Application of Blockchain
in International Trade: An Overview

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Abstract
The purpose of this paper is to present the potential advantages of using blockchain technology in the field of international trade. Blockchain, known as one of the disruptive technologies of the moment, will bring important changes to the process of specific foreign trade operations. In this paper, there are presented elements specific to the blockchain technology, its underlying principles, but also the areas in which this technology can be applied. Referring to the academic literature and various online sources, we identified blockchain-based applications in the international trade field (logistics and financial scope) and we highlighted the potential benefits of this technology.

Keywords: blockchain, distributed ledger technology, international trade, logistics, Supply Chain Management

Jel Codes: O00, M10

1. Introduction

Foreign trade transactions are based on a complex development mechanism and several parties (governmental bodies, institutions, transport companies, international trade auxiliaries, banking institutions) are involved in the execution of the international sales contract (Chain That Limited, 2015). As a result, the costs related to the transaction are high, and the time it takes for the goods to arrive from the manufacturer to the final consumer is long. The implementation of blockchain technology in international trade field would lead to: eliminating intermediary intervention, reducing costs, providing more security and transparency through the use of communication and commodity trading platforms (Manuel et al., 2016). Traceability of products and their control at customs clearance points will be made easily thanks to blockchain technology (Gonzales, 2015).

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2. Blockchain technology

Distributed ledger technology, which is the base of blockchain, is a database that is kept and updated independently by each participant (or node) on a network, and the records are built independently and kept by each node. The entire record chain is protected by complex mathematical algorithms that aim to ensure data integrity and security. Thus, a complete record of all operations included in the database is ensured (The European Central Bank, 2017).

Blockchain was defined as:
a) "a public ledger containing information on every transaction made within a P2P-system" (Nakamoto, 2008);
b) a global platform that contains a spreadsheet for tangible and intangible assets transaction records. Thanks to technology, one can track and monitor assets, communicate much easier, and information is shared. Swan (2015);
c) a decentralized registry enabling parties involved in a transaction to store the information specific to its initiation and development; the information is encrypted in mathematical formulas, and each formula authenticates and validates another mathematical formula that refers to other encrypted data Casota (2018);
d) blockchain is a global registry that works on computers and is made available by volunteers around the world (Tapscott, D. and Tapscott, A., 2016). At the bottom of the blockchain concept there is a network of computational nodes, each client logged on the network receives a copy of the updated and validated data.

The underlying principles of the blockchain (Leloup, 2017, p.15) are as follows:
- ✓ *decentralization and disintermediation*: no central authority controls the blockchain
- ✓ *consensus:* the fact that transactions are accepted or rejected is the result of consensus at the blockchain level and the result is not the decision of a central institution
- ✓ *immutability*: it is impossible to modify or delete information in the system
- ✓ *trust and transparency*: data, operations are shared.

**Figure 1. A blockhain transaction processing**
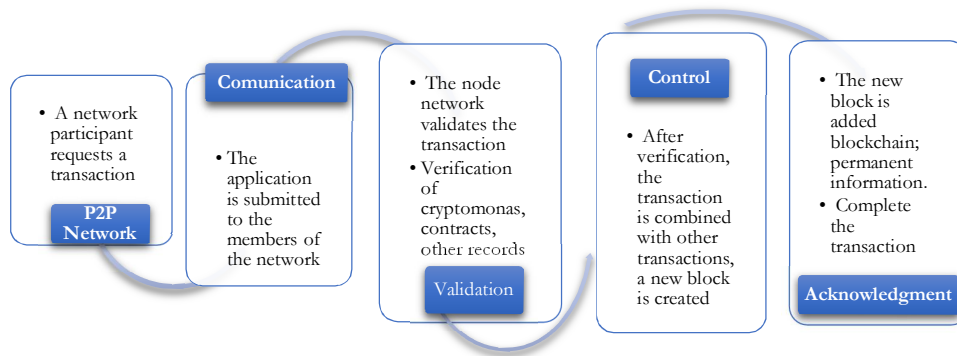
Source: author's conception

Depending on how the platform is managed, there are three types of blockchain: public, private, and consortium (Buterin, 2015): in the case of a public blockchain, anyone can participate in creating, confirming, and recording content; for a private blockchain, permission to enter and validate information is controlled by an entity; the consortium-type blockchain is a form of private blockchain, partially decentralized and managed by a group.

Blockchain technology can be used in various areas, such as banking, government, etc. (see figure 2)

Figure 2. Blockchain applications
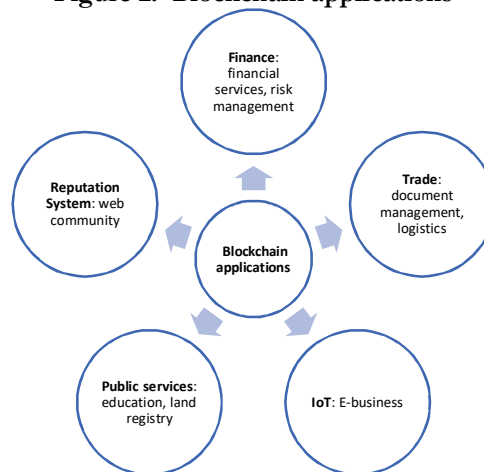
Source: Zheng, Z., Xie, S., 2018, p. 363

Smart contracts, facilitated by the blockchain technology, allow negotiation and conclusion of contracts without the involvement of intermediaries. These contracts are self-executing when certain conditions are met. The most popular platform for smart contracts is Ethereum, a blockchain distributed on tens of thousands of computers, where each participant has a copy of all smart contracts.

Figure 3. From the paper contracts to the smart contracts

Paper contracts   Smart contracts
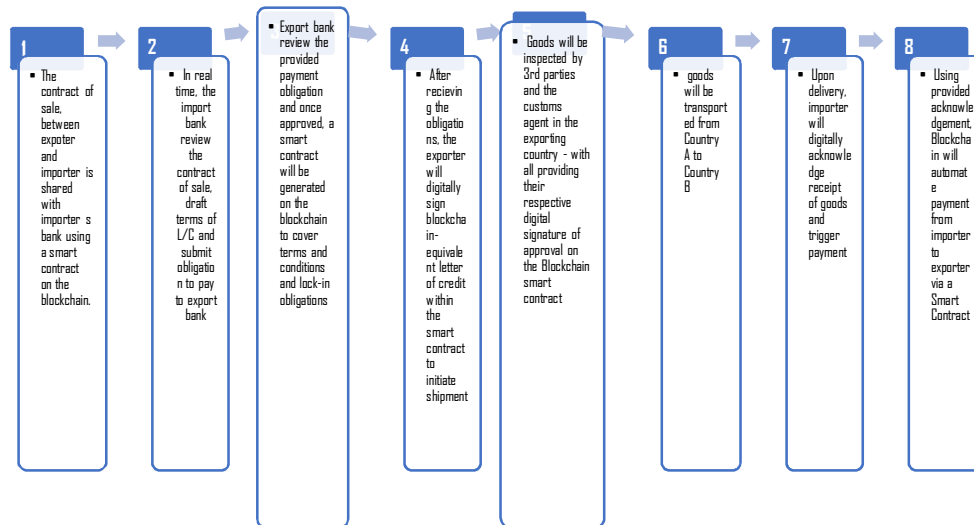
Electronic contracts
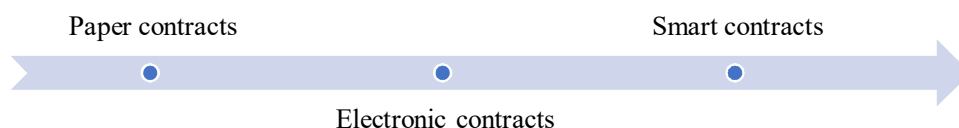
Smart contracts have a number of advantages: speed (in case of paper contracts, time is needed to be transmitted to the parties, in case of digital contracts, there is a risk of counterfeiting); security (in case of classical contracts, the execution of the obligations is not guaranteed, while in case of smart contracts, the fulfillment of the conditions leads to the self-execution of the contract); removing intermediaries, thus lower costs.

3. Application of technology in international trade

3.1 The transactional mechanism

Foreign trade transactions are generally high-value transactions that run between manufacturing, trading and service companies; they are business to business (B2B) operations. As such, they have a number of features regarding the legal framework, the participants, the transactional mechanism. Within an export-import operation, there are involved: the contracting parties; the product (subject of the transaction); the payment (counter value of the service). At the same time, a number of other companies providing the transport (the carrier), the insurance of the goods (the insurer), the payment of the price (the bank), take part in the operation. An important role in the execution of the transaction lies with the public authorities in partner countries: ministries or departments with attributions in the field of foreign trade activity, customs authority, chambers of commerce, etc. If an export transaction currently involves an elaborate mechanism, the assimilation of blockchain technology will lead to the simplification of the transaction mechanism (see figure below).

Figure 4. Transaction mechanism based on blockchain technology

1	2	Export bank review the provided payment obligation and once approved, a smart contract will be generated on the blockchain to cover terms and conditions and lock-in obligations	4	Goods will be inspected by 3rd parties and the customs agent in the exporting country - with all providing their respective digital signature of approval on the Blockchain smart contract	6	7	8
The contract of sale, between expoter and importer is shared with importer s bank using a smart contract on the blockchain.	In real time, the import bank review the contract of sale, draft terms of L/C and submit obligation to pay to export bank		After recieving the obligations, the exporter will digitally sign blockchain-equivalent letter of credit within the smart contract to initiate shipment		goods will be transported from Country A to Country B	Upon delivery, importer will digitally acknowledge receipt of goods and trigger payment	Using provided acknowledgement, Blockchain will automate payment from importer to exporter via a Smart Contract

Source: Deloitte, How Blockchain Can Reshape Trade Finance, p. 2

For entities involved in export-import operations, blockchain technology will offer a number of advantages, such as:
- ✓ *real-time verification of documents*: financial documents accessible via the blockchain can be verified and accepted in real time, reducing the time for preparing the delivery of the goods.
- ✓ *disintermediation*: facilitating funding/payment, no third party is required to take over the risk and correspondent relationships established between the banks involved in the payment mechanism are eliminated;
- ✓ *decentralizing the contract execution*: the contract clauses are recorded in the blockchain, the status is updated, the time needed for monitoring the delivery process is reduced.
- ✓ *proof of ownership*: the property title (bill of lading) is available in the blockchain; transparency on the location and property of the goods is ensured.
- ✓ *reduction of transaction costs*: contract terms executed through the smart contract eliminates the intervention of correspondent banks

3.2 Logistics

In the foreign trade practice, the logistics operations refer to the following activities: packing the goods, loading them into the container, truck, wagon at the factory or the warehouse of departure, pre-transport of the goods (movement of goods to the embarkation port or airport or the grouping platform), export and import customs clearance formalities, main transport, insurance in international traffic, post-transport and unloading of goods from the means of transport (Popa, Belu, 2018).

Responsibility for logistics operations rests with the exporter or importer, depending on the Incoterms clause adopted by the parties in the contract and, in the absence thereof, on how they have established the reciprocal responsibilities and applicable law. However, any malfunction in the logistics chain translates for the exporter in terms of additional costs and the image of the company (Popa, 2008). In an increasingly globalized economy, logistics and logistics costs will be increasingly important factors for competitiveness and modernization, and increasingly important for environmental protection (Belu 2008).

Lately, the fourth industrial revolution has determined a new way of organizing and controlling the value chain for the entire life cycle of the product. It is based on the integration of *Cyber Physical Systems* into the production and logistics process and the use of Internet of Things (IoT) services in the industrial process with implications for the business model, work organization, and value creation. The Internet of Things refers to objects connected with local (Wi-Fi, Bluetooth) or global (GSM, GPRS) networks for remote monitoring and control or performing tasks. Interconnected objects have a number of smart features, and they can be smart production units, smart buildings, smart products (Bartodziej, 2017).

The application of blockchain technology in logistics activities specific to export-import operations would have the following results (Hackius and Petersen, 2017):

- ✓ transparency: it is easy to track the product route from manufacturer/seller to final consumer. All the processes through which the products have passed are visible from the manufacturing stage to packaging and delivery (Williams et al., 2015);
- ✓ easy management of the documents necessary for the transaction, both at the stage of delivering the goods and of collecting the counter value of the goods, as well as at the stage of entering into possession of the purchased goods;
- ✓ supply chain optimization and cost reduction: document management and tracking of shipments through the Internet of Things (IoT); the block allows the storage of large amounts of data in a decentralized manner, the

information is processed quickly and is accessible in a timely manner (Dobrovnik et. al., 2018);

✓ improvement of security: the information stored in blocks is unalterable and immutable, which means that it is almost impossible for someone to partially modify it, because the necessary calculations are carried out by several machines in a decentralized manner.

The use of blockchain technology in logistics activities is exemplified by the following applications:

a) In 2018, IBM and Maersk have set up TradeLens, the *joint solution*, a blockchain built to allow an organization or a consortium of organizations to exchange information and record transactions effectively (IBM, 2018). Currently, from the moment the ship arrives at the port of destination until the content of the lots and their recipient are identified, a few days may pass; in case of use of the blockchain technology, content and recipient information will be accessible when the ship arrives. Therefore, the use of new technologies could lead to rapid and secure operations related to the international commercial transaction.

b) Kuehne + Nagel launched the VGM portal, based on the blockchain technology, to enable shippers to easily finish VGM (*verified gross weight*) statements required for maritime transport under the International Maritime Safety (SOLAS) Convention. This portal is a safe solution for sharing information with third parties, with greater efficiency and greater transparency.

c) Agility (a global provider of logistics solutions) together with Maersk and IBM designs a blockchain-based solution to manage and track container shipments. The use of blockchain technology is aimed at reducing transport costs and increasing the efficiency of operations; all delivery information is integrated into a single secured platform, which is accessible to the parties involved in the supply chain (carriers, shippers, exporters, importers, etc.). Agility will collect information on the handling of individual shipments and then transfer these data through the decentralized and shared registry of transactions operating in blockchain technology.

d) Blockchain in Transport Alliance, a leading body for applying technology in the transport industry, now has more than 60 members, with over 300 applications. For example, UPS has joined BiTA hoping to increase transparency among the various supply chain companies as well as to analyze how to use the blockchain in its personalized brokerage business.

3.3 Payment and finance
a. Payment in international trade

The letter of credit is the most widely used payment method in international trade, followed by the open account payment. For example, in the EU, for intra-Community trade, the letter of credit is rarely used (Ganne, 2018), because the time required to manage the payment through this payment method is long, very often the goods arrive at destination, and the documents are still in the verification phase by the bank workers. In case of open account payments, there is a high risk for the exporter because he delivers the goods and expects the transaction partner (the importer) to honor the payment obligation.

In the classical version, the procedure for payment/ financing by letter of credit is complex (a large number of participants, a large number of documents and high costs). Thus, according to a study made by the Boston Consulting Group, more than 20 entities are involved in a single procedure for financing an international trade operation, which implies a large number of documents and a cumbersome procedure for managing the financing. Only 1% of the interactions between the participants in the transaction (about 5,000) create value. (Boston Consulting Group, 2017).

The adoption of blockchain technology in case of letter of credit payments would simplify the payment process, paper management, and would reduce the costs related to this payment method (see Figure 5).

Figure 5. Letter of credit (LC) vs. blockchain-based LC transaction
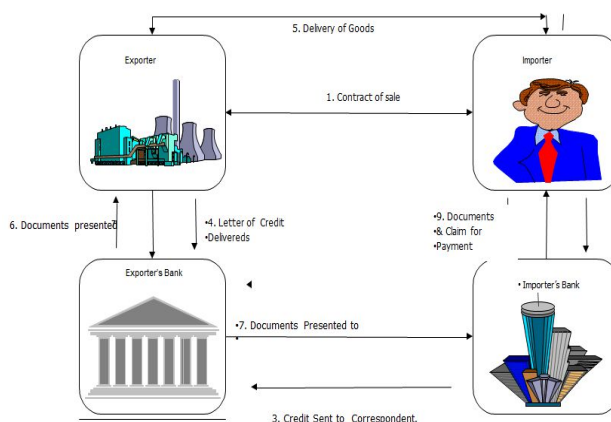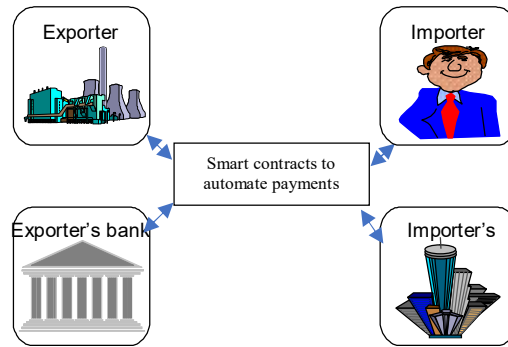
b. Trade finance

Finance is vital for export-import operations. For a very small percentage of international commercial transactions - the payment is made in advance because the buyer wants to pay the value of the goods after receiving them. Up to 80% of export-import transactions are finance through traditional techniques, such as letter of credit, and supply chain finance (WTO, 2016). These financing techniques are associated with high costs and cumbersome procedures due to the requested documents, but also to the large number of participants involved in the process of an export-import operation. Blockchain technology could digitize the finance process, especially through letter of credit.

There are applications based on blockchain in the process of financing, respectively payment in foreign trade. For example:

a) In September 2016, Barclays and Wave funded an export-import operation using blockchain technology. If, in the case of a letter of credit payment, the process takes between 7 and 10 days from the issue of acceptance, using blockchain technology, this time required for a letter of credit payment could be reduced to less than 4 hours (Barclays, 2016).

b) The Digital Trade Chain Consortium, renamed We.trade (Groenfeldt, 2017) - is a bank-centric platform, built by Hyperledger Fabric, involving nine countries, covering 11 EU countries. Merchants enroll on the platform through their banks, then transactions are recorded on the platform, after the parties agree to the terms of the contract (the merchandise marketed, the price, the payment condition). A smart contract provides a guarantee of payment by automatic payment when the conditions set by the parties have been fulfilled. The first operation was carried out in July 2018, involving twenty companies and five major banks (Suberg, 2018).

c) Hongkong and Shanghai Banking Corporation (HSBC), world's top financial and banking institution, has provided the first financing for an export operation using blockchain technology. The transaction was initiated by Cargil and aimed at delivering soy from Argentina to Malaysia. Building on the new technology, participants in the transaction have used a platform developed by the R3 consortium Corda Blockchain. If the transaction normally takes between 5 and 10 days, using blockchain technology, the time required for the execution of the transaction was 24 hours.

d) Batavia is a trade finance platform based on blockchain technology, founded by a consortium consisting of Bank of Montreal, CaixaBank, Commerzbank, Erste Group, IBM and UBS. The first transactions were carried out in real time, an export of textile raw materials from Austria with destination Spain and an intra-Community delivery of vehicles from Germany cars with destination Spain. The facilities offered to Batavia members are: the conclusion of contracts, smart payment execution (these can be automatically determined by events occurring during the trading process and recorded in blockchain), risk management.

3.4 Document management

A particular feature of the transactional mechanism of export-import operations is the essential role of the documents through which the transfer of the rights over the goods is carried out, on the one hand, and the payment of their counter value, on the other hand. Thus, in the logistics phase, the sale and physical movement of goods from the seller to the buyer takes place through a series of operations, each of which results in the issuance of a certain commercial document: the invoice (certifying the sale), the packing list (showing the cargo content), the transport document (attesting that the cargo was loaded on a means of transport), etc. In the financial phase the payment of the goods subject to the contract is carried out, process that, in turn, involves the production of several documents: the letter of credit, the bill of exchange, etc.

The role of the documentary circuit is to link the two phases – logistics and financial – of the export-import operation: the delivery of the goods is documented and the goods are paid in exchange for documents (Popa, 2008). Depending on the issuer and their role, the documents are classified into several categories (see Figure 6).

Figure 6. Specific documents for an export-import business
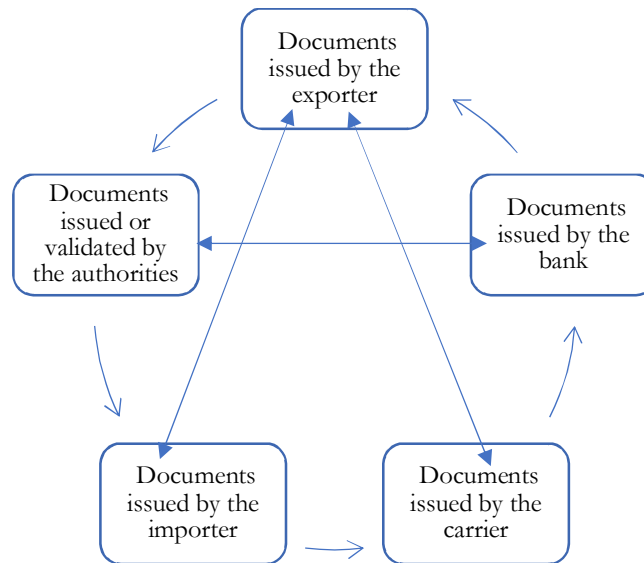
Source: Popa, I., Belu M., 2018

Documents issued or validated by authorities. This category includes documents issued by public bodies regulating and coordinating foreign trade (for example, ministries or ministerial departments), customs authorities, diplomatic and consular representative offices, chambers of commerce and industry.

Documents issued by the exporter. This category includes: the proforma invoice, the commercial invoice, the most important delivery document. At the same time, the exporter may, depending on the delivery condition, issue a number of documents for: the storage of the goods, shipment hiring, the conclusion of the insurance contract, carrying out controls or inspections of the goods. Under the DDP Incoterms, the exporter also prepares the import customs declaration.

The documents issued by the importer are: the application for the letter of credit opening, the import customs declaration. In case of delivery conditions incurring obligations on the importer to carry out transport and insurance, they will issue documents such as: guidelines for drawing up the bill of lading (bill of lading order note) insurance application, both of which are usually sent to an expedient who actually obtains the bill of lading and the insurance policy on behalf of the importer.

Documents issued by the carrier: the bill of lading – used in maritime and river transport – serves to transfer the goods from the sender (the exporter) to the consignee (the importer) and to collect the price; the CIM consignment note (for railway transport), the air freight, the CMR consignment note (for road transport). These are transport documents with functions similar to the bill of lading but they are not negotiable.

Documents issued by the bank: The most important payment document in export-import operations is the letter of credit. The set of documents on the basis of which the payment is made includes: the commercial invoice, the transport document, the insurance policy and other commercial documents.

As shown in the specialized literature (Barelier et al., 2003), success in international trade is determined to a great extent by how commercial and financial documents are handled.

The use of blockchain would allow the digitization of documents associated with an export transaction, and the first steps in this direction have been made. For example, the Fracht Swiss group began, in 2018, to collaborate with CargoX, a provider of innovative solutions based on the blockchain platform, Smart Bill of Lading, in order to digitize the transport document. The CargoX platform allows companies to display and make available the original transport documents - bills of lading - from the Ethereum blockchain network (a cloud decentralized platform managing smart contracts), facilitating the digital transfer of a bill of lading property (CargoX Smart B/L) and, consequently, the related assets from the sender to the consignee, to the shipping agent, shipowner or carrier. Accompanying documentation is made available in cloud encrypted form (Wawryszuk, 2018).

4. Conclusions

Blockchain is still in the development phase, but it is about to drastically change the way business is conducted, and logistics is no different. Blockchain logistics applications can help create a more efficient system, in which consumers invest with more confidence and which carriers and suppliers can rely on. New technologies, *software*, technical progress are promotors that can lead to innovative logistics solutions and/or lower logistics costs.

Through the application of blockchain in the financing and payment process in foreign trade transactions, banks will be able to digitize these activities and, therefore, we will witness a reduction in the costs related to the payment/financing methods, as well as an easier access to cash funds needed to initiate and conduct a trade transaction.

With a view to adopting blockchain technology, the parties involved in initiating, contracting and conducting a trade transaction (manufacturing firms, importing firms, commercial banks, insurance companies, logistics companies, port authorities) must develop a protocol containing the new systems on a platform. At the same time, it is necessary to regulate these activities, a process already initiated in countries like USA, Germany, France, China, Japan and Russia.

To the extent to which entities involved in international trade - government decision-makers, international organizations, companies - will adopt blockchain-based applications, this technology will lead to a paradigm shift in the way of globalization of trade. Blockchain will boost the development of international trade, the value of transactions will increase by one trillion dollars by 2025, due to the implementation of this technology (World Economic Forum, 2018).

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