BLOCKCHAIN, SMART CONTRACTS AND INTERNET OF THINGS

In this section, I would like to explain the features of blockchain as I will refer to these specialities in the following sections.

Blockchain is, **i)**a peer to peer **ii)**distributed ledger that is **iii)**decentralized, **iv)**time stamped**, v)**append-only, **vi)**cryptographically secure, **vii)**borderless, **viii)**open sourced and independent, i**x)**transparent but untraceable and **x)**immutable[1] which mean:

i) the individuals/peers can interact with each other directly as the transactions can be realised without the need of an intermediary (such as banks, land registries, notaries). Since there are no intermediaries, the transactions are faster and the costs are considerably lower.

ii) the records are not kept in a single centre. Blockchain is a type of distributed ledger technology("**DLT**"). In DLT, every participant keeps a copy of the whole ledger. These participants are basically computers called "the nodes". Therefore, there are as many copies as the number of the nodes.[2]

iii) every node from all around the world records all the transaction realised in the network, all the time. Thus, the ledger is always up to date (golden state of the ledger). This is why it is decentralized. Decentralisation eliminates the risk of single point of failure. An act of God cannot harm the ledger. Since there is not one point, but as many as the number of the nodes, a hacker cannot attack the ledger and corrupt it. This makes the ecosystem more secure than the contemporary one. [3]

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[1]Imran Bashir, '*Mastering Blockchain distributed ledgers, decentralization and smart contracts explained'* (Birmingham: Packt, 2017).

[2] Nolan Bauerle, 'Blockchain 101' (Coindesk, 17 March 2017) <https://www.coindesk.com/learn/blockchain-101/what-is-blockchain-technology> accessed on 9.11.2020.

[3] Dr. Arati Baliga, 'Understanding Blockchain Consensus Models' (Persistent, April 2017) <https://www.persistent.com/wp-content/uploads/2017/04/WP-Understanding-Blockchain-Consensus-Models.pdf > accessed on 9.11.2020.

iv) all the transactions are time stamped using the previous transaction's fingerprint. Nobody can change the information in any transaction without changing its fingerprint which will invalidate the next block in the chain. This makes the transaction irreversible providing certainty, alike the central authorities provide in the current system.

v) once the transactions are sent to the network, it cannot be taken back or changed. Therefore, blockchain works only by adding/appending data to the current ledger.

vi) the transactions are done through internet where people do not see or talk to each other while interacting. In order to protect the data transfer against tampering and misusing among parties that do not trust each other, cryptography is used. Due to cryptography, blockchain does not need a third person to secure the data, validate the identity of the addressees as this is done automatically.

vii) blockchain functions on internet, thus, it is as borderless as the internet.

viii) since blockchain is decentralized and borderless, it is not governed by a state or a jurisdiction. It is an open sourced system which means that blockchain has neither hierarchical governance, nor enforcement bodies contrary to the current system. It naturally has a creator, who starts the process by coding the software, deciding its functioning mechanisms and architecture. Once the software is publicly available, the creator does not have any control over it. The process progress in line with the code. Therefore, it is independent.

ix) basically, the content of the transactions is visible by all the participants, thus transparency prevails. However, due to the pseudonymity provided by the cryptography, relevant participants cannot be determined. On the other hand, data can be encrypted

before being stored on a blockchain, rendering it effectively unreadable to third persons.[4]

x) the transactions can be added to the ledger only if the majority of the nodes approve it. This is called the consensus process. A vicious person, who wants to amend/manipulate the ledger has to convince the majority of the entire network to validate a wrongful action. This is technically possible and called as 51% Attack, however, this kind of attempt had never occurred before since it would be too expensive to accomplish it so that would not worth it. Thus, blockchain cannot be changed, manipulated or corrupted; it is immutable.

Blockchain platforms can be classified into two main types – permissionless and permissioned. Permissionless ledgers are publicly available for use. Bitcoin and Ethereum can be given as example. Any node is allowed to join the network, to conduct transactions, to take part in the consensus process to advance the blockchain. Permissioned platforms are closed ecosystems. The users are previously verified and registered by a consortium. They are allowed to submit transactions, however, consensus process is restricted to a fixed set of peering nodes that are run by consortium members. Hyperledger Fabric can be given as an example.

Blockchain covers all the functions of the current system in terms of security, trust and certainty in accordance with its type and provide much more such as the implementation of SC.

SC are self-executing codes that perform in accordance with the irrevocable set of instructions, subject to clear pre-defined exceptions.[5] Once the pre-defined actions occur, SC

[4] D A Zetzsche R P Buckley D W Arner, *'The Distributed Liability of Distributed Ledgers: Legal Risks of Blockchain'* (2018) 13617 UIllL

[5] C Lim T Saw C Sargeant, 'Smart Contracts: Bridging the Gap Between Expectation and Reality' (Oxford Law, 11 Jul 2016) <https://www.law.ox.ac.uk/business-law-blog/blog/2016/07/smart-contracts-bridging-gap-between-expectation-and-reality> accessed 12.11.2020.

take the next step. Therefore, the instructions must be certain and precise. There is no place for discretion, tolerance, discrimination, human error, issues open to interpretation, to be decided afterwards or concepts such as reasonable care. It functions in the transactions that work with IF/THEN logic, therefore, it should be noted that there are many kinds of relations that are not suitable for performance through SC.[6]

There is no doubt that blockchain and SC are todays' hype. It is common mistake to believe that the blockchain will change every current system. A system is deemed appropriate for blockchain only if there is **i)**risk of fraud, **ii)**intermediary/ies who do/es not add value but verify the data, **iii)**certain amount of throughput (manageability in terms of transaction number per second, theoretically with blockchain, 10 transaction can be made per a second), and, **iv)**stability of data. This is called "FITS model".[7]

On the other hand, SC exist in digital world that do not have connection with the real world. In order that a SC can self-execute its code, it needs data. These data are fed to the SC via agents called "oracles". They can be hardware, like sensors; software and/or humans that send and verify real world occurrences and submit this information to SC which will trigger the state changers on the blockchain. The abovementioned hardware is basically the IoT which refers to the network of objects that connects to the internet where each device collects data, known collectively as big data, that is exchanged and analysed in order to realize certain tasks automatically.[8] The implementation of IoT to the supply chains will speed up the usage of the SC and ensure the effectiveness of blockchain collaborations.

This is where artificial intelligence("**AI**") enters into the scene. There is not a specific definition for AI. Its aim is basically mimic the human brain. Within this scope AI accelerates

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[6] ibid.

[7] Steven Hernandez, 'Blockchain: What it is, What it isn't, and Why you should care' (Medium, 23.06.2018) <https://medium.com/@code.sergeant/blockchain-what-it-is-what-it-isnt-and-why-you-should-care-55bd1fe607ee> acessed 12.11.2020.

[8] Teena Maddox, 'Internet of Things (IoT): Cheat Sheet' (TechRepublic, 22 August 2018) <https://www.techrepublic.com/article/internet-of-things-iot-cheat-sheet/> accessed 12.11.2020.

and optimises processes, decreases the errors, increases the efficiency of the services and reduce naturally the demand for human power. In order IoT to function, AI (implemented in the cloud where IoT transfer the data it gathers from real life), analyse the data and make a decision in line with its training methods, then transfer it back to the IoT, and IoT performs the act. Thus, the training method of the AI is crucial. It should be emphasized that if the data fed to the AI is not fit to purpose, the output of the AI will not fit either, this process is called "rubbish in rubbish out". Within this scope, the feeding process of the AI should be regulated. There should be certain ethical rules against for instance discrimination, and the service providers should be obliged to record the features of feeding data in order to achieve quality decisions.

With the implementation of these technological developments, we will be able to automate supply chains and logistics. We will be able to control the conditions such as temperature, humidity and location of the containers in real time remotely; certificate of origin, for instance, will be confirmed automatically, thus quickly; trade documents such as letter of credit or B/L will be drafted electronically and transferred through internet safely and custom clearances will be done within the blink of an eye. Human interaction as well as human error will be minimum, the transactions will be self-executed and fraud free, the processes will be concluded very fast, whereas the records will be safe.

However, this process has a paradox in itself because this technology will develop better with the participation of actors from different sectors, whereas the actors hesitate to join this ecosystem in the absence of legal regulations and lawmakers are waiting for the technology to be improved more. Maritime industry suffers from this paradox a lot, especially in the implementation of e-B/L due to its function of being the document of title which will be explained below.