

Blockchain technology for supply chains—A must or a maybe?

Blockchain's buzz makes it sound like a panacea. Our supply-chain experts evaluate its real potential.

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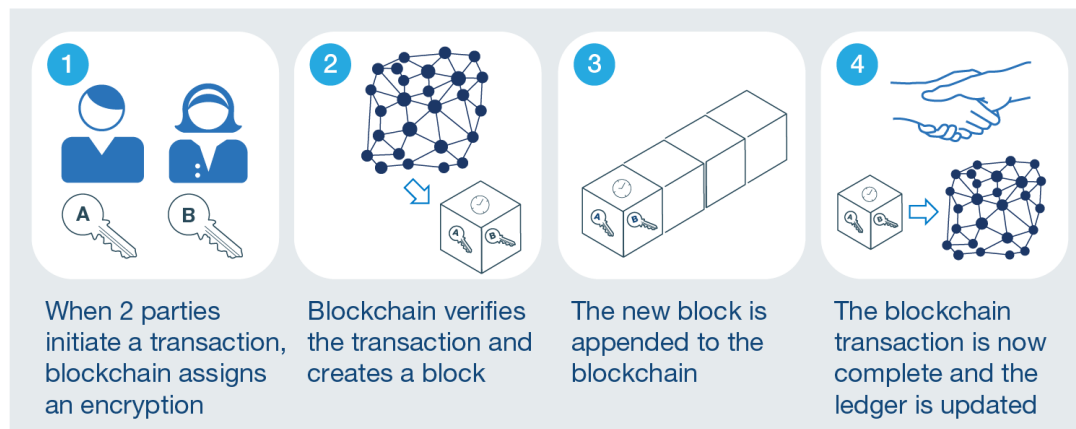
Another day, another new technology to consider. This time it's blockchain, the technology that was created to support bitcoin transactions. According to its cheerleaders, especially in the financial sector, blockchain technology has the potential to turbocharge the effectiveness and profitability of most (if not all) businesses—or even upend business as we know it. In fact, say these early adopters, businesses that ignore blockchain technology do so at their peril.

Strong words, but how true are they? Does blockchain technology really apply to the supply-chain world? Can it solve your supply-chain problems and increase your profitability? These are some of the very practical questions we've been asked by supply-chain executives. Our goals are to give you a clearer understanding of what blockchain technology is all about, and to save you the time of studying, testing, and assessing its value to your operations.

Understanding blockchain technology

Blockchain is an internet-based technology that is prized for its ability to publicly validate, record, and distribute transactions in immutable, encrypted ledgers. The technology was invented to support transactions in bitcoin, a digital cryptocurrency that operates independently from a central bank. In essence, blockchain technology provides the platform for creating and distributing the ledger, or record, of every bitcoin transaction to thousands, if not millions, of computers linked to networks in all parts of the world.

Because the transactions and ledgers are encrypted, blockchain technology offers more security than the banking model, and its instantaneous transmission via the internet eliminates banks' two- to three-day clearing process and accompanying costs for transferring money from one account to another. The term "blockchain" is derived from the "blocks" of validated and immutable transactions and how they link together in chronological order to form a chain (exhibit). Hence the term "blockchain."

Exhibit**How to create a blockchain transaction**

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In essence, blockchains come in two dominant types. “Permissionless” distributed ledgers, such as bitcoin, reside in the public domain, while “permissioned” ledgers are centralized and governed by “actors,” “nodes,” or “miners,” and are held outside the public domain. This distinction has important consequences in the supply-chain context.

Blockchain’s value in today’s supply chains

In most cases, today’s supply chains operate at-scale without blockchain technology. Even so, the technology has excited the IT and supply-chain worlds. It has also inspired many articles and prompted established IT players and start-ups to initiate promising pilot projects, including:

- Walmart tested an application that traces pork in China and produce in the US, to authenticate transactions and the accuracy and efficiency of record keeping.
- Maersk and IBM are working on cross-border, cross-party transactions that use blockchain technology to help improve process efficiency.
- BHP is introducing a blockchain solution that replaces spreadsheets for tracking samples internally and externally from a range of providers.
- Provenance, a UK start-up, just raised \$800,000 to adapt blockchain technology to trace food. It previously piloted tracing tuna in the Southeast Asian supply chain.

Yet to date, the authors are not aware of any at-scale applications to the supply chain, raising an essential question: Can blockchain technology add value to supply chains?

Let’s start with a reality check: As most practitioners know, many of today’s supply chains have good data, which they are able to transfer across supply chain tiers at close to real time speed. To assess blockchain technology’s value at stake for the supply chain world, we looked at three areas where it could add value:

1. Replacing slow, manual processes. Although supply chains can currently handle large, complex data sets, many of their processes, especially those in the lower supply tiers, are slow and rely entirely on paper—such as is still common in the shipping industry.
2. Strengthening traceability. Increasing regulatory and consumer demand for provenance information is already driving change. Moreover, improving traceability also adds value by mitigating the high costs of quality problems, such as recalls, reputational damage, or the loss of revenue from black- or grey-market products. Simplifying a complex supply base offers further value-creation opportunities (see sidebar, “A complex supply chain of unknown parties”).
3. Reducing supply-chain IT transaction costs. At this stage, this benefit is more theoretical than actual. Bitcoin pays people to validate each block or transaction, and requires people who propose a new block to include a fee in their proposal. Such a cost would likely be prohibitive in supply chains because their scale can be staggering. For example, in a 90-day period, a single auto manufacturer would typically issue approximately 10 billion call-offs just to its tier-one suppliers. Also, together all of those transactions would significantly raise demand for data storage, an essential component of blockchain’s distributed-ledger approach. In addition, creating and maintaining numerous copies of data sets would be impractical in the supply-chain environment, especially in permissionless blockchains.

A complex supply chain of unknown parties

Produce is a good example of a complex supply chain where, occasionally, the parties are not always known, such as produce supply chains that source from thousands of growers and farmers, and move goods through multiple distribution points before they reach retail shelves. As the goods often change hands, a permissionless blockchain is a valid solution for tracing and verifying the grower or farmer who supplied the produce. Walmart’s pork traceability is a good example, with a huge number of pig farmers at its lowest tier of supply. But, while Walmart may be one of a handful of companies that can drive this at scale, most supply chains need to assess the cost-benefits of investing in technology to collect and validate data from the lower levels.

The biggest blockchain barrier: who would give permission?

In adopting blockchain technology for its supply chain, a company must first decide on the type of blockchain it would need to build. Recall that the bitcoin approach is a permissionless blockchain populated with parties that are not known or trusted. It resides in the public domain and uses a consensus verification protocol to establish trust in each block. There is no central database or central governance in these blockchains.

A bias for privacy

Conversely, in most supply chains, the parties are known and trusted. Moreover, the supply-chain world is unlikely to accept open access because its users don't want to reveal proprietary details, such as demand, capacities, orders, prices, margins, at all points of the value chain to unknown participants. This means most supply-chain blockchains would need to be permissioned, with access governed centrally and restricted to known parties who may be limited to certain segments of data.

In theory, this approach allows public or private verification of each proposed block. However, we believe it is unlikely that we will ever see public verification of proposed blocks in the supply-chain world when all the parties are known. In shipping, for example, there are only a few known parties in the chain—including haulers, ports, customs, shipping lines—that are responsible for validating each block. When the number of trusted parties is small, the need to independently validate consensus protocols used in the public domain is limited.

A good-enough solution without blockchain

In many cases, supply chains are already moving billions of transactions and data, often in real time. The systems are not perfect, and many supply chains have issues with data that is siloed, disparately formatted, difficult to access, or hard to visualize or analyze in the context of big data. Even so, well-managed central databases with good data management, combined with supply-chain visualization and analytical prowess, can be achieved at scale today.

These solutions do not carry the additional burden of some of the technical complexities that blockchain can raise (see sidebar, "Getting technical"). Thus, we maintain that when all parties in extended supply chains are known and trusted, a blockchain solution is probably not needed, as these known and trusted parties can be relied upon to provide a single, real-time version of the truth. In such a situation, centralized solutions like a cloud-portal, or decentralized peer-to-peer connections would suffice.

Getting technical

Before blockchain becomes widespread in supply chains, several technical challenges must be overcome:

- **Generating standards.** Despite the emergence of platforms such as Hyperledger (used by IBM, Walmart, and Maersk) and Ethereum (used by BHP), no comprehensive supply-chain standards are in place for blockchain solutions or providers. This means there are no definitive answers to questions like how to solve for consensus (immutability) on blocks, and which encryption technology to use; the absence of such standards would add complexities that could hinder, not help, the supply-chain world.
- **Increasing data accuracy.** Better data is essential, but problematic in supply chains. The bitcoin blockchain is comparatively simple. To verify a proposed bitcoin block, the parties need only view a few previous blocks to determine if there are sufficient funds. In a supply chain, actions often involve significant processing, with each step involving the collection and monitoring of fairly big data sets.
- **Offering more than just speed in verification.** Years ago, it took five to seven calendar days to confirm a purchase order from an Asian vendor, a delay that impacted plans for weeks. E-commerce makes it possible to take an order, process and pass it to a distribution center in close to real time. That progress leaves less room for blockchain technology to prove its value in verification.
- **Managing volume.** In bitcoin, validating blocks and storing the ledger requires huge amounts of computing power and energy. But even a large, public network can process only around 450 trillion transactions per second. This is actually minuscule compared to the projected transaction workload that supply chains require. And permissioned blockchains' capabilities still lag those of centralized databases, raising important questions about whether the scope of the data elements that permissioned blockchains can capture will be limited by available throughput capacity—which may not grow at the same pace as big data.
- **Deciding who will pay?** Bitcoin pays “miners” to validate blocks, at a fee that is much lower than the typical bank’s clearing charge. For blockchain technology to spread to supply chains, the value-at-stake must be able to fund the technology, its further development, and the distribution teams it requires. Moreover, realizing value is complex; it’s not a single, linear usage at each point in the chain. It’s useful to remember that ocean freighters today continue to use manual, paper-based processes in part because they serve many purposes beyond those required for blockchain transactions.

Consider the facts before you jump on the blockchain bandwagon

Our research suggests that blockchain technology may ultimately be a good solution for some types of supply chains, but it is not yet ready for mass adoption. We base this view on the following:

- Blockchain pilots run to date have not proven the technology's unique value to the supply-chain sector
- Blockchain technology is not yet able to capture data across a high number of untrusted parties
- Delivering full transparency or traceability can be solved in other ways, not just by blockchain
- The cost of developing and running a blockchain is not yet clear, with few standards now in place
- The gap between blockchain's current capacity and the capacity that supply chains will need is enormous

For supply chains where participants are not known or trusted, blockchain technology can add trust, transparency, and traceability. Almost by definition, these supply chains are complex, multi-tiered, involve many parties, and they operate in a regulated environment that demands a higher level of traceability.

However, for supply chains with known and trusted players, a centralized database approach is generally more than adequate. This does not mean that all these supply chains currently follow a true end-to-end approach, and in fact, many of them use siloed databases that contain data with only limited traceability. Thus, many of these supply chains do not need blockchain technology to solve such issues, as they can leverage existing technologies that are better suited to their high-volume transactions, either on their own or with partners.

It's too early to estimate the costs of operating blockchain technology in the supply-chain world, and compare them with other technologies. No doubt, IT companies will be at the ready to provide this information.

However, the value proposition must be clear. What are the internal transactional efficiencies? What is the potential cost in end-product failures, recalls and litigation? Would a consumer pay more for a product that offers transparency throughout its supply chain? These types of questions should be asked when considering blockchain for use in supply chains.

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A number of companies are exploring the benefits of leveraging blockchain technology in adjacent areas, such as introducing smart contracts, bringing more rigor to purchase order payments or demand chains where "real demand" signals can propagate the upstream supply chain faster. While we salute the power and the promise of blockchain technology, we advise the supply-chain world to take the time to measure its suitability against other, possibly simpler, and less costly technologies ■

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