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Blockchains: A Better Tool For Supply Chain Management

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Blockchain technologies are generating a lot of excitement across industries for their potential to reduce transaction times and costs. Although more commonly associated with cryptocurrencies, blockchains can also be implemented to modernize international supply chains, which suffer from voluminous documentary requirements, layers of middlemen and immense regulation. In this article, we review how blockchains work and why potential applications of this technology have generated so much interest in the realm of international trade transactions.

What Is a Blockchain?

A blockchain is a decentralized database whose records are constantly validated and maintained by a network of computers, rather than a central authority. Essentially, each record stored on a blockchain is duplicated hundreds (or thousands) of times across a digital community, and the system is designed to continuously update and verify the blockchain.[1]

Because the data is stored on a computer network, no single entity has the ability to alter the records stored within a blockchain. This makes blockchain data easily verifiable, resistant to corruption or alteration and instantly accessible to anyone within the network. Moreover, a blockchain can either be open to the public, without restrictions, or private, where access is limited to select stakeholders. Due to this secure design, blockchains can be utilized as "incorruptible digital ledger[s] of economic transactions that can be programmed to record not just financial transactions but virtually everything of value."[2]

There are three basic parts to a blockchain:[3]

- The record — which can be any information or data which you would like to store on the block chain, e.g. purchase orders, shipment information, instruction manuals, etc.;
- The block — a bundle of records; and
- The chain — a series of blocks cryptographically linked together by a hash function.

The first step in generating a blockchain is the creation of a record. This record is then validated by all the computers comprising the blockchain network, or "nodes," before being pooled with other records

to generate a “block.” Each new block contains a unique identifier called a “hash,” and each block also contains the hash of the block immediately preceding it in the chain.[4] The two hash codes contained in every block are the foundation for a cryptographic link, connecting each new block with the previous entry in the series and creating a chain of blocks in an exact, unalterable order, or “blockchain.”[5]

Due to the fixed chronology of the constituent units, blockchains function as an “append-only transaction ledger.” In other words, blockchains can only be modified through the addition of new blocks, but pre-existing blocks themselves cannot be edited, adjusted or changed (without an impractical amount of computing power).[6] This is due to the utilization of a hash code: a string of letters and numbers created by mathematical functions and specifically generated from the unique information contained in the block at the time of creation.[7]

All hash codes for a given blockchain are the same length, and any change to the information stored in a block generates a new hash. Because each block contains both its own unique hash code and the hash code for the block immediately prior, any alteration to the contents of a block breaks this cryptographic connection by invalidating the old hash code contained in the subsequent block. When a block is altered, the chain can only be recreated if the hash codes for all the blocks following the originally altered block are recalculated, a task which requires an enormous amount of computing power.[8]

Blockchains provide two primary benefits over earlier methods of securing and validating information: enhanced security and transparency. First, each record created is verified by, and stored within, every node in the blockchain network, and this self-auditing, decentralized structure obviates the need for storage in a centralized location or oversight by single entity. Not only does a blockchain lack a centralized point of vulnerability, any unauthorized modification to the blockchain is instantly detectable. Indeed, even the deletion of a single comma would lead to cascading effects throughout the chain, which would be immediately distinguishable from chains contained in other nodes.

Second, blockchains provide transparency in the retention and certification of information. The records stored in a block are instantaneously available to anyone with access to the blockchain, so any individual can view the contents of the blockchain and verify that the events that were recorded actually took place. This level of transparency is possible because it is prohibitively difficult to alter data recorded in a blockchain — i.e., it would be impossible to do so undetected.

Possible Applications of Blockchain to Trade

Bitcoin, a cryptocurrency that emerged a decade ago, provided an early platform for the use of blockchain. Blockchain has since become synonymous with other digital currencies that have emerged as competitors to bitcoin, such as Ethereum and Ripple. Due to blockchain’s potential to reduce transaction costs, which we elaborate upon below, large financial institutions have begun testing blockchain-based solutions to improve specific business processes, including data reconciliation, clearance, settlement and even regulatory compliance.[9]

As blockchain technologies continue to expand beyond cryptocurrencies, developers are starting to focus on international trade, which is ripe for the application of blockchain-based solutions. Global trade, despite being bogged down by voluminous documentary requirements, layers of middlemen and immense regulation, has seen little innovation since the advent of containerized freight some seven decades ago.[10] To illustrate the cumbersome nature of cross-border trade, Danish shipper A.P. Moller-Maersk tracked a shipment of flowers from the Port of Mombasa, Kenya, to Rotterdam, Netherlands, in 2014. The process, from start to finish, required the production of dozens of paper documents and close

to 200 communications between 30 parties, including farmers, freight forwarders, land-based transporters, customs brokers, government agencies, port authorities and personnel, carriers and buyers.[11]

Blockchain-based solutions can streamline much of this process. Maersk, in collaboration with IBM, is developing a blockchain-based solution that would consolidate all necessary documents into a single, template-based window, starting with the packing slip submitted by the farmer and ending with the buyer's signed delivery slip. As each stage is completed, documents are captured and shared so that all parties to the blockchain can see what has been submitted in real time.[12]

A complementary blockchain-based solution is the creation of a digital letter of credit, which is currently being developed by a consortium of banks and the Singaporean government.[13] The trade finance market, which exceeds $10 trillion per year,[14] revolves in part around the production and exchange of paper documents, namely bills of lading — which serve as title documents to cargoes of shipped goods — and letters of credit — which permit sight and deferred payment. Failure to timely produce either document, whether due to postal problem or clerical errors discovered in the documents that may trigger dispute resolution processes, can lead to costly delays and ruptured commercial relationships.

Transitioning such documents to a digital ledger, particularly one embedded with a "smart contract" capable of electronically processing contractual steps[15] such as issuance of a payment instrument upon a predetermined event (e.g., clearance of goods through customs), would reduce shipping times by weeks, and slash costs. It is estimated, for instance, that fully digitizing trade paperwork could reduce shipping times in Asia-Pacific countries by up to 44 percent, cut costs by 31 percent, and raise these countries' exports by $257 billion a year.[16]

The immutability of a blockchain, further, obviates the need for parties to engage "trusted third parties" and middlemen. Blockchains provide a tamper-proof record of all material aspects of a transaction, including location, data, quality and price. Moreover, the ability for parties to share information in a blockchain instantaneously and directly with regulators, thereby enabling them to trace the shipment of goods across all stages of production, shipment and distribution, removes the need to engage trusted third parties to conduct independent audits.

Blockchain-based trade solutions can also allow parties to remove middlemen altogether. By some metrics, middlemen — namely freight forwarders that deal with customs clearance issues, insurance, and transfers of goods between sea, road and train — account for over a fifth of the logistics industry's revenues, and can receive as much as 45 percent of the total delivery cost.[17]

Migrating from a paper-based process to a digital ledger will expedite compliance with customs clearance and product labeling requirements that logistics providers charge a premium to facilitate. In addition, the entry into the freight forwarding market of tech giants such as Amazon,[18] keen to explore blockchain-based transportation solutions beyond "last mile" deliveries, will introduce much-needed competition to the sector, leading to increased transparency and lower freight forwarding costs for those exporters that choose, for now, to remain on the sidelines of the blockchain revolution.

In addition to providing a paperless alternative to regulatory filings, such as customs paperwork, blockchain-based solutions can also facilitate compliance with anti-money laundering and "know-your-customer" regulations. For a regulator's purposes, a blockchain can serve as a decentralized certification authority capable of securely mapping identities to public keys.[19] The ability of financial institutions to store and maintain an ever-expanding database of identifying customer information is likely to help with

compliance with varying know-your-customer regulations across the world.

Regulators can benefit from blockchain technologies in other ways as well: Blockchain increases transparency from farm to fork which,[20] as touched upon above, provides for traceability along an immutable record. The ability to trace goods with improved accuracy can also aid in the fight against counterfeit goods. Taking the example of pharmaceutical products, the ability to trace such products from lab to pharmacy is a powerful weapon in the fight against counterfeit medicines, which have caused over 100,000 deaths worldwide.[21]

We have outlined only a few possible blockchain solutions for the most common supply chain stumbling blocks. Although the use of blockchains in the context of international trade is mostly theoretical, the rate of investment and innovation in this technology demonstrate that it is only a matter of time before blockchains supplant their analog counterparts.

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[1] https://blockgeeks.com/guides/what-is-blockchain-technology/.

[2] https://blockgeeks.com/guides/what-is-blockchain-technology/ (quoting Don & Alex Tapscott, authors of Blockchain Revolution (2016)).

[3] http://graphics.reuters.com/TECHNOLOGY-BLOCKCHAIN/010070P11GN/index.html.

[4] http://graphics.reuters.com/TECHNOLOGY-BLOCKCHAIN/010070P11GN/index.html.

[5] https://www.digitaltrends.com/computing/what-is-a-blockchain/.

[6] https://www.forbes.com/sites/forbesagencycouncil/2018/04/05/what-is-blockchain-and-what-can-businesses-benefit-from-it/#63d2a3eb675f.

[7] http://graphics.reuters.com/TECHNOLOGY-BLOCKCHAIN/010070P11GN/index.html.

[8] http://graphics.reuters.com/TECHNOLOGY-BLOCKCHAIN/010070P11GN/index.html.

[9] International Finance Corporation (a member of the World Bank Group), Blockchain in Financial Services in Emerging Markets Part I: Current Trends, EMCompass Note 43 (Aug. 2017), p. 2. Available at: https://www.ifc.org/wps/wcm/connect/0514f539-b97e-4d43-b2d1-e2cdc010ad54/EMCompass+Note+43+FINAL+8-21.pdf?MOD=AJPERES. Not to be left behind, law firms are also exploring blockchain technologies to prepare contracts and verify legal documents. See Jasmine Ye Han, How Blockchain Technology is Transforming the Legal Industry, Bloomberg Law (Feb. 20, 2018).

[10] Adam Green, Will blockchain accelerate trade flows? Financial Times (Nov. 9, 2017). The nondomestic cargo business, which accounts for as much as 90 percent of global trade, boasts revenues of $2.6 trillion per year.

[11] Id.

[12] Id.

[13] FT, supra, note 10.

[14] Deloitte, Over the Horizon: Blockchain and the Future of Financial Infrastructure (2016), p. 11. Available at: https://www2.deloitte.com/content/dam/Deloitte/nl/Documents/financial-services/deloitte-nl-fsi-blockchain-and-the-future-of-financial-infrastructure.pdf.

[15] For more on smart contracts, see John Ream et al, Upgrading blockchains: smart contract use cases in industry (Deloitte University Press, 2016). Available at: https://www2.deloitte.com/content/dam/Deloitte/nl/Documents/innovatie/deloitte-nl-innovatie-upgrading-blockchains-smart-contract-use-cases-in-industry.pdf.

[16] The Economist, The global logistics business is going to be transformed by digitization (April 26, 2018).

[17] Id.

[18] Id.

[19] IFC, supra, note 9, p. 4.

[20] For a practical example of how blockchain can facilitate tracing from farm to fork, in the Wyoming open range cattle market, see Beth McLannahan, Wyoming's pioneering crypto cowboys beef up the supply chain, Financial Times (July 1, 2018).

[21] IFC, Beyond Fintech: Leveraging Blockchain for More Sustainable and Inclusive Supply Chains (EMCompass Note 45, Sept. 2017), p. 4. Available at: https://www.ifc.org/wps/wcm/connect/a4f157bb-cf24-490d-a9d4-6f116a22940c/EM+Compass+Note+45+final.pdf?MOD=AJPERES.