Will Blockchain Technology, Smart Contracts & IoT be the new Lifeblood of Commerce?

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A. Current practices are unable to deal with modern needs – Smart Contracts as a leverage to modern practices

Current research shows that the number of exports is currently forty times higher than it was back in 1913.[1] This is largely, due to the integration of national economies into a Global Economic system, something which could be considered as one of the biggest achievements of the 20th century. This process of integration is called "Globalization" and its value has been materialized in an exceptional enlargement in commerce, especially between importers and exporters who do business in different countries of the world and wish to expand their commercial activities across different jurisdictions and territories with partners whose reputation was unknown to them.[2]

However, the continuously arising commercial practices and needs have rendered every financial instrument which was used in order security and stability to be reassured as insufficient over time. In spite the fact that a lot of attempts took place, everything proved to be inadequate. The risks were not mitigated, the processes were not streamlined, the commercial and legal certainty was not improved and modern practices did not help that much as it was expected to do, reassuring the quality and speed of the transactions which remain as anyone could say "unconquered desires".[3] Many experts believe that Smart

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[1] Federico G, Junguito A: 'A tale of two globalizations: gains from trade and openness 1800–2010', [2017] Review of World Economics Springer; Kiel Institute for the World Economy, vol. 153(3), p.601-626

[2] Ospina E, Beltekian D, Roser M. 'Trade and Globalization'. [2018] <https://ourworldindata.org/trade-and-globalization> , accessed 23 October 2019.

[3] Ganne, E 'Can Blockchain revolutionize international trade?', [2018] World Trade Organization, 17-24. <https://www.wto.org/english/res_e/booksp_e/blockchainrev18_e.pdf>, accessed 15 November 2019.

Contracts and IoT along with Blockchain technology's utilization would be the new "lifeblood" of International Commerce, revolutionizing the existing contractual framework and principles by replacing anything manual, slow and costly with digitized automated processes, even despite the fact that their limits and applications have not been tested all over their range yet. [4]

On the contrary to any other traditional contract as much as Electronic Data Interchange (EDI)[5] contracts which became part of international trade, doing little to change the already existed contractual habits of the parties though[6] , Smart Contracts could be briefly described as a set of coded computer functions that does not require the existence of any legal system, external enforcement mechanism or any central authority's contribution.[7] However, they are not necessarily smart. Quite the opposite, they have been called "dumb non-contracts", because their non-necessarily legally binding operation is only as smart as the machine code which directs it and the inserted information sources it has access to. These agreements, sitting on the top of Blockchain technology, are written in code based in systematic and structured language, operating under a "conditional framework".

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[4] Khalil F, Butler T, O'Brien L and Ceci M, 'Trust in Smart Contracts is a Process, As Well' [2017] Governance, Risk and Compliance Technology Center University College Cork.
<http://fc17.ifca.ai/wtsc/Trust%20in%20Smart%20Contracts%20is%20a%20Process,%20As%20Well.pdf

[5] This concept is not new, albeit blockchain and DLT systems allowed Nick Szabo's vision to be realized today. In particular, the computer scientist had stated that: "A smart contract is a set of promises, specified in digital form, including protocols within which the parties perform on the other promises…. The basic idea of smart contracts is that many kinds of contractual clauses (such as liens, bonding, delineation of property rights, etc.) can be embedded in the hardware and software we deal with, in such a way as to make breach of contract expensive (if desired, sometimes prohibitively so) for the breacher."
See: Szabo N, Smart Contracts: Building Blocks for Digital Markets, [1996].
<http://www.fon.hum.uva.nl/rob/Courses/InformationInSpeech/CDROM/Literature/LOTwinterschool2006/szabo.best.vwh.net/smart_contracts_2.html> ,accessed 12 December 2019.

[6] Primavera De Filippi and Aaron Wright, *Blockchain and The Law: The Rule of Code* (1st edn, Harvard University Press 2018) 73.

[7] ISDA and Linklaters "Smart Contracts and Distributed Ledger – A Legal Perspective",10 <https://www.isda.org/a/6EKDE/smart-contracts-and-distributed-ledger-a-legal-perspective.pdf> , accessed 10 January 2020.

In a more detailed basis, these pre-programmed codes of terms and conditions can be stored, encrypted and self-executed on a distributed ledger, upon the successful fulfillment of specific data conditions, reducing transaction time and unnecessary manual procedures. More specifically, the parties' rights and obligations along with supplementary information, e.g. the precise date, time, amount of goods, payment and mode of transportation can be precisely encrypted therein, being continuously updated in real-time, intending to be maintained on geographically disperse servers, aiming to enhance security between the parties. Contrary to traditional paper based legal contracts which outline the terms of a commercial relationship, Smart Contracts would permit the enforcement of some or every term, using the term "locked" into a blockchain record, facilitating trade execution and contract fulfillment.[8] They would be also empowered to control the goods' ownership and take initiatives like disperse payments without any further action being taken by the parties, mitigating that way any possible settlement risks.[9]

What is more, the parties 'identities could be authenticated therein, using digital signatures private cryptographic keys in order to verify participation and assent to agreed contractual terms which will not be possible to be modified without authorization or common consent. Settlement times would be also reduced, due to their automatic execution combined with the elimination of risks and delays of manual handovers. However, some legal aspects are difficult to automate, due to the subjective dimension which is commonly necessary for a potent implementation of human justice in practice. Additionally, their legitimacy must be assuredly safeguarded in order to be applicable, operative and of course enforceable, as it is in the United States pursuant to the recent

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[8] D.Sonderegger, 'Blockchain: Can Smart Contracts Replace Lawyers'? <https://abovethelaw.com/2018/02/blockchain-can-smart-contracts-replace-lawyers/>,accessed 20 December 2019
[9] Nofer M. et al: Blockchain, [2017] Bus Inf Syst Eng. 59(3):183–187

case Bibb v Allen.[10] It is noteworthy though that real progress is being made, continuously rendering the gap smaller, overcoming step by step any implementation hurdle.

B. Can Oracles and Internet of Things revitalize Trade Finance?

The dynamic and importance of Smart Contracts is becoming even more appreciated, since they can be combined with the so-called oracles as much as the Internet of Things. In other words, they can access or refer to outside real-world certified data and information, aiming to trigger actions.[11] Oracles refer to individuals such as digital agents or programs connected to data feed managed by third policy holders, making sure that all the necessary information is being stored and transmitted in real time from the outside world, responding that way to the continuing needs and amendments that any ongoing contract may present in relation to its conditions and terms. They would give a new pioneering dimension in International Trade, being able to digitally structure any smart contract, adjusting that way every party's performance obligations and rights from the scratch. [12]This could be considered as a source of information which need to be defined and programmed in advance or agreed along the smart contract's operation by the enmeshed participants, facilitating, due to its flexible nature the determination of contractual agreements, rendering real time interactions in respect to consequential information a fact e.g. weather, data, prices, interest rates and event occurrences.[13]

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[10] Bibb v. Allen [1893] 149 U.S. 481

[11] Quiniou M, *Blockchain, The Advent of Disintermediation* (ISTE Ltd and John Wiley & Sons, Inc.2019) p.37

[12] Liu A, 'Smart Oracles: Building Business Logic with Smart Contracts' <https://ripple.com/insights/smart-oracles-building-business-logic-with-smart-contracts/>, accessed 30 December 2019

[13] Chang, S., Chen, Y. and Wu, T. 'Exploring blockchain technology in international trade: Business process re-engineering for letter of credit', [2019] Industrial Management & Data Systems, Vol. 119 No. 8

As far as Internet of Things (IoT) is concerned, this term refers to the next trade finance's buzzword, where sensors and devices are connected to each other, while on the same time they are also capable of transmitting data able to release the physical status of commodities or goods but even more surprisingly information like their real time value, location, temperature etc. The combination of Smart Contracts and IoT will raise the bar even higher. Skuchain Krishnan simplifies the above, referring to the Smart Contracts conditions: *"Those conditions could be certain documents being received, approvals being done, or it could be a message from a sensor saying that something has happened. That's how sensors fit into smart contracts, they are one trigger that can cause a smart contract to implement its actions[14]".* To further understand the role of smart contracts as "lifeblood of commerce", it could be said that under this game changer regime, a payment is being released, should the agreed conditions demonstrate that the delivery of the services has been provided , restoring the transparency through the inter-connectivity of different in nature systems between the parties in a frictionless way which in any other case it would be incompatible.

All the above are undoubtedly signifying the beginning of a new era, where Smart Contracts combined with IoT and oracles will be offering a new viable commercial solution which will serve the rapidly changing needs of modern practices, automating everything in order the efficiency, transparency and mutual trust between the parties to be significantly improved. Every slow paper-based documents' exchange that used to exist, bringing ambiguities to the parties, would be efficiently abolished, assuming that the human intervention will be markedly eliminated.

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[14] Persio S, 'Connect Everything: Trade Finance And the Internet of Things' (*GTR*, 31 August 2016) <https://www.gtreview.com/magazine/volume-15-issue-1/connect-everything-trade-finance-and-the-internet-of-things/> accessed 29 December 2019.

Furthermore, Intermediaries or any other third trusted parties like adjudicators or courts may not be purely included in any Trade Finance's future plans,[15] bringing back the so much needed for the global financial system liquidity, since this radical change could motivate the majority of the small and medium enterprises to get more actively involved.

This statement may sound extreme, but it would be better understood, considering that this mechanism could be structured based on Smart Contracts which are ideally to be made end-to-end, achieving complete freedom of interaction. It could also be highlighted that since all the promises would be converted into code, justice and subsequently the objective criterion would be reestablished in the commercial world, given the fact that no human declaration of will interferes with the rights and obligations, deriving from the Smart Contracts, while in the meantime every procedural pitfall or any other type of barrier, either legal or operational would initially been confronted. Nonetheless, it still remains to be seen, whether this would similarly function as freedom of traditional contracts, not violating fundamental rights which the centrality of the state in the administration of justice was protecting.[16]

C. Utilization of Blockchain technology

As stated above, Blockchain technology could improve the existed limitations, enabling a drastic alternative way of reforming commercial relationships by executing cross border dealings through the use of Smart Contracts and IoT. However, what blockchain technology ultimately is; Blockchain is generally understood as the "marriage" of three

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[15] However, it is not practical nor realistic, especially given the multiple uses of DLT, suggesting a total internal governance being regulated by the protocol rather than arbitrators, courts and lawyers. See: Green S, Sannit A, "Smart Contracts" in *"The Contents of Commercial Contracts: Terms Affecting Freedoms",* Davies P, Raczynska M (Hart Publishing,2020). <https://www.nortonrosefulbright.com/en/knowledge/publications/1bcdc200/smart-contracts> accessed 23 January 2020.

[16] Ortolani P, 'The Judicialization of the Blockchain'. p.307 10.1093/oso/9780198842187.003.0017

different types of technologies which construct tamper-resistant and resilient computer-based structures, where all the relevant data is able to be stored in an "immutable" and transparent manner. [17]In few words, the platform is capable of keeping a continuously list (chain) of records (blocks) that are linked together cryptographically, securing the situation from any tampering and revision, comparing and matching any not needed segregate held records. Every block contains one or a greater number of transactions, while new blocks are steadily added to the existed chain via a consensus mechanism, where all the relevant transactions are being validated by the members of the blockchain network. Finally, all the incoming verified information will be spread by the Blockchain ledger to a network of people using computers, facilitating that way the transparency of the relevant transaction.[18]

1. Distributed Ledger Technology

Its three core aspects could be summarized in distributed ledger technology, immutability and consensus mechanisms. Nevertheless, the fact that blockchain and Distributed Ledger Technology (DLT) are being used interchangeably, [19]the related variations should be analysed. As far as DLT is concerned, this term refers to a digital record system that is structured upon decentralized overlay databases, where any participant is allowed to access, store and disseminate its data across the network. [20]The word "distributed" is

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[17] Reyna, A., Martín, C., Chen, J., Soler, E. and Díaz, M, 'On blockchain and its integration with IoT. Challenges and opportunities' [2018] Future Generation Computer Systems Elsevier BV, 88 ,174

[18] Iansiti, M and Lakhani K: "The Truth about Blockchain." Harvard Business Review 95, no. 1 (January–February 2017): 118–127. <https://hbr.org/2017/01/the-truth-about-blockchain> , accessed 20 January 2020.

[19] "Not all distributed ledgers are blockchains but all blockchains are distributed ledgers". See: P. Treleaven, R. Gendal Brown and D. Yang, 'Blockchain Technology in Finance' [2017] in Computer, vol. 50, no. 9, p. 14-17, <http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=8048631&isnumber=8048614> ,accessed 19 December 2019.

[20] Zetzsche D, Buckley R. and Arner D, 'The Distributed Liability of Distributed Ledgers: Legal Risks of Blockchain' [2017] Working Paper No. 007/2017 University of Luxemburg Law, 9-11.<https://ssrn.com/abstract=3018214> ,accessed 19 December 2019.

being used, because each record is consisted of users or alternatively nodes who operate outside of the scope of a central administration, i.e. a traditional database which stores everything in one single place, rendering itself as altruistic keeper of any relevant personal data. Any inserted information is being validated by the nodes while all of them arrive at a consensus in regard to the verification of the transaction at an earlier time than the data is stored. As soon as systematic equations have been completely puzzled out, the authentication process will be operated via a peer-to-peer basis which verifies the related transactions through the mining process. By the time the validation takes place, every node in the commonly shared network will be simultaneously receiving an identified duplicated copy which would efficiently ensure the data's interoperability, avoiding at the same time the records' reconciliation in spite of the disintermediation.[21]
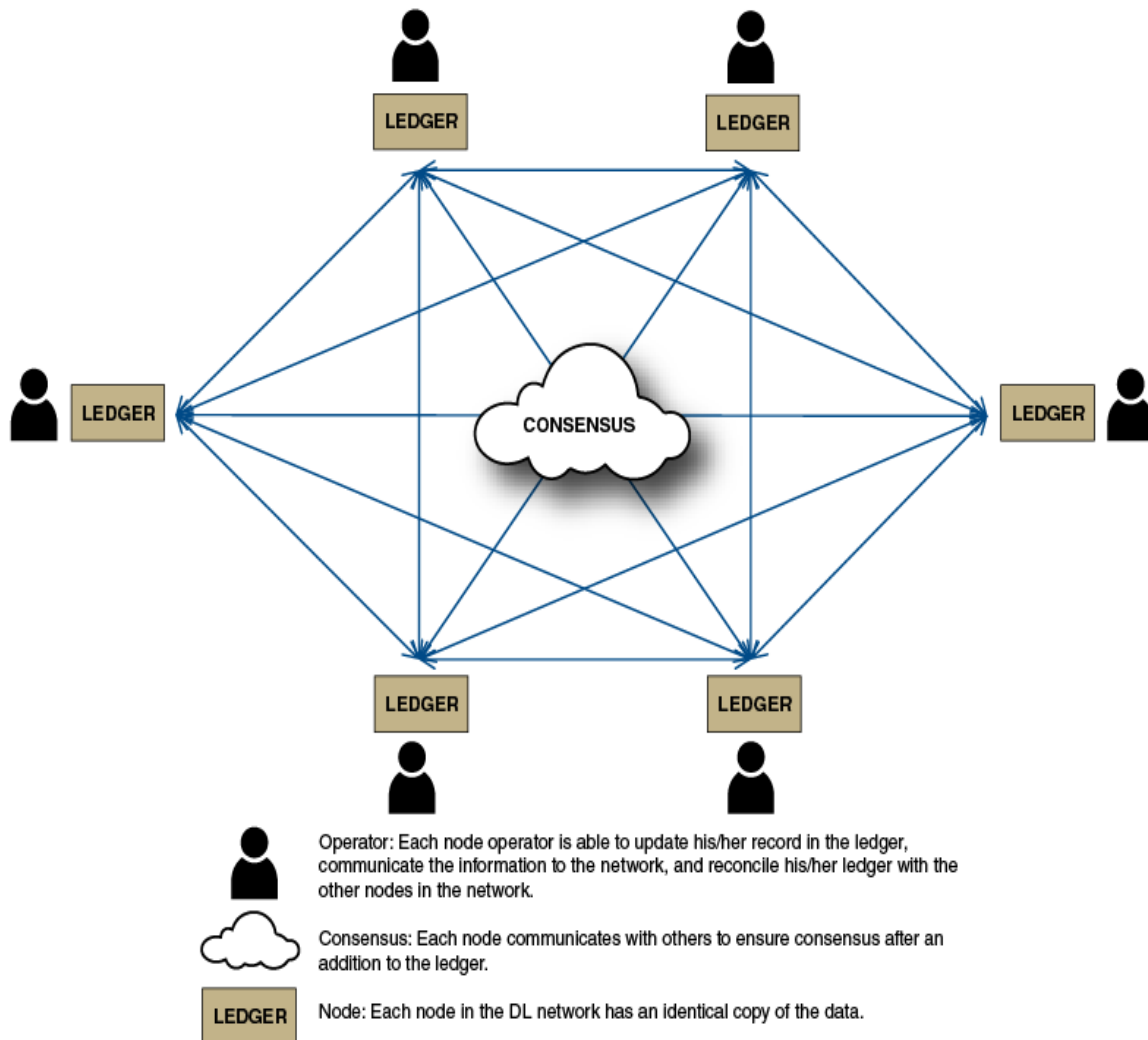
In addition, the distributed network should be large, because, should it be that way, the difficulty is being increased for anyone trying to attack the system, provoking unapproachable costs in relation to the attack's value itself. In this way, all the agents will dully participate in the mining process, aiming to receive the corresponding for each successfully confirmed transaction fee, knowing that the use of the longest prevailing version of the blockchain will alienate every devious and malicious attempt to manipulate the last added block. In general, this mechanism, based mainly in anonymity, is operating outside of the regulated financial system's bounds, on the contrary to current practices like the Letter of Credit mechanism which still lacks in pioneer practices that would bring transparency, risk reduction procedures and the facilitation of low-cost transactions closer. Furthermore, any intermediaries' participation which always represent a high

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[21] Orcutt M, 'How Secure is Blockchain Really?' <https://www.technologyreview.com/s/610836/how-secure-is-blockchain-really/> accessed 13 January 2020.

value target for criminals and hackers will be proved to be a less safe and beneficial option for the interested parties.

DLT encompasses a lot of different types,[22] each one of them being used for particular purposes, distinguishing with each other for its functioning, design characteristics and way of thinking. Particularly, there are two DLT classes which could be mentioned. Those that seek to minimize the role of identifiable third parties and those which fully rely on identifiable third parties for some subset of the network's properties. The basic elements of a DTL network, belonging at any category, are anyhow the same, namely the digital ledgers, the consensus mechanism and the node operators' network. As experts do believe blockchain technology refers to the most prominent anyone could say type of a DLT database.

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[22] Maupin J, 'Mapping the Global Legal Landscape of Blockchain and Other Distributed Ledger Technologies'[2016] Forthcoming in CIGI Academic Paper Series, 2-4 <https://ssrn.com/abstract=2930077>

Operator: Each node operator is able to update his/her record in the ledger, communicate the information to the network, and reconcile his/her ledger with the other nodes in the network.

Consensus: Each node communicates with others to ensure consensus after an addition to the ledger.

Node: Each node in the DL network has an identical copy of the data.

2. Immutability

Immutability constitutes blockchain's second key feature that promisingly increases its trustworthiness. By the time a transaction is added to the blockchain ledger nothing can change thereinafter. The aforementioned peer-to-peer mechanism depends on two key pillars mathematical ideas upon which the blockchain theory is built and designed, i.e. the

public key encryption and harsh[23] keys. It could be stated that public and private keys compose "the cryptography of today's modern world", enhancing in the context of signing and execution the traceability as much as the verification security. Each party has a "public key" freely known to anyone but also has a "private key" which empowers the latter to keep every communication that is held, using that party's public key, secret and safe. This "unbreakable communication" is being ameliorated along with every block's hash key existence which functions as a "digital fingerprint", rendering that way any inversion impossible, since it is automatically built in a "numeric sequence". In order this to be more comprehensibly analysed, each block or alternatively each group of transactions which took place in the same time frame contains along with its own hash the previous block's hash.

Since hash values are unique, fraud can be efficiently prevented, given that any alteration of a block in the chain will amend the respective value without delay. Since a new block is always added after the mining process and nodes' approval through the consensus mechanism, [24]the cryptographic connection with the next block and hash would always appear to be interrupted, should any intervention to the data stored takes place. As a consequence, miners will not ensure that all the transactions contained in the block are valid in comparison with any a traditional centralized database where inserted data can be easily modified or even irreversibly deleted, without anyone realizing it, in case the server's authority and security are compromised.[25]

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[23] A hash is a unique string of numbers and letters created from the text using a mathematical formula.

[24] Q. Liu and K. Li, 'Decentration Transaction Method Based on Blockchain Technology' [2018] International Conference on Intelligent Transportation, Big Data & Smart City (ICITBS), Xiamen, 2018, 416-419.doi: 10.1109/ICITBS.2018.00111

[25] Nagpal R "The Nuts and Bolts of Blockchain Technology"<https://www.expresscomputer.in/news/the-nuts-and-bolts-of-blockchain-technology/19931/> , accessed 2 December 2019.

3. The consensus mechanisms

A consensus mechanism refers to a set of rules which has predestine incentives as much as costs structures that empower blockchain networks and more specifically the majority or in some cases all the network's validators to reach agreement as to the certain state of the distributed data.[26] These mechanisms are being discerned based on the different types of distributed ledgers. For instance, in a bitcoin blockchain system, the transactions are being authenticated by the Proof of Work consensus type (PoW) [27]which motivate all the transaction's validators or miners to race each other in order to find the solution to the complex systematic equations. If successful, they earn a block reward of bitcoins. On the contrary, other algorithms like the Proof-of-Stake (PoS), where miners are being

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[26] Swanson T. 'Consensus-as-a-service: a brief report on the emergence of permissioned, distributed ledger systems.' [2015] https://www.ofnumbers.com/2015/04/06/consensus-as-a-service-a-brief-report-on-the-emergence-of-permissioned-distributed-ledger-systems , accessed 29 January 2020.
[27] Nakamoto S, 'Bitcoin: A Peer-to-Peer Electronic Cash System' <https://bitcoin.org/bitcoin.pdf>, accessed 1 December 2019.

replaced by forgers or provers and Hybrid forms like Proof of Authority (PoA), Delegated Proof of Stake (DPoS), Proof of Capacity (PoC) and Proof of Burn (PoB) are not mathematically proven like PoW but "to be proven". It has to be stated though that despite their inherent deficiencies, all of them aim to the same goal, i.e. the common agreement with respect to the network's changes to the ledgers, knowing that these are resilient, meaning that they can survive as long as at least one node continues to exist.[28]

Supplementary, the verification procedure is distinguished to "permissioned" and "permissionless". Both types' intention and philosophy are the same, although a private blockchain amounts to a permissioned model, where the verification course of action is carried out "under the auspices of a central administrator" and is allowed to a restricted number of authorized participants, whose roles in respect to the ledger can be limited as well. The deployment of this contemporary structure enables translucency among the network participants, due to Anti-Money Laundering (AML) and Know Your Customer (KYC) automated procedures, increasing that way the data's interoperability as much as the transparency of the transactions. In contrast with the above, the second model is open, public and unrestricted, allowing any entity with the requisite computer system to take part, possibly, triggering, albeit legal concerns around pseudonimity or anonymity.

At this stage, a distinct line between the existing networks have to be drawn. The differentiation between private and public networks is related to the extent they ensure anonymity, or they are decentralized. A public chain like bitcoin is regarded as a fully disintermediated database which uses the PoW consensus mechanism, motivating the nodes to "contribute their computational logic", offering in return a valuable reward. On the contrary any private network gears to limited predetermined members, being the

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[28] Tasca P, Claudio 'Taxonomy of Blockchain Technologies. Principles of Identification and Classification', p.13-14 https://ssrn.com/abstract=2977811, accessed 3 January 2020.

only ones capable of carrying out transactions. A "partially decentralized" model, called consortium do also exist, constituting the "middle path" between private and public networks.
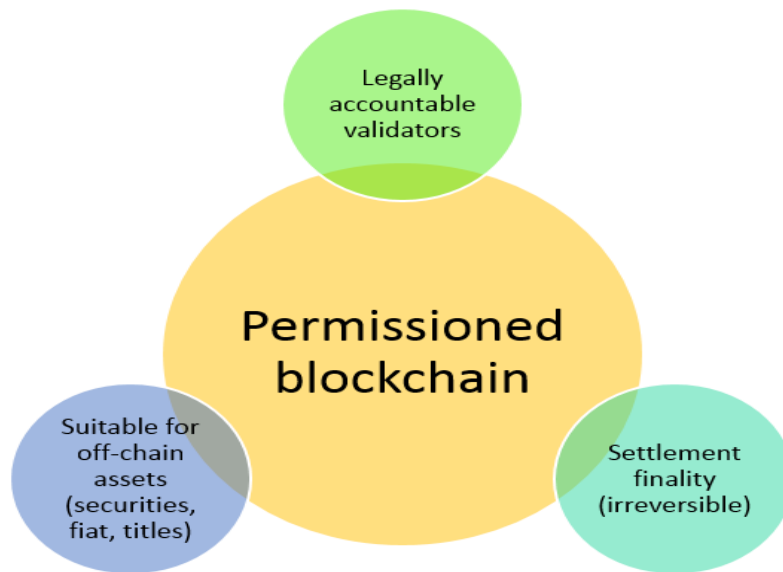
Blockchain technology could be summarized in 5 principles, i.e. the innovative distributed database which gives access to all the enmeshed parties, facilitating the verification of the records. The users' capability to communicate directly via peer-to-peer transmission.

The pseudonimity which safeguards transparency , the irreversibility of the records which stay accessible in chronological order to everyone and last but not least, the computational logic which will revolutionize tomorrow's transactions, triggering the contracts 'automation. It is believed that this mixture could represent an ideal but also realistic solution to Trade Finance instruments' modernization. Therefore, these technologies should be financially supported in order all the previously analysed pain

points be adjusted as much as they could be, harmonizing the credit facilities with innovative supply chain practices.

D. Blockchain, Smart Contracts, IoT & the Law

In conclusion, the current manual, not affordable and slow mechanisms could be effectively replaced by the utilization of Blockchain technology along with the use of Smart Contracts combined with oracles and IoT as well. Human intervention will be no longer necessary and as Mr. Antonopoulos remarkably states: "Blockchain will represent a shift from trusting people to trusting math".[29] Blockchain advantages will provide sufficient ground for market reshape, offering trust, legitimacy and cost efficiency. However, the law will also have to successfully adapt to this kind of change, either by applying the existing regulatory regimes with minor adjustments or drafting new legislative models. This enormous innovative potential must be adequately regulated, pondering the interaction between innovation, law and technology. [30]In any other case, blockchain could be either used not only for advantageous but even for malicious ends as well just like any other type of new technology.

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[29] Antonopoulos A, "Bitcoin security model: trust by computation" [2014] O'Reilly Radar
[30] Guo Y. and Liang C. 'Blockchain Application and Outlook in the Banking Industry' [2016], Financial Innovation Review 1, 8-9.
<https://jfin-swufe.springeropen.com/articles/10.1186/s40854-016-0034-9#citeas>

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