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# *Understanding Blockchain, Part 2:*
# Applications for the Emerging Distributed Ledger Platform

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## Executive Summary

Blockchain is an emerging technology platform for recording, securing and sharing information among members of a business ecosystem. The suitability and benefits of blockchain are being studied and aggressively piloted in a broad range of sectors, including finance, insurance, retail, manufacturing, hospitality, healthcare and government. The results show efficiency and effectiveness opportunities in three main categories: transaction streamlining; tracking and auditing; and data and records management. Leaders of enterprise operations and individual functions such as IT, finance, human resources and procurement, should familiarize themselves with the experiences of early adopters and evaluate the suitability of their own applications and processes for blockchain.

Critics put off by blockchain hype see it as a solution looking for a problem. Those who equate it with the cryptocurrency bitcoin tend to dismiss its relevance for their business. Granted, blockchain technology is inherently complex and difficult to understand. But, it does offer several compelling value drivers for enterprises that conduct business across networked value chains or ecosystems. These include record fidelity, speed, security, selective transparency/privacy, fault tolerance, and the ability to track and trace transactions. Business leaders should look beyond the hype to consider how these value drivers may enhance or enable their existing applications and create the potential to develop new ones.

To appreciate the potential value of blockchain, it is important to understand that it is an emerging enterprise-grade application platform capable of executing, validating and recording transactions across a decentralized network. The platform's digital ledger, including all data entered before, during and after each transaction, is replicated and selectively shared across the network. Any attempt to alter the chain of records would be apparent immediately and invalidated. This effectively renders the record immutable, and as such, it can be depended on as a secure, single version of the truth. (*See sidebar on the next page for a more detailed definition of blockchain.*)

The immutability of records is blockchain's unique value proposition for decentralized, distributed networks. Without blockchain, every member of a network would have to enter and store each transaction record in its own individual ledger or database. Without blockchain, members of a value chain typically receive electronic notifications of transactions and then have to update their respective databases independently. These notifications and updates are subject to errors, omissions and cyber attacks, which cause discrepancies and potential disputes among the members. Blockchain's unchanging, distributed ledger eliminates these vulnerabilities and streamlines the recording of transaction data.

Cost savings are a key business benefit of blockchain. Companies whose ecosystems encompass multiple players with a high degree of transactional "friction" would benefit

### *Blockchain defined*

The Hackett Group defines blockchain as an application platform used to design, build, run and manage decentralized applications, i.e., applications that run across all members, or nodes of a network. Unlike centralized applications that are hosted and controlled by a single entity, the code or business logic of distributed applications is replicated and synchronized on each node of the network. Blockchain networks have a peer-to-peer topology, meaning all nodes share information with each other without having to confer with an authority through a central node.

Blockchain's data architecture is based on the concept of the distributed ledger. A ledger is a table containing records of transactions, and blockchain distributed ledgers are replicated on all nodes on the network. The ledgers are structured as a chain of data "blocks," each one of containing transactional records. Before being added to the chain, new data blocks are validated by consensus of ecosystem participants. Once a block has been added to the chain, it cannot be tampered with by anyone inside or outside the network.

Putting it all together, blockchain is a platform to design, build, run and manage decentralized applications that are based on a distributed ledger data architecture and distributed business logic. Blockchain applications run on a peer-to-peer network and support execution and registration of transactions between participants in an ecosystem or internal application landscape.

from blockchain's efficiency advantages. For example, studies in investment banking have found that a blockchain network tapping into a single, shared source of data could reduce finance reporting costs by 70%. Eliminating the steps of trade confirmation and reconciliation could cut the costs of clearance, settlement and investigations in half. The cost of compliance could be lowered by 30% to 50% thanks to the transaction transparency and auditability of the distributed ledger concept. The relatively simple setup for basic blockchains, which are based on open-source protocols, can also cost less compared to establishing traditional multinode networks accessing multiple databases.

While cost savings represent the most fundamental benefit, blockchain offers several distinct value drivers that can generate effectiveness as well as efficiency:

- Data integrity and consistency: It is highly improbable for inconsistent records to exist within different nodes of a blockchain network.
- Availability and fault tolerance: Blockchain applications are always available (at least meeting "five 9s" availability, or 99.999% percent) and the architecture is inherently fault tolerant; there is no single point of failure common to centralized networks.
- Information security: Authentication and encryption techniques in blockchain provide higher levels of security and the ability to shield private or privileged information from unconcerned network participants, compared to traditional distributed data and application architecture.
- Auditability: Blockchain ensures data integrity and the immutability of transaction records, allowing for accurate audits of recorded transactions.
- Process improvement: Blockchain's peer-to-peer network structure permits faster, simpler and more automated transaction processes because it eliminates many of the activities and human interventions required in a hierarchical, centralized structure.
- Business model innovation: Disintermediation of actors and actions in a business ecosystem makes possible the redesign of value chains and development of new business models.

These individual value drivers translate into three main benefit categories: transaction streamlining; tracking and auditing; and data and records management. For each, there are applicable use cases which align with different vertical industries. Further, these use cases may originate with, or affect, specific business functions in the adopting enterprises.

## Use Cases: Transaction Streamlining

Blockchain records, validates and distributes the transactional information needed by members of business value chain. It also streamlines, accelerates and potentially reduces the costs of transactions by eliminating the need for transacting businesses or their intermediaries to conduct (often manually) data entry, inquiry, validation, authorization and escrowing of funds.

Ecosystem participants benefit from the instantly updated, trusted, secure and more accurate transaction record that the blockchain builds and shares. It can be difficult to integrate and share data between disparate ERP systems belonging to multiple members of a business ecosystem. A blockchain, however, can import certain data from members' ERP systems, standardize it, and make it shareable by the participants.

Transaction streams can be further accelerated and automated by the addition of distributed application logic (implemented as coded smart contracts[1], chaincode and others) built atop the blockchain. This code can automatically execute actions within the transaction stream without the need for manual authorization.

[1] Originating in the ethereum blockchain framework, smart contracts define agreed-upon actions between contracting and transacting parties, which are self-executing (i.e., without involvement of third parties) based on conditions defined in the contract as verified by the blockchain. The hyperledger framework uses so-called chaincode to implement similar distributed business logic

Blockchain's ability to streamline transactions has the broadest appeal of the three major benefit categories identified.

The appeal of blockchain's transaction streamlining is the broadest of the three major benefit categories and promises the biggest bang for the buck. It serves global finance as well as microfinance, traditional e-commerce and direct creator-to-consumer sales models (Fig. 1).

**FIG. 1 Transaction streamlining blockchain use-case landscape**

| Transaction streamlining use cases | Primary value drivers | Relevant vertical industries | Principal business functions impacted |
|---|---|---|---|
| Trade settlement | Data integrity, availability, security, auditability | Finance, banking, shipping | Finance, legal, IT* |
| Financial fraud and duplicate payment reduction | Data integrity, auditability, process improvement | Finance, banking, insurance | Finance, legal, IT |
| E-commerce transactions | Availability, security, process improvement | Retail, online consumer and business services, shipping | Sales, supply chain, procurement, IT |
| Lean manufacturing | Data integrity, availability, process improvement | Manufacturing | Supply chain, procurement, operations |
| Microfinance | Security, process improvement | Lending institutions, humanitarian NGOs | Finance, legal, IT |
| Direct sales by content creators | Security, process improvement, business model innovation | Music, publishing | Sales, supply chain |
| X-as-a-service (pay per use) | Availability, security, process improvement, business model innovation | Software, subscription services | Sales, supply chain, procurement, IT |

**IT includes cybersecurity*

Source: The Hackett Group

In public blockchains such as bitcoin, replication of transaction data on every node of the network is an aspect of its value. At the same time, this characteristic has been a source of concern for institutions such as banks and brokerages that need to maintain the privacy of individual customers' transaction activity. However, private blockchain platforms are now able to use mechanisms to restrict access to transaction data, and cryptographic tools allow transaction verification between parties while keeping some details private, such as client identities. Consequently, the financial sectors have launched some of the most advanced blockchain pilots.

Some of the most advanced blockchain pilots have been launched in the financial sector.

For example, TD Ameritrade has a dedicated team looking into how blockchain can be used to accelerate asset clearance by facilitating asset transfer and verification between entities. To manage risk, pilots have been limited to in-house ecosystem participants – the first being a money transfer between TD Ameritrade's brokerage service and its affiliate TD Bank, conducted in near real-time.

Governments are using blockchain to facilitate trade within their borders and globally. This spring, United Arab Emirates announced a blockchain initiative that would have 50% of all government transactions conducted on the technology by 2021. According to UAE leadership, the government will save $3 billion annually on document transaction processing, cut the number of government documents by 389 million, save 77 million hours of work, and eliminate nearly one billion miles of driving.

For the emerging "everything as a service" delivery model, blockchain application code will be a key to enabling pay-by-the-use arrangements between service providers and consumers. The capability may inspire new business models, such as variations on a subscription-based business model. For IT, procurement and finance functions working with vendors of software and platform as a service, blockchain will make it more practical and effective to pay for services on a usage basis.

Blockchain provides an unimpeachable audit trail, making it an attractive platform for law enforcement, healthcare, hospitality and entertainment.

## Use Cases: Tracking and Auditing

Blockchain can record the individual node's activity (transactions), create and share a record of the same, and provide an unimpeachable audit trail. These capabilities have made blockchain attractive as a platform for industries ranging from hospitality to healthcare and entertainment to law enforcement. Finance and procurement functions within these industries are planning to tap blockchain's tracking and auditing capabilities to reduce redundant, unauthorized or incorrect payments for products, services and invoices (Fig. 2).

**FIG. 2 Tracking and auditing blockchain use-case landscape**

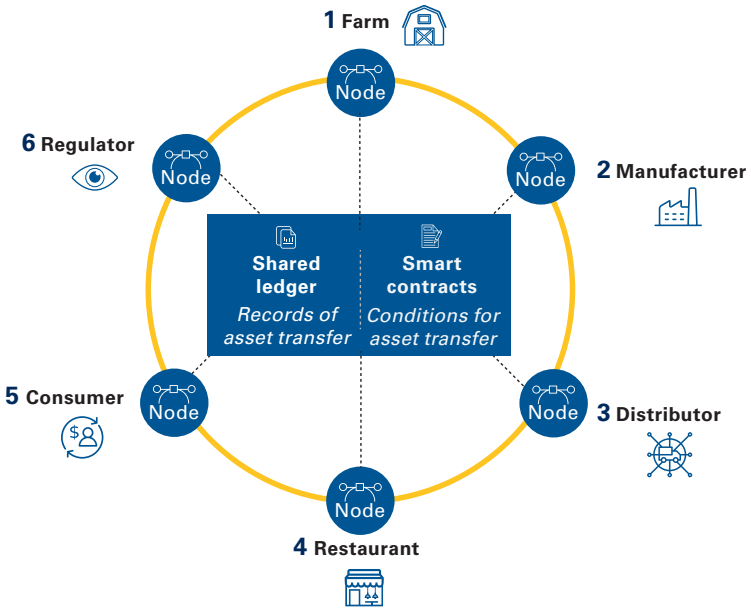
| Tracking and auditing use cases | Primary value drivers | Relevant vertical industries | Principal business functions impacted |
|---|---|---|---|
| Consumables lifecycle management/ingredient tracking | Data integrity, security, auditability, process improvement | Pharma, healthcare, agriculture, food/ beverage, retail, shipping, regulators | Supply chain, procurement, operations, legal |
| E-commerce counterfeit goods reduction | Security, auditability | Online retail, luxury goods manufacturers, law enforcement, shipping | Supply chain, operations, legal |
| Intellectual property rights enforcement | Data integrity, security, auditability | Entertainment, R&D, law enforcement, legal | Finance, legal, IT* |
| Regulatory monitoring | Availability, security, auditability | Public sector | Operations, legal, IT |
| Customer loyalty programs | Availability, security, auditability, process improvement | Retail, hospitality, entertainment | Supply chain, procurement, operations |
| Electronic voting | Availability, security, auditability | Public sector, research organizations, entertainment | Operations, legal, IT |

**IT includes cybersecurity*

Source: The Hackett Group

Food-service companies can similarly validate the origins and routes of their products and ingredients from harvest to point of sale, which will help with inventory management. The information can also be used in marketing to customers. The same ledger technology can be used in combination with smart-contract code to automate many of the transactions associated with the movement and inspection of food items (Fig. 3).

**FIG. 3 Blockchain for a food distribution ecosystem**




Source: The Hackett Group

IBM is working with food growers such as Dole and Driscoll's, and food retailers, including Walmart, on applications that track the origins of foods as a way to speed responses to breakouts of food-borne illnesses. Another food-related blockchain application is validation of organic or fair-trade certifications for specific food batches.

The healthcare sector is interested in blockchain's replication and tracking capabilities for medical products and patient records. Edwina Payne, the CIO of medical-device company Halyard Health, speaking at The Hackett Group's Best Practices Conference in May 2018, explained her company's blockchain interest: "We spend a great deal of time within the medical-device and life-sciences industry doing lot traceability," she said. "We could start to leverage blockchain to get that traceability information from our raw materials through our contract manufacturers and be able to record it as part of our own manufacturing processes." The efficiency benefits would accrue not only to Halyard, but to the patients and hospitals that buy its products. In pharmaceuticals, Pfizer formed a dedicated team in 2017 to study the potential application of blockchain to pharmaceutical development, manufacture and distribution.

In large, diverse enterprises or business ecosystems, blockchain could be leveraged as a master data management solution.

## Use Cases: Data and Records Management

At its core, blockchain is an electronic ledger, and ledgers are tools for record-keeping. Therefore, one of the technology's most fundamental applications is accurate and secure record sharing among network nodes. The records can be rendered transparent or kept private as desired. As a distributed data architecture, blockchain can help business ecosystems or even large, diverse enterprises share data that would otherwise be impossible or highly problematic because of divergent data standards, protocols and models. In this sense, IT functions could leverage blockchain as a master data management solution for non-relational data, potentially saving the cost and effort of standardizing data architectures or models (Fig. 4).

**FIG. 4 Data and records management blockchain use-case landscape**

| Data and records management use cases | Primary value drivers | Relevant vertical industries | Principal business functions impacted |
|---|---|---|---|
| Electronic medical records | Data integrity, security, auditability, process improvement | Pharma, healthcare providers, humanitarian NGOs | Operations, IT*, legal |
| Voting records | Data integrity, security, auditability | Public sector, research organizations | Legal, IT |
| Proof of identity | Data integrity, security, auditability | Public sector, law enforcement, legal, finance | Operations, finance, IT, legal |
| Property ownership registry | Data integrity, security, auditability | Public sector, legal, humanitarian NGOs | Finance, legal |
| Professional credentialing | Data integrity, security, auditability | Public sector, legal, finance insurance | Legal, IT |
| Enterprise/ecosystem master data management | Data integrity, availability, security, auditability, process improvement | Retail, hospitality, entertainment | IT, operations, finance, supply chain, human resources |

**IT includes cybersecurity*

Source: The Hackett Group

In healthcare, blockchain has the potential to enable the long-desired portable platform for patient medical records. With patients' permission, electronic records could be shared across a secure distributed network of providers. Any changes made, such as addition of tests ordered and their results, would be replicated to the shared record. This could help avoid duplicative testing, medication errors and other costly and harmful mistakes that are common in decentralized healthcare systems. The best-known pilot occurred last year, when Beth Israel Deaconess Medical Center in Boston teamed with the Massachusetts Institute of Technology. It used an ethereum smart-contract blockchain to retrieve permission-granted patient data from separate local databases and share it with medical professionals.

Other pilots have been run by humanitarian organizations in refugee camps, where medical records are particularly challenging to handle. Iryo, a medical-records startup, used blockchain in camps in Jordan to enable refugees to store their health data on their own mobile phones. Humanitarian NGOs can also use open-source blockchain platforms to identify recipients and authorize aid distribution. The World Food Program is running a full-scale pilot in Jordan with more than 10,000 Syrian refugees. Individuals' identities are verified and their food-purchase transactions from local shops are recorded in a blockchain.

In developing countries, blockchain has been proposed as a platform for property registries. Land and property ownership would be legally registered and documented in a distributed public ledger, making it easy for people to prove ownership. For example, destruction from hurricane Maria in Puerto Rico last year left many without documentation of home ownership. This made them ineligible for government rebuilding assistance.

## Recommendations

Leaders in finance, IT, procurement, human resources and enterprise operations should familiarize themselves with blockchain's value drivers and use-case categories in order to make informed decisions about the technology's applicability. Organizations in a broad range of industries are already conducting proofs of concept internally, as well as piloting more robust applications with trusted partners in their ecosystems. Critical steps to take now include:

- Understand the differences between private blockchain networks and public blockchains such as ethereum, bitcoin, and other cryptocurrency networks. The latter have less relevance to most private-sector organizations.
- Identify the organization's enterprise and business ecosystem-spanning processes that are the most cumbersome, costly or suboptimized. These could be candidates for blockchain.
- Map organization processes and business ecosystems to blockchain's value drivers, relevant industries and business functions impacted.
- Learn about the technology landscape of blockchain platforms and providers.
- Conduct a proof of concept using an internal, enterprise-spanning process that draws on data from a diverse selection of databases.
- Evaluate the suitability of potential blockchain applications based on potential benefits and the relevance of various application process and technology factors. *(See next page for an example.)*
- Conduct a pilot; then evaluate ROI and nonfinancial benefits while weighing risks.

# Evaluating the suitability of blockchain applications

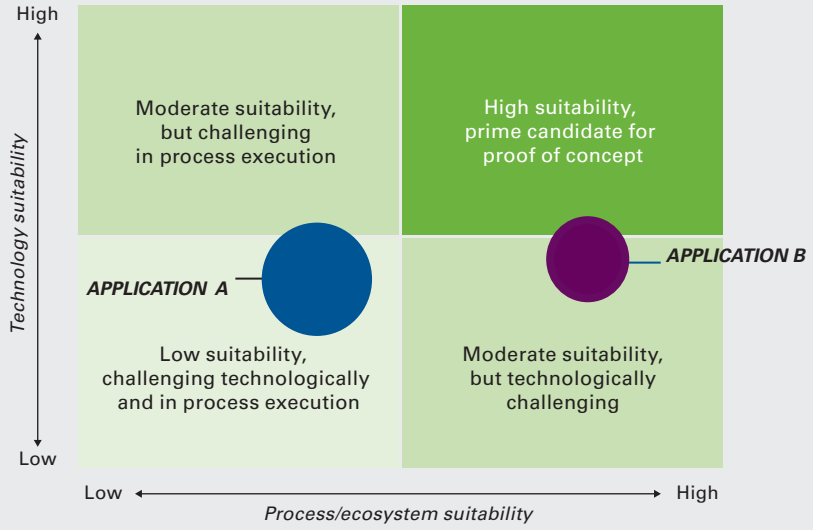
Business leaders considering whether and how blockchain can improve or enable a specific application or process can adapt the following evaluation criteria and decision matrix to their needs. With it, they can determine which blockchain value drivers are most relevant to the application or process being considered. By assigning importance weightings to each benefit and a score for its relevance to the particular application being considered, an overall benefit-relevance level can be determined for a given application.

Blockchain's fit for particular applications can be further refined by gauging the importance and applicability of various process, ecosystem and technology factors. The higher the score, the more suitable the application is for blockchain. The X-Y plot for high-scoring applications will trend toward the upper-right quadrant.

The degree of benefit relevance/importance of each considered application can be diagrammed in a chart like the one shown here as Fig. A, with the highest-scoring applications represented by the largest circles. The degree of process and technology suitability will be represented on the chart's X and Y axes. Multiple application alternatives can be positioned on the grid to show relative suitability.

The Hackett Group can help organizations apply a suitability evaluation to their potential blockchain applications, and advise on which make sense to develop into proofs of concept.

**FIG. A Comparison of blockchain application candidates**




Source: The Hackett Group

## About the Advisors

**Richard Pastore**
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Mr. Pastore develops and delivers research and related resources for The Hackett Group's advisory programs, including IT. He has over 25 years of experience working with CIOs and their teams to apply thought leadership and best practices to help them extract the maximum business value from strategic investments in technology. Mr. Pastore has spent the last 10 years designing, implementing and managing IT and business transformation leadership programs, including best practices research, seminars, workshops and conferences, assessment tools and frameworks for Fortune 1000 companies. He is former editor of *CIO* magazine and vice president of the CIO Executive Council.

**Adeel Haque**
*Blockchain EMEA Lead and Senior Manager, Finance Transformation*

Mr. Haque is The Hackett Group's lead for blockchain and fintech engagements in the EMEA region, heading technology-related transformation and optimization initiatives in finance organizations. He also leads development teams as an architect and manages complex system design and implementation projects. Among his areas of expertise are finance organization optimization (blockchain, ERP and EPM); system strategy, and governance and support process design. Before joining the company two years ago, he held various strategic and technical finance leadership roles at companies including IBM, Fergusson Plc and GE Healthcare.

**Mark Peicker**
*Director, Finance Transformation*

Mr. Peicker has over 12 years of business and 15 years of consulting experience in designing and leading order-to-cash, purchase-to-pay, shared services, and other transformation and globalization projects. Working with clients in finance and procurement, he redesigns strategic and tactical business processes for greater efficiency and effectiveness, and helps improve the decision-making cycle. Other competencies include design and implementation of global business services; organization design; and business process outsourcing and transition.

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