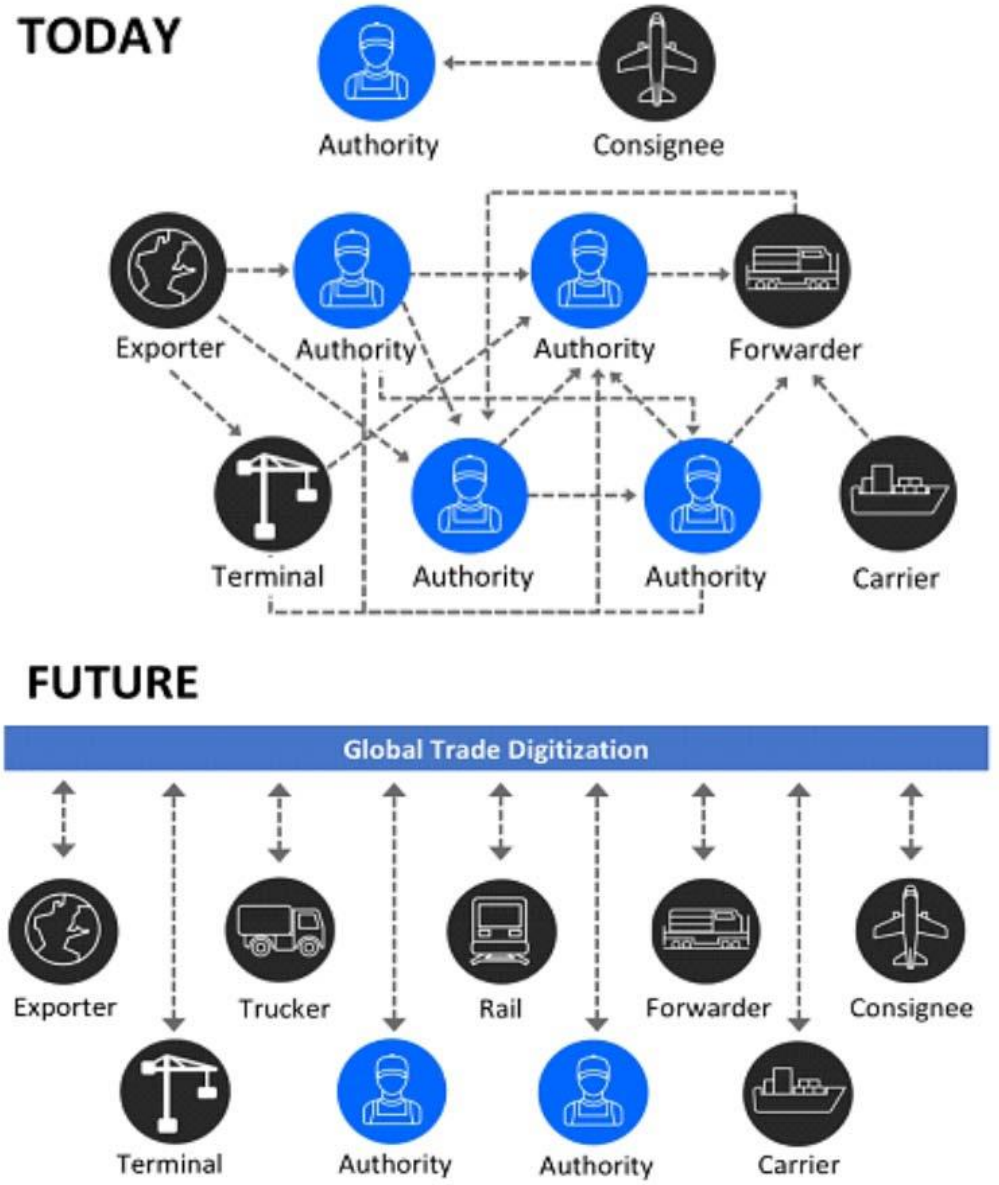

Figure 1- Maersk and IBM blockchain solution for global business digitalization (IBM-Blockchain, 2018)

The procedures involved in transporting international goods overseas are complicated, since a large number of organizations and individuals are involved, such as the transportation network, freight transport, ocean shipping, ports, and customs officials. With the ability to monitor shipments, the platform reduces the need for documents, and automated documentation allows secure sending and signing of contracts using blockchain technology. Smart blockchain-based contract will play a significant role in the Maersk platform as it enables authentication management, accelerates data processing compared to the current system, and reduces the

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number of errors to null (Blockchain Shipping: Maersk spin-off for commercialization Software platform, CoinDesk, 2018).

BDTS – CargoX

CargoX developed the BDTS (Blockchain Document Trading System) system. BDTS offers a platform with highly practical applications, among which Smart B / L™ is the most popular. CargoX is an independent provider of blockchain document trading systems that offers a very fast, secure, reliable and cost-effective way to process international shipping documents anywhere in the world. (CargoX | Transforming the future of global trade with the first blockchain global bill of lading, 2019). CargoX has created an open system based on blockchain technology and decentralized storage of encrypted data that allows the creation and exchange of traffic documents through smart contracts.

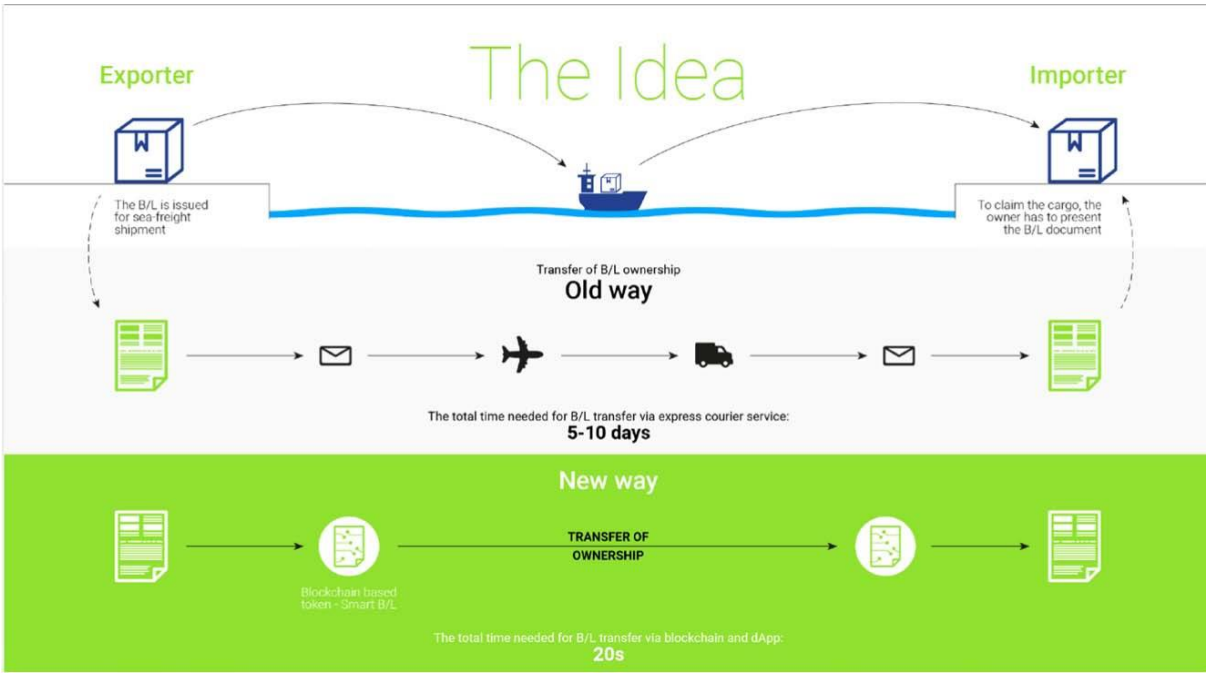

Figure 2. Comparison between the current solution and the CargoX digital solution (From the Past to the Future, 2019)

Through the Smart B / L program, CargoX intends to replace today's physical (paper-based) proof of ownership (which is used to confirm ownership of cargo at the port of destination) with digital proof of ownership which is immediately portable; hence, making the bill of lading more secure, archiving easier and much cheaper compared to the current paper-based bill of lading.

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Figure 2 depicts a comparison between the current workflow and the workflow provided by the CargoX Smart B/ L blockchain-based solution to transfer documents in less than 20 seconds. (From the Past to the Future, 2019)

CargoX intends to connect exporters, international shipping companies, importers, exporters and other stakeholders in a balanced system based on trust and interaction. In this regard, CargoX aims to bring down the need for intermediaries, remarkably reduce costs and delivery time by providing tools for secure document sharing, while providing a high level of security and transparency.

Cooper Port is a good case in point of the successful implementation of blockchain technology. In August 2018, the first processed container with the new blockchain-based CargoX smart loading bill was released in the above-mentioned port. The bill of lading was electronically issued and transported in a matter of minutes instead of days or weeks, with the help of a very secure and reliable blockchain network, and the probability of losing, stealing or damaging the bill of lading was significantly reduced to nearly zero (7 Major Blockchain Technology Developments in Maritime Industry in 2018, 2019).

Blockchain platform for global commodity monitoring - ShipChain

ShipChain was founded to solve the problems of the logistics industry. The solution offered by ShipChain requires the use of blockchain technology, which is based on the entire chain of delivery of information to the end user - from the moment the product leaves the factory, farm, etc. - to the receiving customer through the system "less trust". What's more, blockchain contracts are transparent (ShipChain: The Logistics Platform Powered by Blockchain, 2018).

With the support of the ShipChain platform, it is possible to monitor load points and status worldwide, i.e. in all geographical locations. Each point is encrypted and available for interpretation, and only the involved stakeholders view all load data. Transport companies are more visible through their supply chain and communicate more easily. Information on times, geographical locations and basic compliance information is recorded in the "side chain" and is publicly verified. A sidechain is a separate blockchain that links to its source blockchain through a two-way connection. The two-way connection provides the capacity to exchange assets at a predetermined rate between the source blockchain and the sidechain (Hacker Noon, 2018). The

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contract is completed and registered in the main chain after delivery and receipt of cargo (ShipChain, 2018).

ShipChain features may be summarized as follows (ShipChain, 2018)

1. Vision - A single solution for asset tracking (a single platform from shipping to delivery)
2. Trust - Transparency through immutability (data storage that cannot be changed and is verified by all participants)
3. Control - Thanks to ShipChain treasures, business owners have full control over who asks and how he asks them for information.

Morpheus Network1

Morpheus Network is a complete, global, and automated supply chain platform that has an integrated payment system using blockchain technology (Morpheus Network – Disrupt Global Trade, 2019). Any mistake in the documents may ruin the entire shipment or impose additional costs on the stakeholders. Many international shipping stakeholders (e.g. importers, exporters, carriers, customs brokers, terminal operators, etc.) make use of a variety of documents; such documents must be reviewed by the above parties and be sent to the next location. Morpheus network intends to make the described process easier and more effective. Each time a document has to be shared between multiple institutions. Placing that record in the blockchain allows instant updates that are visible but not changeable.This provides an opportunity for outstanding savings in both time and expenses while ensuring a high level of trust (Morpheus Network - Disrupt Global Trade, 2019).

Global shared container platform

The blockshipping company created the Global Common Container Platform (GSCP), that is a platform for managing containers more and solving some of the most essential container-building problems in international shipping. Figure 3 represents the workflow of the GSCP platform (ICO-5 review of why blockshipping should be a revolution in the international container shipping industry, 2018).

The GSCP platform is meant to become the main IoT (Internet of Things) for the international transportation industry.

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Blockchain technology provides thorough transparency because the GSCP platform enables a large number of marine industry stakeholders to achieve significant cost savings (GSCP ICO blockshipping - Global Container Transportation Industry Conversion, 2019).

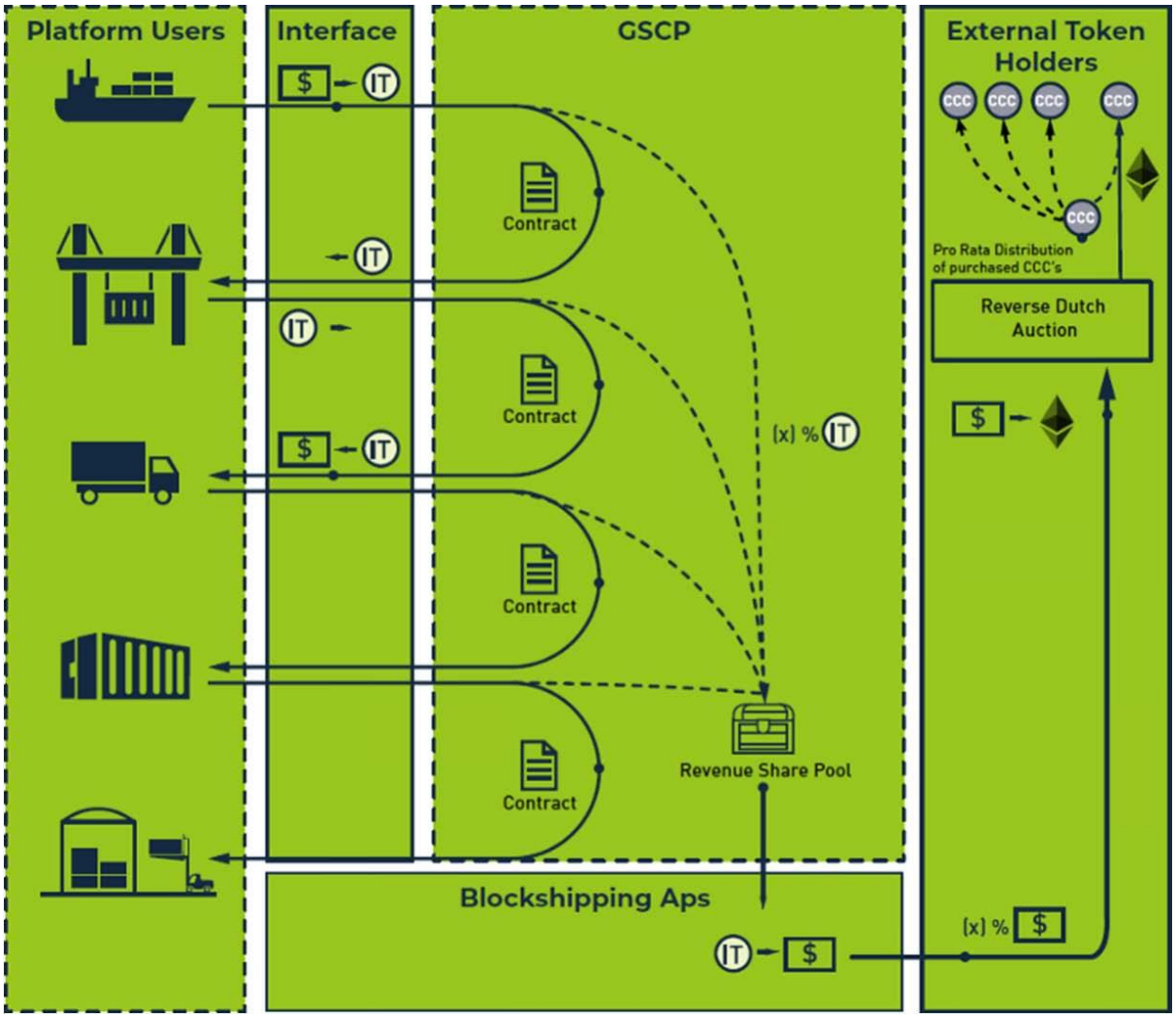

Figure 3. The GSCP platform (ICO-5 review of why blockshipping should be a revolution in the international container shipping industry, 2018)

Ports are important hubs in intermodal transportation, and many stakeholders operate in complex seaport environments (e.g. transport companies, port authorities, terminal operators, transport agents, and so on) (Tijan, Jović, et al., 2019). Ideally, all shipment information is available to all relevant stakeholders and thus creates a digital connection. Any port that is competitive must embrace digitization which would enable transparency and smooth data

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exchange. Nonetheless, a prerequisite for the implementation of the blockchain is connecting the shareholders.

Blockchain is definitely one of the topics debated in recent years and can have a significant impact on the future of port logistics and digitalization (Blockchain potential for port logistics | KennisDC Logistiek, 2017). One of the seaports that showed great interest in digitization and use of blockchain is the port of Rotterdam. Blocklab (News - Blocklab, 2019) (Rotterdam Port Subsidiary, in collaboration with the City of Rotterdam) has built a program based on blockchain software that can securely track the ownership and location of shipments: On average, 28 specific parties participate in each transport logistics transaction. Documents containing potentially sensitive shipping data have changed 200 times from the time of final shipment to final delivery (Rotterdam Port Blockchain Solutions Begins, 2019).

Blockchain technology can connect previously unrelated stakeholders, enable new forms of collaboration, and create new job opportunities in international transportation. In logistics, blockchain has the potential to transform port procedures by documenting, validating, and securing any event in the chain (Blockchain potential for port logistics | KennisDC Logistiek, 2017).

Through its typical features, blockchain can add value to logistics and the dighitalization of international transportation in a variety of ways (an exploratory study of blockchain technology in the use of port logistics | KennisDC Logistiek, 2018). Therefore, according to KennisDC Logistiek, these are related to building trust, providing secure data, being visible, expanding network, and integrating supply streams (blockchain potential for Port Logistics | KennisDC Logistiek, 2017).

According to Oude Wernink et al. (2017), blockchain can be employed in seaports in several ways, such as:

1. Exchange of current information in international transport companies

When the international shipping company enters the port, the cargo documents are generally processed by the ship's representative and are then sent to the PCS - "Port Community System". Figure 4 illustrates the current flow of information in the import carrier process (Oude Weernink et al., 2017).

PCS allows the distribution of information among network stakeholders to facilitate the movement of containers during the procedure. Not all parties involved in the network (insurance

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companies, banks, etc.) are included. This process has inefficient means of communication and leaves enough room for improvements that a blockchain can make.

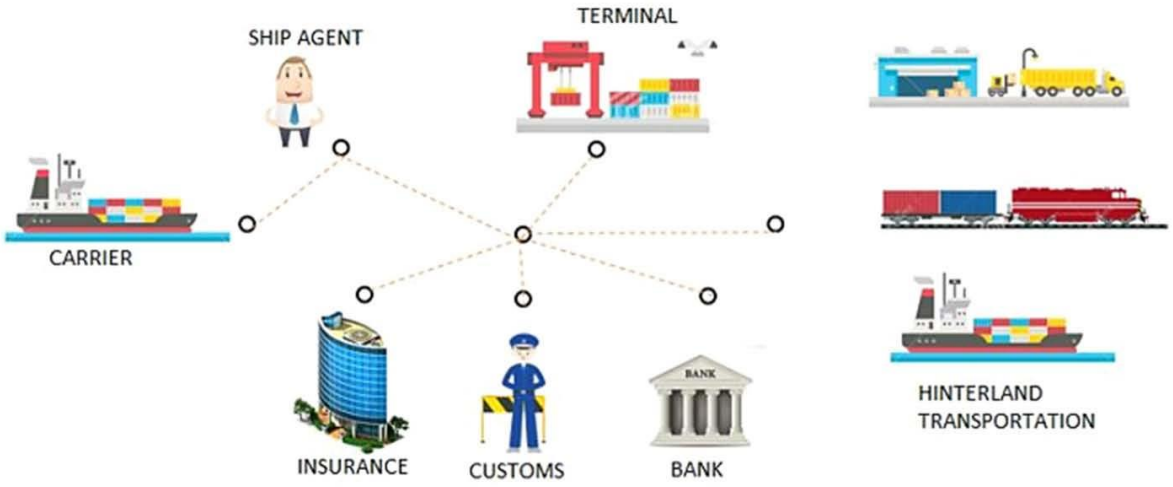

Figure 4. Current information flow in the import carrier procedure (Oude Weernink et al., 2017).

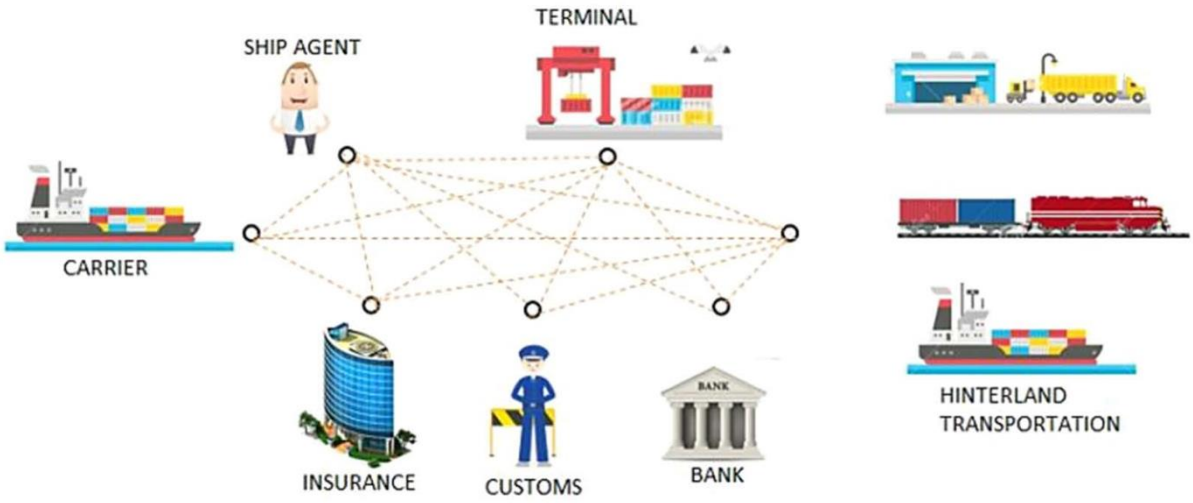

Figure 5. Blockchain information flow in the import carrier procedure (Oude Weernink et al., 2017)

2. Information flow in seaports supporting blockchain technology

Implementing a blockchain may facilitate the exchange of information between the parties involved in this process. This can be recorded by storing load information in the loading bill. Figure 5 shows the flow of blockchain information in the import carrier process (Oude Weernink et al., 2017). Instead of exchanging documents, beneficiaries involved in the process are allowed to access data storage blocks. This leads to unique and shared information that is accessible in real

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time at a lower transaction cost. The process can be accelerated by including the stakeholders that are currently out of the procedure (such as banks and insurance companies).

3. Blockchain program in all international transport operation areas

The database can be further upgraded by implementing an IoT device by connecting them as blockchain nodes. For instance, trackers can be installed on containers, so that the sensor signals can automatically store data in a blockchain without any user input. In addition, sensors installed in the container can monitor the condition of the commodity and can present the information to the insurance company. Besides, by connecting smart devices, it is possible to fully automate the process.

5. Discussion

Definitely blockchain has recently been one of the most debated topics and could have a lasting impact on the future of the international shipping industry. In this study, business processes that are part of the international transportation industry were identified and the current state of blockchain technology was analyzed. This research has been conducted by collecting the most prominent methods of using blockchain technology in the international transportation industry while emphasizing on maritime transport to determine the development orientation of blockchain technology.

In terms of the researched samples, the impact of blockchain technology in the international transportation industry is undoubtedly regarded to be positive. As mentioned earlier, the implementation of blockchain in the international transport industry faces particular challenges or risks which must be minimized in order to take full advantage of the above-mentioned benefits (Figure 6). (Tijan, Aksentijević, et al., 2019), (Gatteschi et al., 2018), (Karame & Capkun, 2018), (Zyskind, Nathan & Sandy' Pentland, 2015).

One of the challenges that blockchain technology faces is lack of criterion, since not all stakeholders are looking for implementing blockchain-like solutions and operating systems. As a result, an interoperability issue may arise. Even though blockchain technology offers an innovative platform for a new decentralized and transparent trading mechanism in industry and commerce, it is still very immature (Abeyratne & Monfared, 2016). There are numerous blockchain experiments and pilot projects worldwide, but these are now primarily in touch with smaller

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groups of industry, i.e. Maersk, IBM participants who have begun to unite their forces to take advantage of blockchain technology.

6. Conclusion

Blockchain technology is a digital and distributed ledger that allows decentralization, real-time peer-to-peer performance, transparency, and more. This is based on a method by which unknown individuals can generate and maintain almost any database in a fully distributed manner. Blockchain technology is a potential solution to a myriad of problems, namely lack of adequate access to freight monitoring -international shipping involves many stakeholders- and lack of transparency -due to poor data handling, as well as reliance on evidence in the 21st century and so on. In this regard, Maersk and IBM have developed their own blockchain solution where the need for documentation is reduced, and automated documentation allows secure sending and signing of contracts through blockchain technology. Another example of the implementation of blockchain in international transportation is an open system based on blockchain technology and decentralized data storage encrypted by CargoX. Stakeholders such as traders, carriers, importers and exporters connect in a balanced and based system based on trust and interaction using its BDTS platform.

Each port must accept digitalization which aims to be competitive as part of international transportation. Blockchain can have a huge impact on the future of port digitization. One of the seaports showing great interest in digitalization and the use of blockchain is the port of Rotterdam, which has developed a blockchain-based software program to securely track ownership and cargo transportation.

Although blockchain technology offers numerous advantages, its disadvantage is not only the absence of a basic standard. What's more, concepts are difficult to master and programming intervention is essential in even the simplest forms of implementation. In addition, all chain nodes must process all transactions and this issue is raised on a large scale, especially across the globe. This work was supported by the DigLogs project - Logistics Process Digitization (Interreg V-A Italy - Croatia 2014-2020).

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