



Blockchain technology in the international supply chains

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Abstract

The relevance of the study is that globalization and the integration of the international economy provide excellent opportunities for economic development through international trade and investment. It is necessary to make the product and services more competitive. One of the factors determining the competitiveness of trade is how quickly and how economically the goods can be delivered.

The competition in the logistics industry is continually growing, which forces participants to improve their efficiency, improve quality and reduce costs. In these conditions effective IT solutions are vital tools for logistics and the ability to manage the logistics processes in the business environment in the context of globalization is a factor of competitiveness.

Within the framework of this paper, the existing business processes of cargo delivery were described. The study of the process of interaction of international supply chain participants made it possible to identify the ineffectiveness of existing processes to understand what can be replaced and corrected with the introduction of blockchain technology. The main reason of inefficiency is the low level of business processes digitalization. The cases of existing blockchain projects for the logistics industry were investigated. The article provides possible cases of using blockchain for the logistics industry.

Keywords: international trade; supply chain; efficiency; cargo; delivery; transportation; logistics; business process; document; payment.

1. Introduction

Firms engaged in the international economy aim to develop the efficient supply chain and distribution networks that improve service while reducing the amount of working capital tied up in the delivery chain [1]. Achieving this goal is complicated by the fact that an international trade transaction is made up of multiple steps involving a myriad of players with often-redundant functions who require the same pieces of data to accomplish their role in the process.

The primary goal of companies participating in the international economy is to increase the efficiency of supply chains, its development while reducing the volume of working capital associated with the supply chain [2]. The main obstacle to achieving this goal is a large number of players, often with redundant functions and the complexity of interaction within the chain.

The first article dedicated to the increase of complexity was in 1984 by Gouesbet and Weill [3]. Christopher in his article also highlighted that “the complexity of the logistics task appears to be increasing exponentially” [4].

Complex systems are chaotic, the dynamics of their interactions between their parts is not very clear, nonlinear. This system is difficult to predict [5].

The process of international trade in its simplest form consists of the purchase, shipment of cargo and payment at the international level (fig. 1). However, in reality, the process is more detailed. It includes a large number of intermediaries, agents and representatives of power with their role and interest.

The international economic context in which the Italian enterprises are working is strongly integrated and inter-dependent. The nature of the competition is radically changing due to the crisis of 2008 which managed to

destabilize the Western economies, speeding a process that was already started - the expansion of their presence in the foreign markets. Taking into consideration this scenario of irreversible globalization, internationalization does not represent only a possibility, but a necessity.

The concept of internationalization can be defined as the union of those processes acted in order to ensure the company the possibility of being present and participate on an international level [1]. It is important to point out that this term refers in the first place to entering into foreign markets in order to take the opportunity that the new country proposes from the sales point of view. On the other hand, the penetration into a new market with the aim of exploiting the cost advantages cannot be defined as internationalization, otherwise, it can be defined delocalization. This concept rose especially in the last few years, due to the directions taken by the small and medium-sized enterprises with the purpose to fight the crisis, which hit the economy in 2008. [2]



Figure1: The International Transaction Source: [6]

To understand the extent to which the cost of delivery and the timing of the passage of customs control may differ, the World Bank's Doing Business data on cross-border trade, total time and financial costs were analyzed. A description of the indicators (time and cost) of logistics activities in international trade is presented in a table [7].

Table 1: A detailed description of the indicators (time and cost) of logistics activities in international trade

Region	Time to export and import (hours)	Totalcost (USD)
EastAsia&Pacific	260.2	1042
LatinAmerica&Caribbean	260.1	1440.4
MiddleEast&NorthAfrica	343.7	1514.9
OECD (Organisation for Economic Co-operation and Development)	27.3	322.5
SouthAsiacountries	354.9	1528.9
Sub-SaharanAfrica	427.3	1794.1
Europe&CentralAsia	109.1	585

Source: compiled by the author

It is evident that the leader is OECD with the lowest time needed to export and import and lowest total cost needed for import and export. The worst result has the Sub-Saharan Africa region with the time to export and import 427.3 hours and total costs 1794.1 USD.

Compared with the OECD, in lagging countries, the cost of transportation varies from 1.8 times in comparison with Europe and up to 5.56 compared to Sub-Saharan Africa. In terms of time indicators for export and import in the OECD region, it needs four times less time compared to Europe and 15.65 times less time compared to Africa. It seems evident that the changes and new technologies should be implemented to increase efficiency.

Analyzing the OECD reports it is becoming clear that in these countries the digitalization plays a significant role [8]. Governments of OECD countries are undergoing and see the need to develop digitalization to more accurately understand the situation in the country, to develop their advantages.

2. The description of existing business processes of cargo delivery

Each activity in the chain has a legal and regulatory framework, administrative and infrastructural processes that can simplify or complicate the transportation process. To understand what can be improved with blockchain technologies, it is necessary to study the process in advance.

Subjects within the supply chain interact with each other and work based on the information that the participant's exchange. The process of information communication is essential here, and IT solutions can effectively build proper standardized communication. A model for the delivery AS-IS was constructed in the IDEF0 notation, which consists of the following stages:

1. Receiving an application and concluding a contract

2. Export activities
3. Activities under Export Customs Authority
4. Transit
5. Activities under Import Customs Authority
6. Delivering cargo to the customer.

The model was prepared with the suggestions that the cargo was delivered by road transport (fig. 2). The time needed for every stage of cargo delivery was estimated based on the data from logistics company Freight Masters.

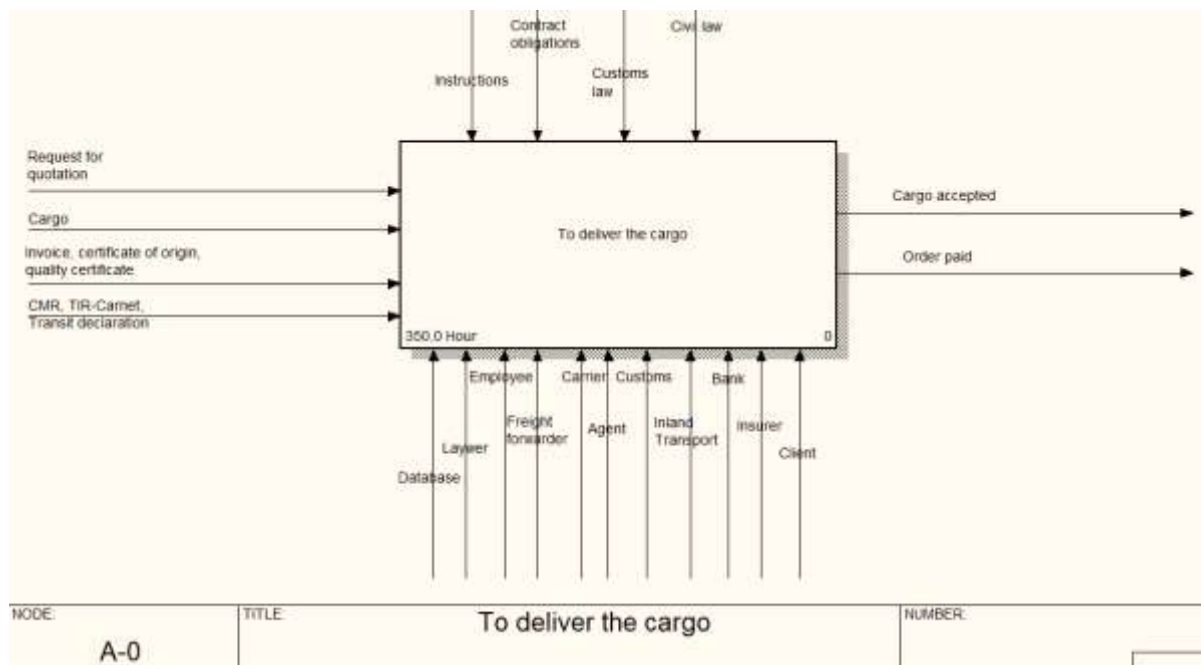


Figure 2: IDEFO description of business processes of international cargo delivering

Source: compiled by the author

Step 1 - To receive an application and conclude a contract

The process begins with a request from the client. The main criteria that important are the price of delivery, the quality of transportation, the delivery time, the reliability of the supplier, the terms of payment and the location of the supplier.

The customer sends the request to clarify the conditions that the supplier provides and choose the most optimal supplier. The supplier receives a request for a quotation, prepares a commercial offer and if the parties agree, the next step is the conclusion of a contract. At the stage of the contract, the main clauses are negotiated, such as the subject matter of the treaty, the price and the total value of the contract, payment terms, delivery date, marking and packaging, shipment notice, guarantees, force majeure, arbitration, limitation of liability, conditions for rescission and contract.

They discuss the payment of goods in a contract for the international sale of goods. Payment can be made in several ways: advance payment, collection (mutual settlement, in which the seller receives money for shipped goods on the basis of collection orders), a documentary credit (the bank's obligation to pay to the seller the value of commodity documents subject to all conditions letter of credit), an open account (payment for the goods is made within the period specified in the contract after the shipment of the goods, documents for the goods are sent directly to the buyer).

The companies-participants in foreign economic activity (exporters, importers) have to work with several partner banks, with their incompatible systems and processes, to service their requirements for trade financing on a global

basis. According to the information from Freight Masters, the whole process from receiving an application to sign the contract on average takes 7 days or 56 working hours (fig. 3).

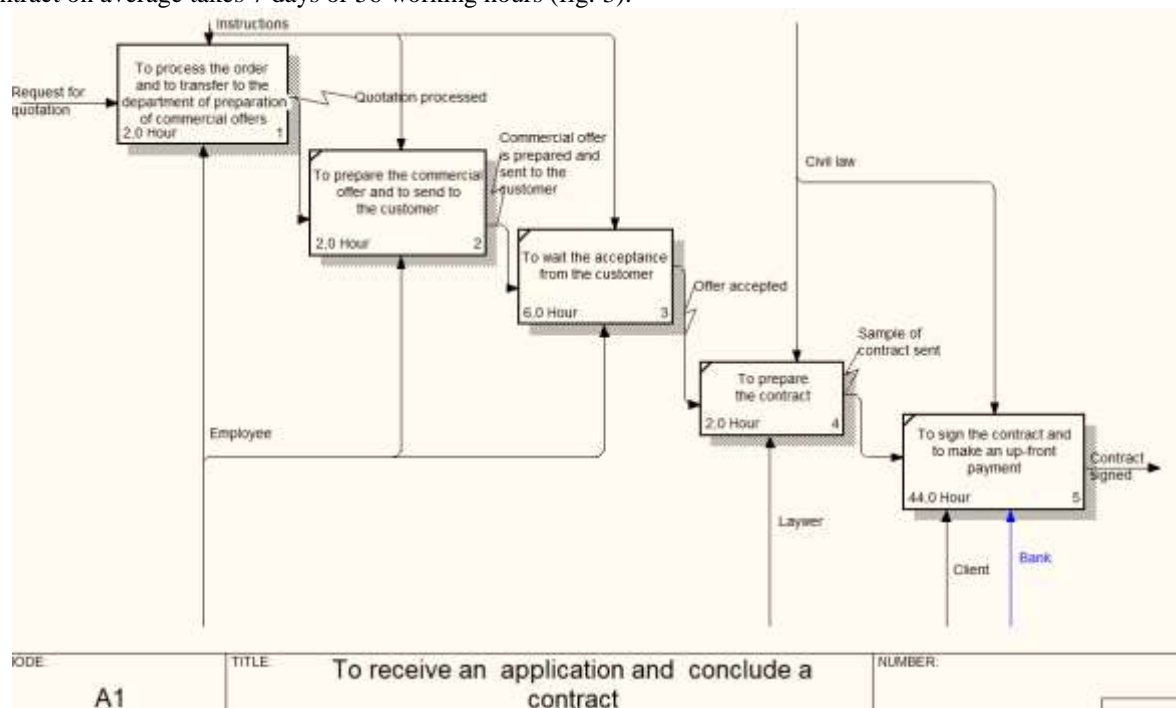


Figure 3: The process of receiving the application and conclude a contract – 2nd level

Source: compiled by the author

Step 2 – Export activities

After all the conditions have been negotiated, preparation for the export begins. It includes the receiving of the up-front payment and starting the development of shipping and licensing documents, insurance, and preparation of documents for transportation.

The primary documents are an invoice, certificate of origin, quality certificate, dangerous goods of the declaration.

The documents for transportation are established depending on what type of delivery is used:

- For sea transportation - a Bill of lading (BL), Mate's receipt.
- For air transports are MAWB (Master Air Waybill) and HAWB (House Air Waybill).
- For railway transportation is a railway bill (RWB), a road record, a carload sheet.
- For road transport - CMR, TIR-Carnet, Transit declaration.

The organization of cargo transportation can be carried out directly by the carrier (road carrier, airline or sea line) or the freight forwarder. The work of freight forwarders in international transportation is reduced to reserving a place for cargo and passing customs procedures. Freight forwarders are an essential part of the global trade chain between the seller and the buyer.

There are several types of freight forwarders: consolidators (NVOCC companies, which combine different consignments of goods); multimodal transport operators (companies offering a full list of logistics services "from door to door"); customs brokers (agents of exporters and importers providing customs clearance services); the agent that offers services in the port (the company that provides services for handling operations when changing the mode of transport in the harbor, as well as additional services).

The insurance is divided into categories A, B and C [9]. The insurance amount corresponds to the price of the goods stipulated in the contract plus 10%. An additional 10% is intended to cover the profit expected by the buyer from the sale. Category C provides the minimum insurance, and then insurance is progressively expanded in categories B, A. The whole process of preparing for the export of cargo takes on average 10 hours (fig. 4).

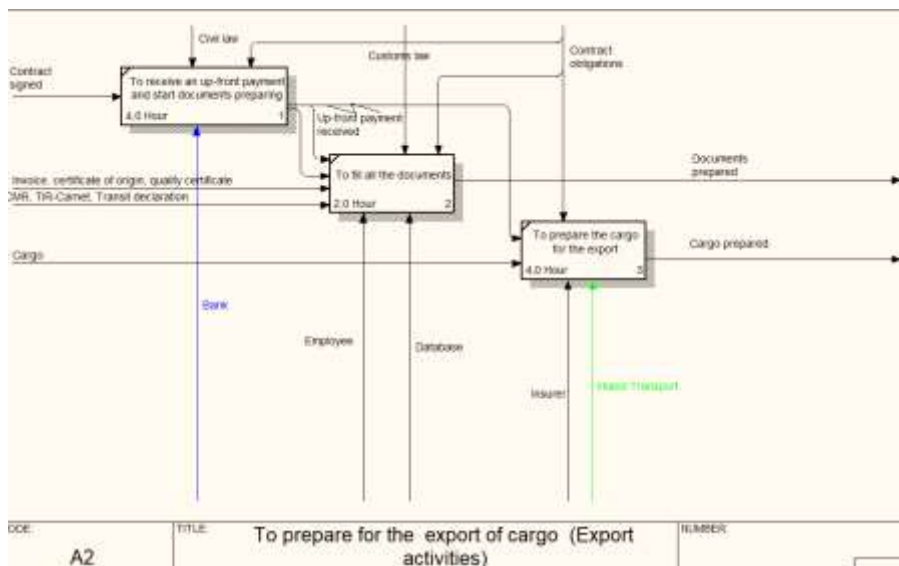


Figure 4: The process of preparing for the export of cargo – 2nd level
 Source: compiled by the author

Steps 3-5 - Activities under Export and Import and Customs Authority and Transit

The next big step is the border crossing process and the customs clearance of goods for export and import and transit (fig. 5). Border customs service's mark ("Goods imported" and "Goods exported") in transport confirming the import/export of products. These marks are a stamp or note specifying the date of actual export/import of goods. And then it moves to the cargo placement at the terminal of the temporary storage in a warehouse(WFS) or the temporary customs control zone. Temporary storage in a warehouse is a specially allocated place for the temporary storage of goods and vehicles, from the moment of submission of data to the customs office and before their release. Usually, the cargo is placed at the warehouse in case of auto and air transportation. Temporary customs control zone - is used to create a temporary area for customs control in a particular place in the absence of the possibility of placing cargo at the WFS, it is usually used for water and rail transport [10].

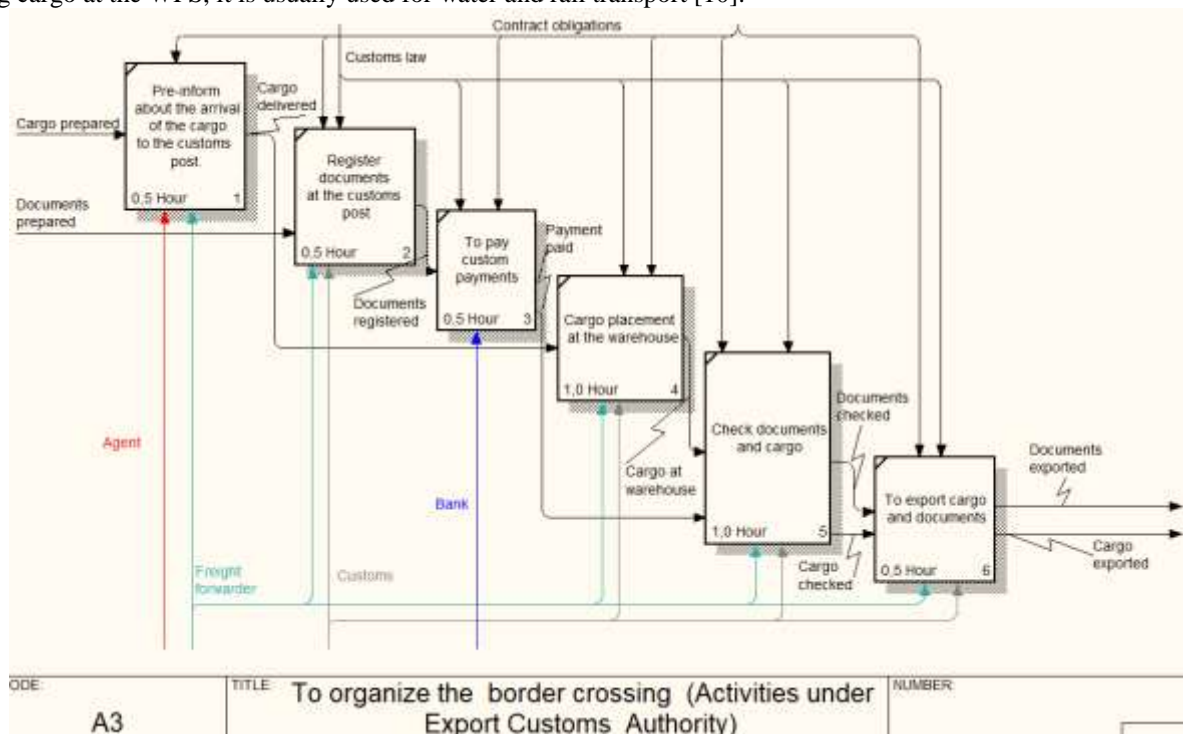


Figure 5: The process of border crossing – 2nd level
 Source: compiled by the author

Step 6 - Delivering cargo to the customer

And the final stage is the delivery of goods to the destination and acceptance of goods by the consignee. After the permission by the customs body of the Declaration of Goods (DT), the goods can freely apply on the territory of the country. The importer informs the temporary storage in a warehouse about the release of the goods, after which the goods are allowed to be removed from the temporary storage in a warehouse. Then the cargo is loaded onto the transport and delivered to the final destination of the consignee. Finally, the customer checks the cargo conditions, documents and if everything is ok the order is paid. The average time to fulfill all obligations takes 24 hours. For international payments, SWIFT is using. The international payments take from 1-5 days (fig. 6).

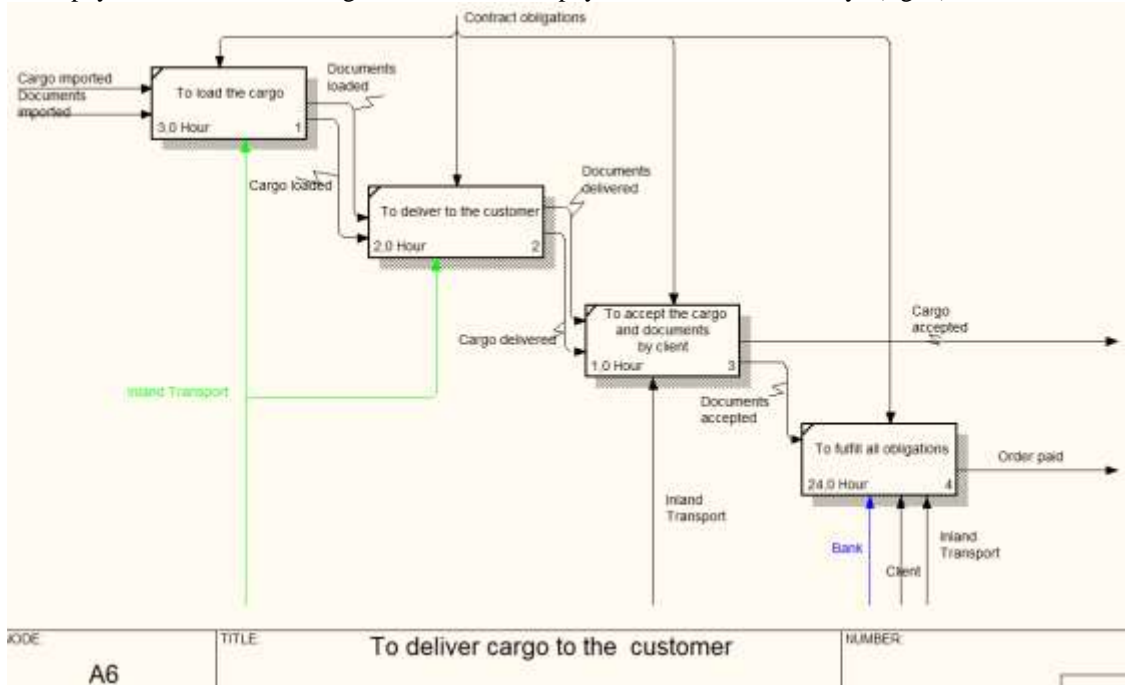


Figure 6: The process of delivering cargo to the customer – 2nd level
 Source: compiled by the author

The decomposition of the processes of cargo delivery is demonstrated (fig. 7).

The average time needed for truck transportation from Europe to Russia is 328 hours or 14 days.

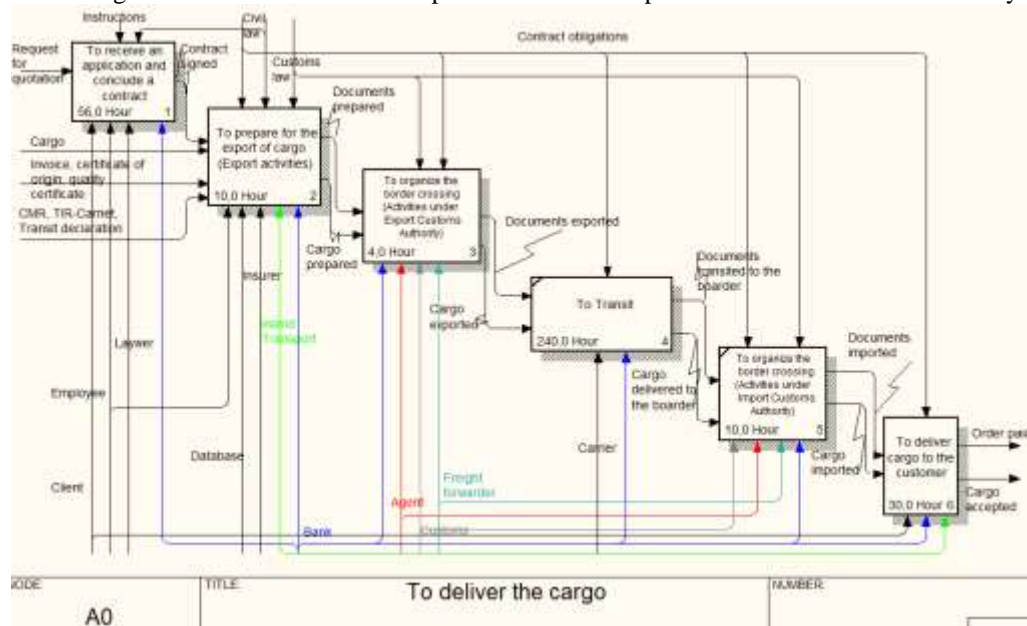


Figure 7: IDEFO description of business processes of international cargo delivering - decomposition– 1st level
 Source: compiled by the author

Structural and functional modeling and analysis of the process of cargo delivery by road transport showed that in the process of delivery of goods a large number of participants is involved and communication interaction is complicated and confusing. The main obstacles to rapid exchange are the entanglement of communications, duplication of information and a large number of participants in the process.

To eliminate these problems it is possible only with the introduction of a platform that could unite all the participants in the network and within which it would be possible to carry out a consolidated exchange of information. Today it is necessary to develop the digitalization of the entire supply chain and to standardize it [11]. The primary tool that solves this problem is blockchain technology.

3. Existing projects for the logistics industry using blockchain technology

In 2017 it became trendy conduct Initial Coin Offering (ICO). The company pursues a goal of raising funds, and the investor - a profitable investment for profit. The initial coins offering (ICO) is a new way of raising funds, which has appeared thanks to digital currencies and blockchain technology. Anyone can invest in fiat currencies and get tokens (digital assets) in return. ICO is widely regarded as an innovative alternative to the traditional primary public offering (IPO) as a method of attracting capital. A project or company in need of money creates a new kind of digital coins and sells some of it on trading platforms (exchanges). Currently, there is no standardized way to prepare a technical document in comparison with a regulated IPO.

The ICO project, dedicated to the logistics industry, became International MultiModal Logistic Application (IMMLA) (fig. 8). The main idea of the project is to make it easier for the cargo owner and freighters to interact using a decentralized system. The investments will be used for creating a service that provides a full range of services for tracking cargo, preparing the necessary documents for transport and insurance companies, as well as payment for the services. All operations are saved in the block and automatically managed by a smart contract [12]. IMMLA project aims to conquer about 0.7% of global logistics market share till 2022 which equals approximately 95 \$ million[13].

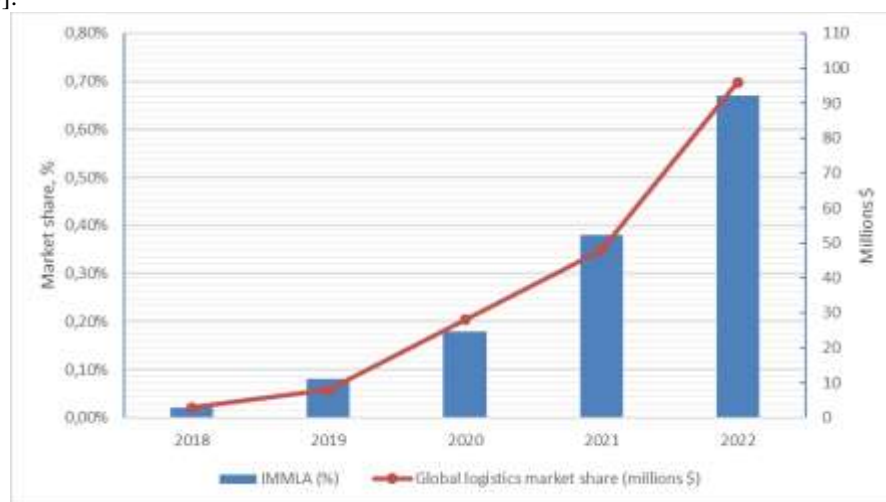


Figure 8: Revenue aims of the ICO Project IMMLA

Source: [12]

According to the white paper, IMMLA's revenue goals are aimed at developing in two directions: the implementation of new modules and the strategic expansion. The application of new modules includes the step-by-step development of air, railways, maritime transport, warehouses modules. The company promises to launch transport and sea cargo modules in 2018-2020, with further implementation of air transportation and road modules. The realization of warehousing is expected by 2020. According to the company's forecasts, by 2023 the service is expected to be used around the world.

Another promising ICO project in logistics is called 300 cubits and aimed to solve the problem in the container shipping industry. The problem is called "booking shortfall." It is a situation when a customer books a slot for container space on a ship but does not show up with its cargo on the ship. This is happening because the customer makes the payment after the cargo is loaded on the ship or after the cargo was delivered to the customer. Because of this "no-show" pain, both a shipper and a customer are suffered. The industry shippers lose their money and customers with a confirmed booking may not receive their shipments on board. 300 cubits are going to solve this

problem with blockchain and TEU tokens which will be used as a booking deposit. Both container liners and customers will receive TEU-tokens, which will be stored as a deposit. In the case that one of the parties fails to fulfill the conditions, the aggrieved party receives compensation. For example, if the customer defaults, the deposit is transferred to the container liner and vice versa. The entire process is managed by a smart contract (fig. 9).

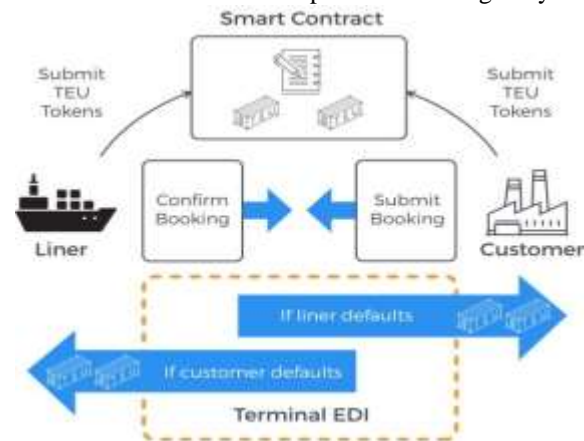


Figure 9: The demonstration of how TEU- works as a deposit

Source: [14]

The company expects that solving this pain will save up to \$ 23 billion a year in losses caused by non-delivery of cargo for transportation. "For the most part, this problem occurs because counterparties (carriers and shippers) process orders haphazardly. The deposit for the reservation will force the two sides to seriously assess the likelihood of fulfilling their duties before signing the contract"—Lewing said. 300 cubits expect to earn a fee per transaction in the amount of 0.7% of each TEU-token lines and their customers. Also, the company intends to attract financing through the initial coins offering (ICO) realizing 18 million TEU-tokens [14].

4. Cases of possible using blockchain technology for the logistics industry

Blockchain can be used in the logistics industry as a disruptive technology that helps the industry to manage the challenge of digitalization. The digitalization provides many benefits such as participants' flexible integration, networked processes, data automation, easy and quick access to the crucial information, business processes coordination. The logistics industry regarding digitalization lags behind most other industries, such as media, telecommunications, banking, and retail. That is a problem that is why the digitalization dominates the thematic agenda in logistics today [15].

The second case of using blockchain technology in logistics is to ensure the transparency of the entire supply chain [16]. The blockchain allows to determine the participation of people, to track their activities in real time and automatically distribute the funds between the participants by contractual agreements. Since the records were made in blockchain, they cannot be changed or deleted. This fact will make it possible to clarify the negotiations between parties and substantially reduce the number of trials and litigations due to the dissatisfaction of one or the other party with the results of the performance of the contract. Also, the risk of unscrupulous intermediaries disappears, since this function entirely lays on the program code of the network and the human factor is excluded.

The third possible scenario is using Smart Contract on blockchain technology for payments automation. It will reduce time, costs to redistribute money between stakeholders to a micropayment processing time (a few seconds), which allows all parties to the contract almost immediately receive compensation for work as soon as possible. Also, all cryptocurrencies already include a compensation payment for the confirmation of the transaction block, which reduces the transaction costs of the micropayment only to this small amount. It is an important aspect, given the relatively small amount of micropayment, because the introduction of an alternative technology with higher transaction costs would be economically unprofitable. Also, the organization of sales through smart contracts will almost instantly manage and distribute compensation payments between the parties to the agreement. Instead of having to pass through many intermediaries and third parties, revenue can automatically be shared between the parties to pre-agreed terms and conditions prescribed in the smart contract.

The fourth case is using blockchain for the secure operating of the Internet of Things in logistics. IoT is the concept of connecting a large number of devices (things) in one network, so devices communicate with each other via the Internet [17]. The Internet of things has brought many business benefits such as an interconnection between objects,

almost real-time tracking, but despite the advantages of IoT, the current internet-architecture has a significant drawback. [18]. According to Gartner report, it is expected over 20 billion connected things by 2020 and the architecture built on servers may not be able to support such an increasing number of devices. Moreover, each server is a potential failure point. All these factors make existing architectures less reliable in comparison with blockchain technology which is decentralized and can connect and manage more devices[19].

Considering a large number of potential IoT objects (vehicles, shipments, containers, etc.), logistics can become one of the most promising industry for the application of IoT and blockchain. For example, it could be systems of the route planning system, cargo condition monitoring systems, traffic monitoring, vehicle monitoring. All these operations will be performed automatically without human beings and more quickly [20] [21].

5. Conclusion

Growing competition forces the logistics industry to increase the efficiency of its operations. The main goal for logistics is to reduce costs and reduce delays in cargo, increase the transparency of operations and minimize the participation of people in processes, and for this, it is necessary to digitize the processes that are hidden today.

Progressive countries like OECD understand the importance of digitalization today and implementing digitalization is the priority in their development to identify the strong sides of a country and weak points and improve them.

The business process of AS-IS was built in the notation of IDEF0 to demonstrate the existing processes in logistics and understand the weak points. Analysis of the existing processes identified three apparent risks that exist in the logistics: low level of standardization, high risk of forgery and low level of communication. Participants do not exchange electronic information through a single centralized platform but send information electronically to each recipient separately. The hypothesis was mentioned that the technology blockchain could mitigate the mentioned risks.

As a part of future work, it is needed to transform the standard AS-IS model of international cargo delivery into an innovative model of international cargo delivery based blockchain technology. Additional work in studying blockchain in logistics and a more detailed study of business processes will make it possible to draw up the requirement list for further realization.

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