Blockchain for Supply Chain:
Ghost in the Machine or Breakthrough Technology?

Introduction

The purpose of this White Paper is to demonstrate the myriad ways in which the open-source software known as, "blockchain" can be applied to international trade. Specifically, we'll be analyzing the blockchain Value Proposition and how this technology can enhance supply chain management, logistics operations and ultimately, financial performance.

To the above end, we'll kick things off with some context as to the origins of blockchain and then provide an explanation of what it is. From there, we'll get into specific examples of how it can be used to support the transactional nature of international business. In an effort to balance the storyline, we'll also point out some of the pitfalls inherent to the technology, as well as summarize both the structural and public relations work that must be done to make it a widespread commercial reality.

The reader may be surprised to learn that blockchain serves as the digital backbone of the cryptocurrency known as, "bitcoin." The speculative nature of bitcoin aside, blockchain is comprised of the shared computer code and databases that allow parties to engage in Machine-To-Machine (M2M) trading of the currency. In general terms, blockchain enables the creation, authentication, sequencing, time-stamping, replication and completion of a bitcoin transaction.

Basically, each step in a bitcoin exchange represents a, "block" that is indelibly recorded by the software. As a transaction proceeds, each block is linked to the previous one, thus creating a permanent, "chain." Of particular importance, any change or update to a previous block not only requires the consent of the parties, but the addition of an entirely new block. There is no doubt that this building-block approach, when properly repurposed, can have powerful applications in the field of global trade.

All of the above activities are based on the use of a, "digital ledger." Referred to generically as, "Digital Ledger Technology" (DLT), a digital ledger is a decentralized database that is shared by network participants across any number of peer-to-peer computer connections. Somewhat analogous to a traditional accounting ledger, a user-certified, distributed ledger is where cryptographic signatures are verified, transactions are authenticated, assets are exchanged and in the end, where blockchains are built. At its core, blockchain is the distributed ledger that was designed to power bitcoin.

As the reader may have discerned, the origins of blockchain are purely financial in nature. In addition to supporting the transactional sequence of bitcoin, "mining," the digital ledger provides important elements of encryption that facilitate the exchange of assets (i.e. bitcoins), enable auditing and augment transparency. In a world rife with hacking and cyber theft, blockchain has also been heralded for the regulatory contributions it can make in areas such as, "Know Your Customer" (KYC) and "Anti-Money Laundering" (AML).

Based on the above definition and applications, the obvious question for global trade professionals is, "How can financially-oriented code that was written specifically for bitcoin be applied to supply chain management and logistics operations?" Luckily, the answer to this question isn't found in the arcane world of programming or relational databases, but rather in a fundamental understanding of what makes the technology of value in the first place. Ultimately, the real trick for blockchain is to expand beyond its financial origins to support all aspects of an international transaction.

Blockchain for Supply Chain

In order for any DLT to work in a multi-faceted business setting three elements that drive the exchange of goods and/or services must be present: An underlying (contractual) agreement, the business rules that govern the execution of said agreement and the completion of an actual transaction. When these three variables are in place the blockchain Value Proposition can transcend the supply chain, thus bringing a number of benefits to global commerce.

In the parlance of blockchain, the digital agreement between a seller and buyer is known as a, "Smart Contract," the terms of which provide the business rules and foundation of the chain. As the terms of a Smart Contract are executed during a transaction, the blocks are created per the agreed upon business rules, and the chain is constructed. Of particular importance, each block is digitally verified against the clauses in a Smart Contract, thus assuring the sharing of, and visibility into what becomes a, "Single version of the truth."

When the Value Proposition of blockchain is understood to include the digital authentication and execution of the interrelated activities that are born of agreements, business rules and transactions, its applications to global trade come into focus. This is especially so when one realizes that global supply chain management comes down to ***multiple*** parties carrying out ***several*** agreements, all of which unfold from the terms between a buyer and seller for the purchase of goods (i.e. the exchange of assets). At this point, an analysis of a basic international transaction may help to bring the, "Blockchain for Supply Chain" story to life.

Think for a moment about the contracts, business rules, transactions and documents that are created when a U.S. importer of footwear agrees to make a purchase of shoes from a manufacturer in Vietnam. In support of this transaction, we'll state that the main mode of transport is ocean freight and that payment terms will be under a letter of credit (L/C). In what should be considered a fairly run-of-the-mill scenario, one can anticipate the creation of at least four agreements that have the potential to be converted to Smart Contracts. It is very important to note that some elements of these agreements are between the seller and buyer, while others involve third party supply chain players.

In global trade, the Smart Contract that serves as the genesis for all blockchain activities is the Purchase Agreement between the seller and buyer. As most any business person knows, the Purchase Agreement (aka Sales Contract) contains all of the conditions under which goods are to be sold, including product features, unit price, quantities, payment terms, etc. Although there are several elements of a Purchase Agreement that can benefit from blockchain applications, we're going to begin our analysis with payment terms, which is the above-mentioned letter credit.

We've chosen to begin our study with the letter of credit because it is the mechanism that triggers the, "exchange of assets" that was previously alluded to in this White Paper. Bearing in mind that the purpose of blockchain is to enable the exchange of ***digital*** assets (bitcoins), recognition of the analog that exists between bitcoin mining and the exchange of ***tangible*** goods for funds in a seller/buyer relationship is extremely important. Ultimately, it is this recognition that begins blockchain's transition away from bitcoin and towards broader applications for international business.

Whereas our seller and buyer have several options related to negotiating payment terms (cash in advance, thirty days credit, etc.), a letter of credit is defined as a bank's commitment to effect payment based on the seller's fulfillment of agreed upon business rules. When viewed as the enabler of the aforementioned exchange of goods for funds, a letter of credit is no longer an analog, it is a Smart Contract. Because a bank's obligation to pay is based on the seller's timely presentation of complete, consistent and correct documentation, a financial obligation is created that is tailor made for blockchain.

With L/C requirements that include the Vietnamese seller delivering the goods to an agreed upon location, the need to meet multiple deadlines, as well as present invoices, packing lists, bills of lading, et al to the bank, it is easy to see how quickly a blockchain can enhance this singular facet of an international sale. Hopefully, blockchain for L/C's will soon become the premiere Use Case that drives the development of other trade-related solutions.

Moving on, either the U.S. buyer or the Vietnamese seller is going to be responsible for ocean transportation, the details of which are subject to the Terms & Conditions of the ocean bill of lading. Because a B/L is a, "Contract for Carriage" it can serve as the Smart Contract that governs the main mode of transport in our footwear example. Also, if the buyer is responsible for freight charges, he/she may have direct contracts with a steamship line or, have a contract in place with a Non-Vessel Operating Common Carrier in the form of a Negotiated Rate Arrangement. Needless to say, these hard-copy contracts can be treated as Smart Contracts, too.

In most cases, an agreement such as the one under analysis involves the services of a Freight Forwarder and Customs Broker. These days, it is not uncommon to see shippers, forwarders and brokers agree to Standard Operating Procedures (SOP's) and/or Service Level Agreements (SLA's). While not necessarily contractually binding, SOP's and SLA's can be construed as a set of business rules and as such, be used as a Smart Contract that governs things like damage-free goods movement, accurate documentation, transit-time adherence, the precise classification of goods, and the timely submission of Customs entries.

Although markedly different from the Use Cases we've seen thus far, the regulatory requirements born of global trade can also benefit from blockchain. Continuing along with our footwear transaction, both the seller and buyer have to carry out export and import Customs clearance processes. Implicit in these activities is the submitting party's assurance that all export/import laws and regulations have been followed…or in other words that the government-mandated business rules have been complied with. When government regulations are viewed as another form of business rules, the application of blockchain to regulatory activities becomes very interesting indeed.

While not applicable to our footwear example, there are other areas related to regulatory compliance that could make use of blockchain. One segment is that of tracking the application, issuance and record-keeping of U.S. export licenses that are administered by the Department of Commerce, Bureau of Industry and Security (BIS). Another is the management of the licenses issued for the exportation of military hardware by the U.S. Department of State, Directorate of Defense Trade Controls (DDTC). Certainly not limited to the export controls enforced by the U.S., this use of blockchain is applicable to any country that has export regulations in place.

Yet another use of blockchain can be found in the area of product-testing and the regulations that exist to safeguard children's products from dangers like flammability, lead content and choke hazards. Anyone unfamiliar with the product-testing field may be shocked to not only learn about the depth of regulations put forth by entities like the American Society for Testing and Materials (ASTM), but also how complex and paper bound product-testing procedures really are. Given its nature, product-testing is a great candidate for the use of blockchain, not just in the U.S., but around the world.

It is important to note that many of the above portrayals are not a Wish List; they are taking place in the Right Now. In fact, a number of companies are already using blockchain to enhance transactional integrity, augment financial auditing and improve operational effectiveness. One high profile example is the partnership between Maersk Lines and IBM to bring efficiencies to all facets of the ocean container shipping business. Given the sub-optimized processes that hobble container shipping in areas like contract management, no-show bookings and inaccurate billing, the blockchain opportunities for the steamship lines are considerable.

Another example is that of the Israeli start-up, WAVE, who successfully executed the first-ever negotiation of a letter of credit using blockchain technology. As noted in our footwear example, the fact that letters of credit involve so many different parties, are subject to multiple time-sensitive business rules and are document-intensive, adds great credence to the belief that blockchain really can be a game changing technology. In addition to its work with L/C's, WAVE and ZIM Lines announced in November of 2017 a project for the creation of a paperless bill of lading based on a blockchain distributed ledger.

Here in the U.S., the transportation industry consortium known as the, "Blockchain in Transport Alliance" (BiTA) was formed to create technology standards that can be applied to the trucking industry. Because trucking is driven by the business rules and procedures tied to a bill of lading, the +200 members of BiTA see a great future for the use of blockchain not just for trucking, but for multiple modes of transport. BiTA's work is progressing and it is possible that they will publish blockchain standards for U.S. trucking in the coming year.

A Blockchain of Blockchains: The Meta-Block

While the above Use Cases certainly add credibility to the, "Blockchain for Supply Chain" narrative, they also point out two important facts. First, it should be clear that wherever in the world of business there exists an agreement to exchange assets, governing business rules and a document-driven transaction, blockchain can create value. On the other hand, the blockchain solutions that have been launched thus far are application-specific tools that may perpetuate the fragmented nature of global trade, not cure it. A seemingly contradictory pair of statements, the latter of the two requires further explanation.

One of the biggest complaints that business people have about international trade is its highly fragmented structure. With at least ten players involved in a transaction, multiple agreements in place, dozens of corresponding documents and the repeated hand-off of goods from one player to the next, it is not unusual to experience inefficiencies that impact lead times, drive up inventory levels, increase landed costs and/or erode profit margins.

Whereas the contributions of software like Enterprise Resource Planning and cloud-based trading platforms such as Ariba Network must be acknowledged, the technology side of trade remains as fragmented as its physical world counterpart. Because every party to a sale has its own level of sophistication, the execution of global commerce can quickly degenerate into a potpourri of faxes, emails, spread sheets, EDI messages and XML files. If that's not sufficiently confounding, all of that information feeds into an array of discrete software, among which figure Material Requirements Planning, Purchase Order Management, Sales Order Management and Accounting.

If blockchain has any hope of becoming the, "New, New Thing" for international business, solutions have to be created that allow for the true integration of the interdependent activities of ***all*** supply chain players and functions. Stated simply, the continued development of stand-alone blockchain solutions for activities like placing a purchase order, cutting a bill of lading or negotiating a letter of credit will not transform blockchain into a leapfrog technology. More accurately, blockchain will likely land a few degrees of separation ahead of its EDI and XML predecessors, thus falling short of its potential.

Grounded in the knowledge that access to blockchain information must be permission based, what is really needed for global trade is a, "Blockchain of Blockchains," or what can be termed a, "Meta-Block." In essence, a Meta-Block is an overarching blockchain that unites all of the Smart Contracts tied to a sale, whether it's payment terms, a contract for carriage or regulatory compliance. When the trade community adopts this holistic approach to commerce it will have truly advanced the disciplines of finance, supply chain management and logistics in a significant fashion. In order for that to happen, several technological, as well as public relations hurdles must be overcome.

The Recipe

-The most glaring factor constraining blockchain is the need for global technology standards. Just like Electronic Data Interchange and eXtensible Markup Language are based on standards that all users adopt, so must blockchain have its standards. Without the creation of universally recognized technology protocols, the use of blockchain will become a hodgepodge of different approaches that by its very nature will never achieve what it is really capable of.

As a point of interest regarding technology standards, the International Standards Organization has formed ISO Technical Committee 307 to begin the process of creating the protocols upon which global blockchains can be built. With its first meeting held in November of 2016, ISO/TC 307 is studying important elements of blockchain such as architecture, user identify, security, Smart Contracts, governance and interoperability.

On the commercial side of the house, IBM has made substantial headway with a standards-oriented project that it has dubbed, "Hyperledger." Run by the Linux Foundation, Hyperledger is an open-source endeavor whose objective it is to provide, "Robust and efficient standards for blockchain ledger technology." Hyperledger was launched in December of 2015 and now has more than one hundred and thirty company members around the world.

In both of these instances, and in particular that of ISO, the speed with which standards are developed, agreed upon and adopted will determine just how pervasive blockchain becomes.

-Equally critical as the deployment of blockchain standards is the need for a robust ecosystem of developers, platform operators and "Blockchain as a Service" (BaaS) providers that solve supply chain-centric challenges. As noted previously, the current reality is that most existing blockchain projects focus on banking and finance. While it is true that endeavors like IBM's Hyperledger Fabric and Microsoft's Azure have begun the shift towards purpose-built supply chain capabilities, more players are needed to convert supply chain operational requirements into blockchain solutions.

-Next up on the blockchain Hit Parade is the issue of how to integrate all supply chain players and their disparate software capabilities under one technological roof. Mentioned earlier and presented as the need for an overarching Meta-Block, the lack of interoperability between systems is arguably the greatest obstacle for blockchain supporters to overcome. As is the case with earlier technologies that experienced similar interoperability constraints, Application Programming Interfaces (API's) must be developed to create the links that enable the deployment of Meta-Blocks.

-Closely related to the above points is that of marshalling the human capital necessary to create blockchain solutions that address real-world supply chain challenges. This might sound like a pedestrian task, but experience has shown that the bane of any supply chain software project is the disconnect between the "techies" and the "operators," and how the inability to translate needs into code produces solutions that just don't work very well. Due to blockchain's complexities and relative newness, finding people that know how to write the code *and* that understand supply chain won't be so easy.

-One facet of Blockchain for Supply Chain that cannot be overlooked is the Pricing Models that emerge as service providers enter the space. Noted previously, a robust ecosystem of developers, platform operators and BaaS providers is indeed needed, but potential customers also have to know how various services will be priced, and what the actual costs are going to be.

Using other software models as a guide, it is likely that the Blockchain for Supply Chain scheme will evolve into a combination of development, licensing and/or transactional fees. Certainly not unusual, what is important for blockchain growth is that any transactional (or block-based) fees be in line with the volume of business that will be carried out. With individual blocks forming the foundation of the millions of blockchains that will be built every day, the success of Blockchain for Supply Chain will hinge on that fee being pennies per block, or even a fraction thereof.

-Until now, the theme of this White Paper has been how purpose-built blockchain applications can support global trade. But if one really thinks about it, blockchain can do so much more if it extends beyond its own domain to integrate with another technological phenomenon, the Internet of Things (IoT). Imagine how incredibly powerful Blockchain for Supply Chain would be if it could somehow connect with the billions of sensors that are being embedded in products and transportation assets. A pipe dream right now, the marriage of blockchain with IoT is destined to soon become a must-have.

-The last piece of the Blockchain for Supply Chain puzzle doesn't involve technology; it actually has to do with public relationships and branding. The honest truth is that there are a lot of smart people out there that don't understand what blockchain really is, or what it can be used for (the author certainly had this problem, and some people may argue that he still does☹). Worse yet, when one adds to these

misunderstandings blockchain's somewhat dubious connection to bitcoin, a certain percentage of people will automatically write it off as pure quackery.

Given this unfortunate reality, those blockchain professionals committed to moving beyond bitcoin have to mount a public relations campaign that dispels misconceptions while positioning the technology as a true creator of supply chain value. There are many ways to do that…Use Cases, webinars, seminars, attendance at supply chain events and most importantly, incessant evangelizing. Regardless of how the message is delivered, evangelists must craft a brand message that avoids the use of technical jargon.

Honestly, it's almost comical to peruse the web sites, literature and PowerPoint presentations of companies in the blockchain field. Given that many supply chain executives are just starting to research blockchain, the last thing they need to hear are phrases like, "Asset entropy," "Surjection proofs" and "Borromean Ring Signatures." All that is missing from this esoteric lexicon are the customary five letter acronyms that no one can write out long-hand, and the blockchain Swan Song can kick off in earnest.

In all seriousness, what's really missing from the story is a consistent, plain-English brand message that links blockchain capabilities to the resolution of supply chain problems. The early successes of the companies mentioned herein have certainly made a contribution to that effort, but additional work remains to be done. Much more of a process than a singular event, Blockchain for Supply Chain believers must first agree to, and then disseminate the brand message.

Wrap-Up

Hopefully, this White Paper has achieved its goal of explaining how the blockchain Value Proposition can be applied to global trade. While admittedly imperfect, its content is intended to serve as a catalyst for the continued debate, research and investments that are required to convert Blockchain for Supply Chain from a, "Ghost in the machine," to a breakthrough technology.

About the author

Dan Gardner is Vice President of Supply Chain Management for Lakeshore Learning Materials in Carson, California and is co-founder of the global trade consulting firm, Trade Facilitators, Inc. He can be reached for comments, questions and critiques at dgardner@tradefacil.com.