



Fast forward

Rethinking enterprises, ecosystems and economies with blockchains

IBM Institute for Business Value

Propelling business with blockchains

For centuries, global trade has been the single greatest creator of wealth in human history and market friction the greatest obstacle to wealth. Over the years, businesses have overcome multiple sources of friction. Institutions and instruments of trust emerged to reduce risk in business transactions. Technology innovations helped overcome inefficiencies. Still, many business transactions remain inefficient, expensive and vulnerable.

Blockchain technology – which creates a permanent and transparent record of transactions – has the potential to obviate intractable inhibitors across industries. As frictions fall, a new science of organization emerges, and the way we structure industries and enterprises will take novel shape. With transparency the norm, a robust foundation for trust can become the springboard for further ecosystem evolution. Participants and assets once shut out of markets can join in, unleashing an accelerated flow of capital and unprecedented opportunities to create wealth.

Executive summary

The long history of human progress has been a steady march against friction. From the introduction of money to replace barter and the gradual replacement of wax seals by digital signatures, we have seen steady progress facilitated by digital innovations.

The internet primed friction for a free-fall. Since then, some frictions fell while others rose. The friction of imperfect information, for example, took on added importance in an era that promotes transparency by business partners and consumers alike. New frictions like cybercrime threaten to cripple even the most successful organizations.

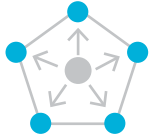
Today, three types of frictions predominate: information, interaction and innovation. In varying degrees to different industries, they're a drag on efficiency. A distributed ledger for business networks based on blockchain technology has the potential to eliminate these frictions.

The first system of record for business was a ledger captured on a clay tablet. Centuries later, the double-entry ledger helped promote modern finance. Since then, ledgers have been digitized but otherwise changed little, capturing only a snapshot of a transaction at a moment in time. They reflect only the information held by a single organization. Once a transaction has taken place, an asset is off one ledger and on to somebody else's.

Distributed ledgers like blockchains are shared and write business transactions to an unbreakable chain that is a permanent record, viewable by the parties in a transaction. Blockchains shift the lens from information held by an individual owner to the cross-entity history of an asset or transaction. Our research shows that once that happens, five attributes that are fundamental to blockchains have the potential to vaporize the frictions that hold us back today.



Today, three types of frictions – information, interaction and innovation – are a drag on efficiency.



Five attributes that are fundamental to blockchains have the potential to vaporize the frictions that hold us back today.



Monumental business model changes enabled by blockchains could transform: the science of organizational management, the tightening of trust and the economics of wealth creation.

Our analysis of the impact of blockchains across the enterprise, ecosystems and economies shows that frictions can be greatly reduced or even eliminated. The result, we believe, will be a new economic equation for organizations, trust and value exchange.

The enterprise, once constrained by complexity, can scale with impunity. It can integrate vertically or laterally across a network or ecosystem, or both. It can be small and transact with super efficiency. It can be a coalition of individuals that come together briefly. Moreover, it can operate autonomously and as part of a self-governing, cognitive network.

Distributed ledgers can become the foundation of a robust system of trust, a decentralized platform for massive collaboration. With that, intermediaries will be shuttered. Assets that were once dormant can be exploited. Profit pools can shift and be redistributed. New services delivered on blockchain networks can accelerate access and liberate those that were once locked out of efficient value creation to fully participate in an all-in economy.

Beyond friction: Tackling the challenges of our times

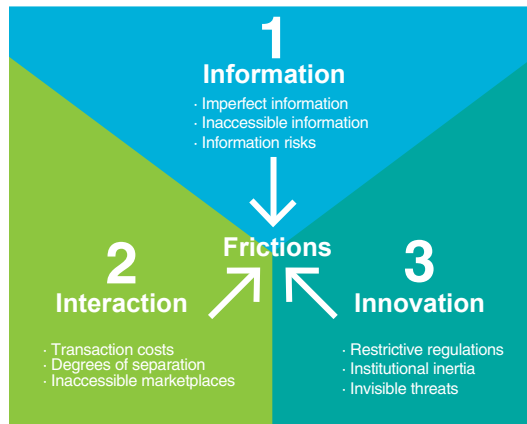
In every century, new technologies have chipped away at the sources of friction – the inefficiencies that held back progress. The Silk Road connected East to West. The first letters of credit established a new basis for trust in the 14th century. In the 19th century, the telephone connected us in real-time. The internet threw into hyper-drive what was once a slow march to dissipate friction. Technologists and economists alike began to anticipate a world that was friction-free. Friction, in theory, could be “digitized away.”

The internet did flatten some frictions, like transaction costs. And while it has ameliorated some forms of imperfect information, it has not solved for it completely. The frictions that remain, however, are consequential.¹ Indeed, they have become the basis for competition as start-ups race to capitalize on their destruction.

At the same time, other frictions have grown. Conflicting cross-border regulations throttle globalization. New threats like cyber-attacks are costly to prevent and even more expensive to recover from. Ecosystems are choked by intermediaries ready to take their cuts.

Figure 1

Frictions framework: Information, interaction and innovation frictions challenge business efficiency



Source: IBM Institute for Business Value analysis.

Friction defined

Today, a number of frictions – of varying degrees of importance to different industries – add costs and remain a drag on global business and trade (see Figure 1). They have the power to slow us down and sometimes to stop us cold.

Information frictions

Imperfect information. Participants in a transaction don't have access to the same information. In the age of big data, that can put them at a disadvantage, potentially diminishing the value for their full ecosystem. Too often, information may also be incorrect or inconsistent, leading to bad decisions or delays while reconciling it.

Inaccessible information. The potential value of abundant data and information is greatly constrained by the technical challenges of storing, processing, sharing and analyzing it. As a result, much information is not collected or remains inaccessible.

Information risks. Technological risks to information, from hacking to cybercrime and privacy concerns to identity theft are on the rise. These incur growing costs, as well as damage to brand reputations.

Interaction frictions

Transaction costs. The cost of conducting business is a function of its complexity and grows with scale, its size and the resources that need to be managed, including intermediaries. In almost every case, the cost of complexity yields diminishing returns.

Degrees of separation. As the world flattens and digital platforms connect disparate parties, distance has shrunk, but delays remain due to arcane business processes. Business transactions that take days and are costly to manage via intermediaries are prime for disruption by nimbler competitors.

Inaccessible marketplaces. Many local economies lack access to an efficient or trusted marketplace, unable to exploit their assets. Even large enterprises are confronted with barriers, and have assets that remain dormant and don't contribute to revenue growth or the creation of wealth.

Innovation frictions

Institutional inertia. With success, organizations calcify; legacy systems and bureaucratic processes slow down their responsiveness and ability to change. This sclerosis renders them particularly vulnerable to digital disruption, and impedes their ability to innovate and adapt.

Restrictive regulations. Highly regulated industries are stifled by delays; cross-border operations are curbed by conflicting regulations. Of course, some frictions are by design and are intentionally built into the system. While automation can lower costs and speed up regulatory processes, it cannot entirely eliminate governance through regulation.

Invisible threats. New competitive business models made possible by new technologies are threats for which organizations can't plan. For many, this growing uncertainty will disrupt continued business success. Both small organizations and nimble larger ones will try new approaches. And although many will fail, some will redefine entire industries.

As these frictions fall, near-term achievable benefits include reducing time, cost and risk. Over time, and as both industries and societies grow their use of blockchain networks, we anticipate structural changes to business models across industries – and as a result, even to economies as a whole.

The cost of organizational complexity

Economist Ronald Coase introduced the theory that transaction costs are lower for institutions than individuals. However, in recent years as enterprises have scaled, the added complexity of operations has grown exponentially while revenue growth has remained linear. The result? At a certain point, organizations are faced with diminishing returns. Blockchains have the potential to eradicate the cost of complexity and ultimately redefine the traditional boundaries of an organization.

Why fight friction?

Consider a universally common asset, such as land. Bound by arcane processes that define the transfer of property, laws in both the developed and developing world are ambiguous. A landowner in Honduras may have no record of his property and even have it possessed by another party. It's estimated that nearly 60 percent of the land in Honduras is undocumented.² These owners aren't just precluded from selling their land; they can't raise capital or credit from it, and are effectively locked out of the economy.

In countries like the U.S., the housing market faces a different problem: lack of transparency on who owns – and thus carries the risk associated with – a mortgage. Ownership is muddled in large part by complex financial instruments, such as collateralized debt obligations (CDOs). The chain of transactions grows increasingly disputable, depletes trust, accrues added costs and can have grave consequences, as we saw in the 2008 financial crisis.

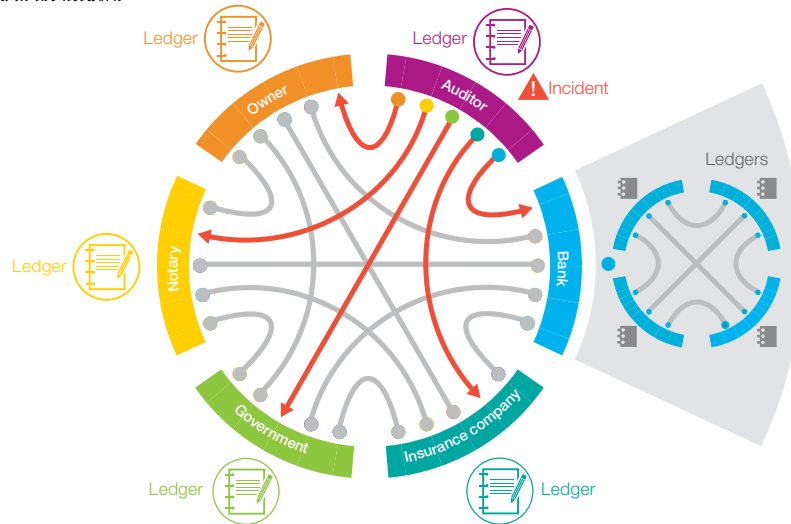
The work of Peruvian economist Hernando de Soto on the importance of property rights to economic development inspired the First Annual Block Chain Summit in May of 2015.³ De Soto calculates that some 5 billion persons and USD 20 trillion have been shut out of the economy due to disputed assets.⁴ Participants at the conference asked: If blockchain technology could unleash wealth like this, what else might it do?

The network of participants required to securely document an asset like a property record illustrates how complexity takes its toll (see Figure 2). In this example, participants manage their own ledgers to record transactions and have access to different information, which is also vulnerable to tampering.

By contrast, assets from cars to warranties, art to corporate bonds – even assets that are aspects of our identity, like health or tax records – can be shared, exchanged or transferred on a blockchain platform with far greater efficiency and far less risk. With friction at our backs, we can move with new speed to remake our future.

Figure 2

Current view: Individual ledgers and organizational siloes complicate how information and incidents are managed in the network



Source: IBM Institute for Business Value analysis.

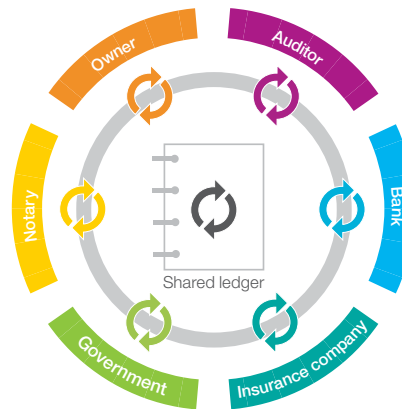
Engineered for motion: How blockchains propel us forward

Today, transactions are recorded in multiple ledgers. Each one captures at best a moment in time and reflects the information held by a single party: Bank X purchased or sold a mortgage, for example. They don't record what happens next, what came before, or the role of others – partners, suppliers, consumers – in the transaction. Moreover, they're prone to human error and vulnerable to tampering.

By contrast, distributed ledgers can be shared and updated in near real-time across a group of participants (see Figure 3). Every transaction becomes part of the permanent record and can be scrutinized by those that have permission – and relevant information can be shared with others based on their roles and access privileges.

Figure 3

Future view: A shared ledger built on blockchain offers visibility, trust and permanence



Source: IBM Institute for Business Value analysis.

Today, cross-border payment transactions occur over secure and reliable messaging infrastructure like SWIFT. Banks send messages back and forth on SWIFT to accomplish various tasks, with each bank maintaining its state of the task locally. One can imagine a blockchain-based approach where banks send messages on the blockchain that represent the shared state of the task, with each message moving the task to the next state in its lifecycle.

Blockchains shift the paradigm from information held by a single owner to a shared lifetime history of an asset or transaction. Instead of messaging-based communications, the new paradigm is state-based. Information that was once obscure now becomes visible.

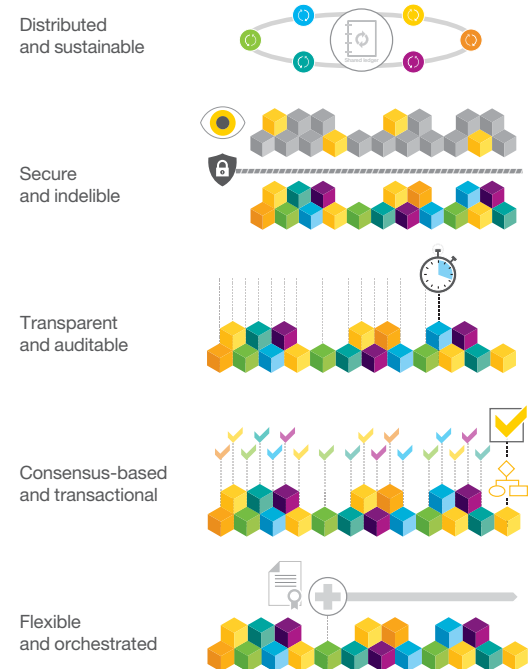
Friction in free-fall

Blockchains can be “permissioned” or “permissionless.” Unlike their permissionless counterparts, permissioned blockchains enforce identity-based policies that can constrain both access to data and network participation. This enables participating organizations to comply with data protection regulations. Permissioned blockchains are also more effective at controlling the consistency of the data that gets appended to the block, allowing for more granular decision processes to be built on top of them.

But common to both is a set of attributes (see Figure 4). Our research suggests that five blockchain attributes are instrumental in stripping out frictions.

Figure 4

Blockchain attributes framework: Five are key to reducing frictions



Source: IBM Institute for Business Value analysis.

It takes a community: Hyperledger collaboration

The full potential of the blockchain is unleashed when it operates across ecosystems. The Hyperledger Project at the Linux Foundation is a shared and open source development project to identify and advance the features of blockchain across industries.⁵

It brings together partners in the finance, technology and other related industries. Accenture, ANZ Bank, Cisco, CLS, Credits, Deutsche Börse, Digital Asset, DTCC, Fujitsu, IC3, IBM, Intel, London Stock Exchange, R3, State Street, SWIFT and Wells Fargo were its founding members. Since then, many more members have joined.⁶

Distributed and sustainable. The ledger is shared, updated with every transaction and selectively replicated among participants in near real-time. Privacy is maintained via cryptographic techniques and/or data partitioning techniques to give participants selective visibility into the ledger; both transactions and the identity of transacting parties can be masked. Because it is not owned or controlled by any single organization, the blockchain platform's continued existence isn't dependent on any individual entity.

Secure and indelible. Cryptography authenticates and verifies transactions and allows participants to see only the parts of the ledger that are relevant to them. Once conditions are agreed to, participants can't tamper with a record of the transaction. Errors can only be reversed with new transactions.

Transparent and auditable. Because participants in a transaction have access to the same records, they can validate transactions, and verify identities or ownership without the need for third-party intermediaries. Transactions are time-stamped and can be verified in near real-time.

Consensus-based and transactional. All relevant network participants must agree that a transaction is valid. This is achieved by using consensus algorithms. Blockchains establish the conditions under which a transaction or asset exchange can occur.

Orchestrated and flexible. Because business rules and smart contracts that execute based on one or more conditions can be built into the platform, blockchain business networks can evolve as they mature to support end-to-end business processes and a wide range of activities.

Blockchains transforming ecosystems

Supply chains are prime examples of blockchain's potential for transformation that spans industries. Initial blockchain efforts could have quick impact by transforming even a small portion of the supply chain, such as the information used during importing. If import terminals received data from bills of lading earlier in the process, terminals could plan and execute more efficiently and without privacy concerns. Blockchain technology could make appropriate data visible in near real-time – for example, the departure time and weight of containers – while making inaccessible the information about the owners and value of the cargo. Costly delays and losses due to missing paperwork would be avoided.

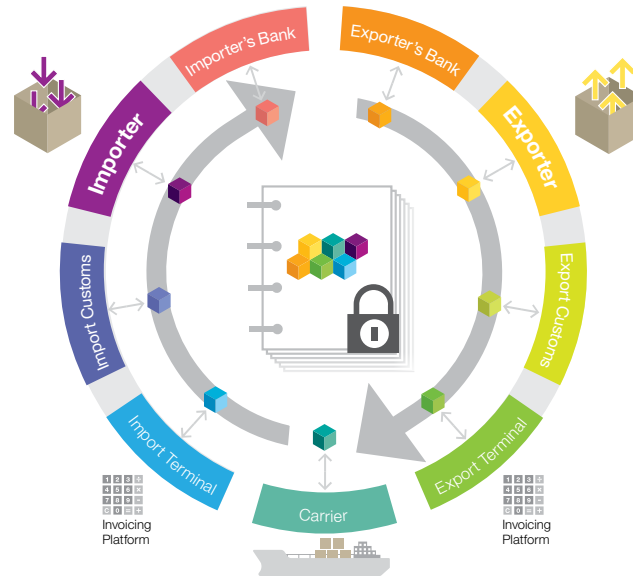
Blockchains could also enable a robust and secure exchange for shared logistics, coordinating a vast array of activities from sharing spare space in a warehouse to optimizing truck fleets and shipping containers. Retailers and manufacturers could greatly improve demand forecasting and stock replenishment. Financial institutions, armed with a detailed track record of a supplier's reliability, could extend much needed credit to fuel the trading industry. Regulators could trace the origin of goods from raw materials, making it easier to identify counterfeit items, as well as sources of tainted materials.

“Blockchain provides a revolutionary approach that enables businesses across industries all around the world to completely change their logistics business and operations. We’re excited about the potential for blockchain to transform logistics value chains into a more seamless process that provides a trusted view of every piece of cargo.”

Mika Lammi, Head of IoT business development at Kouvola Innovation, Finland

The value derived from something as fundamental as a blockchain-enabled bill of lading ripples out beyond the port of entry to span many industries (see Figure 5). For blockchains, true transformation and network effects kick in not just with the number of users that join a blockchain network, but the variety of industries and activities that come together.

Figure 5
Improving interactions: A blockchain-enabled bill of lading spans many industries



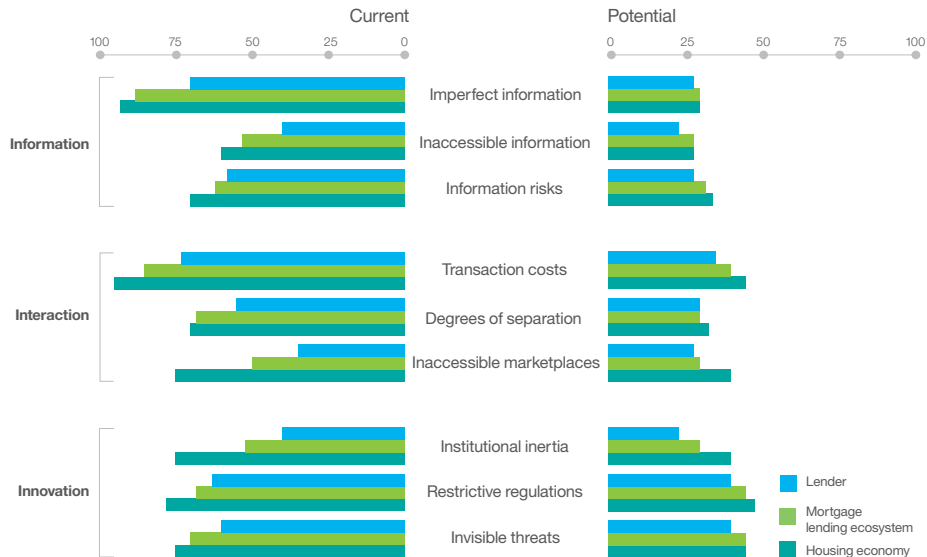
Source: IBM Institute for Business Value analysis.

Toward perpetual motion: New business model possibilities

As blockchains vaporize friction, the economic equation will change. Our analysis of frictions across the business network is indicative of how far friction can fall when blockchains are put in place. We studied how frictions across a lender, the mortgage lending ecosystem and the housing economy, normalized on a scale of 100, respond to attributes of the blockchain (see Figure 6).

Figure 6

Better business: This is an illustrative example of the relative degree of increased efficiency blockchains make possible for each type of friction



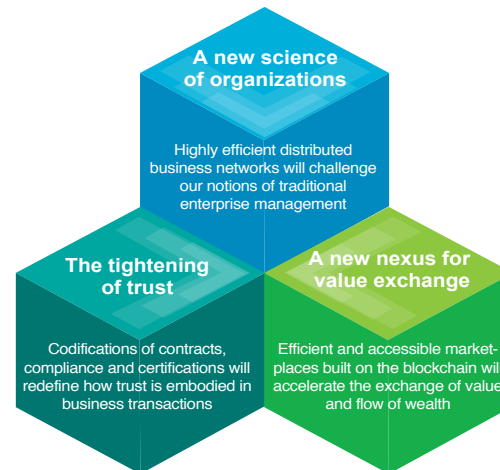
Source: IBM Institute for Business Value analysis.

The leveling effects across frictions at various level of the economy are startling. They suggest that transaction costs and enterprise friction could be so greatly reduced that organizations will be transformed in ways not yet imagined. Ecosystems can operate with much more robust trust. Blockchain networks, by propelling the movement of capital and exchange of value, can change how markets function and expand economic opportunity.

A change as monumental as this would reset the clock on the science of organizational management, the tightening of trust and the economics of wealth creation (see Figure 7). What happens next can't be forecast with certainty. But as blockchains eradicate friction, they will recast our institutions and economy in new form.

Figure 7

Transformation triad: Three ways that enterprises, ecosystems and economies can benefit from blockchains



Source: IBM Institute for Business Value analysis.

A new science of organizations

The modern enterprise was built on friction – or rather, it assumed the structure it has today to harness friction to one’s advantage. Once friction topples, radically new kinds of organizations could emerge. The cost advantage of Coase’s theory, which has been challenged by the added costs of complexity, will become true again: the enterprise can scale more easily than before. It can also stay small and still compete. The size of the organization won’t matter – how it’s governed will.

Institutions once vertically integrated can scale laterally through partners. Activities guided by smart contracts can be executed at high speed and efficiency. Stripped of some hierarchy and bureaucratic controls, organizations won’t just change the way they work, but what they choose to do. Pricing, profitability and ownership will need to be reconsidered.

Because of their distributed nature, blockchains will evolve over time and are potentially self-sustaining. Businesses that are born on a blockchain will surely assume new forms. The most novel may be the capacity for an organization to act autonomously.⁷

As blockchain-based transactions become more sophisticated, the business network as a whole will achieve greater levels of autonomy, reducing the need for human governance and ultimately evolving into self-governing, cognitive business networks. These autonomous organizations will stretch our definition of what it means to be a dynamic enterprise.

“We know – thanks to Hayek – that information is best used when it is not centralized, and when it is not being monopolized by some central institution. We know that flat and non-hierarchical systems use info best... New innovations like the blockchain make this possible.”

Patrick Byrne, CEO, Overstock⁸

“In cyberspace, trust is based on two key requirements: prove to me that you are who you say you are (authentication); and prove to me that you have the permissions necessary to do what you ask (authorisation). In return, I will prove to you that I am trustworthy by delivering services or products to you in a secure, efficient and reliable fashion.”

“Distributed Ledger Technology: beyond block chain, A Report by the UK Government Chief Scientific Officer”⁹

The tightening of trust

In business, trust is incredibly hard to engineer and impossible to guarantee. Until now, we’ve relied on instruments and institutions to be surrogates for our trust. With blockchains, trust can be embodied in the transaction itself. A far greater assurance of trust is now possible.

As this heightened sense of trust pervades the ecosystem, third parties that were once necessary to broker trust will be disintermediated. Smart contracts, certifications and digital compliance on blockchain networks will codify trust at the level of the individual transaction. This codification of trust can optimize transactional relationships, making business interactions across ecosystems far more efficient.

Trust will become a dynamic state: Depending on the role of the participant and the particular transaction, individuals and institutions can be deemed as trusted, semi-trusted or untrusted. A financial institution could trust an overseas partner to do X but not Y, for example.

Today, online rankings and ratings are proxies for trust. In the future, reputation systems built on blockchains will serve as a permanent record of an organization’s or individual’s behavior. Ledgers, once the system of record for business, become a robust record of trust – for business and government alike.

A new nexus for value exchange

Blockchain networks can give commerce the attributes of assurance and provenance; and with that, new markets can be created to foster value exchange across the whole of the digitized world. Industries once shut out of digital commerce, from agriculture to construction, will find new access to ultra-efficient, trusted marketplaces. And as with the example of land in developing nations, blockchain asset registries can empower once-dormant assets to join the global economy.

An all-in economy unleashes a torrent of value creation – and also new competitors. Across industries, profit pools will shift and be redistributed among industry competitors, incumbent organizations from other industries, new players and even consumers. Governments that curtail fraud and bureaucracy can create a better social contract with their citizens. The field of science, which has always stood on the shoulders of giants, now has a secure platform for collaboration on everything from medical research to renewable energy.

But all of this will require more than a blockchain platform. Like mobile apps before them, a new generation of decentralized apps will make blockchain technology accessible to the shopkeeper in Nairobi, the individual who generates solar power in Tucson and the inventor with a 3D printer in Bangalore.

As blockchains speed up the flow of capital and the creation of wealth, our economy and interactions will be less subject to the fits and starts of friction, and instead head toward something more like perpetual motion.

“We believe this technology has the potential to drive change across the industry, but will need to be developed in partnership with customers and industry participants under an open source approach.”

Moiz Kohari, EVP, Group head of technology innovation,
London Stock Exchange Group

Blockchains in practice

Blockchains first gained attention as a platform for cryptocurrency. Since then, non-currency assets on the blockchain have grown 1,600 percent to reach USD 1.6 billion between 2013 and 2016.¹⁰ Now, 45 banks have formed the R3 consortium to address what's next.¹¹ BNY Mellon in New York is working on applying the blockchain to transfer assets in securities lending.¹² The Japan Exchange Group is testing blockchain technology for trading in low liquidity markets.¹³

Blockchain technology is nascent, but other pioneers are already demonstrating its power to overcome friction.

Speedy access to capital. The retailer Overstock won government approval to use blockchain technology for the global issuance, settlement and trading of corporate bonds. The private bonds Overstock issued offered same-day settlement instead of the 2 or 3 days it typically takes now. That doesn't just speed access to financing; it can reduce the risk of naked short selling – selling securities without owning them first.¹⁴

The "e-Citizen." In Estonia, citizens can verify the integrity of the records held on them in government databases and are assured they are tamper-proof. That sense of security has made possible new digital services like e-tax and e-Business Register. Together with NASDAQ, Estonia is now offering a blockchain-based e-voting service that allows shareholders of companies listed on Estonia's NASDAQ exchange to vote in shareholder meetings.¹⁵

In the driver's seat. Visa and DocuSign came together for a proof-of-concept that meets the demands of impatient consumers. The pilot registered cars on a blockchain and asked potential owners to step into the driver's seat to configure lease options on the dashboard, receive a contract immediately and click to sign. New owners could then choose among insurance options and pay the first installment directly. Future in-car payments, from downloaded music to parking to driver's registration fees are also expedited from the dashboard – all before the new owner drives off the lot.¹⁶

Faster dispute resolution. The IBM Global Financing Unit, which facilitates credit among 4000-plus suppliers and partners worldwide and handles 2.9M invoices a year, is using blockchain technology to reduce dispute times from over 40 days to under 10 days and free up about USD 100 million in capital that is otherwise tied up at any time.¹⁷

Disrupting the disruptors. New blockchain-based start-ups are attacking business models like Uber that were themselves only born yesterday. La'Zooz, a pilot in Israel cuts out the middlemen – in this case, professional drivers – and establishes a trusted system that allows car owners to share rides with each other.¹⁸ Arcade City allows riders to directly negotiate rates with drivers.¹⁹

Blockchain considerations

- Value is limited within the boundaries of one organization
- Ecosystem participants have to agree on a standard
- Risk of overregulation exists without coordinated control
- Efforts may require large scale re-engineering.

Putting blockchains to work for you

While blockchains can be extremely powerful in their ability to overcome friction and improve efficiency, trust and value, businesses must carefully evaluate where blockchains can provide the greatest gains and where they do not. They are not simply a modern database replacement; they bring the most value as a shared system of record. Blockchain-based business networks also require checks and controls across the system at the same speed to achieve the full advantage of instantaneous sharing.

To best extract value from blockchains, we recommend businesses answer three questions.

1. How fast should I move?

First movers and early adopters can position themselves for quicker returns and sharper competitiveness by leveraging blockchain efficiencies.

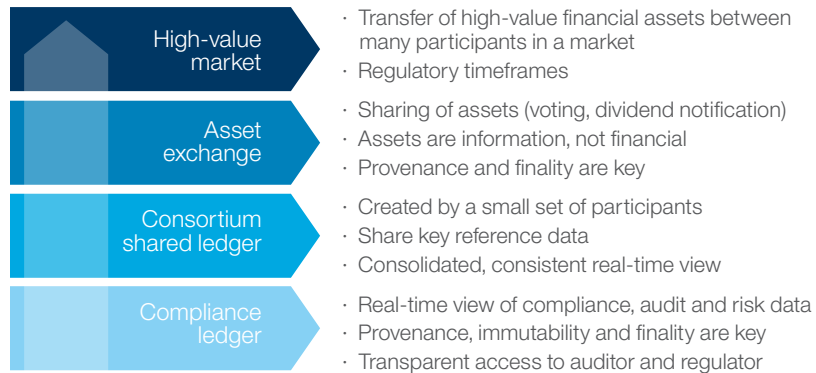
Identify the most compelling use cases by considering which frictions are holding back your enterprise. Our frictions framework can help evaluate the current inefficiencies in your business.

Experiment in discrete areas where the attributes of blockchains drive rapid impact. Our attributes framework can help evaluate which features of the blockchain can provide the greatest benefit.

Consider agile proofs of concept and incrementally expand scope for major business results. Use insights from earlier, more limited projects to re-engineer and implement larger efforts, for example see Figure 8.

Figure 8

Example of adoption patterns: From simple compliance ledgers to high-value markets



Source: IBM Institute for Business Value analysis.

Projects that expose blockchains to consumers can't rest exclusively in the hands of technologists; use design thinking to simplify the user experience for employees and consumers to drive rapid adoption.

2. Can we achieve network-wide accepted standards?

Success in blockchain adoption will depend not on who has the best technology or app, but who can build the strongest network.

Recognize the need for global standards: Blockchain innovation may accelerate faster and scale further than the internet did – requiring standards even sooner. Place your bets and invest your time now.

Get more of our blockchain research

This cross-industry report is the first in a blockchain series we'll develop over the coming months. We plan to interview over a thousand executives on their experiences, intentions and expectations about the technology's impact on their businesses.

Future reports will offer industry-specific perspectives. As each becomes available, it will be posted on ibm.com/business/value/blockchain

Explore the role of alliances and consortia in making blockchains scalable, open and interoperable. Blockchains will benefit from open-standard governance. Consider how your ecosystem could best benefit from network effects, and how profit pools might be redistributed in your industry or ecosystem. Then evaluate your role in this disruption.

Play for the long term – consider the blockchain as the new business environment and collaboration the optimal way of working. Consider with whom you should partner to create the optimal business network.

3. How can I scale with new revenue models?

Although implementing new technologies may be daunting, understand how they can help your business profit and scale quickly.

As business models are disrupted by blockchains, think through how you can make money in new ways. Consider business models and markets that will benefit most from consumption-based pricing, licensing and micro-payments.

Understand how blockchains will extract further value from other technologies, such as big data analytics, the Internet of Things and cognitive computing.

Explore how new blockchain-based services and apps can complement and scale existing revenue models.

In cases where revenue is not the objective, such as in government, evaluate how blockchains can free up capital or help secure privacy.

Study team

The IBM Institute for Business Value brought together a core team of blockchain experts and business thinkers to envision the future of distributed ledgers:

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Related publications

“The Economy of Things: Extracting new value from the Internet of Things.” Veena Pureswaran and Dr. Robin Lougee. IBM Institute for Business Value. June 2015. ibm.biz/economyofthings

“Empowering the edge: Practical insights on a decentralized Internet of Things.” Veena Pureswaran, Sanjay Panikkar and Sumabala Nair. IBM Institute for Business Value. March 2015. ibm.biz/empoweringedge

“Device democracy: Saving the future of the Internet of Things.” Paul Brody and Veena Pureswaran. IBM Institute for Business Value. September 2014. ibm.biz/devicedemocracy

For more information

To learn more about this IBM Institute for Business Value study, please contact us at iibv@us.ibm.com. Follow @IBMIBV on Twitter, and for a full catalog of our research or to subscribe to our monthly newsletter, visit: ibm.com/iibv.

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Notes and sources

- 1 BCG. “Greasing the wheels of the internet economy.” https://www.bcgperspectives.com/content/articles/digital_economy_telecommunications_greasing_wheels_internet_economy/?chapter=2
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