BLOCKCHAIN, SMART CONTRACTS AND IOT IN E-B/L

Blockchain was invented by a person using the names Satoshi Nakamoto, in 2008, to serve as the public transaction ledger of cryptocurrency called Bitcoin. This ledger is limited with the exchange of Bitcoin. The combination of blockchain and SCs is invented by Vitalik Buterin in late 2013 which went live in 2015 under the Etherium platform, enabled blockchain technology to be used by all industries in various transactions. This started a new era in technology that become an immense field of creativity for all industries, as well as for maritime trade.

Furthermore, with the usage of IoT devices many analogue systems have started to be automatized. It is desired to implement IoT to animate all the incidents on land, at sea and in the air in a seamless global network. This will enable autonomous communication of information between smart shipping technologies such as smart containers, smart port equipment and autonomous ships[1], which will lead to the self-execution of the daily trade transactions via SCs. For instance, '*equipping containers with IoT sensors allows the real-time collection and transmission of data concerning geographic location, speed and internal conditions of the container. Analysis of that data, would allow a reasonably accurate assessment of the extent the damage during transportation'*.[2] Moreover, the payment will be released automatically upon delivery due to the data achieved from the IoT devices. It should be mentioned here that in order for these technologies to transmit data with each other in real-time, there should not be latency. This will be made possible implementation of 5G network.[3]

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[1] Elson Ong, 'Blockchain bills of lading and the UNCITRAL Model Law on Electronic Transferable Records' (2020) 3 JBL 202.
[2] Malcolm Dowden, 'Rise of the machines (Pt 2)' (2017) 167(7740) The New Law Journal 15.
[3] Ong, 64.

In order to accomplish these projects, it is a fact that the most crucial trade document for maritime trade which is B/L, should become the part of it, thus be digitized. As stated above, the industry has serious concerns regarding the adoption of e-B/Ls. However, these hesitations except the lack of common substantive law, can be fulfilled by the implementation of blockchain technology into e-B/L systems.

Blockchain can be accepted as the most suitable solution for e-B/Ls because;

Initially, the FITS model can be very well applied to B/Ls as **i)**B/L is subject to fraud since it has high has value; **ii)**intermediaries such as port authorities, banks take part in the transactions in order to verify the transactions without adding any value; **iii)**the amount of throughput is convenient which is calculated as approximately 6 transaction per second; **iv)**B/L has stable data such as particular ship name/time/date/destination.

Secondly, blockchain based e-B/Ls("**BBe-B/L")** can eliminate the common problems arisen from paper B/L by making the document instantaneously available to all parties relevant to the transaction, and thus, eliminating the demurrage costs and carrier liability resulting from the delayed receipt of paper B/L. Moreover, as it removes the single point of failure, it is extremely secure, which lessens the risks of cyber-attacks. This also would compromise the integrity and uniqueness of e-B/. Manipulating dates and condition of goods etc will be impossible. It also protects ownership interest in cargo, as carriers cannot misdeliver cargo against fraudulent paper bills. Furthermore, the banks can have access and use the system '*to automate financing requirements by matching information in the electronic manifest against digital letters of credit*'[4] will accelerate the trade. Finally, it is estimated that the international trade transactions will cost less as the intermediaries will be removed from the chain.

Two reasons why past efforts were not welcomed by the industry were the need of a verification from the carrier or the registrar in order to transfer e-B/L to another party, thus,

[4] Bury, 9.

sharing the transaction info and/or trade secrets with third parties; and the limit of trading within the closed ecosystem. In contrast to past efforts of e-B/L, blockchain technology does not require that all parties decide on an alternative third party to trust; it creates trust with its consensus process through algorithms.[5] As the system timestamps the transfers and automatically record it in the shape of blocks which are connected to the previous transactions, it is therefore clear who owns the B/L, indirectly the goods. To this end it replaces an administrator with an algorithm and guarantees that there is a single true version of the record.[6] Briefly, '*Blockchain protocols ensure that transactions are valid and never recorded to the shared repository more than once, enabling people to coordinate transactions individually in a decentralized manner without the need to rely on a trusted authority to verify the transactions'*.[7]

Furthermore, due to the encryption methods embodied in SC, the confidential information is available to the relevant parties' access only. By this way, the actors need neither a registrar in order to issue or endorse e-B/L, nor to share confidential information with third parties.

On the other hand, blockchain technology complies with the principles of MLETR determined for an e-B/L:

i. MLETR does not restrict technologies to be used in order to accept a record as ETR. Instead, it hugs and encourages the future technologies. To this end, blockchain and SCs are, neither excluded, nor expressly encompassed under the scope of MLETR.[8] In line with this aspect, a Chinese Commercial Court[9] held that data stored on blockchain is admissible as evidence for the authenticity and genuineness of the information

[5] Chetrit, 23.
[6] Takahashi, 22.
[7] Chetrit, 23.
[8] Albrecht, 25.
[9] *Hangzhou Huatai Yimei Culture Media Co. v Shenzhen Daotong Tech. Dev. Co*., (2018) People's Republic of China Hangzhou Internet Court Province of Zhejiang 055078 Zhe 0192 No. 81.

contained in the record and stated that technologies like blockchain should be considered even though they are novel and complex technical means at present.[10]

ii. MLETR's approach is not to discriminate the paper records over electronic forms, therefore, BBe-B/L is a valid record under MLETR provided that it fulfils the necessary conditions.

iii. Blockchain provide functional equivalence to ETRs more than the previous attempts;

a. BBe-B/L can contain all the salient information that paper B/L has, such as shippers', loading port's, destination port's, vessels names, specifications, quantity of goods loaded and statement that the goods are shipped in apparent good order and condition. Relevant charterparty clauses can be incorporated to BBe-B/L.[11] Such data can be included in the SC under encryption so that the third parties who are not involved in the transaction cannot have any access.

b. Blockchain provides exclusive control over ETR. As explained above, exclusive control of an electronic record is deemed to be functionally equivalent to the possession of a paper B/L. Blockchain enables this condition due to its token model. Tokens symbolize B/L and are created through the execution of SC. An electronic token can be possessed by users directly, contrary to registry model.[12] Albrecht states that full control of a token is equal to the state of being a possessor in the eye of the law and accepts this process as the delivery under common law stating that '*Transfer of exclusive control to the transferee and loss of control by the transferor through cryptographic one-way hashing is equivalent to a transfer of legal possession'*.[13]

Regarding the exclusivity, since tokens are kept in the addresses which are secured by private keys, BBe-B/L is subject to control of the holder of the private key which

[10] Albrecht, 25.
[11] Ong, 64.
[12] ibid.
[13] Albrecht, 25.

enable the holder to demonstrate him/herself that he/she is the owner.[14] Furthermore, since a blockchain transaction that transfers token is immutable due to the hashing procedure, only one person/private key can have control over BBe-B/L and this makes the control exclusive. Within this scope, as two persons could not claim to hold the same token at the same time, it is equivalent to physical possession,[15] or even safer than the physical possession as such records cannot be manipulated and be subject to fraud.

Accordingly, the holder will be able to assert his/her rights, enforce the remedies arisen from possession and contractual relationship in case of a wrongful act.[16] However, it should be emphasized here that the holder of the private key corresponding to the address at which an e-B/L is kept, is not necessarily the rightful person entitled to claim delivery of the goods. Rightfulness should be determined by the applicable law as specified by the choice of law rules of the relevant forum.[17]

c. Blockchain provides integrity for ETRs as it creates immutable, appended only records. Before blockchain, unique electronic records could be created but they could not be transferred as unique tokens, therefore, there was a necessity of third-party registries. Blockchain solved this problem by behaving as clearing houses for the transactions in the network since its algorithms single out automatically the earliest transfer of the relevant token as the authorised transfer and void later unauthorised transfers in the process, due to its timestamping and cryptographic techniques. Each block authorises the transfer only if it ascertains that there are no conflicting transfers within its block. This ensures that each BBe-B/L is unique.[18]

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[14] Ibid -Ong, 64.
[15] Chetrit, 23 -Takahashi, 25.
[16] Ong, 64.
[17] Takahashi, 25.
[18] Ong, 64.

Within this scope BBe-B/L can, replicate the practical and legal objectives achieved by paper B/L,[19] thus can be accepted as its functional equivalence.

iv. As stated in the Section 5.v above, MLETR seeks for reliable methods in order to accept e-B/L as a valid ETR. It is deemed as blockchain technology comply with these methods, as it is tamper-proof, as it allows amendments for the future transactions, as the tokens can be made inoperable in case of a change of medium from electronic to paper[20], as the tokens are signed by digital signatures and the chain of digital signatures can be established.

In any way, a token will not be a legally valid B/L per se if nations do not regulate MLETR equivalent domestic laws that includes e-B/Ls and enables their negotiability, thus, review the notion of control in the digital environment.[21]

Several states in the USA[22] have enacted blockchain statutes which combine contract law and evidentiary standards, refraining from addressing property law effects, assuming tacitly that digital assets constitute intangible property. For instance, the Arizona regulated that '*The data on the ledger is protected with cryptography, is immutable and auditable and provides an uncensored truth*' and '*Contract relating to a transaction may not be denied legal effect, validity or enforceability solely because that contract contains a SC term*'. Wyoming law enables the usage of open blockchain tokens in exchange for goods, services or content, including of access thereto. Delaware authorises the use of blockchain technology for replacing physical registers of shareholders.[23] In Europe, Italy has introduced SC legislation

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[19] ibid.
[20] Abdellatif, 34.
[21] Ibid -I Carr P Indira, '*International Trade Law*' (6th ed, Taylor & Francis, 2017).
[22] Heather Morton, 'Blockchain State Legislation' NCSL 28.03.2019 <https://www.ncsl.org/research/financial-services-and-commerce/the-fundamentals-of-risk-management-and-insurance-viewed-through-the-lens-of-emerging-technology-webinar.aspx> accessed 12.11.2020 -Zetzsche, 4 -M Durovic F Lech, 'The Enforceability of Smart Contracts' (2019) 5 Italian LJ 493.
[23] Rainer Kulms, 'Blockchains: Private Law Matters' (2020) Sing J Legal Stud 63.

recognizes smart contract's full legal validity and enforceability.[24] France, Gibraltar, Luxembourg[25] has efforts in regulating blockchain as well.

Apart from these efforts, nations hesitate to regulate blockchain. Within this scope, until more guidance and/or law develops, BBe-B/L is best analysed under traditional contract law as it functions through SC.

Through this lens, it is accepted that SC fulfils the basic elements of a contract. The offer requirement is fulfilled through a posting on the blockchain ledger. Once the ledger receives the offer, it automatically sends a message setting out the terms and conditions, as well as the consideration of the offer with an option to accept, to the relevant parties. If the contract executes, it meets the requisite elements of offer, acceptance, and consideration; if not, there is no contract, only an offer.[26]

On the other hand, Todd explains that novation and attornment concepts are used in BBe-B/L as legal grounds. He states that SC would trigger an action, the payment -for instance, only against the tender of BBe-B/L which is an offer for a new contract by the carrier. '*(T)he carrier's obligation in this regard would derive from his initial contract with the shipper'*. This process repeats itself in each successive novation. *'(T)he new holder would be required not only to pay, but also to accept any applicable carriage contract obligations'*. This system, as well as the rejection option, which is another requirement of novation, will be embodied in the SC's code. [27] Thus, each transfer will renew the initial affreightment under the previously agreed SC.

With regards to the attornment, the SC executes and signalizes the carrier's attornment to a new holder upon the transfer of the token from the previous holder (transferor), to the new

[24] Durovic 85.
[25] Kulms, 86.
[26] ibid.
[27] Todd, 45.

holder (transferee), automatically. The predetermined condition x here, is the transfer of token, whereas the consequence y, is the attornment of the carrier. SC can be accepted the carrier's smart agent. To this end, this system does not need a central registry to deal with attornment, contrary to the previous attempts such as Bolero, as SC executes the transaction automatically in a secure way. '(*H)owever, attornment needs to be supported by an underlying will of the carrier to hold goods for a new bailor, which is best compared to consent'*. This consent should be acquired from the carrier at the time of the conclusion of SC. SC's terms should indicate that carrier agrees to use SC as its smart agent and to be bound by the SC's actions. Since the consequences of SC are predetermined by the underlying code, the carrier can trust its agent as it can only acts within its codified mandate.[28]

In any way, it should be underlined here that software builders should place these processes and/or rules in SC while coding. These technical rules will enable the courts to enforce SC, as these coded rules will prevent SC to be invalidated as a result of failure to comply with specific formalities. [29]

On the other hand, Albrecht states that issuance of a unique blockchain token is sufficient to deem the holder of this token to be the bailor in an attornment. He bases his conclusion to the decision given in the case Sonicare International Ltd. v East Anglia Freight Terminal Ltd.[30], where '*The judge found that the transfer of an electronic "Unique Consignment Number" is sufficient to constitute attornment to whoever holds this number and entitled its holder to claim the goods from the bailee'*. Within this scope, if the transfer of a unique number can establish attornment, an exclusive token on the blockchain would likewise suffice.[31]

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[28] Albrecht, 25.
[29] Morgan N Temte, 'Blockchain Challenges Traditional Contract Law: Just How Smart Are Smart Contracts' (2019) 19 Wyo L Rev 87.
[30] *Sonicare International Ltd v. East Anglia Freight Terminal Ltd and Neptune Orient Lines Ltd,* [1997] County Court (Central London), [1997] 2 Lloyd's Rep. 48.
[31] Albrecht, 25.

This is basically the same process of paper B/L where the carrier accepts to deliver the goods whoever tender the original B/L to him at the destination port once it issues a negotiable B/L. Shipper may endorse the paper B/L to a third party upon its sole discretion. As stated above, the main problem is that, this negotiability feature is given by specific substantive law to paper B/Ls. Thus, this function cannot automatically apply to e-B/L. Therefore, substantive law giving functional equivalence to BBe-B/L is absolute must.

The main difficulty of regulating SC is arisen from the allocation of risk and liability in case of a conflict. It is considered that liability may arise from contract, tort, partnership or joint liability, or specific legislation in particular competition law.[32] It is not simple to set a system which takes into account all the conduct-related legislation such as data protection, copyright laws, consumer-protection laws, tax laws, Anti-Money Laundering/Combating the Financing of Terrorism(AML/CFT) checks and landlord-tenant laws etc.[33]

Bearing these handicaps in mind, it was argued that a permissioned blockchain would match better for e-B/L due to the necessity of identification of the other party. It was concerned that in open ledgers, participants would not be able to identify every party on the system due to the anonymity.[34] Whereas, in permissioned networks, only identified nodes are permitted to submit transactions to the network or to take part in the consensus process of blockchain and these nodes have undergone some form of validation before being allowed to join as users or block producers by an administrator with "super-user" powers over the platform.[35] Thus, the transacting parties are determinable. However, permissioned ledgers do not satisfy the

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[32] Zetzsche, 4.
[33] ibid.
[34] Albrecht, 25.
[35] 'Legal analysis of the governed blockchain' (Norton Rose Fulbright, June 2018) <https://www.nortonrosefulbright.com/-/media/files/nrf/nrfweb/imported/emea4957online-publication-and-pdflegal-analysis-of-the-governed-blockchainv4.pdf?laen&revision=cl5aa8eb-48d5-4d06-8851-8226bdb1145f> accessed 12.11.2020 [hereinafter Norton Rose]

industry as the membership requirement has been known as a major obstacle to the spread of e-B/L[36] and there will still be a third-party governance that the actors avoid.

On the other hand, it was concerning that in open systems anonymous parties could see the information regarding shipping transactions and/or freight lists that could enable malicious people to select their target vessels.[37] Merchants cannot afford to expose commercial secrets/data for either legal or competitive reasons.

The solution was found in encrypting valuable data in a manner that renders access merely for the involved parties.[38] With the invention of privacy-enhancing techniques, identities of the transacting parties and/or the content of the transaction itself can be obfuscated[39] and sensitive information can be coded as metadata onto the token.[40] By this way, access to sensitive data will be limited to those who are involved in the transaction and the concerns about data privacy and ambiguity regarding the transacting parties will be removed.

Actually, permissionless systems, even with anonymous parties, resemble the current paper-based situation more since carriers merely check whether the party holds an original bill or not, the holder does not have to be identified by name. In addition, even MLETR only seeks exclusive control, not the identification of the party in control.[41] Therefore, it can be alleged that permissionless blockchain is appropriate for e-B/L.

Furthermore, in international trade, banks, insurers and traders would like to have access to details of B/L transactions, to check B/L alongside other digitised documents such as bills of exchange in order to secure the circulation of goods.[42] In paper form, these actors can analyse the documents upon submission. Thus, it is important to create the same environment and

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[36] Takahashi, 25.
[37] Albrecht, 25.
[38] ibid.
[39] G Hileman M Rauchs, 'Global Blockchain Benchmarking Study' (2017) <https://j2-capital.com/wp-content/uploads/2017/11/GLOBAL-BLOCKCHAIN.pdf> accessed 12.11.2020.
[40] Abdellatif, 34.
[41] Albrecht, 25.
[42] Mohd Hwaidi, 'Switching from paper to electronic bills of lading – Part 2' (2019) 25(5) JIML 371.

provide access to these actors in the electronic format without their extra effort such as being accepted by a permissioned ledger. Within this scope, the fact that permissionless blockchain, welcomes everybody to join the network and to submit transactions to the network in accordance with its protocol,[43] without any validation process, will enable worldwide participation from various industries.[44]

It should be cited here that, although permissionless blockchain allows anyone to take part, there is a requirement for transactions to contain a reference in a hash form to a separate document called "constitution". Only transactions that contain a reference to constitution can be incorporated into blockchain. Constitutions can be accepted as the multilateral agreements in Bolero or essDocs. They are intended to supply a legal framework to permissionless blockchains. In subscribing to the protocol and downloading the relevant software, users accept the constitution of the platform. Thus, legal frameworks of permissioned blockchains are regulated under such constitutions, in the lack of substantive law.

Within this scope, abovementioned technical codes should be incorporated to constitutions, as well as certain essential provisions such as governing law and jurisdiction clauses. They basically set out the user's rights and obligations. By these mechanisms, through the data achieved from IoT devices and the immutable and timestamped transactions/records, SC will allocate the liabilities automatically without further effort and cost. A constitution may also provide a mechanism in order to amend its provisions.[45] It should be underlined here that the substantive law should provide enforceability to such transactions.

All in all, SC as well as constitutions should be evaluated prudently. First of all, to avoid misallocation of liability, parties should allocate risk in a prior agreement or in the SC itself.[46] Damage may occur due to coding errors. A prior agreement allocating liability in the case of a

[43] Norton Rose, 98.
[44] Takahashi, 25.
[45] Norton Rose, 98.
[46] Temte, 92.

coding mistake or breach of cyber security may protect the parties. If the parties want to avoid a court interference, they can program dispute resolution mechanisms into the codes[47] or arbitration clauses can be implemented in constitutions.

On the other hand, like other digital system attempts, international groups can always collaborate to insure the users against such liabilities, alike P&I Club's coverages. The parties can be obliged to impose certain amount of insurance in case a damage occurs. This may prevent the new developers to enter into the market due to the high insurance costs. In order to prevent this, establishment of sandboxes[48] can be popularized and incentives can be granted to start-up projects which successfully complete their trials in the sandboxes. From another point of view, contractual agreements may include clauses that limits the liabilities associated with the growing risks of these new technologies[49] in order to protect the service providers as well.

However, such contractual relationship may push the users to accept contracts like clickwrap agreements which require users to affirmatively click a box on the website acknowledging agreement to the terms of service, in order to proceed. These agreements legally bind the users even though they are rarely read. SCs, just like clickwrap agreements, are open similar abuses including lack of clarity in the contract's terms, failure to provide adequate notice as well as unjust liability allocation. Current situation is similar to the initial uncertainty surrounding clickwrap agreements.[50] Such negativities regarding clickwrap agreements had been removed after the procuration of legal standards that embraced them. It may be the case for SCs as well. For instance, service providers can be forces to use natural language in SCs' terms and conditions instead of codes in order that users can understand. Furthermore, SCs

[47] Ibid -Pietro Ortolani, 'The impact of blockchain technologies and smart contracts on dispute resolution: arbitration and court litigation at the crossroads' (2019) 24(2) Unif. L. Rev 430.
[48] A sandbox is an isolated testing environment that enables users to run programs or execute files without affecting the application, system on which they run.
[49] Chetrit, 23.
[50] Charlotte R Young, 'A Lawyer's Divorce: Will Decentralized Ledgers and Smart Contracts Succeed in Cutting Out the Middleman' (2018) 96 Wash U L Rev 649.

can be banned from including nonliability clauses behalf of the service providers arisen from coding defects, or service providers can be forced to have sufficient insurances which cover such liabilities etc.

Another concern arises from the application of personal data protection laws. General Data Protection Law[51]("**GDPR**") regulates the right of erasure and right to be forgotten for the people whose personal data is processed(**"Data Subject**"). GDPR also orders basically to ensure that data is only stored and processed in permitted geographic locations and to inform the Data Subject where their data is/will be transferred. It is argued that, blockchain cannot comply with GDPR, **i)**since the ledger is immutable, to amend or erase data from blockchain is almost impossible as it requires %51 of the network's consent, thus right to be forgotten cannot be executed, **ii)**since there is not a single registry but as much as the number of the nodes that are part of the global network, data cannot be stored within a geographical region and it is not possible to determine the data controller or processor in order to make a complaint. However, due to the techniques mentioned above embodied in SC regarding data privacy enabling data to be accessible only to the relevant parties, it seems that these concerns will be removed. Regarding the right of erasure, a technical solution is to make personal data impossible to access by encrypting all personal data with a key or hash that could be deleted upon request of Data Subject or after some interval.[52] Within this scope, it seems that GDPR is not a major obstacle anymore for e-B/L. In anyway, it should also be emphasized that e-B/L generally include data regarding companies which are not accepted as personal data under GDPR, therefore, these concerns are not deemed of the essence. As an alternative strategy, the nations may oblige the companies to eliminate the personal data of their employees from the trade documents by implementing corporate rules that obliges the usage of the titles instead of

[51] Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and repealing Directive 95/46/EC (General Data Protection Regulation) [2016] OJ L 119/1.
[52] Sandy Tsakiridi, 'Blockchain and the GDPR -friends or foes?' (2020) 13(1) Data Protection Ireland 4.

personal data which are linked to employees through digital signatures where such digital signatures will be allocated to the employees through internal directives. Within this scope, trade documents will include only the titles. The person involved will be determined through checking the relevant internal directive, if necessary.

On the other hand, in my opinion, it would be useful that the states keep a registry of public keys that enable the transfer of the token, like electronic notification address registries. This ledger may be a safeguard for the users of the various online platforms where SC does not include the necessary details of the parties. By this way, in case of a conflict, the parties will be identified through national records. This can be regulated as a principle of e-commerce.

Leaving all these concerns aside and despite the lack of legislation, BBe-B/Ls have already started to be used. Within this scope, P&I Club approved the platforms edoxOnline in June 2019, Wave in January 2020, and CargoX in February 2020.

Among them, Wave is a permissioned blockchain platform that connects all members of the international trade supply chain and enables them to directly exchange documents, including B/L in a way that allows title transfer, endorsements, and surrender under layers of cryptography[53]whereas cargoX is a permissionless blockchain working on Ethereum network which enables an audit trail of events only to the participants involved while preserving total confidentiality and full data, identity, and business connection privacy.[54]

There are many other platforms being used but have not yet approved by P&I Club, one of which is Tradelens. It uses the Hyperledger Fabric permissioned blockchain to guarantee the immutability and traceability of trade documents where the peer members are known to the

[53] ibid -<www.wavebl.com> accessed 12.11.2020.
[54] <https://cargox.io/?ref=cargox> accessed 12.11.2020.

network based on cryptographic identities.[55] Tradelens is currently attracting the biggest cargo shipping companies.[56]

All in all, it is seen that the legal grounds developed by the international organisations and technological improvements currently creates a convenient environment for the implementation of BBe-B/L. Blockchain technology is the essential component of the functional equivalence which has been missing before. Providing substantive law recognition in line with MLETR to BBe-B/L will increase its usage and enable all the actors to enjoy the advantages of paperless trade. It looks promising that the actors started participating in the ecosystem, however, this variety is creating another essential problem which is the lack of interoperability and in my point of view, preventing the nations to take the next step.

[55] <www.tradelens.com> accessed 12.11.2020.

[56] 'CMA CGM and MSC complete TradeLens integration and join as foundation carriers working with the IBM and Maersk Shipping Platform to improve data sharing across the industry' MAERSK 15.10.2020 <https://www.maersk.com/news/articles/2020/10/15/cma-msc-complete-tradelens-integration-to-improve-data-sharing-across-industry> accessed 12.11.2020.