Application of “blockchain” and “smart contract” tehnology in international payments – the case of reimbursement banks

Pečarić, Mario; Peronja, Ivan; Mostarac, Mislav

Source / Izvornik: **Pomorstvo, 2020, 34, 166 - 177**

Journal article, Published version
Rad u časopisu, Objavljena verzija rada (izdavačev PDF)

https://doi.org/10.31217/p.34.1.18

Permanent link / Trajna poveznica: https://urn.nsk.hr/urn:nbn:hr:187:703356

Multidisciplinary
SCIENTIFIC JOURNAL
OF MARITIME RESEARCH

University of Rijeka
FACULTY OF MARITIME STUDIES

Multidisciplinarni
znanstveni časopis
POMORSTVO

https://doi.org/10.31217/p.34.1.18

Application of "blockchain" and "smart contract" tehnology in international payments – the case of reimbursement banks

Mario Pečarić[1], Ivan Peronja[2], Mislav Mostarac[1]

[1] Faculty of Economics and Business, University of Split, Cvite Fiskovića 5, 21000 Split, Croatia, e-mail: mpecaric@efst.hr; mislav.mostarac@gmail.com
[2] Faculty of Maritime Studies, University of Split, Ruđera Boškovića 37, 21000 Split, Croatia, e-mail: iperonja@pfst.hr

ABSTRACT

The aim of this paper is to find alternative method of executing reimbursement loan, as a form of documentary loan, that is, to investigate new digital technology methods (fintech) to improve the efficiency of the international exchange. Reimbursement loans are often used to credit the trade of overseas goods. The reason of such case is that the shipment of goods by the maritime transport requires a significant amount of time and those trades are often associated with high financial amounts. Since international trade (exchange) is a kind of a generator of society's progress, it is necessary to explore the possibilities for making international payment cheaper, more efficient and more secure. In this case, we based our research on the implementation of modern technologies, more precisely "blockchain"/DLT (Distributed Ledger Technology) and "smart contracts". The new reimbursement loan model presented in the paper is based on the aforementioned technologies. It could potentially change not only the documentary lending techniques, but also, eventually, overall financial paradigm. The effectiveness of the application of modern technologies is proven comparing the results of the so called conventional and unconventional reimbursement credit model on a real case involving two companies in Indonesia and Singapore. The paper also tackles on the further implementation of "smart contract" technology and "blockchain"/DLT, thus considering the potential impact of these technologies on overseas trade, credit markets and financial institutions. Finally, the paper argues on the limitations in implementing this new technique (e.g. legal, political and technical challenges).

ARTICLE INFO

Review article
Received 20 January 2020
Accepted 2 June 2020

Key words:
Blockchain/DLT
Smart Contract
Reimbursement Loan
International Payments

1 Introduction and literature review

The aim of this paper is to find alternative methods of executing reimbursement loans, as a complex form of documentary loans. In essence, we will investigate methods to improve the efficiency of reimbursement bank's business process, regarding its key role with securing and executing reimbursement loans. The fundamental point of the research is the persistence of costs and risks in the way of processing bills of reimbursement, or other, less complex documentary loans. Consequently, our hypothesis is that we could reduce risks of asymmetric information and moral hazard, also increase efficiency and operability of the reimbursement loans process, by using model which is based on modern technologies – "Blockchain/Distributed Ledger Technology (DLT)"[1] and "Smart Contracts".[2] Nowadays, these aforementioned technologies are exposed to massive amount of public interest and science research. Technologies are also mentioned as a cru-

[1] Blockchain, as a technology, was conceptualized in 2008. as a core of Bitcoin digital currency. It is open, distributed ledger that can record transactions between two parties efficiently, securely and permanently. (Iansiti & Lakhani, 2017)

[2] Smart contracts are configurable contracts which are only executed if certain conditions are met, without necessary human interaction. They are based on certain cryptographic principles, firstly introduced by the Nick Szabo (1996.) In certain industries, there is already a widespread adoption of smart contracts, blockchain/DLT and those two combined, for example in: micro-insurance industry, coupon payments, medical records, retail, voting, trade settlements and other.

cial part of forthcoming FinTech ("Financial Technology") revolution, especially used in new forms of decentralized, so called *peer-to-peer* lending.[3] International monetary fund (IMF) (2016) believes that use of smart contracts and blockchain/DLT technology could contribute on reducing *moral hazard* risk and generally optimize use of contracts in business.

In his research about potential risks affecting sides included in international payments, Mofleh, A.I. (2005) created a list of direct and indirect reimbursement loans which have failed in its execution. In his paper author showcased negative effects of conventional model of documentary credits, emphasizing the importance of powerful institutions (courts) and modern technology that helps provide trust and familiarity between the parties involved in trade so that the possible negative outcomes are less likely to occur. At the similar type of research, Basimanyane, D.K. (2016) used Botswana as a geographic region for studying legal implications of electronic Letter of Credit as a trade payment mechanism. In his remarks, author underlies importance of law harmonization between the countries and parties involved in trade. Other than law framework, he calls for use of trade model which could make the most of the benefits of modern financial technology available. Regarding the use of modern technologies like Smart Contracts and Blockchain/DLT, IMF (2016) in its Discussion Note states that the use of smart contracts and blockchain/DLT technology could contribute on reducing moral hazard risk and generally optimize use of contracts in business. Furthermore, Lagarde (2017) claims that the combination of the development of decentralized forms of lending, crypto currencies, blockchain/DLT and smart contracts, will change banking through three different aspects: reduced need for mediation (bankers, brokers), increased interoperability and security and lower cost of financing. This author also states that these aforementioned technologies can have the similar effects on changes of society as the invention of Internet. On the other hand, Deshpande, A. et al. (2017), in their research about challenges and opportunities of mentioned technologies widespread, emphasize the crucial role of the new standards in area of financial trade based on Distributed Ledger Technologies. These authors conclude that if the new standard framework occurs too late, there will be risk of potentially missing the opportunity to maximize the benefits the technology could deliver. Even though it is hard to find any existing literature that focuses solely on developing alternative methods to process reimbursement loans, like this paper will, it is evident that many authors see these modern technologies (Blockchain/DLT and Smart Contracts) as a major factor in new financial and documentary credits era.

Global supply chain is an extremely complex ecosystem. Since maritime transport is dominant and most cost-effective form of transport, the need for applying new technologies in this sector is always present. Implementing technologies presented in this paper could benefit maritime business in numerous ways. Detailed explanations of advantages this technology could bring for maritime industry would be presented in the second chapter.

In order to prove hypothesis, we compare the results of the real and new reimbursement loan/credit model, based on a real case between two companies in Indonesia and Singapore. After defining aims, main topic and topicality of subject, in the second part of the paper we focus on the role of reimbursement banks[4] (reimbursement loans) in international payments. Furthermore, we will discuss current limitations of technology presently used by the reimbursement banks for carrying out reimbursement loans. Reimbursement loans are often used to credit maritime transport/trade; due to long shipping time, massive cargo and high amount of financial resources required. In accordance with the facts above, we will argue what positive effects smart contracts, accompanied with blockchain/DLT, could bring to maritime transport and reimbursement loans related to.

Third chapter will consist of thorough explanation of unconventional model used to process reimbursement loans, on the basis of actual example. In his research about potential risks affecting sides included in international payments, Mofleh, A.I. (2005, 196) created a list of direct and indirect reimbursement loans which have failed in its execution, causing significant financial and material losses to exporters and importers. On that basis, we will implement our new model in one of his real-life examples (including "Standard Chartered Singapore", "Beam Technologies (Mfg)" and "PT Mulia Persada Permai") and try to showcase positive effects of using smart contracts and blockchain/DLT technology in reimbursement loans.

It is important to emphasize that we have taken example of reimbursement loan because it represents most complex form of documentary credit, so it could finely highlight benefits of mentioned technologies. These technologies could easily be implemented in other forms of documentary loans/credits.

Before concluding remarks, we will refer to possible obstacles that could aggravate widespread adoption of unconventional model of reimbursement loans and mentioned technologies individually.

[3] FinTech is a new financial industry, of financial industry paradigm that applies modern technology to improve financial activities. (Schuffel, 2016, 32). Peer-to-peer lending refers to a application based borrowing and lending between the verified "peers" or users (individuals). Use of application as a neutral entity that connects supply and demand of loans, the need for financial mediator like banking institutions is reduced to minimum.

[4] Related to the banks which used to have reimburstment loans as product offer to the client.

2 The role of reimbursement bank in international payments – limitations of current technology

In the process of international payments carried out through reimbursement loans, reimbursement bank occurs as intermediary between bank of exporter (*Issuing bank*) and bank of importer (*Claiming bank*). As a mediator of this payment process, reimbursement bank accepts letter of credit (LC) issued by the Issuing bank and legally obliges to pay the required amount to importer, that is to Claiming bank, within a certain period of time. The reimbursement bank then owns the right to charge the Claiming bank (which subsequently charges its client, the importer) for the same amount and additional reimbursement loan fee. This would represent an act of *indirect* reimbursement loan. *Direct* reimbursement loan presents a situation where LC would be accepted by the Claiming or Issuing bank. In our research, we will use the example of *direct* reimbursement loan.

The reimbursement bank will generally only pay the relevant claim if funds are available in the account of the issuing bank, or if there is sufficient possibility of overdraft to account. However, the issuing bank may ask reimbursement bank to issue its own *Irrevocable Reimbursement Undertaking* (IRU) which legally obliges reimbursement bank to pay off corresponding claim. (Simmons & Simmons, 2016). Since reimbursement banks are very often located in the country of the currency of documentary credit, issuing bank can utilize foreign currency it holds on an account with the reimbursement bank (if it holds). Otherwise, the issuing bank would face exchange rate risks associated with converting local to foreign currency in order to execute payment. The role of reimbursement banks in this process is crucial because of the frequent unfamiliarity between parties included in international trade; the multiple risks occurring for importers and exporters that will be mentioned below; or the poor financial relation history among issuing and claiming banks. By engaging its reputation and financial resources, reimbursement bank is obliged to secure safe and efficient international flow of funds and goods. On the other side, it has no concern regarding to the documents presented under the documentary credit, whether they are compliant or not. Every reimbursement bank has to conduct business in accordance with UCP 600 or URR 725. The Uniform Customs & Practice for Documentary Credits (UCP 600) is a universally used set of rules, terms and conditions agreed by the International Chamber of Commerce, which apply to financial institutions which issue various forms of Letters of Credit. The Uniform Rules for Bank-to-Bank Reimbursements (URR 725) clarify a number of issues in

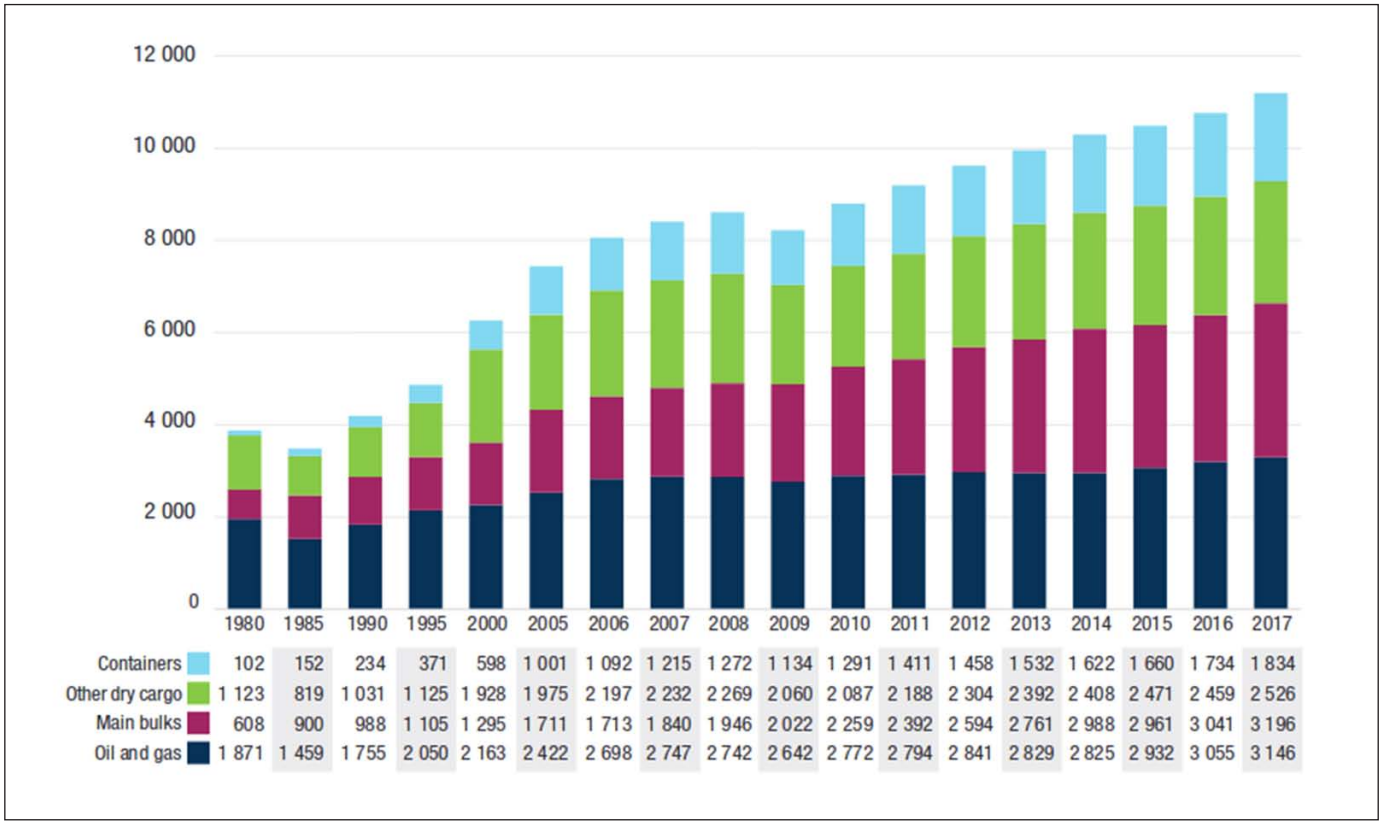

Figure 1 International seaborne trade 1980-2017 (millions of tons loaded)

Source: Review of Maritime Transport (2018) – UNCTAD

bank-to-bank reimbursements, such as expiry and conditions under which claims can be authenticated. These rules were updated in 2008 to bring URR into conformity with the UCP 600.

Reimbursement loan (or credit) is defined as a unique and complex form of documentary loan (credit) which contains aspects of bank guarantee and acceptance credit. Reimbursement banks approve this type of loans on a basis of commodity and services documents attached to required credit instruments. This type of loan is characteristic by its complex structure and very detailed rules. Every reimbursement loan should have: precisely defined parties included into trade; the exact amount of purchase and sale defined in a specific currency; supporting documents that define LC expiration date, exchange rate and defined conditions of commodity shipping and other specific terms.

The documentary credit system has been in use for over 150 years and still continues to play a key role in international trade as a form of payment. During the years the technical forms of documentary business have been evaluated due to technological improvements in field of security and communications channels (SWIFT network). SWIFT or "Society for Worldwide Interbank Financial Telecommunication" is the global provider and leader on the field of secure financial messaging services. It's messaging, standards and services connect counterparties worldwide, so the financial funds can be transacted surely and reliably.

Reimbursement loans are often used to credit the trade of overseas goods. The reason of such case is that the shipment of goods by the maritime transport requires a significant amount of time and those trades are often associated with high financial amounts. Shipment time allows exporters and importers, along with their banks, to execute complex reimbursement loans which are time-consuming by themselves. Maritime trade is crucial for the global economy. It carries out 90 % of the total world trade and is by far most cost-effective form of mass movement of goods and raw materials (Kucuksolak, 2017, 160), so the need of convenient reimbursement loan model is obvious.

The upward trend in international maritime trade has been present since the early 1990s, as we can see on Figure 1.[5] The greater variety of cargo, the greater number of subjects involved in trade is (exporting and importing companies, financial institutions that credit import-export business, freight forwarding companies, port companies and so on). Due to increased container shipping traffic, there is a need for more efficient solutions for controlling, recording and executing shipment and payment process. Advantages of implementing blockchain/DLT technologies in maritime industry are numerous.

First of all, it reduces the paper documentation. This is the most time and money consuming part of whole shipping process. For international shipment, companies and customs officials need to fill out over 20 different types of paper-based documents in order to move goods. Blockchain/DLT technologie would not only eliminate need for printed shipping documents; it would also make shipment checks faster, minimizing the risks of shipment delays and providing real-time data visibility (tracking) of goods and money transfers. In the first quarter of 2017, Maersk and IBM showed that use of aforementioned technologies can lead to cutting down the administrative cost up to 15 % of the value of shipped goods. That could create savings of $1.5 trillion globally.[6] Documentation and administration are estimated to be one-fifth of the $1.8 trillion spent annually to move goods across borders.

According to The World Economic Forum, by reducing barriers within the international supply chain, global trade could increase by nearly 15 percent. Furthermore, use of blockchain/DLT technology would increase transparency and safety of maritime industry, including cargo shipments and seaborne trade. Information stored on the blockchain/DLT is impossible to delete or edit so frauds in terms of cybercrime are impracticable. Biggest challenge of implementing these technologies in maritime industry is setting the industry standards. Since only one shipment or trade in this industry can include 20 or 30 different business parties (companies) in order to execute delivery of cargo globally, there is a substantial need for building highly standardized model of trade and shipment that would legaly and technically cover all business protocols for companies involved in maritime trade and transport, so the compliance costs don't nullify the benefits of modern technologies.

International trade represents low risk area for reimbursement banks. Banks are pretty much secured by the structure and form of documentary credits and commodities traded. Also, banks are only obliged to ensure financial flow of funds and supporting documents, they are not responsible for the quality of goods included, as they are intermediary part of trade. However, there are many risks affecting importers and exporters. Despite the extreme importance of reimbursement loans (as a form of documentary credit) for international exchange of goods, participants of the reimbursement loan process are still exposed to numerous risks, such as: moral hazard, asymmetric information, fraud risk, counterparty risk, operational risk, third-party risk, product damage risk and so on. Also, participants are exposed to risks that they cannot influence, such as: country risk, risk of emerging markets, exchange rate risk, interest rates, price change etc. Any discrepancy in the documents lengthens the process, requires additional financial engagement, and causes a potential loss of earnings due to changing market conditions.

[5] We can also notice how the share of oil and gas in total overseas trade stagnates, suggesting some emerging trends, that is, the growth of share of containerized and other dry cargo shipments. Container shipments are more complex and costly than shipments of oil, gas and bulk cargo. That is caused by a great variety of cargo that is shipped in containers.

[6] Source: [online] available at: https://www.hellenicshippingnews.com/blockchain-at-sea-how-technology-is-transforming-the-maritime-industry/ [accessed: September, 2019]

Furthermore, any discrepancy or spelling error in LC documents implies a new delay in the payment and in whole trade process. It can even serve as a reason for the rejection of payment. By the URR 725 rules, importer's or exporter's bank has a right to issue a rejection notice in case of finding some discrepancies in trade documents. The opposite party then has a legal obligation to answer the corresponding problem in one week, which unnecessarily extends documentary credit process (Youseff, et al. 1998, 6). It is believed, that in international trade carried out with the help of documentary loans, importer (buyer) is much more vulnerable side.

In economy, we often equate risk with cost, therefore, reimbursement loans can potentially be very expensive. In light of the above facts, there are clearly a number of disadvantages, limitations and risks included in the conventional model of reimbursement loan.

The main problem is that the LC in this case isn't definitive guarantee of settlement of obligation, but merely mechanism that reduces risk of non-payment. In other words, there is no technology that allows reimbursement banks to terminate the malfunctioned trade process *before* the financial claim has been made. In the international trade one participant is always exposed to the risk (in the segment of non -covered payments or in the related collateral). The implication of the new technologies could reduce counter party risk in international trade activities. The purpose of the new technologies is in recognizing the credit quality and technical and financial capacities of counter party.

To show the risks and limitations of conventional model of reimbursement loan more clearly, we will use a real-life example of trade between two companies in India and Singapore. Before we continue, it is important to emphasize that we have taken example of reimbursement loan because it is the most complex form of documentary credit. Since we want to implement modern technologies (blockchain/DLT, smart contracts) in processing documentary loans, choosing conventional reimbursement loan model will allow us to showcase the highest number of positive effects of implementation possible, regarding its complexity.

In his research about potential risks affecting sides included in international payments, Mofleh, A.I. (2005) created a list of direct and indirect reimbursement loans which have failed in its execution, causing significant financial and material losses to exporters and importers.

We have chosen to present the case of the trade between "Beam Technology (Mfg)" company from Singapore and "PT Mulia Persada Permai" from Indonesia. Reimbursement bank in charge of this case of direct reimbursement was "Standard Chartered", also a bank of Indonesian importer. Singapore-based Beam Technology has agreed to sell electronic components to its customer, Indonesia's PT Mulia Persada Permai. To secure payment, Singaporean company, with the help of its bank, issues a letter of credit (LC) named on Standard Chartered bank, which represents its client, the Mulia Persada Permai. One of the conditions for accepting the LC was the presentation of a *clean* and *valid* waybill. Waybill or *bill of lading* is just a detailed list of a shipment of goods in the form of receipt. It is commonly used as a commodity document in every form of shipment (or international trade); air, sea and land transport (Horowitz, 2010). The *clean* or *valid* waybill represents a confirmation that the goods arrived without damage, in the correct number or weight and in good condition. In an agreement between these two companies, it was defined that waybill would be issued by "Link Express Pte Ltd", as their freight forwarder. In July, 2000 Beam Technology submitted documents to Standard Chartered bank, however, the bank responds by issuing a *note of rejection* claiming that there are certain discrepancies in the commodity documents. Standard Chartered informs a Singaporean company of how the waybill has been issued by non-existent entity called "Link Express Pte Ltd". In the same evening, bank recalled all documents, stating that the waybill is a forgery (Horowitz, 2010, 55). After that, Beam Technology resubmitted the necessary enforcement documents within a week. However, Standard Charterd, the reimbursement bank, refused to receive them. In other words, it refused to make a payment to Singaporean company because of the forgery.

At that point, Beam Technology is suing Standard Chartered Bank to force the payment of shipped electronic components. Reimbursement bank then "agreed" to go to court on the assumptions that exporters had nothing to do with the forgery act (Horowitz, 2010, p. 56). According to Sing (2006, p. 5) the Standard Chartered argued in the court that at the time of implementation of reimbursement loan was alerted to the criminal acts of an non-existent entity "Link Express Pte Ltd" from other banks that had previously been scammed similarly.

Counterfeit documents allowed unknown perpetrators to seize, or steal the electronic components, presenting themselves as freight forwarding company. Even though in this case there was no responsibility on the side of Singapore-based Beam Technology, the Singapore High Court ruled that Standard Chartered is not obliged to pay the required amount because the documents required for the execution of payment were forged and therefore null and void under the law. High Court also stated that banks do not need to investigate credit documents in a detective sense, but in case they come up with the information that reveals some illegal facts about documents (as Standard Chartered did in this example), banks are not required to execute payment (Sing, 2006, p. 5).

Even though we mentioned earlier in the paper that the importer/buyer is the most vulnerable party in process of reimbursement loans, we could see from this example that nor exporter/seller does not enjoy sufficient protection from the structure of this conventional model. Although quite innocent, Beam Technology lost the right to reimburse and suffered significant financial loss. The Indonesian buyer also did not receive the wanted goods. In

this example we could see how the conventional model of reimbursement loan leaves enough room for manipulation that can disrupt the process of international trade. It is a perfect example of asymmetric information harm (companies involved in trade did not have the same quality information about freight forwarding company Link Express, as their reimbursement bank did), and potential danger of moral hazard (the forgery of waybill and the acquisition of illegal financial value by the non-existent company).

3 Advantages and limitations of implementing smart contracts and blockchain/DLT technology in the reimbursement bank's business

3.1 General advantages of Blockchain/DLT and Smart Contracts

Therefore, overseas trade, as it often involves use of various forms of documentary loans, is a potentially excellent market for the application of reimbursement loans based on smart contracts and blockchain/DLT technology. Use of blockchain/DLT would greatly facilitate data processing (record of financial transactions/documents, record and management of container shipments…) and it would also provide secure and cost-effective business support. On the other hand, smart contracts would enable easier execution of trade contracts; insurance of payment and reduced need for human labor – which would consequently mean less costs and less mistakes.

There are already such cases in financial world. Blockchain-based documentary loan was executed in 2018 between "HSBC India" and Belgian "ING" bank. Belgian bank issued a version of electronic LC on behalf of company named "Tricon Energy", which was then traced to HSBC India as a bank representing "Reliance Industries" company. HSBC India (2018) stated that this transaction confirmed commercial and operational sustainability of blockchain/DLT as an alternative for conventional paper document exchanges. For the participants of this reimbursement loan, using blockchain/DLT as the base platform meant significantly shortened processing time of documents (from 7-10 days to just 1 day). The benefits of using blockchain/DLT technology are evident in this real case. The only issue regarding this job is the use of private blockchain/DLT.

To achieve full transparency and trust in these technologies, it is advised to use public blockhain/DLT. Use of private blockchain/DLT, requires central body, as oppose to public blockchain/DLTs where transactions are open and visible to all users of network. For the unconventional reimbursement loan model we will show below, we don't necessarily need to use the Bitcoin network and its specific blockchain transaction format.

Any kind of distributed ledger technology (DLT) is suitable for our model creation which we present below paper; as long as it is safe against 51 % attack. That is why we refer to the blockchain/DLT term throughout the whole paper. Peercoin network is a great example of *51 % attack resistant* network; it also has an advantage of the predictable transaction fees. Also, we are only interested in information transfer, which in Bitcoin case is a digital currency, but in reality can be anything. In principle, blockchain/DLT can be used in any area that requires fast, accurate and safe record (data) keeping. Such as land and credit registers, payment infrastructures, settlement for transactions in existing currencies, securities and other assets (IMF, 2016, p. 19). Therefore, there is no technical limitation or reason why we should not be able to use this technology to support the implementation of reimbursement loan process, as a one of the crucial parts of international exchange of goods. It is also important to emphasize that in our model of reimbursement loan, we will use a *public blockchain* form. Unlike private and hybrid blockchain types, use of public blockchain won't jeopardize much needed transparency of documentary credit process.

Other technology that will be accompanied with blockchain/DLT in our model is the so-called smart contracts. The creator of this concept, Szabo, (1994, 3) defines smart contract as computerized transaction protocol that enforces the terms of a contract. A smart contract encodes the terms of a traditional contract into a computer program and executes them automatically when default terms of contract are satisfied.[7]

The International Monetary Fund (2016) stated that the complementarity of smart contracts and blockchain/DLT could improve "back office" for securities traders, and increase their transparency.

Of course, the same matter may also apply to reimbursement loans and reimbursement banks. Securities and Exchange Commission (SEC, 2015) approved blockchain securities trading in 2015.[8] These technologies combined can shorten settlement time for most securities, which can currently take up to 3 days (T+3). Therefore, financial institutions like Goldman Sachs invest significantly in this area to avoid the occurrence of counterparty risk (IMF, 2016). For example, the collapse of "Lehman Brothers" caused numerous failures in execution of settlements in numerous markets and others financial institutions that were damaged by the event did not have an adequate way of protecting against this risk. Furthermore, the technologies mentioned above could potentially greatly reduce the costs of international money transfers, especially remittances (IMF, 2016). For example, Goldman Sachs (2014) calculated that the average cost of a transac-

[7] According to Szabo (1994, 5), the main goals of a smart contract are: to satisfy standard contractual terms (payment terms, liens, confidentiality, and even enforcement), minimize discrepancies (intentional and accidental) and need for reliable mediators. Furthermore, the economic goals are: minimizing the incidence and costs of fraud, reducing costs of arbitration and other transaction costs.

[8] Source: [online] available at: http://www.wired.com/2015/12/sec-approves-plan-to-issue-company-stock-via-the-Bitcoin-blockchain/ [accessed: September, 2019]

tion via bitcoin is only 1 %. Compared to other competing digital currencies in function of low-cost money transfer, Bitcoin quotes very low. Recognizing the increasing importance of overseas remittances for the growth of domicile countries, in 2009 the G-20 pledged to reduce the cost of such transactions to at least 5 % over the next 5 years, again not nearly as effective as we could by using digital currency technology.

Lagarde (2017), ex IMF leader, claims that crypto currencies are not just a passing fad, but a true innovation in the sphere of money, which, according to her assumptions, can have the similar effects on changes of society as the invention of internet. Blockchain/DLT and smart contracts are recently being more and more adapted in FinTech (digital, online structures for executing financial credit activities, outside the jurisdiction of commercial banks). According to that, Lagarde (2017) also states that the combination of the development of decentralized forms of lending, crypto currencies, blockchain/DLT and smart contracts, will change banking through three different aspects: reduced need for mediation (bankers, brokers), increased interoperability and security and lower cost of financing. In pages below we will create an unconventional model of reimbursement loan to thoroughly present all advantages of these technologies that we mentioned previously.

3.2 The application model of smart contracts and blockchain/DLT technology

In this section, we will present a solution to the case mentioned earlier in the paper (reimbursement loan between "Standard Chartered", "Beam Technology" and "PT Mulia Persada Permai") by using the application of smart contracts and blockchain/DLT technology. As we create this model, we will instantly compare its performances with previous model of processing reimbursement loans. To give a full overview of the process, we will assume that the reimbursement loan has passed without any difficulties, as opposed to real case. This new model of reimbursement loan will be presented through 3 phases: 1) Input phase, 2) Transaction and Signature phase and 3) Execution phase.

1) Input phase

The input phase of the new reimbursement loan process follows after an initial agreement between the importer, exporter, their banks, freight forwarding company and reimbursement bank around the subject of the sale, its characteristics and the timing of the sale. At this stage, we are creating a so-called "pool of inputs". Pool of input can be identified with a smart contract, since the set of inputs in this process can only be *consumed* within a certain rules – rules defined by a smart contract. It should be noted that at this stage of the lending process there is no real change of values between the parties involved in the sale process. Therefore, we could call this phase as a phase of harmonization of interests, that is, the fulfillment of the primary conditions.

1a) First step – In the mentioned pool of inputs, the chronological first input is provided by the seller, or in our case Singapore-based "Beam Technology (Mfg)". To secure the payment, Singaporean company is currently enclosing a *token* in the said pool as an electronic version of letter of credit (LC). This token is, by appointment in zero-phase addressed to the reimbursement bank – Singapore's "Standard Chartered". With the token, the Beam Technology also attaches the necessary commodity documents so that the goods can subsequently be lifted from customs. As a condition of acceptance, reimbursement bank has cited *valid* or *clean* waybill and a sufficient financial amount on Mulia Persada's bank account, on whose behalf it accepts the LC for certain fee amount due to activation of funds and reputation risk. At this point, unlike the conventional model, a Singaporean company is still not sending its goods (electronic components) to a customer in Indonesia, because, as we mentioned, there are no possible changes in the real values between the parties of the contract. Changes in the sheet balances of parties involved in a trade are not possible at this stage and it won't be before the final harmonization of interests.

Before proceeding with the steps in the input phase, we need to explain a few technical characteristics of this model in order to make it easier to understand in the continuation of the paper. We mentioned earlier that the "pool of inputs" is in principle equal to a smart contract. A smart contract is part of some blockchain/DLT that provides support for its work and security of data records. Lopez (2017, p. 2) explains how the software client of this blockchain/DLT manages the network and its *private* and *public keys* as crucial cryptographically defined and compatible components that enable secure communication on the network. A public key allows you as a network participant to receive some value, and a private key to keep that value secure. For example, on the Bitcoin digital currency network, a public key allows you to receive a certain Bitcoin value, and a private key to hold that value securely in "your hands". Public and private keys are paired to ensure secure communication, such as email. Private keys are usually only extremely large random numbers, while public keys are generated using cryptographic methods. Creating a public key is not difficult to perform if you know the private key, however, it would take millions of years to deduct a private key from a public key – this is why this method of communication on the blockchain/DLT network is so secure. Each participant in this smart contract (importer, exporter, reimbursement bank, freight forwarding company) must own both public and private key as confirmation of their entity, in order to access the network and make valid transactions within it. If this was a case in conventional model of reimbursement loan, freight forwarding company "Link Express Ltd" would not be able to perform a forgery, because it could not be able to confirm its valid identity through public and private keys protocol. In other

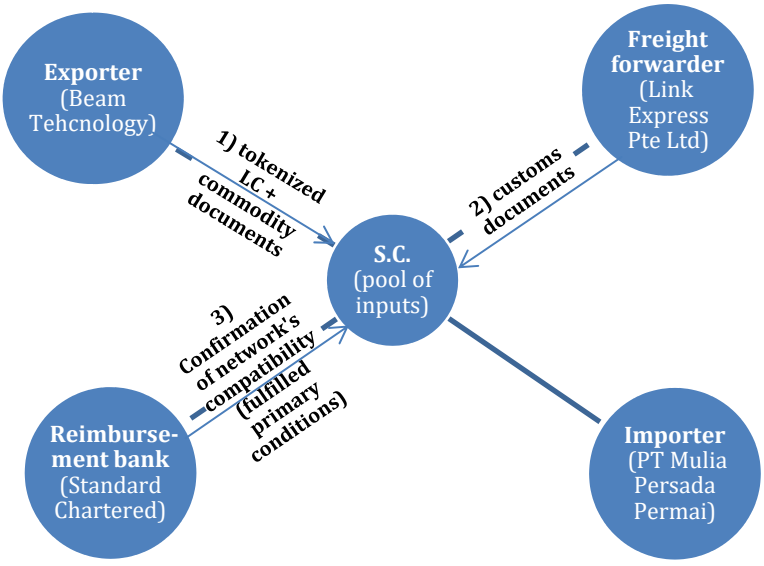

Figure 2 Input phase scheme – unconventional model of reimbursement loan

Note: The importer does not make any input at this stage, since he has an account with a reimbursement bank that can check his account easily

Source: Author

words, this process would be terminated in the early stage and would end without financial consequences.

The positive thing about blockchain/DLT technology is that it does not require any central authority that issues keys and maintains the network, but only needs an independent, self-sustaining software client to take care of network operability – like Bitcoin software. Otherwise, the reimbursement bank should issue private keys, thus undermining the whole concept of process transparency, which is one of the key ideas of this paper. Now that we explained a secure communication protocol within this network, we can proceed with the following steps in Input phase.

1b) Second step – The next company that attaches the input to the said *pool* is a freight forwarding company. This company should enclose customs documents, i.e. confirm that the papers of goods are *clean* so the reimbursement bank can accept the tokenized LC so the process of sale can continue. In this case, importer had chosen a "Link Express Ltd" as their freight forwarding company. If we would display this model realistically, according to the real facts (freight forwarding company did not really exist as a legal entity and all the commodity documents were counterfeited), this would again be terminated. Why? Because, *again*, there would be no technical or any other possibility for the non-existing company to confirm the validity of any commodity documents, as well as the possibility to attach a counterfeited waybill. The reason is that it could not own a private key that is the responsibility of a software client that manages the blockchain/DLT public and private keys that this smart contract relies on. As oppose to conventional model, this model would once more be able (by using modern technologies) to terminate this compromised process of reimbursement, before any financial claims have been made. However, for work purposes, we will assume that the freight forwarding company is a legal entity and that they have done their job by law, so that we can show how the model works fully.

1c) Third step – By the assumption of legality and correctness of the freight forwarding company and for the purposes of this research, we are moving further to develop a new model of reimbursement loans. After checking the sum on a Mulia Persada's account, in order to securely accept the issued LC, reimbursement bank should now check the validity of commodity documents attached by freight forwarding and exporting company. Reimbursement bank executes validation of documents attached in to the *pool of inputs* by using hashing process.[9] Without opening the two files to compare them word-by-word, computing the hash values of those files will allow the owner to immediately know if they are different. In this way, a private validation (i.e. equality of documents attached to *pool of* inputs with those defined by a smart contract) of documents will also be easily handled by the reimbursement bank. The reimbursement bank will only

[9] Hashing is an algorithm process that calculates the value of a series of fixed-size bits from a file. In other words, the hash value we get after the hash process can be considered a concise version of a document. Except for shortening files, we also use hashing in order to compare the equality of two files. A quality hash algorithm should be complex enough not to produce the same hash value with two different inputs.
Source: [online] "www.2brightsparks.com". Available at: https://www.2brightsparks.com/resources/articles/introduction-to-hashing-and-its-uses.html [accessed: June, 2019]

run documents through a hash algorithm. If the calculated hash value is not the same for both documents (documents attached to the *pool and* documents defined by a smart contracts) the bank can immediately conclude that it is an inadequate, or rather different, document that is attached to the *pool of inputs*. In that case, reimbursement bank can stop the reimbursement process. Compared to traditional model of reimbursement loan, reimbursement bank does not have such technical capability of investigating validity of documents. Using hashing process, along with the smart contracts and blockchain/DLT allows reimbursement banks to be more reliable and secure intermediary than it is the case in the traditional model. In other words, it can exterminate the risk of moral hazard and asymmetric information risk very early in the process. Also, hashing will significantly reduce amount of the time needed for coordination of documents, which is a serious problem of the conventional mode. For work purposes, we suppose that the documents provided by the freight forwarding company and the exporter are valid and that the reimbursement bank is sure that the import-export business will be carried out undisturbed. At that point, Standard Chartered concludes the first phase by confirming network's compatibility. In translation, this means that the commodity documents are *clean*, there is a sufficient amount of funds in the account of the importer, and multilateral interests are confirmed for the completion of this reimbursement process. The process of this phase, for easer understanding, is shown in Figure 2.

2) Transaction and signature phase

According to the existing *blueprint* (fulfilled primary terms of the contract from the input phase) the reimbursement bank at this stage is moving into the process of creating the transaction. The state of the first phase of this process is irreversible and cannot be changed subsequently. As in the previous phase, it should be noted that during the transaction and signature phase, there is still no change in the balance sheets of the companies involved in the reimbursement loan. We can still think of a smart contract as something fictitious. The aim of this phase is to create a legal basis according to which real-life transfers of value would occur. At this stage, reimbursement banks creates an appropriate output for each input from the smart contract (*pool of inputs*), that is, forms the transaction that each party of the contract should sign in order to become valid and to allow smart contract to be executed.

The transaction created by the reimbursement banks implies following:

A) Singapore-based Beam Technology (Mfg) becomes the owner of a tokenized LC that can be reimbursed at Standard Chartered bank
B) Standard Chartered achieves a right to charge Mulia Persada Permai for LC amount and to charge additional fee for reimbursement service
C) PT Mulia Persada Permai becomes the owner of valid merchandise documents that will allow it to lift computer components from customs

When all parties of the contract digitally sign this transaction, the smart contract executes, the transaction describing it is permanently recorded on the blockchain/DLT and becomes the legal basis for executing the real transaction with real changes in the balance sheets.[10] Upon completion of this phase, the rights of the parties involved in the reimbursement loan are known, the smart contract is permanently recorded on the blockchain/DLT and as such serves as the legal template and basis for executing the last phase of the unconventional reimbursement loan model – the execution phase.

3) Execution phase

In the last phase of unconventional reimbursement loan model, changes in the balance sheets of subjects involved in trade occur for the first time – the real transfer of ownership is formed. This phase suggests the end of the reimbursement process. Completion of this loan is based on the draft of executed smart contract from the previous phase and the assumption of the existence of a legal framework that will make digital signatures and permanent record of the smart contract on blockchain/DLT legal basis for these actions:

1) PT Mulia Persada Permai becomes the legal owner of the computer components
2) Beam Technology (Mfg) executes the reimbursement – it charges Standard Chartered for the amount named on the LC
3) Standard Chartered charges PT Mulia Persada Permai for the amount of the sale and a commission fee for the execution of reimbursement loan.

We could see, that the reimbursement bank is fully able to help us, with the use of aforementioned modern technologies, to eliminate the risk of moral hazard and information asymmetry in the early stages of reimbursement process – before the acceptance of LC and creation of financial claims. Therefore, as oppose to the conventional, unconventional model fully protects us from: fraud risk, counterparty risk, document counterfeiting, moral hazard and information asymmetry. The cost of the reimbursement loan mostly depends on the cost of opening a letter of credit (LC). This cost varies from country to country. In most developed countries, the cost of opening a LC for reimbursement loan is approximately 0.75 % of the sale, for the amounts excessing 100 000 $. For undeveloped countries, the percentage can be raised to 1.5 % of the amount of the sale. As reimbursement loans are usually issued for trades including huge financial amounts

[10] Of course, in order to do this, we must assume that there is a legal framework that will allow an executed smart contract that is written or recorded on some form of blockchain/DLT to be a valid legal basis for the transfer of ownership rights.

(like overseas trade mentioned earlier in the paper), this cost is not negligible. Compared to the conventional model, the unconventional model does not require as much infrastructure to carry out rambling operations. The vast majority of work is automated, and thus the cost of implementing this type of bank loan is somewhat lower. A lower cost of implementation, of course, does not mean that the reimbursement banks would be willing to offer lower tariffs for service. However, in some competing environment a cost reduction in sense of lower fees would be expected. Furthermore, if we were to look at cost through the prism of risk and time, an unconventional model would certainly be a cheaper option for import-export deals. In the international exchange, the risk of changing the price of a product is always present, any delay in the purchase due to discrepancies in the documents can mean a consequential loss for one or the other party involved in the sale. Cryptographically secure online communication, provided by reimbursement bank, and the aforementioned applicable technologies in an unconventional model could solve issues such as commodity document discrepancies more efficiently, faster and cheaper than the standard model – especially, when studies show that 50 % of initially presented documents are rejected and sent for revision (Youseff, F. et al. 1998, p. 26). The presence of reimbursement banks in import-export transactions is necessary because of the lack of mutual knowledge of the trading companies, that is, to allow transparency. However, judging by the case from work, the engagement of a world-renowned and stable bank was not enough to complete the rambling business successfully. If reimbursement loans would be executed in a non-conventional manner explained in the paper, gathering the necessary information for reimbursement banks would be quite facilitated since all transactions would be recorded to a public decentralized distributed ledger. Therefore, unconventional model of reimbursement is able to provide higher levels of transparency than the traditional one.

3.3 Limitations of implementing Blockchain/DLT and Smart Contracts in Reimbursement bank's Business

The absence of a uniform set of rules, i.e., the legal framework for bank-to-bank reimbursement through the application of these innovative technologies is the biggest challenge of the unconventional reimbursement loan model presented in the paper. In order to create legal basis for the implementation of this unconventional model, it will be necessary to reshape 150 years old form and tradition of reimbursement loans – which is quite challenging. The first and foremost challenge facing these technologies is regulation. Regulatory bodies such as ESMA ("European Securities and Market Authority") and SEC ("Security and Exchange Commission") will need to put in the extra effort and develop the skills necessary to control and interpret activities in order to implement this technology in the financial world. Deshpande et al. (2017, p. 9) considering the decentralized/distributed nature of technology, the biggest challenge for regulators will be to set clear rules for protocol management because blockchain/DLT will require individual users (approved by regulatory authorities) to conduct transactions through their private keys. In addition to protocol supervision, regulatory bodies should enable blockchain/DLT and smart contracts to communicate with pre-existing implemented financial protocols (such as SWIFT – "Society for Worldwide Interbank Financial Telecommunication") and other financial infrastructure. If quality implementation of these technologies does not happen, it could lead to fragmentation of financial system which would consequently result in increased costs of financial transactions and reduced inter-operability among financial institutions.

Further challenges will be maintaining network security and data privacy – it is necessary to ensure that only those parties holding a private key can access the data on the blockchain/DLT. The standardization of access to and use of the network itself will also present an extraordinary challenge, given the number and diversity of institutions that could potentially use this network for transactions providing. Furthermore, Sherborne (2017, 5) notes that the enforcement of a smart contract does not fit the traditional basis of territorial jurisdiction and thus makes it difficult to determine the law that will apply in managing issues related to a specific smart contract. Moreover, there is a challenge to determine which court has jurisdiction to hear the lawsuits occurred due to use of smart contracts. Considering that this form of contract does not require central executive body, it is very difficult to predict how disagreements can be resolved.

Regarding that these technologies have a potential to change a complete financial paradigm, as Lagarde (2017) stated, we are going to touch on further limits of implementations of the smart contracts and blockchain/DLT in financial world. First limitation would be convertibility in a currency sense. In case of widespread adoption of crypto currencies which are not, in essence, anchored to national currencies, it is going to be hard to reach a consensus on a dominant and reliable currency of payment. On the other hand, there may be a problem in the selection of certain forms of collateral. The loans market is most dependent on collateral, as insurance for creditors. If we assume that these technologies will boost up use of FinTech, as a financial innovation that implies use of decentralized lending, there may be hard to reach an agreement on accepting various kinds of collateral. When we talk about the global financial market, we are talking about different practices and rules of financial activity, although we know it as the "most perfect" market in the economy. In a global context, it is very difficult to expect consensus in terms of accepting different collateral forms – especially in the market where a large of new financial companies would operate.

4 Concluding remarks

Documentary credits, as well as reimbursement loans, are the dominant form of payment in international trade. Since 90 % of world trade is carried out by maritime transport, the importance of reimbursement loans in seaborne trade (where those loans are mostly used) is obvious. In the paper, we mentioned a study in which it was concluded that as many as 50 % of initially presented reimbursement loan documents are rejected and sent for revision. Fraud can cause extreme financial costs, as we saw in a case study of this paper. Although the importer is considered to be the more vulnerable side of the reimbursement process, we saw in a case study of a Singaporean company that the exporter, despite his innocence, lost the reimbursement right and thus suffered an extreme financial loss. Given these facts and the case study between Beam Technology (Mfg) and PT Mulia Persada Permai, it is evident that the conventional reimbursement loan model requires high costs, involves exposure to multiple risks, and opens enough room for manipulation and fraud. Therefore, based on case study and actual facts (results) that we have compared with the results of an unconventional model in work, we can conclude that adopting smart contracts and blockchain/DLT as a key parts (or new core features) of reimbursement bank's technical infrastructure could significantly reduce moral hazard and asymmetric information risk in bank-to-bank reimbursements.

The first and foremost challenge facing widespread adoption of these technologies is regulation. Regulatory bodies such as ESMA ("European Securities and Market Authority") and SEC ("Security and Exchange Commission") will need to put in the extra effort and develop the skills necessary to control and interpret activities in order to implement this technology in the financial world. The following challenge for regulators will be to set clear rules for protocol management because blockchain/DLT will require individual users (approved by regulatory authorities) to conduct transactions through their private keys.

In addition to protocol supervision, regulatory bodies should enable blockchain/DLT and smart contracts to communicate with pre-existing implemented financial protocols such as SWIFT and other financial infrastructure. In order to create legal basis for the adoption of this unconventional model, it will be necessary to reshape 150 years old form and tradition of reimbursement loans – which is quite challenging.

Given the great number of national memberships, large infrastructure and global activity, tasks such as: drafting a new legal framework for financial operations using modern technologies, consensus on accepting collateral, educating financial officers on the use and application and regulation of modern financial activities should be best left to the International Monetary Fund (IMF) as a future an umbrella organization to supervise a modern, unconventional financial market.

References

[1] 7 Major Blockchain Technology Developments In Maritime Industry In 2018, MI News Network, Last Updated on December 26, 2019; https://www.marineinsight.com/know-more/7-major-blockchain-technology-developments-in-maritime-industry-in-2018/

[2] Basimanyane, D.K. (2016). "The legal Implications of Electronic Letter of Credit as a Cross Border Trade Payment Mechanism: Botswana as a case study" – University of Pretoria

[3] Blockchain at sea: How technology is transforming the maritime industry in International Shipping News 08/03/2019, https://www.hellenicshippingnews.com/blockchain-at-sea-how-technology-is-transforming-the-maritime-industry/

[4] BLOCKCHAIN TECHNOLOGY IN MARITIME TRADE, 2019, https://www.ippo-engineering.eu/en/blockchain-technology-in-maritime-trade/

[5] Boland, P.J. (1997). "Risk involved in international trade finance: a banker's perspective" – International Trade Association

[6] Claessens, Frost, Turner, Zhu (2018). "International banking and financial market developments" – BIS quarterly review

[7] Czachorowski K., Solesvik M. and Kondratenko Y. (2019). The Application of Blockchain Technology in the Maritime Industry, In book: V. Kharchenko et al. (eds.), Green IT Engineering: Social, Businessand Industrial Applications, Studies in Systems, Decision and Control 171 Springer Nature Switzerland AG

[8] Deshpande, A., Stewart, K., Lepetit, L. & Gunashekar, S. (2017). "Distributed Ledger Technologies/Blockchain: Challenges, Opportunities and the Prospects for Standards" – BSI Group

[9] Greenspan, G. (2015). "Ending the bitcoin vs blockchain debate" Available at: https://www.multichain.com/blog/2015/07/bitcoin-vs-blockchain-debate/

[10] Hamed, A. (2016). "Documentary Letters of Credit, Legal Nature and Sources of Law" Journal of legal studies, Tallinn University of Technology

[11] Horowitz, D. (2010). "Letters of Credit and Demand Guarantees: Defenses to Payment" OUP, Oxford

[12] International Monetary Fund (IMF) (2016). "Virtual Currencies and Beyond: Initial Considerations" – IMF Discussion Note

[13] Introduction to hashing and its uses, htm https://www.2brightsparks.com/resources/articles/ [accessed: June, 2019]

[14] Kucuksolak, O.K. (2017). "Current debates in international relations & law" IJOPEC publication Limited

[15] Lagarde, C. (2017). "Central banking and fintech – a brave new world? – press conference, Bank of England, London.

[16] Längerich R. (2009). "Documentary credits in practice", Nordea Denmark

[17] Lipton, J. D. (1998). "Documentary Credit Law and Practice in the Global Information Age" Fordham International Law Journal, Volume 22, Issue 5, Article 3.

[18] Lopez, H. (2017). "How are public and private keys created in bitcoin". Dostupno na: https://medium.com/@hlopez_/how-are-public-and-private-keys-created-in-bitcoin-f90b2b88f40a

[19] Mishra B. (2018). Why is Blockchain Crucial for the Shipping Industry, https://seanews.co.uk/features/why-is-blockchain-crucial-for-the-shipping-industry/

[20] Mofleh, A.I. (2005). "Abstract payment undertakings: to what extent are they truly abstract?" Faculty of Law, University of Leicester

[21] Nian, Lam Pak, Chuen, Lee Kuo (2015). "A Light Touch of Regulation for Virtual Currencies". In Chuen, David LEE Kuo. Handbook of Digital Currency: Bitcoin, Innovation, Financial Instruments, and Big Data. Academic Press. p. 319. ISBN 978-0-12-802351-8

[22] Schueffel, P. (2017). "Taming the Beast: A Scientific Definition of Fintech". Journal of Innovation Management. 4 (4): 32–54. ISSN 2183-0606.

[23] Sec approves plan to issue company stock via the Bitcoin blockchain – http://www.wired.com/2015/12/ [accesed: September, 2019]

[24] Sherborne, A. (2017). "Blockchain, Smart Contracts and Lawyers". available at: https://www.ibanet.org/

[25] Sillaber & Waltl, (2017). "Life Cycle of Smart Contracts in Blockchain Ecosystems", DuD, Springer

[26] Simmons and Simmons – Elexica [online] (2016). "Structures and Solutions in Trade Finance". Available at: http://www.elexica.com/~/media/files/microsites/structures%20solutions%20in%20trade%20finance/structures%20and%20solutions%20in%20trade%20finance%20portrait.pdf

[27] Sing, T.K. (2006). "Significant Letter of Credit – Decisions in Singapore" Available at: https://docplayer.net › 3561100-Decisions-in-singapore

[28] Szabo, Nick (1996). "Smart contracts: Building blocks for Digital Markets". Extropy magazine

[29] Transparency Market Research (TMR) (2016). "Blockchain Distributed Ledger Market – Global Industry Analysis, Size, Share, Growth, Trends and Forecast 2016–2023" Available at: https://www.transparencymarketresearch.com/blockchain-distributed-ledger-market.html

[30] Wagner N., Wiśnicki B. (2019). Application Of Blockchain Technology In Maritime Logistics, DIEM: Dubrovnik International Economic Meeting, Vol. 4 No. 1, pp. 155-164.

[31] Yates M., Zelnick B., Brennan C. (2018). "Blockchain 2.0 – Cryptocurrencies are only the beginning" Credit Suisse Connections Series

[32] Youseff, F et al. (1998). "Documentary risk in commodity trade" – UNCTAD