Risk and Opportunity:
A Board Primer on Blockchain

NACD ELEVATE BOARD PERFORMANCE

Ready for Next

Blockchain: it's probably the best-known and least-understood emerging technology today.

Many assume blockchain is synonymous with cryptocurrency, especially since Bitcoin gets most of the headlines. But that's just the tip of the iceberg.

At its most basic, blockchain delivers a more secure and efficient recordkeeping mechanism. Although there are currently few widespread use cases beyond cryptocurrency, most experts agree that the technology is poised to create enormous value by driving new operational efficiencies and helping organizations manage risk.

In the next decade, expect widespread adoption as many basic operations and business processes (e.g., information and data management, supply-chain communications, and payments) begin to utilize blockchain technology. Any industry reliant on intermediaries to facilitate transactions or manage interactions is subject to disruption from blockchain. The financial services industry, in particular, will likely undergo massive change.

Such disruption presents tremendous risk and opportunity. Blockchain will create new markets that forward-thinking companies can exploit. There will be significant competitive advantage for leaders who can innovate in this space. At the same time, many companies and existing service providers may be rendered redundant or ultimately obsolete.

Drawing on interviews with blockchain experts, this white paper discusses four key questions to help strengthen director understanding of this rapidly emerging technology.

Our goal is to equip corporate directors with the resources to ignite meaningful conversation with management about blockchain so that they can take advantage of the strategic opportunities offered by this new technology and begin putting the pieces in place for long-term success.

TABLE OF CONTENTS

Part 1: What is blockchain?

Blockchain is a digital record-keeping mechanism designed to generate trust between counterparties without the need for a third-party intermediary. Consider, for example, all of the intermediaries involved in home buying: someone must verify a clear title, provide title insurance, ensure that monies are in the bank and so on. This kind of trust dilemma can be resolved with blockchain because the technology preserves a mutually-intelligible, single source of truth. Here's how it works:

BLOCKS IN A CHAIN

First, transaction data is recorded in a "block" using what are called "hash codes." Every new transaction generates a new block of information. The key is that each subsequent block captures data not only for the new transaction, but also for every previous transaction as well. That's how the "chain" in a blockchain is created.

DISTRIBUTED LEDGER TECHNOLOGY

The distributed ledger is where all the blocks in a chain are stored. It's called a distributed ledger because the ledger itself is "distributed" across all "nodes" in a computer network—data is never stored in a single place. In other words, instead of a single database on a single server, the distributed ledger contains many copies of the same database across many servers. Any node can cohost the distributed ledger, which is synchronized every time a new block is created. The advantage is that all participants have a copy of the ledger, so there is no need for a centralized recordkeeper.

CRYPTOGRAPHY

Since a blockchain is stored on a peer-to-peer distributed ledger, any node in the network is vulnerable to a security breach. For that reason, each block in the chain is encrypted so that only those with permission can access the data. Because of data redundancy across the chain, a breach to one block does not affect the rest of the chain.

In its simplest form, this is what a blockchain looks like:

| Block 1	Block 2	Block 3	Block 4	Block 5
A	B + A	C + B + A	D + C + B + A	E + D + C + B + A
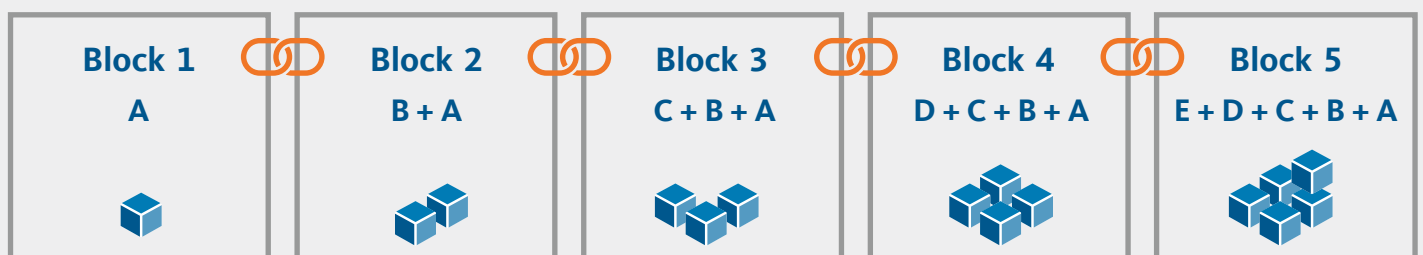
Imagine that each letter represents the data associated with a single transaction. Notice that when the second transaction is recorded in Block 2, it captures data for the new transaction (B) as well as the previous transaction (A). It does the same thing for every subsequent block *ad infinitum*.

The advantage is that each block effectively contains a verification of the existing chain of transactions. Redundant verifications make it extremely difficult to revise/edit data inputs, since new revisions will not match the hash code contained in the previous blocks.
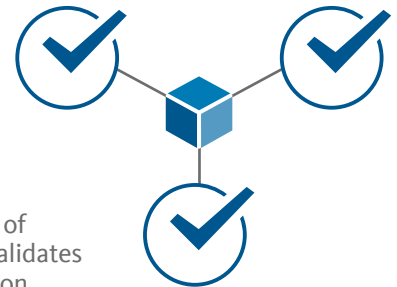
How blockchain technology works.
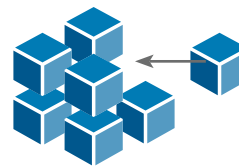
Someone requests a transaction
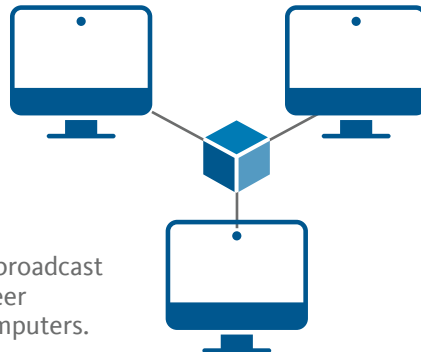
The requested transaction is broadcast to a peer-to-peer network of computers.
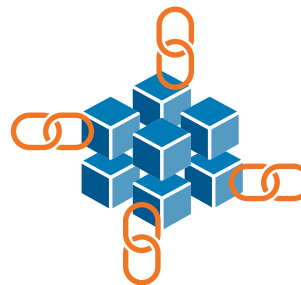
The network of computers validates the transaction.

Once verified, the transaction is combined with other transactions to create a new block of data for the ledger.

The new block is then added to the existing blockchain. Once added, it is permanent and unalterable.

The transaction is complete.

Advantages of blockchain technology

TRANSPARENCY

Because every node carries an exact copy of the entire chain, and because each block contains a copy of every previous block, blockchain can maximize transparency and visibility.

SECURITY

Encryption helps minimize vulnerability to hacking. And even if there is a security breach, data redundancies across the chain help preserve data integrity.

EFFICIENCY

Distributed ledger technology eliminates the need for a third party, eliminating the costs associated with intermediaries.

Part 2: How is blockchain technology being used in business?

Horacio Barakat, vice president of corporate strategy at Broadridge Financial Solutions, describes the two main ways that blockchain technology is making an impact: "First, we're seeing existing business models undergo change. Any ecosystem reliant on one or more fiduciaries that provide transactional trust will experience disruption. Secondly, we're seeing blockchain generate new process efficiencies."

Ecosystems built on multiple intermediaries depend on a bevy of expensive, time-consuming and error-prone reconciliation processes. Blockchain helps alleviate these challenges by eliminating intermediaries while creating a unified recordkeeping ledger. With blockchain, there is no need for reconciliation because there is only one distributed ledger to which all parties are already connected.

Here are a number of different ways blockchain is being used to enhance security, boost efficiency and maximize transparency.

SUPPLY CHAIN MANAGEMENT

Food supply chains involve several participants, from farmers and processors to distributors and transporters. Each participant maintains their own recordkeeping system, which tracks different indicators and captures different data points. Some of the recordkeeping systems are still paper-based and almost none of the systems can communicate with any other system. Blockchain can be used to create a single source of reality for all participants, one that makes it easier to track movement and improve accountability. Stores can now identify exactly where all food comes from, whether it was responsibly grown, at what temperature it was stored during transport, the length of time the food was in transit and so on. "The biggest thing is that stores can quickly and accurately locate the source of contaminated food to prevent outbreaks," explained Christa Steele, founder and CEO of Boardroom Consulting LLC.

FINANCIAL SERVICES

Securities clearing and settlement: In late 2017, the Australian Securities Exchange (ASX) announced that it would move all clearance and settlement to a permissioned distributed ledger to minimize reconciliation and improve recordkeeping.[1] Today, securities can be traded very quickly (usually in only a few seconds), yet settling a transaction still takes days. Delays are caused by the myriad of intermediaries required to certify and transfer share ownership and move assets from one account to another. ASX is betting that transitioning to a distributed ledger can help accelerate the process. If all participants are connected to a distributed ledger, then, in theory, clearance and settlement can be completed as fast as the trade itself.

Proxy voting: Broadridge recently completed a successful pilot using blockchain technology to manage proxy voting for a shareholder meeting. "Traditionally, proxy voting requires real-time reconciliation of multiple databases, while blockchain creates a single, shared database on which all constituents agree," said Lyell Dampeer, president, Investor Communications Solutions US at Broadridge. Agendas, entitlements and votes are captured in cryptographically signed blocks, creating an immutable record of voting and the meeting results.

HEALTHCARE RECORDS

Doctors and insurers need access to patient histories, researchers need access to large datasets and all parties need to maximize data security. Distributed ledger technology provides an efficient means to achieve all of these goals—simultaneously. Imagine if each patient had a longitudinal, tamper-proof record of all doctor visits, procedures, prescribed medicines, and so on. There would never be a need to transition medical records from one provider to another or to reconcile data from multiple systems. Over time, patient records would include family history, making it much easier for doctors to identify relevant risk factors. Eventually, there could be a master ledger of *all* patient records, the holy grail of medical research.

[1] Anna Irrera and Susan Mathew, "Australia's ASX selects blockchain to cut costs," Reuters, December 6, 2017.

Part 3: What are the main hurdles, barriers and risks?

Most blockchain applications are in an experimental phase. As such, each technological breakthrough brings new, unexpected challenges. Here are some of the main problems early adopters have encountered.

Technology limitations	All transactions posted to a blockchain must be verified and recorded by every node (or participant) hosting a copy of the distributed ledger. That means each node must complete the same verification process every time a new block is added to the chain. Verification is thus slow and redundant—and can require enormous computing power. Right now, Bitcoin mining alone consumes enough energy to power all of Switzerland for an entire year. Accordingly, large-scale blockchains may remain out of reach until computing processing power becomes more efficient and cost effective.
Security risks	Blockchains are uniquely suited to ensuring data integrity by making it very difficult to revise or edit records. But, as blockchains become larger, vulnerabilities related to data access increase. "Complex distributed ledgers contain a host of rules and entitlements regarding which participants can access what information and when. Each time a new layer of rules is added there is another opportunity for error," said John Oliveri. Owing mostly to the experimental nature of the technology, developers and engineers don't yet have the experience or expertise necessary to ensure that data access is managed with the requisite degree of security.
Mutualization	Blockchain can't operate effectively unless all participants are connected to the distributed ledger. Think about how it was in the early days of email: if you were the only one among your friends with an email account, email didn't do you much good. It's the same with blockchain. Consider how hard it is to transform one business unit in a single organization—now imagine finding a way to get everyone across an entire industry to adopt and implement a new technology. No one wants to take the leap and invest in blockchain without assurance that others are planning the same investment. Challenges are compounded because there are existing intermediaries who stand to lose if blockchain is widely adopted.

"Part of what's delaying widespread adoption is that we still don't have a standard industry platform. It's a lot like the late '70s when you had to choose between VHS and Betamax. Except in this case the gamble might be millions of dollars, so there's a lot of hesitancy. Companies are taking a wait-and-see approach—waiting for a true industry standard to capture the market. They want a safe bet."

— John Oliveri, Chief Technology Officer, Broadridge

Part 4: How can I start a strategic conversation about blockchain with management?

Many corporate directors express worry that their board isn't prepared to have intelligent, strategic conversations with management about the risks and opportunities associated with blockchain. Part of it is an educational gap: some simply don't understand the technology or feel confident enough to meaningfully engage in a conversation about it.

Here we outline some key questions to help spark productive dialogue, including various frameworks to help guide the right discussions with management.

HOW ARE WE GOING TO BE IMPACTED?

In her recent book, *Blockchain in the Boardroom* (2018), Jennifer C. Wolfe advises boards to perform Blockchain Mapping, a process by which boards convene stakeholders to evaluate ways business practices may be impacted. Wolfe writes that boards should particularly focus on how relationships with customers and suppliers will change in the following areas:

- Real estate ownership or rights
- Financial transactions
- Product supply tracking
- Manufacturing tracking
- Internet of Things
- Digital rights
- Currency
- Delivery tracking

In addition, Wolfe suggests inviting management to conduct a competitive analysis to help protect against potential displacement:

- What are competitors doing with blockchain?
- Who is filing new patents? How many? For what applications?
- Which competitors are driving innovation?
- Are new industry partnerships taking shape?

WHAT ARE OUR INVESTMENT OR PARTNERSHIP OPPORTUNITIES?

To stay current, some companies are starting to make minority investments in early- and late-stage blockchain start-ups. Others are seeking to build internal capabilities, directing additional resources toward research and development. If such investment isn't an option, consider forging new strategic partnerships— perhaps with existing clients or vendors—to discover whether blockchain can create value. The key is giving management the support to cultivate new industry relationships.

HOW DOES BLOCKCHAIN FIT INTO OUR COMPANY'S BROADER DIGITAL TRANSFORMATION?

Technology is transforming nearly every dimension of our world. At this point, boards need to review their company's overall digital strategy:

- How is technology integrated across the enterprise?
- How does management's current technology strategy align with our broader corporate strategy?
- Which emerging technologies can help accelerate growth?
- How can we leverage new technologies to increase our competitive differentiation?
- Do we outsource technology services and operations, or is there good reason to build a new digital infrastructure from the ground up?

No matter the approach, blockchain will only be a small piece of the puzzle.

"There's a convergence of social media, digital retail, robotics, artificial intelligence, wearables, blockchain, Internet of Things, big data and advanced analytics. Corporate directors must look at the whole picture. How do all the pieces fit together?"

— Christa Steele, Founder and CEO, Boardroom Consulting LLC

WHO TAKES THE LEAD ON BLOCKCHAIN?

Some organizations create internal centers for innovation to drive experimentation around new technologies. Others choose to bring in tech-savvy CEOs. There are, however, downsides to promoting developers and engineers who tend to view the world through narrower lenses. "Sometimes it's better to educate existing executives who already do big-picture thinking," said Steele.

Regardless of who takes the lead, corporate directors must work to ensure effective communication across all relevant business units to maximize utility and value. In addition, boards should install accountability mechanisms, as well as provide leadership with sufficient authority, funding and access to the rest of the organization.

ARE WE OPERATIONALLY PREPARED TO REAP THE BENEFITS FROM BLOCKCHAIN?

Not every organization can immediately benefit from blockchain technology. It's important to identify specific business problems to solve for and develop appropriate criteria to measure outcomes. Take time to identify pain points and process inefficiencies, risks, and vulnerabilities. Consider the answers to these questions:

• Is there an infrastructure in place?
• Do we have the right talent?
• Are we distributing resources effectively?
• Do our internal decision-making processes reflect our goals?
• Do we have a clear understanding why a distributed ledger (through the use of blockchain) is better for our organization than a secure, well-constructed database?

Below is a decision tree we adapted from the United States Department of Homeland Security. Decision trees help guide and orient discussions with management to help boards identify areas where additional investment and innovation may be warranted.

ARE WE GOING TO BE THE DISRUPTOR OR THE DISRUPTED?

There's no way around it: some companies will be rendered obsolete once blockchain achieves widespread adoption. "I don't want to overstate the point, but many companies need to seriously understand and evaluate the potential impact on their business model and the risk of marginalization or outright disintermediation," said Dampeer. Companies in financial services, technology and the supply-chain management space are most vulnerable. Other risk factors include these:

• Lack of preparedness for the rapid rate of adoption
• Inability to recruit strong talent
• Incomplete understanding at the management level
• Innovation projects that do not support core business objectives

Too often, if nothing is obviously broken, there's no impetus for change. But, there are costs associated with inaction. Organizations that don't get out in front risk getting left behind.

▼ BLOCKCHAIN DECISION TREE
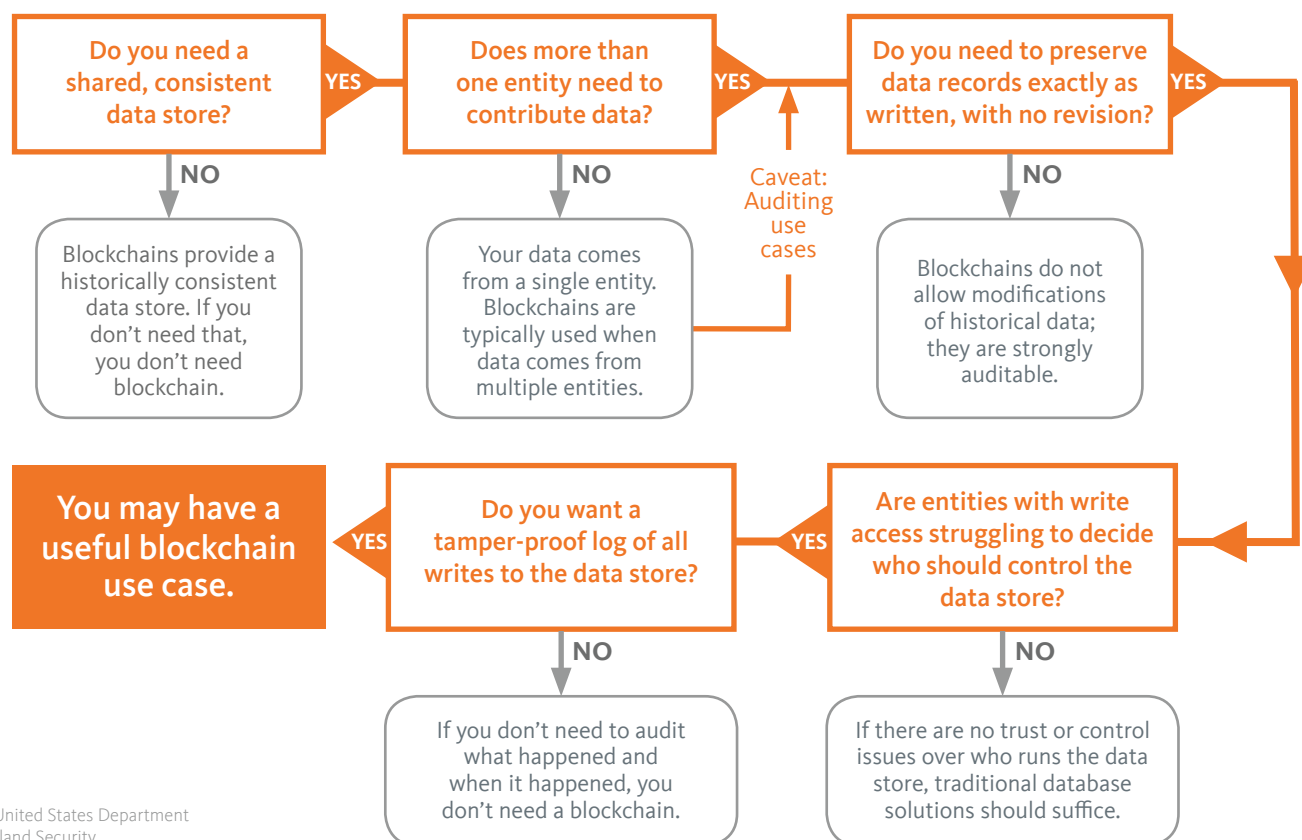
Source: United States Department of Homeland Security

FURTHER READING

Blockchain Revolution: How the Technology Behind Bitcoin is Changing Money, Business, and the World
— Alex Tapscott and Don Tapscott, 2016

Blockchain in the Boardroom: A Practical Guide for Directors and C-Suite Executives
— Jennifer C. Wolfe, 2018

"Blockchain Information Series: It's All About the Block"
— Christa Steele, BankDirector.com, February 15, 2017

"Mapping the decentralized world of tomorrow"
— Alexander Lange, Medium.com, June 1, 2017

Blockchain in Capital Markets: The Prize and the Journey
— Oliver Wyman and Euroclear, February 2016

"Blockchain explainer: a revolution only in its infancy"
— Hannah Murphy and Philip Stafford, _Financial Times,_ February 1, 2018

"35 Amazing Real World Examples of How Blockchain is Changing Our World"
— Bernard Marr, _Forbes,_ January 22, 2018.

NACD | ELEVATE BOARD PERFORMANCE

ABOUT NACD
The National Association of Corporate Directors (NACD) empowers more than 19,000 directors to lead with confidence in the boardroom. As the recognized authority on leading boardroom practices, NACD helps boards strengthen investor trust and public confidence by ensuring that today's directors are well prepared for tomorrow's challenges. World-class boards join NACD to elevate performance, gain foresight, and instill confidence. Fostering collaboration among directors, investors, and corporate governance stakeholders, NACD has been setting the standard for responsible board leadership for 40 years. To learn more about NACD, visit **www.NACDonline.org.**

ABOUT BROADRIDGE
Broadridge, a global fintech leader with $4 billion in revenue, provides communications, technology, data and analytics solutions. We help drive business transformation for our clients with solutions for enriching client engagement, navigating risk, optimizing efficiency and generating revenue growth.

broadridge.com

Ready for Next

Communications
Technology
Data and Analytics

Broadridge®