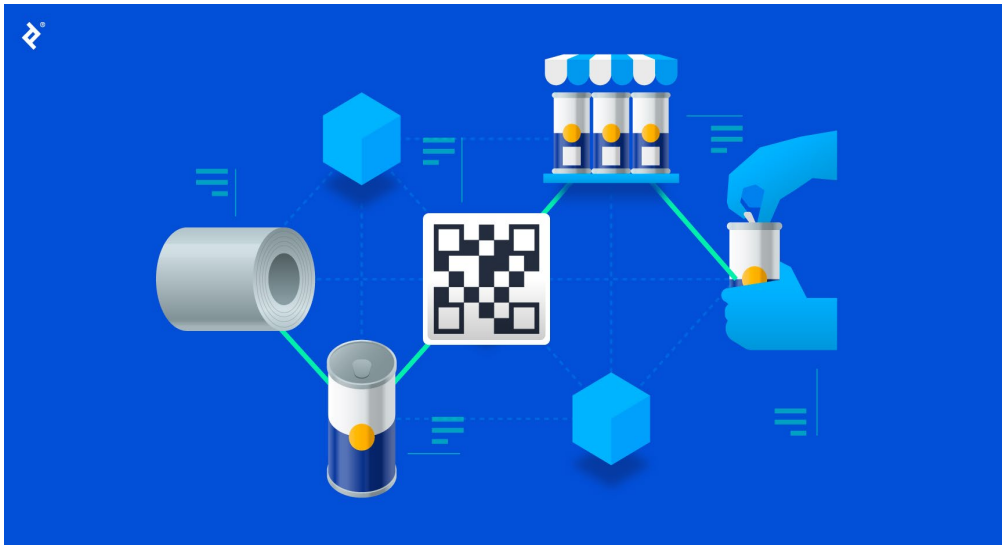
Digital Ledgers vs. Databases: Can Blockchain Optimize Your Supply Chain?

Blockchain isn't just for cryptocurrency. The technology can also be used to make supply chain management more efficient, transparent, and secure. Here's how.



By Neil Mann

Neil is a business transformation expert and management consultant with more than 20 years of experience across the financial services, natural resources, hospitality, and fast-moving consumer goods sectors. He has created and implemented digital ledger technology solutions at Kearney and global mining group Rio Tinto, and is a board advisor for LogChain, a digital supply chain logistics platform.

No tool is inherently good or bad. When it comes to blockchain, it's crucial to distinguish between the speculative crypto markets that the technology enables and the business solutions that its underlying digital ledger architecture makes possible. In this article, I'll explain how enterprise-grade applications developed using blockchain's distributed ledger

structure can provide a more efficient, transparent, and secure way for businesses to manage data as an asset, mitigate operational risks, cut costs, and even resolve supply chain issues.

Cryptocurrency markets may now seem like the epitome of risk, with volatile prices, Ponzi schemes, and the persistent hacking and heists of digital assets including non-fungible tokens (NFTs). But blockchain is a robust innovation that provides the operating framework for numerous information-management platforms used in industries from financial services to healthcare. Indeed, as early as 2018, McKinsey & Company noted that blockchain's greatest short-term value was as a means to increase productivity in business processes. And other sources, such as Stanford University's Graduate School of Business, have continued to attest to its potential in this area.

Blockchain applications hold particular promise for logistics—an area ripe for digital transformation. The supply chain crisis of 2021-22 highlighted the growing complexity of the global movement of goods as producers, shippers, logistics experts, and delivery companies struggled to communicate in a timely manner and provide end-to-end visibility. Yet customer expectations for transparency, dependability, and service continue to increase. I've been working as a digital strategist for more than two decades, advising companies on using technology to transform their business models, operations, and customer experiences, and I believe that blockchain technology can help solve many of these problems.

Why Use Blockchain for Supply Chain Management?

To meet today's supply chain challenges, a company needs to bring all of its disparate logistical data and processes onto a single platform where the information can be aggregated, analyzed, validated, and displayed as orders are processed, inventory is prepared and packaged, and items are dispatched. The more granular, integrated, and comprehensive these platforms, the greater the efficiency and cost savings they can generate.

For most firms, that has historically meant investing in database management systems, which use powerful software applications and advanced cloud-based computing solutions that analyze and integrate large sets of data with millions of records. But there are limits to how efficiently and dependably a database can manage and share so much detailed information. Companies that use the most advanced cloud-based database solutions must often still rely on analog tools like telephones, printers, and fax machines to ensure that every node in their complex global supply chain is connected. Latency and errors are commonplace and largely accepted.

Blockchain isn't subject to these shortcomings. At its core, blockchain is a decentralized information management system. It's like a database, but as I'll explain shortly, it's structured differently and equipped with distinct functions. Blockchain's digital ledger technology delivers a level of granularity and certitude that more traditional solutions can't. And because

all the data is controlled transparently across a distributed network, collaboration and trust come more easily.

Blockchain vs. Databases: Understanding Key Features

To clarify why and when blockchain can be better than conventional databases, let's take a closer look at some of its most powerful and distinctive features.

Transparency: Databases use a client-server architecture, storing information organized in tables and files in a central logical server and granting users limited access to create, read, update, or delete it. By contrast, blockchain runs on a decentralized digital ledger network protocol, using digital "blocks" that can be thought of as pages in a ledger. In a public blockchain, all participants can see all the same information at the same time; in a private one, the information is typically segmented to meet the needs of multiple customers on the platform.

In both types of blockchain, data is distributed across multiple nodes, instead of housed centrally like in a traditional database. Most newer databases are cloud-based and they, too, can distribute data across more than one node, but someone has to manually create each additional node. In blockchain, node creation is inherent in the network formation and thus more seamless.

Traceability: Blockchain stores data in an append-only structure in which new blocks are cryptographically linked to existing ones in chronological order. This naturally creates an audit trail. Saving hash values in a timestamped block enables a user to prove that a document existed at a certain time in a certain version and verify who created and was involved in each transaction. For example, Singapore-based startup LogChain, where I have served as a board advisor since 2020, helps chemical companies re-engineer their supply chains, using blockchain to create records to track each container of potentially dangerous substances at every step of its journey.

Security and Immutability: The information in a blockchain can't be altered or deleted unless all parties agree upon the changes. This creates an unchangeable record that's extraordinarily difficult to overwrite, falsify, or reverse. It also means that the record is encrypted end-to-end in the network, providing greater security against fraud and unauthorized activity than a database. That's why a logistics platform built on blockchain is powerful for establishing a product's provenance and tracking its journey through a complex global supply chain, especially when it comes to satisfying standards for ethical or sustainable sourcing or passing enhanced customs inspections.

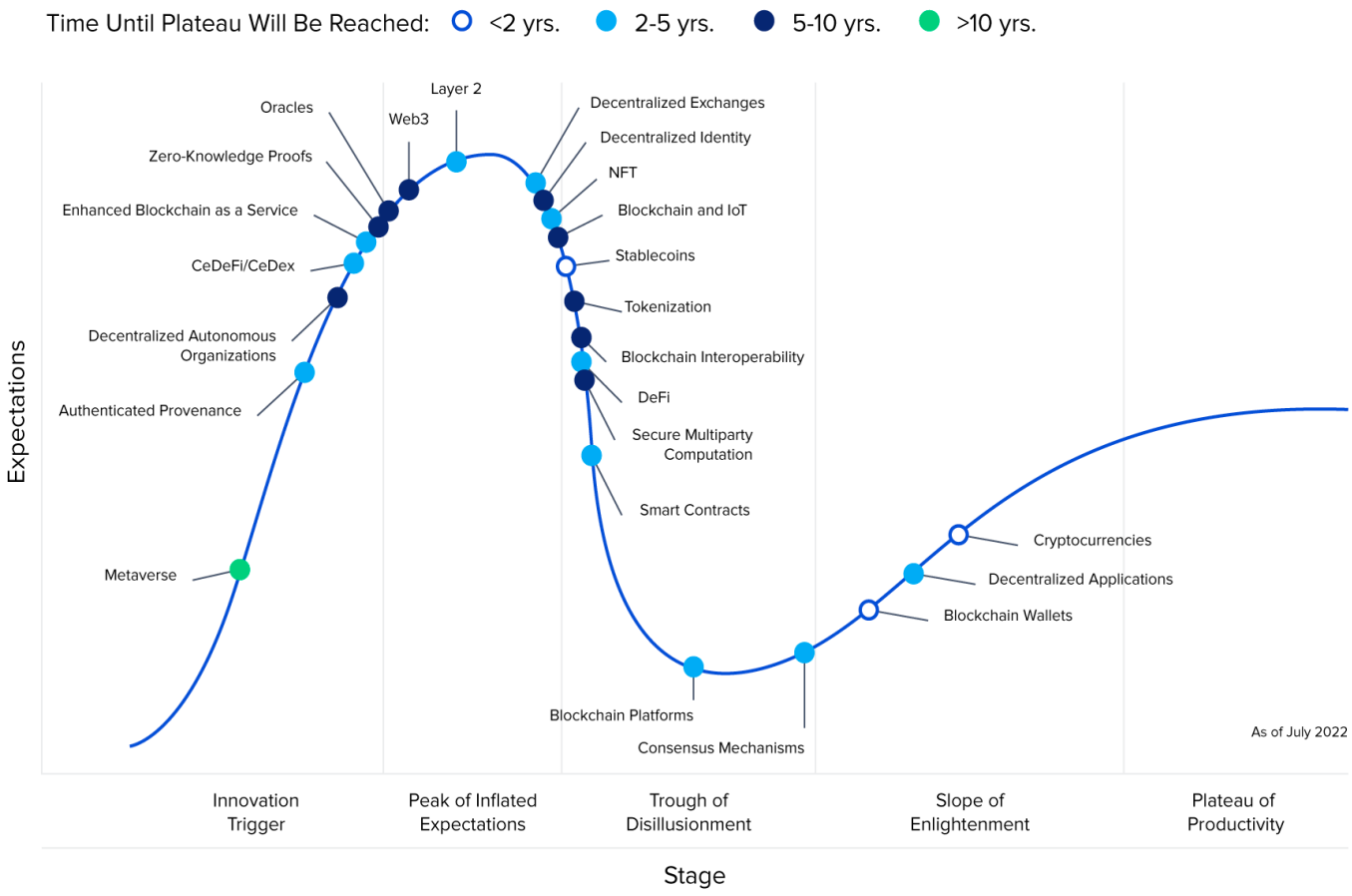
Efficiency and Automation: Blockchain's structure–managing a single distributed ledger collectively through a network of computers–eliminates the need for a central administrator

and creates potential efficiencies. There's no need to reconcile multiple databases in different locations around the globe, so clearing and settlement of, say, financial instruments can be much faster. Certain transactions, like insurance payouts, can also be automated by embedding smart contracts into an application.

However, even for tech-savvy users well versed in e-commerce or enterprise resource planning, blockchain's structure and implementation can be hard to grasp. This helps explain why, even with the multitude of proposed use cases, the adoption of blockchain-based solutions by enterprises has remained low, apart from cautious pilot projects.

Another reason for the slow uptake is the wild ride that cryptocurrencies and other digital asset markets have had. The volatility and 2022 crash are enough to give any company pause, regardless of how tech-forward it may be. And this reluctance may simply be part of the normal process of accepting a new technology. The consulting firm Gartner assessed the industry in July, showing blockchain platforms were mired in a *trough of disillusionment*. The next stage Gartner predicts, however, is an upward *slope of enlightenment*.

Gartner Hype Cycle for Blockchain and Web3



Source: Gartner, July 2022

[Alt text: A line graph depicts Gartner's hype cycle for blockchain and other innovations

related to web3, the decentralized model of the internet running on the open ledger. The cycle rises to a peak of inflated expectations, drops into a "trough of disillusionment," and then rises up a "slope of enlightenment" to a "plateau of productivity." Various applications, such as the metaverse, decentralized exchanges, and NFTs are featured on the cycle. The data indicates companies have recently become disillusioned with blockchain platforms and consensus mechanisms, but their confidence is expected to rebound within two to five years.] [Caption: The hype cycle for blockchain and web3 shows the typical evolution of how companies feel about innovative technologies over time. Despite blockchain platforms' position at the bottom of the trajectory in mid-2022, confidence in the technology is projected to rise again as more businesses realize the potential for non-crypto applications.]

Arguably, we have already begun traveling up the slope of enlightenment. Walmart has used the technology to better manage consumer products in the US and China while also deploying a blockchain-based solution to address persistent discrepancies in the invoice and payment process for its freight carriers in Canada. IBM and the shipping giant Maersk have been working together on a platform to eliminate inefficient paper-based processes.

But perhaps the best argument for blockchain's usefulness and versatility in supply chain management is seeing it in action. I'll use an example from my own work to illustrate the technology's application and benefits.

Blockchain for Supply Chain Case Study: Rio Tinto and Corona Beer

From 2019 to 2021, I was an advisor on digital strategy and transformation at Rio Tinto, helping the world's second-largest metals and mining company develop an application that tracks aluminum from mine to market. The Melbourne, Australia-based company produces more than 3 million metric tons of the metal each year. The process begins with the mining of bauxite ore globally, though predominantly in Australia and Canada; the ore is then shipped to plants throughout the same countries, where it is refined and smelted into aluminum and sold to customers around the world that shape the sheets, rods, or ingots into everything from beverage cans to car parts.

When I started working with Rio Tinto, the company wanted to increase transparency and traceability across the metal's value chain, and we built a bespoke platform on a private blockchain-based network. Blockchain enabled the firm to give its manufacturing and operations customers full end-to-end visibility into its trade lanes in real time. It could track each sheet of aluminum along the supply chain. All data was stored as an immutable record that all producers, shippers, logistics specialists, and deliverers could access—saving time and money by eliminating repeated manual handling of information. As a result, the company delivered the increased transparency that its consumers demanded.

The company's ability to share the origin of all inputs into the production process—including its recycled materials—with greater assurance and ease built investor confidence in Rio

Tinto's customers and ensured that they could meet evolving industry standards and government regulations.

In 2021, Rio Tinto launched START Responsible Aluminum, a platform that includes, among other key pieces of information, sustainability reporting collected from each site where the metal is produced. Through this platform, Rio Tinto's customers access personalized dashboards where they can see all documents related to their orders, including sustainability insights. Every aluminum order is assigned a QR code that is linked to a report generated from the dashboard, showing the aluminum's provenance. Customers can also use the platform to map their industry-specific environmental reporting requirements and conduct comparative life cycle assessments of their inputs, quantifying impacts such as energy use and air emissions.

Consumer Benefits: QR Codes for Corona Cans

One of Rio Tinto's partners, Corona Canada, a unit of AB InBev, conducted a trial of the START technology by printing QR codes from the platform on 1.2 million cans of beer it sold in Ontario. Consumers who hovered their smartphones over the code got a link to a webpage generated by Rio Tinto's platform that showed the journey of the cans, from bauxite mine to liquor store, including data on sustainability and environmental impact. The page specifies how much of the aluminum was derived from recycling and how much from mining, as well as the carbon footprint, water use, and regulatory compliance of the production site. Thus, consumers can see that, for example, the large amount of energy required to produce the aluminum was offset by low carbon, renewable hydropower, and high recycled content.

Source: Business Wire

[Alt text: An image of a can of Corona Extra beer with a QR code from the aluminum producer, Rio Tinto. Consumers can scan the code to access a webpage on the blockchain

detailing the can's journey from mine to market, including data on sustainability and environmental impact. Text to the right of the code reads, "Scan here to learn more," and text above it says, "This can's carbon footprint is now 30% lower."]
[Caption: Rio Tinto's QR code, prominently positioned on Corona Canada's can of Corona Extra beer, gives consumers detailed, traceable, and immutable information about the production of the aluminum used in the can and suggests how environmentally responsible its producers are.]

Corona provides just one example of how this technology can benefit consumers. Carrefour, the French supermarket chain, has shown how blockchain can be applied to the food sector, using it to store information about the origin of products beginning with organic chicken in 2018. The company also prints QR codes on packaging so consumers have complete transparency.

What to Consider Before Switching to Blockchain

Every company has its own individual needs and a unique supply chain. But there are some basic factors to evaluate if you're thinking about using a blockchain platform.

Public vs. Private Platforms

Your first major choice will be whether to go with a public or private blockchain. The best-known blockchains are public, like the one that supports the cryptocurrency Bitcoin. It's a distributed, encrypted ledger implemented on top of a peer-to-peer network open to anyone to use and view. The same is true of Ethereum, though, in addition to its cryptocurrency, Ether (or ETH), it supports smart contract functionality and about 3,000 decentralized apps, or dApps, largely focused on providing alternatives for payments and financial services.

If your company's a startup, you'll most likely want the public option, which is preferred by most early-stage businesses—it's turnkey, making it conducive to industry disruption. Established companies favor private, or permissioned, blockchains, and these are the networks I recommend. They were developed so businesses could use the same distributed ledger technology to design customized solutions, but with advanced privacy controls. Data is shared only with authenticated, authorized members. The peer-to-peer network is limited, which may hamper functionality but can improve other aspects, such as speed and scalability, and drive down development cost.

Evaluating Permissioned Blockchains

If your firm opts for a permissioned blockchain, there are numerous platforms that merit consideration. One of the most popular permissioned blockchains for enterprise businesses is Hyperledger Fabric, which enables companies to develop their own networks. It's overseen by the Linux Foundation, which manages the open-source computer programming language.

Like Linux, Hyperledger's code is written collaboratively and the technology is free for developers. R3's Corda is primarily used on finance-related projects to track and trade digital assets. Although Ethereum is public, it also operates a private network isolated from its main blockchain to appeal specifically to enterprises seeking more privacy. JPMorgan Chase developed the platform Quorum by creating a fork (a copy) from the Ethereum blockchain. Like Corda, it's intended mainly for financial services.

Given the multitude of options, your company should consider the following questions as you make your choice:

What is the consensus mechanism? Blockchains all use a consensus mechanism, the algorithm that allows independent participants on a network to operate without having to trust each other. The original and arguably most secure mechanism, used by Bitcoin, is known as proof of work. The problem is this algorithm requires tremendous computing power, which consumes vast amounts of electricity and attracts scrutiny from government regulators and environmentalists. Ethereum recently switched from proof of work to proof of stake, a less power-hungry option that reduced energy consumption by more than 99%. If the energy cost and environmental impact of your network factor into your decision, you may favor permissioned platforms, which don't use proof of work, either.

What about governance? A permissioned blockchain essentially reintroduces the notion of a central point of control, even though it maintains the other features of digital ledger technology. However, whether it's a wide or narrow network that's being created, it must have some degree of appropriate governance to protect the interest of all stakeholders, especially if the platform will be used to share proprietary information with customers or government officials. Corda collaborates with regulators, trade associations, and government agencies to help develop standards.

How much does it cost? Some permissioned blockchains, like Hyperledger Fabric, are free, at least to access existing software to develop a platform. But there are other costs to consider, like licensing and the operating expense of cloud services, not to mention the need to hire software developers with blockchain expertise to configure, customize, and support your platform. However, because the nodes are centrally managed, there's no need for expensive systems like mining or staking rewards, or the transaction fees that compensate node runners.

What about the company's existing system? Interoperability and integration are always big questions. A blockchain-based solution doesn't have to replace a legacy system—it can be built alongside it. Then, your company has to determine what or whom it can connect that solution to inside and outside your organization, and how easy, secure, cost-effective, and efficient that will be. Modern systems use Application Programming Interfaces (APIs) as robust, versatile, consistent ways to facilitate this connection and data exchange. Many

enterprises have dedicated platforms on the premises or in the cloud for API management, and open-source blockchain systems, particularly Hyperledger Fabric, make secure, scalable data transfer straightforward.

It's impossible to tell exactly what the future holds. But blockchain has proven its usefulness in supply chain management for companies like Rio Tinto. PWC predicts it will boost global gross domestic product by $1.76 trillion by 2030, as industries discover how to employ it to better secure, share, and use their data. While I can't be certain that will come to pass, I am sure that the technology will continue to produce success stories that will demonstrate to other businesses how valuable it can be for their operations efficiency.

Link to article on Toptal finance blog: Blockchain and Supply Chain Management | Toptal®