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Improving the Supply Chain through Technology: From Trade Finance to Produce[i]

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Three powerful technologies are being combined to drive a supply chain evolution: (1) blockchain and distributed ledger technology; (2) the Internet of Things ("IoT"); and (3) powerful machine learning capable cognitive tools (*e.g.*, IBM's Watson) that are capable of analyzing vast amounts of data that humans simply can't do. The transformation occurring in supply chain management also impacts the trade finance that supports it. Approximately 80-90% of global trade is reliant on trade finance.

This transformation is not simply about converting from paper documents, such as letters of credit and bills of lading, to electronic documents. To the contrary, the changes that are occurring are about new ways that participants in supply chains can share information in a very granular and controlled manner, utilizing novel technology that allows economic participants to trust the outcome of transactions without any need to trust the actual counterparties to a transaction. Equally important is the ability of distributed ledgers to accomplish the foregoing without the need for a trusted third party to act as an intermediary for the transaction– disintermediation has become a key theme of distributed ledger technology, and supply chains and the trade financing vehicles that keep them operating are not exempt from this phenomenon.

The convergence of these three technologies will likely first impact the trade finance industry, which is estimated to be worth nearly $10 trillion a year.[iv] But the reach of these technologies extends to every facet of the supply chain and every industry, perhaps none more so than perishable food such as produce. The paper addresses both the near-term potential of these technologies with respect to trade finance, and the longer-term potential of these technologies with respect to the supply chain, and the produce industry in particular.

1. Emerging Technologies – Blockchain Technology

Blockchain technology is commonly defined as a decentralized peer-to-peer network that maintains a public, or private, ledger of transactions that utilizes cryptographic tools to maintain the integrity of transactions and some method of protocol-wide consensus to maintain the integrity of the ledger itself. The term "ledger" should be thought of in its most simple terms; imagine a simple database (like an Excel spreadsheet) that can store all sorts of information (*e.g.*, someone's name, age, address, date of birth). As you can write an entire book on the topic of blockchain technology and the law (one of the authors of this paper did just that).

Blockchains tracking the transfer of virtual currency, such as Bitcoin, essentially maintain a ledger that tracks the transfer of Bitcoin from a transferor to a transferee. Perhaps most importantly, such ledgers are considered decentralized because transactions are stored on several thousand computers connected to a common network via the Internet. These computers are known as "nodes." Each node contains a complete history of every transaction completed on a blockchain beginning with the first transaction that was processed into the first block on that blockchain. This network of nodes is connected via the Internet, but in a completely decentralized manner (*i.e.*, there is no single server to which all the nodes are connected). So, when we refer to the network, this describes all the peer-to-peer nodes operating under the same set of rules (commonly referred to as a "protocol"), which are embodied in computer code under which all participants in such blockchain operate. Thus, at the heart of every blockchain is an agreed upon protocol that ensures that only information upon which the network reaches consensus will be included in the blockchain. In other words, a network of computers, all running a common software application, must come to agreement upon whether a change to the blockchain (again, think "ledger") should be made, and if so, what that change should be.

As a proposed transaction propagates throughout this peer-to-peer network, there is still one last step left to consummate the transaction – the transaction needs to be memorialized into a block on the given blockchain ledger. "Blocks" are simply a convenient way of aggregating transactions into larger groups (or batches) for processing purposes. The perceived immutable nature of the ledger is rooted in the aggregation of time-stamped transactions into linear sequenced blocks. It is the aggregation into blocks that permits us to create links between transactions – the proverbial "chain" in the blockchain. Each block contains a reference to the block before it. This resulting relationship between all the blocks makes it exponentially more difficult to alter a prior entry in the ledger. Recently, certain protocols have been developed which have all the character of a blockchain, but without the block structures – hence the reason all blockchains are distributed ledgers while not all distributed ledgers are, or need to be, blockchains. For purposes of this paper, the terms distributed ledger technology and blockchain are generally used interchangeably. While Bitcoin was the first implementation of blockchain technology (and the only implementation for several years), with the advent of the Ethereum protocol and the subsequent "Blockchain 2.0" protocols, the capability of the technology skyrocketed – as did the potential use cases. The reference to "Blockchain 2.0" generally refers to the development of smart contracts, which is executable computer code that is broadcast to all of the nodes connected to a distributed ledger – the resulting computation being what determines any changes to the ledger. While the term "smart contract" does not necessarily refer to a legally binding contract (but rather any snippet of code), some smart contracts do constitute legally binding agreements. The advent of smart contracts is critically important to its adoption for trade finance – without it, we would not be able to model the functionality and provisions of a letter of credit or bill of lading.

Another recent development that was necessary for distributed ledgers to play an active role in trade finance was the ability for parties to include all the details of a trade in the transmission of a transaction to a distributed ledger – but limit who can see which details with very fine control. For example, if a seller of crops experiences a liquidity crisis and must sell a portion of his crop for below market prices, the seller will want neither his competitors nor other buyers in the market to know the price for those crops. In this example, it is possible to broadcast the transaction with only the buyer and seller seeing the price and needing to validate the terms to the contract. Any other consensus on the network will be limited to the existence of the transaction itself (and most likely a time stamp as well).

While there are no less than a dozen protocols in regular use today, the two most public blockchains are Bitcoin and Ethereum. Anyone is free to connect to either of those protocols. Unlike public blockchains, most financial institutions and other enterprise users are not comfortable using public blockchains because of data security and privacy concerns, among others reasons. Instead, these institutions have or intend to deploy permissioned and/or private distributed ledgers, where each member of the distributed ledger knows with whom it is transacting. Again, there are many more protocols that are listed herein, but some of the more popular permissioned protocols are: (1) R3CEV's Corda platform; (2) Hyperledger Fabric (also hosted on IBM's cloud as its native blockchain solution); (3) Monax (formerly known as Eris); and (4) Quorum (permissioned version of Ethereum, developed by JPMorgan).

2. Emerging Technologies – The Internet of Things

Even alone, distributed ledgers would have a significant impact on supply chains and trade finance, but when coupled with two other technologies – the Internet of Things (IoT) and cognitive analytics (including machine learning) – the impact will be nothing short of a paradigm shift. IoT is one of the other technological advances that will have a major impact on the financial industries. IoT refers to the simple concept that more and more physical devices are becoming connected to the Internet (*i.e.*, networked). Today, the types of devices being connected to the Internet is growing exponentially – both in terms of consumer and industrial products. For example, in January of 2018, Maersk and IBM announced the intention to establish a joint venture to provide more efficient and secure methods for conducting global trade using blockchain technology and IoT devices. The new venture aims at bringing the shipping industry together on an open global trade digitization platform that offers a suite of digital products and integration services like transportation tracking systems.[v]

This trend is expected to continue over the next several years, such that virtually all physical objects in the world will be (or at least have the capability to be) connected to the Internet. These connections will work both ways. Physical objects will transmit information about their internal state and/or information about environmental factors (*e.g.*, temperature, humidity). Many objects will also have physical actuators (*i.e.*, things that interact with physical world such as motors, locks, LEDs). Together with sensors, this means that many physical objects will be able to transmit real-time information over the Internet (whether by ZigBee meshes, cellular or satellite transmissions) to applications that can analyze that data and send commands back to physical devices to interact with the physical world. For example, if a Maersk storage container's internal temperature is too hot, that data will trigger an application monitoring that information over the Internet to send a signal back to the container's internal fans to cool it down again.

Blockchain technology will augment IoT in several positive ways. First, blockchains built in cryptocurrency payment protocols are perfect for interacting with automated payment systems, especially in the context of complex trade cycles that do not necessarily require human interaction. Second, and probably more importantly, the blockchain can add a level of security that no other existing technology can. The distributed ledger is perfect for ensuring that use and ownership rights are adequately tracked. For example, the generation of public/private keys is perfect for ensuring that only an authorized user can authorize the dispatch or delivery of goods.

3. Emerging Technologies – Artificial Intelligence and Cognitive Analytics

Artificial intelligence and cognitive analytics, including applications leveraging machine learning, are the final ingredients needed to radically transform supply chains and trade finance. By combining distributed ledger technology with IoT devices, such as sensors, real-time data is available to the parties to the transaction and can be recorded on an immutable, tamper-proof ledger. This capability alone significantly improves the overall supply chain and trade finance process, but what about data from one or more business processes that requires intensive calculations or analytics that the human brain cannot do? Artificial intelligence, especially the subsets known as machine learning and natural language processing have made significant advancements in just the last couple of years. These tools can receive the raw data from the IoT devices, process the data and format it into useful structured data that can be used to monitor contract compliance matters. These tools remove any limitation on human cognition and traditional computing devices that impair our ability to process complicated and voluminous data sets. For example, Oaken Innovations and the Toyota Research Institute partnered to create a blockchain ecosystem of IoT devices that will support the future of autonomous cars. The infrastructure will accommodate voluminous, frequent, heterogeneous transactions like toll payments, peer-to-peer ride and car sharing arrangements and immediate insurance claims.[vi]

In addition to real-time compliance oversight, artificial intelligence is also helping sellers and purchasers with business decisions that impact their entire enterprise, especially with respect to supply chain management. For example, price discovery is made possible so that a purchaser can unleash sophisticated algorithmic tools on massive amounts of data available online or through private network data feeds. Price discovery, however, is just the tip of the iceberg – a purchaser's entire inventory management process can be run by artificially intelligent machines, which can contract for supplies when appropriate without any human interaction. Machine learning capabilities are particularly useful because as these systems are used and provide feedback on the decisions they make, its performance or percentage of accurate decisions increases until it performs its function far better than its former human counterpart.

Of course, the real-time data feeds monitoring in-route products and the price discovery and inventory management are ultimately all part of one operation – to ensure the smooth and optimal purchase order and inventory life cycle. We must also keep in mind that these machine capabilities will continue to grow at a rapid pace, especially given the fact that Moore's Law appears to still have some run left in it before humans are no longer capable of fitting more transistors on smaller and smaller pieces of silicon. This assumes, however, that we do not discover entirely new ways to supply ever increasing computational power (*e.g.*, quantum computing).

4. Traditional Trade Finance

What is Trade Finance – Basic Mechanics

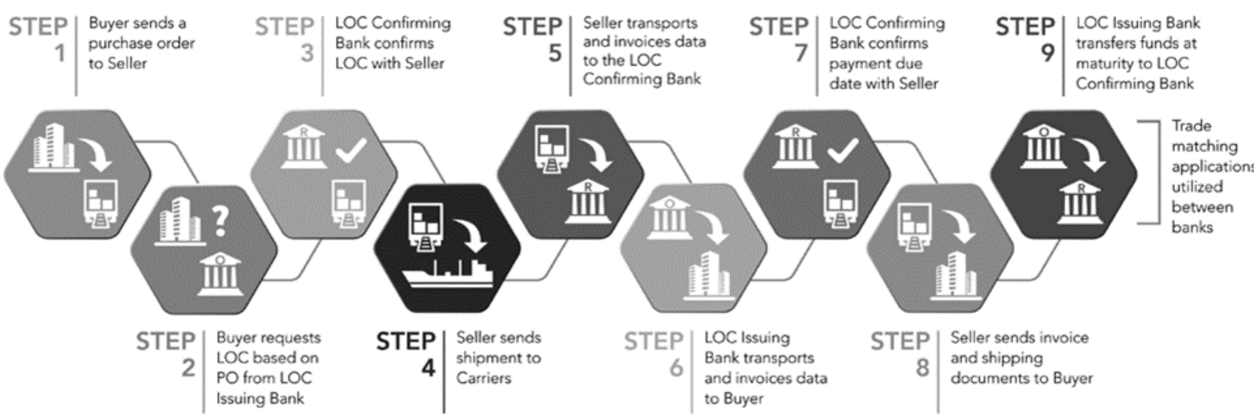
Before discussing the future of trade finance, it's important to understand the current mechanisms used to facilitate the movement of goods and commodities across the globe – much of which has remained static over the last few hundred years. It did not take human civilization long to discover the benefits of specialization and trading resources that might be prevalent in one geographic region for other goods which are scarce in the same region. In the beginning, bartering ruled most forms of trade and even after stores of value, such as gold, allowed for the acquisition of goods for money, marketplaces were often static in terms of point of sale– thus requiring trading groups and companies to venture across long and often dangerous trading routes. With the advent of oceanic shipping, however, it became far easier to move large quantities of goods and commodities from one port to another far more efficiently.

While a superior approach in terms of economic efficiency, "chicken and egg" situations soon arose when sellers did not want to place their goods on a ship for delivery to the purchaser without payment; and likewise, buyers did not want to pay for goods that they had not received– enter trade financing solutions. In its most simple form, trade financing addresses the "chicken and egg" dilemma by effectively creating an intermediary, such as a bank who issues a merchant letter of credit, who can assure the seller of payment if the seller performs and protect the buyer from ever paying for undelivered or non-conforming goods. In most circumstances, this is accomplished by the buyer causing its bank to issue to the seller a merchant letter of credit in the amount of the purchase price for the goods. The bank who issues the merchant letter of credit generally requires that the seller present, together with the merchant letter of credit, documentary proof that conforming goods were delivered to the buyer and that the seller has met the conditions of payment. One of those conditions will be the delivery of a properly-executed negotiable bill of lading (a document of title) to the buyer, who with that and an opportunity to inspect to goods to ensure conformance, is never at risk of losing his or her capital in the event of the seller's nonperformance.

It should be apparent that in many respect, the "finance" transaction described above has less to do with loaning money and extending credit and more to do with facilitating a transaction that might otherwise introduce too much risk for the buyer, seller or both. There are plenty of trade finance transactions that are akin to more traditional extensions of credit. For example, a farmer may need trade finance to acquire seeds and fertilizer and is unable to repay such financing until the farmer harvests his crop. In that case, the transaction could be solely driven by credit considerations. In some cases, trade finance serves both as a transaction facilitator and an extension of credit necessary to provide a farmer or manufacturer with inputs necessary to generate the profits necessary to repay the extension of credit. In the case of the farmer, the seeds and fertilizer may be shipped from a foreign producer, such that the trade finance solution serves both purposes – the role of an intermediary with respect to the exchange between the farmer and the foreign producer and that of an extension of credit because the farmer lacks the liquidity to purchase the inputs necessary to grow his crop.

Trade Finance – Traditional Lifecycle

While there are several forms of trade finance, we have chosen to further illustrate, via graphical illustration (which the author admits is an oversimplification with respect to many transactions), the mechanics of this industry through one of the most conventional types of trade finance facilities – a merchant letter of credit:



As entire books are frequently written on trade finance, we cannot analyze the above transaction from every participant's perspective here. So, we will look at some of the most common pain points and areas of "friction" from the perspective of a bank or other financial institution providing trade financing in a transaction following the lifecycle depicted above. In any secured transaction, a trade finance lender will want to ensure that its position:

(i) is adequately collateralized (*i.e.*, the seller has the goods it purports to have or will have when it is required to tender and the value of such goods is consistent with the assumptions made by the lender in underwriting the credit);
(ii) consists of a first-priority security interest (unless providing subordinate financing); and

(iii) is consistent with its understanding of risks posed by acts of god, casualty or other force majeure events, and that such risks have been mitigated by insurance or other means to the extent available.

To achieve the above three objectives, lenders often employ the following “controls”:

(i) implementing relevant financial controls throughout the trade transaction lifecycle;
(ii) monitoring all material aspects of the transaction; and
(iii) ensuring that the collateral (*i.e.* the trade goods) are properly stored and transferred.

Using the Bill of Lading example illustrated above, implementing these controls can be a cumbersome and fragmented process for lenders, which often lead to the following “pain points”:

(i) Fraud. Current methods of documentation, and documentation transfer, do not protect against the risk of parties, including lenders, relying on falsified documentation.
(ii) Tracking and Reconciliation Costs. Current fragmented trade lifecycles, which require human involvement and interaction throughout, require constant tracking and reconciliation by lenders and often require that such be done amongst several different platforms.
(iii) Authenticity of Goods. A lack of uniform tracking mechanisms from “source to sale” provides susceptibility for counterfeit goods to enter the trade lifecycle.
(iv) Confidentiality. The current necessity to (humanly) verify and reconcile points throughout the trade cycle make it difficult to ensure the confidentiality of the trading parties and terms.

It should come as no surprise that the above complexities often leave bank customers less than satisfied with the overall experience of obtaining the credit. To make matters worse, there has been a steady increase in transaction costs, in part, due to the increasingly difficult regulatory environment. Fortunately, all participants may soon be receiving relief from all of the above.

Trade Finance – Increasing Number of Stakeholders Means Growing Complexity

It is also worth noting that some of the additional friction in the market today is due to an increase in the overall number of persons involved in the process, including trade finance credit insurers, customs personnel and certification organizations – who depending on the existence of friendly trade arrangements – may be required to hold the goods at port or other locations for extended periods of time. This increase in participants has led to a corresponding level of complexity. Simply put, supply chain management and trade finance have become more complicated, while innovation was non-existent. Seemingly overnight, the paper documents that remained in use for decades are on the verge of extinction.

5. Trade Finance 2.0: Applying Emerging Technologies and Paradigm Shift

Any lawyer or professional who has practice transactional law for any length of time, knows that the more stakeholders involved in a transaction or series of related transactions, the more difficult it becomes and the more “friction” is involved in the form of higher transactional costs and lost efficiency and output. Often, trade finance and supply chain transactions involve several stakeholders, especially when there is a cross-border aspect to the transaction. The number of participants can grow fast. Possible participants include the buyer, the seller, a letter of credit issuer (*i.e.*, a bank), one or more correspondent banks, customs and revenue (tariff) officials, warehouse owners, carriers, logistics companies, insurance companies, and a host of other possible involved participants. It is for this reason, that distributed ledgers when combined with IoT devices and cognitive analytics prove to be one of the most powerful uses of distributed ledger technology. The cost savings and reduction in transactional costs and friction in many cases are extreme. For example, the ability to model a merchant letter of credit in the form of computer code (*e.g.*, Solidity, Java, Go); and more importantly, the ability of that code to execute on a distributed ledger using self-implementing conditions to, in the case of a letter of credit, release funds programmatically to the seller without any need for the seller to present a paper letter of credit to anyone. Consider the reduction in friction afforded by this mechanism. Rather than a paper letter of credit needing to work its way through a series of correspondent banks, each of which must be paid a fee, a digital letter of credit that is self-implementing executes automatically when the conditions to payment are met – resulting in a significant reduction of expenses. Recently, BBVA applied blockchain technology to a letter of credit transaction between two offices in Mexico and Spain. Based on the trial, BBVA observed that the time taken to submit, verify and authorize an international letter of credit trade transaction was reduced from seven to 10 days, to just 2.5 hours.[vii]

The inverse is also true, and no less important – meaning that the bill of lading, which evidences the transfer of ownership to the goods to the purchaser, is also transformed into computer code where it resides on a distributed ledger until payment is released to the seller. Upon payment, the bill of lading will automatically be released to the purchaser in digital form. This removes any issues with respect to fraudulently procured or produced documents of title, such as a bill of lading. In Q4 of 2017, ZIM, an Israeli container shipping company, announced it completed a pilot that used blockchain technology to carry out a paperless bill of lading. During the trial, all participants issued, transferred and received original electronic documents using blockchain technology, which managed the ownership of documents in order to eliminate disputes, forgeries and unnecessary risks.[viii]

In addition to payments and documents of title, many more aspects (in fact, virtually all of them) can be converted to self-implementing code broadcast to a distributed ledger, together with corresponding, real-time contract administration and monitoring, including casualty insurance covering the goods during transit, foreign trade credit insurance and the coordination of any other logistics companies (*e.g.*, last mile carriers).

6. Direct Supply Chain Implications: Produce

The power of blockchain technology, IoT, and machine learning to impact the supply chain will likely have their first impacts on trade finance and bills of lading, because the required investment to implement the technology in these cases – when compared to the rest of the supply chain – is comparatively lower, and benefits can be realized in the relatively near future. However, the power of these technologies extends into every aspect of the supply chain. The perishable food industry – produce in particular – serves as one example of an industry that stands to gain tremendously from these technologies. This is because when it comes to produce, supply chain weaknesses are magnified and consequence such as food contamination are more severe. The Centers for Disease Control and Prevention (CDC) estimates that almost 28 million people become sick and approximately 3,000 die in the United States each year due to foodborne illnesses.

Some of the challenges facing the produce supply chain that could be improved with the integration blockchain technology, IoT, and machine learning will be described briefly below. While these technologies cannot fix every problem – it will not teleport produce in perfect condition from the source to the buyer – these technologies can dramatically improve the predictability of the supply chain for perishable foods, and the ability to trace back produce to its origin.

Sourcing

Produce is sourced from all over the world. Variable weather conditions impact the yield, timing of a harvest, and quality of the produce, which results in inconsistent products or sourcing from many different produces and farms and shifting the relative quantity from each from year to year. While weather cannot be controlled, IoT sensors and devices can take sophisticated readings to facilitate precision agriculture. This data can, for example, indicate which seeds to buy, inform seed and chemical placement to accuracy of less than an inch, and trigger automated processes based upon the measurements taken, all of which can generate a better and more consistent product with greater harvest predictability.[ix] On a macro level, this data can be analyzed with machine learning to better predict which sources are likely to have better products in any given year.

Detailed data about the precise location within a field and timing of certain events such as harvesting, inspection, and departure can be added to the blockchain ledger for better traceability. This can facilitate both a product recall (discussed below) and be used to reliably authenticate products that are claimed to be, for example, non-GMO or organic.

Timing

Produce can only be harvested at certain times, and when it is ready, it is a race against the clock before the produce spoils. Furthermore, certain produce is picked before it is ready to be eaten (e.g., bananas) and there is only a narrow window of time that it can be eaten. Imported produce is subject to customs inspection of the produce itself and the paperwork accompanying the produce. Furthermore, in order to meet demand, the supply of produce must be distributed geographically and over time so that there is not a glut in one place at one time.

Predictability and speed are paramount in any supply chain, and even more so with produce. Produce that sits in a warehouse, or waits on a customs inspection, or must be rerouted to meet demand all has the potential to cause the product to rot before it can be delivered. Blockchain technology can ensure that the information recorded about the produce is more secure, with greater assurances of authenticity, and allow for automatic triggering of payment from the purchaser and to the government for taxes and customs fees. For governments, both taxation and import requirements are far easier to enforce when all of the data for products and manufactured goods flowing into and out of a country are monitored in real-time and stored in a tamper-proof, immutable ledger. Governments and regulators can easily require a “master key” with respect to goods and products over which they have some jurisdictional interest. U.S. Customs and Border Patrol has worked to digitize its processes. It recently launched its final major scheduled core trade processing capabilities to allow electronic transmission of data for import and export cargo, which is an important step in bringing about a blockchain future for the U.S. customs process.[x] With respect to delivering the right amount of produce at the right time to the right locations, machine learning can be applied to better predict demand.

Damage

Produce is easily damaged during transit or in storage due to failure to maintain proper temperature or humidity. Because food safety is so important, just the threat that food safety has been compromised may result in a shipment being rejected, even if contamination is not apparent. Shipments are frequently rejected due to failure to maintain proper environmental controls or a broken seal on a container of sealed perishable items.

Temperature sensors and shock monitors are already in use, but IoT is capable of allowing these kinds of devices to take a step further by monitoring and reporting the condition of the produce in real time on the blockchain ledger, as well as automatically correcting for certain environmental conditions of the produce. This data is also capable of allowing for more precise determinations as to whether or not food safety has been compromised rather than overly broad tools used today such as seal breach. If, however, the produce has been compromised, this data, when recorded in the blockchain, could trigger automatic payments by insurance, and automatically cause the produce to be rejected even before it reaches its destination.

Recall

If food is contaminated, illness and death can result, which in addition to its own problems, add the cost of recalls and litigation. According to a joint study of the Food Marketing Institute and the Grocery Manufacturers' Association, the average cost of a recall to a food company is $10M in direct costs, which does not include damage to reputation and lost sales. Broad recalls have the potential to wreak havoc on a supply chain, and can cripple an industry while the source of contamination is isolated and the cause determined. As on recent example, in late 2017, more than 60 people in the United States and Canada became sick and two people died as a result of E.coli. The CDC was only able to determine that "leafy greens" were likely the source.

With the amount of data points recorded in the blockchain ledger, it is possible for each item of produce to have a digital biography. If there is a need for a recall, machine learning can be used to swiftly sort through the data to determine the likely source, clearing the rest of the industry to be able to carry on without the devastating interruption caused by a recall. In one recent trial, Walmart's Vice President of Food Safety brought a package of sliced mangoes and asked his team to trace it's origin from farm to store. It took his team seven days. After implementing a blockchain pilot, the same information was able to be determined in 2.2 seconds.[xi] Walmart and nine other major companies that ship or purchase food are working with IBM to explore the use of blockchain technology in their food supply chains.[xii]

7. Impediments to the Technological Supply Chain Future can be Overcome

It is important to appreciate that the concepts described in this paper are not mere academic discussions or the thoughts of a futurist. To the contrary, everything has been implemented in real world pilot programs, and some aspects are already in deployed, production systems. In fact, of all the potential use cases generally discussed as appropriate for distributed ledger technology, there is no other use case likely to reach critical mass in deployed, production-ready distributed ledgers. The world's largest participants in all aspects of trade finance and supply chain management are actively pursuing pilots and otherwise moving full speed ahead – these companies include Walmart, BNY Mellon, IBM, HSBC, Bank of America, Microsoft and Barclays, just to name a few. The feedback received from all the companies involved in pilot or prototype programs has been unanimous – distributed ledger technology (as augmented by IoT and AI) will soon result in a complete paradigm shift.

While the promise land is in sight, there are still obstacles that must be overcome before all the world's trade is completed on distributed ledgers. Payment rails for the distributed systems currently under investigation are still not perfect. More specifically, unlike Bitcoin and Ethereum, Hyperledger Fabric (IBM Blockchain) and R3's Corda do not include a native cryptocurrency, and even if one were added (it's possible to model digital cash on either platform), there is no existing system to process the volume of exchanges of fiat currency and digital currency that would be generated by global trade. As such, it is more likely that payments made will be triggered by messages from the distributed ledger that instruct the payment from a traditional fiat account (*e.g.*, messaging with SWIFT codes to release funds from the purchaser's account or its letter of credit issuer).

Maybe a more systemic hurdle to overcome is the lack of uniformity in the different distributed ledgers that are currently under active development. As discussed earlier, there are several different distributed ledger protocols under active development. These different ledgers cannot currently communicate with each other, but this may, however, be a temporary impediment. Several development shops are working on interfaces and other strategies to achieve interoperability between these different ledgers. In addition, systems are being developed to ensure backwards compatibility for each new distributed system with existing legacy systems since it's not possible to transition the world's information technology systems all at one time. Furthermore, given the rather nascent nature of the technology, many companies prefer to overlay their distributed systems atop their legacy system to maintain a level of redundancy (a "training wheels" approach, which we believe to be prudent).

While no one is certain of the exact timing, based on the current pace of advancement, it seems likely that there will be several deployed, production systems in operation within five years. Be skeptical of anyone who suggests these systems are 15 or 20 years away from production. In fact, if these systems are not in production before 10 years, that means they are likely never going into production and a newer, better system has surfaced (*e.g.*, quantum computing). The reason for such a statement is that the potential benefits are so fundamental and so enormous when scaled on a global basis, that most major players in every industry imaginable are in a sprint towards implementation. The growing number of pilot programs and proof of concepts appearing in the general news and economic journals is only further testament to the investment being made around the globe.

This rapid pace of development is likely to continue or even accelerate as industries reach critical mass – which triggers another key benefit of distributed ledgers, which is the metallization of the cost to implement new systems. Because distributed systems allow all participants to access a common truth, only one distributed ledger system needs to be designed and engineered to a common set of specifications and standards. Today, every participant maintains its own centralized database that is the subject of costly reconciliations with other counterparty records. For example, rather than 10,000 manufacturers in a province of China maintaining their own central database – as they do today – only one decentralized system must be operational; thus, resulting in each company paying 1/10,000th of the costs of such decentralized system. It is tempting to think distributed ledger technology is an area limited to the world's megabanks or largest retailers, like Walmart. The headlines certainly reinforce this perception.

For small to midsize banks, suppliers, manufactures and others involved in supply chain management and trade finance (or any other industry for that matter), distributed ledger technology is an opportunity to level the playing field and eliminate certain competitive advantages held by their larger competitors, especially with respect to the banking industry in the United States. Anti-money laundering (AML), OFAC and other compliance costs represent a disproportionate amount of expenses for small and midsize banks. Distributed ledger technology also can permit banks to mutualize the cost of compliance, and in doing so, improve the effectiveness of their overall programs. This is just one of the many potential benefits (others include participation trading platforms) available to small and midsize banks. The choice seems simple. For those institutions willing to be innovative and to take some risk, there is an opportunity to be a trailblazer with potentially market-changing innovative solutions. For those who remain complacent and willing to allow the world's largest banks to maintain a monopoly on the future, their own future does not seem bright.

Perhaps the one force that can derail the implementation of distributed ledger technology across the globe is regulations or other policy enforcement that is too restrictive, and ultimately smothers out the innovation needed to reform our existing and inefficient processes. Fortunately, many jurisdictions, including the United States, already have existing legislation that, while passed years before distributed ledger technology existed, is broad enough in scope because of their origins out of the original Internet revolution. So, electronic or digital signatures, including public key infrastructure, are already accepted practice. While there will almost certainly be a need to tweak commercial laws here and there, especially in the cross-border context, those efforts should be easy to accomplish given the mutual benefits for all involved, including governments. The policy decisions that will impede distributed ledger technology are those too myopic on counterbalancing issues, such as consumer protection. Any policy that says no to any risk, is a policy that will shutter innovation. Going forward, it is important that the regulators and policymakers both in the United States, the U.K., continental Europe, China and the rest of the world's global trade powers, implement regulations and rules that foster innovation and encourage institutions to take chances to achieve potentially game changing results. That is not to say that financial institutions need a license to engage in reckless activities, but rather enough flexibility to innovate by take calculated chances and risk. There is a balance that can be found where consumer safety and the soundness of the economic environment is maintained, while innovation fosters much needed economic and employment growth around the globe.

Notes

[i] This paper was derived from a piece written for ICLG To: Lending & Secured Finance 2018, Trade Finance on the Blockchain: 2018 Update.

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[iv] https://www.tradefinanceglobal.com/finance-products/trade- finance/.

[v] https://www.ibm.com/blogs/blockchain/2018/01/digitizing-global/trade-maersk-ibm/.

[vi] https://www.reuters.com/article/toyota-selfdriving-blockchain-idUSL1N1IO178.

[vii] https://www.bbva.com/en/bbva-and-wave-carry-first-blockchain-based-international-trade-transaction-europe-and-latin-america/.

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