

BLOCKCHAIN AND THE GLOBAL CIO

How Distributed Ledger Technology Will Transform Enterprise Architecture and the CIO Role

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Realizing the new promise of the digital economy

In 1994, Don Tapscott coined the phrase, “the digital economy,” with his book of that title. It discussed how the Web and the Internet of information would bring important changes in business and society. Today the Internet of value creates profound new possibilities.

In 2017, Don and Alex Tapscott launched the Blockchain Research Institute to help realize the new promise of the digital economy. We research the strategic implications of blockchain technology and produce practical insights to contribute global blockchain knowledge and help our members navigate this revolution.

Our findings, conclusions, and recommendations are initially proprietary to our members and ultimately released to the public in support of our mission. To find out more, please visit www.blockchainresearchinstitute.org.



Blockchain Research Institute, 2018

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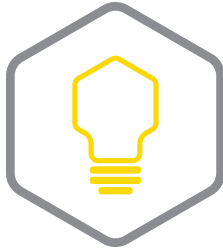
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Foreword

I have long believed that the CIO needs to be an innovator—not just a person who “keeps the train running,” but a person who reinvents the train. Each time I have studied a major technological transformation, I have observed that the firms most adept at harnessing its power are those with strong leadership at all levels. The CIO must be not just a practitioner but a leader.

In *Wikinomics* and *MacroWikinomics*, Anthony Williams and I described the “wiki workplace,” a phenomenon where a CIO-led executive team would engage uniquely qualified talent regardless of the boundaries of the firm.

This project looks at how CIOs can yoke the power of the blockchain and shape its nature even as they reimagine enterprise architecture and the boundaries of the firm. It expertly describes the CIO challenges that blockchain presents and addresses how the role must become multifaceted; he or she must simultaneously be a futurist, an evangelist, a business strategist, and an orchestrator of innovation.

To lead this project, we needed someone who has executive experience and deep expertise in technology—Oliver Bussmann, twice named to the *Financial News* “FinTech 40.” His career spans positions at SAP, Allianz, Deutsche Bank, and IBM; and he was well respected as group chief information officer of UBS.



DON TAPSCOTT

*Co-Founder and Executive Chairman
Blockchain Research Institute*



Idea in brief

By now, few in the enterprise IT space have *not* heard of blockchain. Yet many questions remain about the possibilities, risks, and implications of this new technology.

In this paper, we examine blockchain technology in the enterprise context through the eyes the chief information officer (CIO). We first dig into the technology itself. Like the Internet before it, blockchain has potential to disrupt or transform long-established business models and create all-new ones.

As in previous periods of technological innovation, most of the early work has revolved around blockchain use cases—“low-hanging fruit” where processes are ripe for change, volumes are predictably low, and the potential rewards are large.

We look at these use cases first and then turn to blockchain technology’s impact on enterprise IT architecture. We then examine the role that blockchain will play in the coming convergence of emerging technologies and how it will lead to the development of new, broad-based ecosystems. These, in turn, will catalyze brand-new business models based on decentralized structures and disintermediated transactions.

In the second half of the paper, we look at the changing role and responsibilities of the chief information officer (CIO) in this new environment, both generally and with respect to blockchain.

In the coming fourth industrial revolution, technology will play a far more central and transformative role in business and, ultimately, society.¹ The CIO role will expand beyond helping a business to implement its strategy and realize its ambitions; the CIO will help to define that strategy and those ambitions.

The new possibilities that technology provides will not only result in new roles for the CIO; it will also require a broad range of abilities such as “seeing the future” and “communicating the vision” in terms that non-technologists can understand.

Perhaps the most important role for the CIO remains that of ensuring that the right technology is built and deployed at the right time. The CIO will need to be able to orchestrate innovation; find, develop, and retain the necessary talent; and manage the great cultural transformations that are sure to occur both within and outside the enterprise.

We end with a short conclusion and a number of recommendations—our advice for CIOs looking to navigate this transformation successfully and master the new age of blockchain.

In the coming fourth industrial revolution, technology will play a far more central and transformative role in business and, ultimately, society.



Blockchain, the enterprise, and new ecosystems

Three decades ago, few people could have imagined how the Internet would disrupt enterprises and completely transform long-established business models. By enabling the exchange of information on a massive scale, these at-the-time new technologies reshaped the enterprise in remarkable ways. Today, we are witnessing the emergence of a new era driven by a new technological phenomenon—*blockchain*—that will have a similar impact across industries and the enterprise, and promises to reshape the very foundation of how business is transacted.

Blockchain technology first appeared in 2009 as the technology behind bitcoin.² Today blockchain is recognized as a technological breakthrough in its own right. To understand why, we must first understand the fundamental change blockchain technology represents.

While the Internet of today is driven by the transfer of *information* between parties, blockchain technology enables the transfer of information with an immutable audit trail. With appropriate agreements, these can be considered as the transfer of *assets* online through direct peer-to-peer (P2P) transactions that are recorded on a single, shared, unalterable distributed ledger. Among other things, this removes the need for trusted (and compensated) third parties by enabling trusted and secure direct transactions on open networks. With blockchain technology we have a tool to build the *Internet of value*.³

While that might not sound revolutionary on the face of it, the possibilities that are opened up by disintermediation through distributed ledgers are immense. Companies and organizations around the globe have come to realize that blockchain technology has the potential to disrupt and transform established business models. While some companies have identified areas with potential and have already begun to implement the technology in earnest, many more are still coming to grips with what it means. That said, there is a growing global consensus that blockchain technology holds the vital keys to the next generation of computing, as well as related business architecture. Against such a backdrop, we can easily see how the emergence and growth of blockchain technology will usher in a profound change in enterprise computing—and that will place new and extraordinary demands on CIOs.

There can be little doubt of the strength of the interest in blockchain technology in the enterprise community, as confirmed by the IBM study. IBM asked more than 3,000 C-suite executives to better understand cross-industry acceptance of blockchain technology. The numbers spoke clearly, with over 33 percent of the participants stating that their companies were actively engaged with or were considering using blockchain technology. IBM dubbed

There is a growing global consensus that blockchain technology holds the vital keys to the next generation of computing as well as related business architecture.



Over half the explorers whose business models are under threat expect to launch an entirely new business model either within or outside of their own industries.

the organizations that are already actively experimenting with, or implementing blockchain technology, “the explorers.” Of the explorers, 63 percent believe that blockchain technology will be used to increase transactional transparency, while 100 percent expect it to support their enterprise strategy. Over half the explorers whose business models are under threat expect to launch an entirely new business model either within or outside of their own industries. Importantly, 71 percent believe that industry consortia are important for progress. It is clear that these executives recognize blockchain technology is here to stay, and they are showing real, concrete optimism about its prospects.⁴





Other statistics are indicative of the current blockchain technology boom. The last three years have seen over \$2 billion in venture capital investment in blockchain technology start-ups, the creation of over 25 consortia, and more than 2,500 patents. These are key indicators, all evidencing that blockchain technology has found its foothold and is starting to gain momentum.⁵

Industry-specific use cases

Where will this momentum lead? When considering the likely trajectory of blockchain technology in the enterprise, we can look at both current developments and, based on experience with the history of technological innovation as well as an understanding of the implications of this particular technology, make predictions about its future course (Figure 1).

Figure 1: The focus of blockchain first movers

Blockchain first movers are focusing on selective and existing cases into production with the highest benefit. For example, the financial services industry has a potential \$80 billion to \$110 billion efficiency impact.

Use case	Value driver	Benefits
Trade finance	 Operational simplification	<ul style="list-style-type: none"> Real-time multi-party tracking and management of letters of credit, faster automated settlement Efficiency potential: \$14-\$17 billion
Automated compliance	 Regulatory efficiency improvement	<ul style="list-style-type: none"> Faster and more accurate reporting Efficiency potential: \$3-\$5 billion
Global payments	 Settlement time reduction	<ul style="list-style-type: none"> Near real-time point-to-point transfer of funds Efficiency potential: \$50-\$60 billion
Post trade procession	 Operational simplification Risk reduction	<ul style="list-style-type: none"> Reduce settlement time, lower operational risks Efficiency potential: \$15-\$20 billion

Source: Oliver T. Bussmann analysis, 2017; World Economic Forum, “The Future of Financial Infrastructure,” August 2016; McKinsey analysis, January 2017.



Some early initiatives can serve as navigational tools for CIOs as they map out their own blockchain journey.

We are beginning to see the disruptive nature and huge potential of blockchain technology, as early adopters begin to implement the technology. Such “first movers” typically focus on selective use cases where they can most easily implement the technology and have the highest likelihood of success, and this has certainly been the case in blockchain.

We generally find this kind of low-hanging fruit in processes already ripe for change—with less risk and the highest potential benefit. Some early initiatives can serve as navigational tools for CIOs as they map out their own blockchain journey.

Blockchain technology in financial services

Because blockchain technology was originally invented for a financial services use case, it is perhaps no surprise that the financial services sector was among the first to consider the use of blockchain technology in any significant way.

There is any number of compelling potential use cases. In trade finance, which still relies on complex, manual—and, hence, error-prone—processes, blockchain technology has great potential to lower costs and operational risk. In cross-border business-to-business (B2B) payments, which are expensive and slow today, blockchain-based technology has the potential to bring down operational costs dramatically, and with them fees, while reducing settlement times from days to hours—and, for bitcoin (BTC) and P2P payments, from weeks to hours. Other compelling financial services use cases include repurchase agreement transactions (very high value, and very low volume); over-the-counter (OTC) derivatives (which can contractually be very complex); and automated compliance as well as various identity use cases like know your client/anti-money laundering management—all of which are characterized by “easy wins” or dramatic savings. Ironically, bitcoin’s original appeal was anonymity. We can use slightly different implementations to ensure identity.

Potential efficiencies from using blockchain in banking run between \$80 and \$110 billion. Be it a threat or an opportunity, the potential for disruption here is huge.

There are both compelling early use cases and extremely strong incentives for implementing blockchain technology in financial services. By one estimate, potential efficiency gains from the utilization of blockchain technology in banking run between \$80 and \$110 billion.⁶ The gains could be even greater: in 2015, B2B cross-border payments generated about \$240 billion in bank revenues on \$135 trillion in flows.⁷ With business as usual (which we at the BRI don’t expect), McKinsey estimates that the global payments industry (both domestic and international) will generate an estimated \$2.2 trillion in revenue. Be it a threat or an opportunity, the potential for disruption here is huge. Many distributed ledger technology-based start-ups would be happy to have a thousandth (\$ billions) of that revenue.

Despite early interest and a fair amount of experimentation with the technology, actual implementation in banking has been slow for several reasons: a disinterest in financial institutions to



Legacy mindsets have also slowed down blockchain technology in banks. The financial services industry is heavily invested in centralized models, while blockchain technology represents a distributed worldview.

disintermediate themselves, throughput and privacy concerns, stringent regulatory and compliance regimes, and banking's reliance on large, inflexible legacy IT systems.

Legacy mindsets have also slowed down blockchain technology in banks. The financial services industry, after all, is heavily invested in centralized models, while blockchain technology represents a distributed worldview. Considering the vast potential for savings, we expect the industry (or potential disruptors) to overcome these hurdles over time.

Blockchain technology outside financial services

Many other industries have realized blockchain's potential, and we can expect movement to be more rapid. For example, blockchain could disrupt and improve global supply chains, especially in conjunction with the Internet of Things (IoT). Here, it could reduce friction through automation, decreasing costs while improving the security and integrity of the chains. These benefits could have significant impact on such essential supply chains as food and pharmaceuticals. Such innovation could lead to new kinds of supply chain markets, with dynamic pricing or real-time auctions.

The pharmaceutical and medical industries are also looking closely at blockchain technology for ways to improve the handling of records for patients and medicines, improvements that could lead to more personalized medical care and more patient control over medical data.⁸ The insurance industry is looking at blockchain technology as a means of dramatically improving claims processing and administration and helping detect fraud and automate processes such as underwriting.⁹ Blockchain technology is gaining an increasing foothold in e-government as well, with applications in e-voting, vehicle registration, benefits administration, and intellectual property.¹⁰

Indeed, blockchain technology's native capabilities as a viable, public, tamper-proof ledger make it applicable to almost any use case involving registration of ownership.

Indeed, blockchain technology's native capabilities as a viable, public, tamper-proof ledger make it applicable to almost any use case involving registration of ownership. We are, for instance, seeing work on use cases in the registration of assets, ranging from diamonds to wine to land titles—the latter of which promises to bring great benefits to small landowners in developing regions where property registration is often subject to corruption and abuse.

The use cases mentioned above, of course, only scratch the surface of the potential for blockchain technology. Indeed, there is hardly any industry today that cannot benefit in some way from the application of this technology. The challenge in many industries will be getting beyond the initial beachhead use case and move on to broader, widespread, repeatable, institution-level adaptations.



Blockchain is paving the way for new value creation. Over time, we can expect this new technology to spawn use cases that surpass existing models.

Improving old business models and building new ones

That said, the greater part of the use cases being explored today has to do with finding efficiencies and other gains based on existing business models. In this regard, it is very much like the Internet 20 years ago, when websites were mere calling cards for existing businesses, not businesses in their own right.

Ripple, which is disrupting the global cross-border payments industry, is a good example of a company in the banking sector that was early to identify an opportunity for blockchain technology based solely on dramatic improvements to an existing model.

By using blockchain technology and implementing a ledger, as opposed to a messaging model, Ripple has increased transparency while cutting reconciliation and transaction costs and settlement time. While payments with a traditional cross-border payment platform like SWIFT can cost over \$25 and take two to three days to settle, with little transparency on timing, commissions, and fees, payments with Ripple's blockchain solution occur almost instantaneously and cost less than \$10.¹¹ Though SWIFT is still the clear industry leader, with upwards of 12,000 banks using its platform, more than 100 institutions have already adopted Ripple, and the number of participating banks is constantly growing. However, apart from the lower fees and faster settlement, banks joining Ripple will be in familiar territory, as Ripple has not changed the cross-border business model of settling through correspondent banks and nostro/vostro accounts.

Over time, we can expect this new technology to spawn use cases that surpass existing models. Consider Melonport, a project for using blockchain technology to manage digital assets. Conceived as a system of blockchain-based tools, Melonport enables users to "set up, manage, and invest in digital assets and have management strategies that exist within a customizable, predefined ruleset. The system itself is decentralized and minimizes the requirement for trust" in traditional systems or people.¹²

Melonport reduces the complexity and cost of fund setup and administration, while increasing flexibility and, more importantly, both transparency and security. By doing so, however, it also lowers the barrier to entry for new fund managers and new business models, such as enabling funds with extremely low minimum investment, perhaps even microinvestments.¹³ Blockchain is paving the way for new value creation (Figure 2, next page).

The impact of blockchain technology on enterprise architecture

Blockchain technology will have a profound impact not only on processes external to the enterprise but also on the architecture stack within the enterprise—generally by moving business logic



and processes out of enterprise silos and onto shared blockchains and broader-based ecosystems. A number of developments in the blockchain space will influence these effects.

Smart contracts

A smart contract is computer code that models the logic of agreements between parties and automates their execution in a secure and verifiable manner.

We believe that the second most important innovation in blockchain technology, after the blockchain itself, has been the *smart contract*. A smart contract is a digital, self-executing, secure, and verifiable agreement between parties that is saved directly on the blockchain ledger—computer code that models the logic of contracts in the real world, while allowing for the automation of their execution.¹⁴

Smart contracts have a number of very interesting properties, most of them deriving from the immutability of blockchains. Like a cryptocurrency on a blockchain, a smart contract can be examined but not altered by all who have access to the chain. That means that, depending on how the contract is designed and implemented, its execution can be preprogrammed. This in turn allows for full automation of agreements between counterparties, which has the potential to introduce significant efficiencies to transactions. Because (again, depending on the design) blockchain-based smart contracts cannot be stopped once deployed, they also can provide parties to the contract with a high degree of transparency and trust that its stipulations will be carried out. None of this is possible in the “real world” of contracts in quite the same way.¹⁵

Figure 2: Popular scenarios where blockchain adds value

Financial services <ul style="list-style-type: none"> • Syndicated loans • Trade finance • Fixed income • Automated compliance • Proxy voting • Asset management • Equity post trade • Asset re-hypothecation • Repos • Collateral management • Cryptocurrencies • Initial coin offerings/ crowdfunding • Know your client (KYC) • Anti-money laundering (AML) • Global payments • Peer-to-peer lending • Trade reporting and risk visualizations • Betting and prediction markets 	Insurance <ul style="list-style-type: none"> • Claims processing and admin • MBS/property payments • Fraud detection/prediction • Telematics and ratings • Digital authentication • Automated underwriting • Self-administered insurance 	Supply chain/logistics <ul style="list-style-type: none"> • Dynamic ag commodities pricing • Real time auction for supply delivery • Pharmaceutical tracking and purity • Agricultural food authentication • Shipping and logistics management
	Healthcare/pharma <ul style="list-style-type: none"> • Records sharing • Prescription sharing • Compliance • Personalized medicine • DNA sequencing 	Public administration <ul style="list-style-type: none"> • Voting • Vehicle registration • Social security, benefits, licensing, and identification • Copyrights
	Consumer <ul style="list-style-type: none"> • Digital rewards • Uber, Airbnb • P2P selling, Craigslist • Brand, loyalty tracking 	Asset titles <ul style="list-style-type: none"> • Diamonds • Wine • Home mortgages and payments • Land title ownership • Digital asset records

Source: Oliver T. Bussmann, 2017.



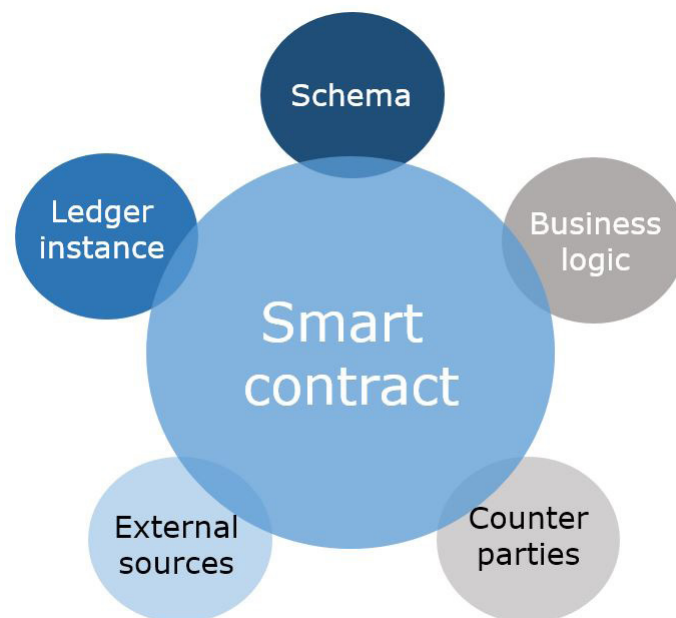
Smart contracts shift business logic from the enterprise application layer to the shared blockchain.

Smart contracts have other uses as well. Using smart contracts, for instance, it becomes possible to shift business logic from the enterprise application layer directly to the shared chain. Since smart contracts can hold information of any kind, they make it possible to move all the process-related data onto the chain as well. As we will see below, we can use these qualities in interesting ways to reimagine the enterprise architecture stack and build large business ecosystems (Figure 3).

Blockchain platforms

The significance of smart contracts was recognized early on, and along with a general maturing of blockchain technology, has inspired a number of what we might call second-generation blockchain platforms.

Figure 3: Impact of smart contracts on enterprise architecture



Significant changes

- » Shift of the business logic from the application layer to smart contracts
- » Move of the process/contract-related data from centralized databases into smart contract layer in distributed ledger
- » Access for all involved counterparties
- » Integration of external sources

Source: Oliver T. Bussmann, 2017.



Unlike the original Bitcoin blockchain, which was designed solely to enable the exchange of cryptotokens, these platforms are designed for general-purpose use. In many cases, they can be designed to cater specifically to the needs of businesses. Of these platforms, three are of particular interest to CIOs for their potential in the enterprise setting.¹⁶

In a "blockchain enterprise stack," blockchains are used as data repositories and messaging layers, while smart contracts are used to code business logic onto the chain.

- › **Ethereum** is a generic, fully-programmable public blockchain platform that is designed to be able to handle all possible use cases. Like Bitcoin, Ethereum is "permissionless," which means anyone can use it to execute blockchain-facilitated smart contracts. There are efforts to build an enterprise version of Ethereum, under the aegis of the Enterprise Ethereum Alliance, that CIOs could use to build robust, large-scale private blockchain implementations in almost any industry for almost any purpose.
- › **Hyperledger Fabric** is a cross-industry modular blockchain platform that is private and restrictive (a.k.a. "permissioned"). It is a public cloud service created by the Linux Foundation and used to build secure blockchain networks. The platform allows private companies or government agencies to set up a trusted network and to share information freely; only members can see this information and cannot alter it once it has been entered. Hyperledger gives enterprise-level customers the option of building scalable, commercial businesses.
- › **R3 Corda** is a private and permissioned distributed ledger platform for the financial services industry. Corda is designed to handle complex transactions and restricts access to transaction data. However, while it is geared for financial markets, Corda is applicable to any commercial scenario.

Table 1: Open-source blockchain platforms			
Open-source development drives rapid innovation of blockchain platforms. Here is a comparison of Ethereum, Hyperledger Fabric, and R3 Corda blockchain platforms.			
	Ethereum	Hyperledger Fabric	R3 Corda
Description	Generic blockchain platform	Modular blockchain platform	Specialized distributed ledger platform
Governance	Open source	Open source Linux Foundation	Open source R3
Industry	Cross	Cross	Financial services
Mode of operation	Permissionless Public or private	Permissioned Private	Permissioned Private

Source: Oliver T. Bussmann, 2017.



Blockchain enterprise stack

The combination of blockchain technology and smart contracts allows us to reimagine the enterprise technology stack. In a “blockchain enterprise stack,” blockchains are used as data repositories and messaging layers, while smart contracts are used to code business logic onto the chain. Such a stack gives us new ways of looking at business processes.

The advantages of the blockchain enterprise stack are more evolutionary than revolutionary: they represent improvements to current processes and practices. Let's consider how we might use these technologies to design radically new ways of working.

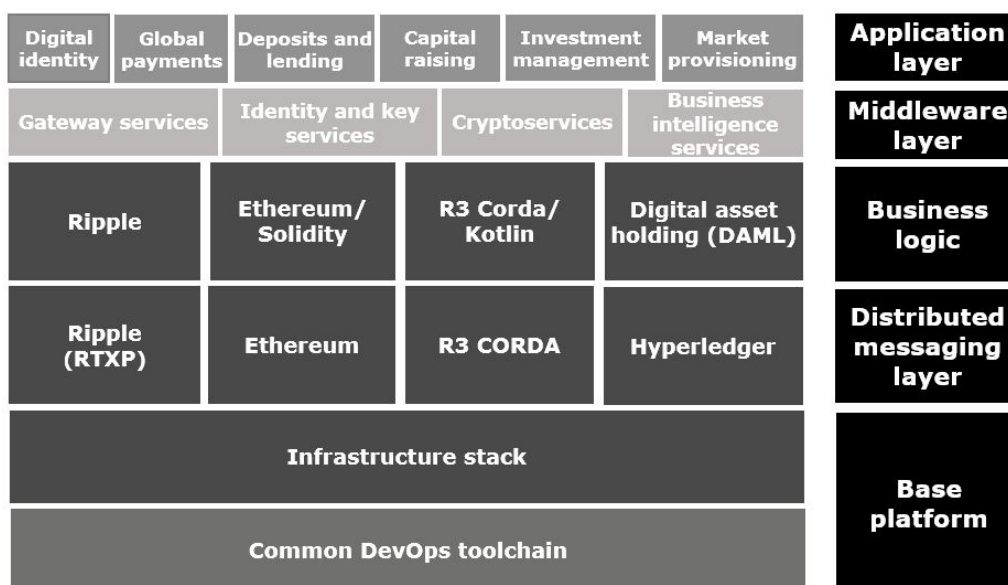
For instance, instead of residing in silos on each business's own internal systems, enterprises can share a secure, trustworthy, decentralized database. Sharing a common infrastructure and data store instead of each enterprise building its own can lead to massive efficiency gains. A shared data repository also reduces costs significantly by eliminating the need for reconciliation between different databases.

Because smart contract technology enables us to encode shared business logic on the chain, we can use it to automate most, if not all, of these processes. Of course, automation almost always means increased efficiencies and reduced costs, both highly desirable properties.

As with initial blockchain technology use cases, the advantages of the blockchain enterprise stack are more evolutionary than revolutionary: they represent improvements to current processes and practices (Figure 4). While evolution is good, let's consider how we might use this architecture and these technologies to design radically new ways of working.

Figure 4: Blockchain enterprise stack

DAML stands for *digital asset modeling language*, designed for financial institutions to write and execute smart contracts.



Source: Oliver T. Bussmann, 2017.



Mercedes-Benz is developing smart contracts for its new mobile operating system, designed to integrate different kinds of transportation and accommodations seamlessly into one platform.

The Swiss-based blockchain technology start-up Deon Digital is trying to catalyze innovation on the smart contract layer itself by developing a blockchain-agnostic smart contract modeling language. This language is designed so that business analysts and process designers can easily model business processes without knowing how to code them on blockchain technology. Instead, the software handles the conversion of the models into contract code, endowing a greater number of innovators with the ability to write smart contracts.

This broad capability will, in turn, expedite product innovation by making new business models faster, cheaper, and easier to design and implement. Since Deon Digital's modeling language is blockchain-agnostic, it is flexible—we can use it in a number of settings—and it future-proofs the solutions we create with it by ensuring their compatibility with whichever blockchain platform becomes the standard.¹⁷

Mercedes-Benz is using Deon Digital technology to develop smart contracts for its new *mobile operating system (MOS)*. MOS is designed to integrate different kinds of transportation and accommodation into one seamless platform. A user could, for instance, book a trip from Zurich to London and arrange for taxi, train, hotel, limousine, and so on—all elements of the trip—in one step because MOS will incorporate all the necessary smart contracts.

Blockchains and smart contracts will support new business models in other ways, most prominently by facilitating the growth of large-scale, highly automated business ecosystems. To understand how these will function, let's first look at blockchain technology's role in technological convergence.

The convergence of emerging technologies

We have been focusing on blockchain as a transformative technology for the enterprise. However, blockchain technology does not exist in a vacuum, nor is it the only emerging technology with significant implications for how we do business.¹⁸

Further, there are vast differences in the methods for businesses to approach technological overhaul. Organizations have major investments in proven systems and applications. Choosing the appropriate new technology and refactoring or rewriting applications to support new technology are very expensive undertakings. CIOs need to examine these costs carefully and fund them on a *total cost of service* (not on a *true cost of ownership*) basis throughout the IT process life cycle.

Larger companies with heavy legacy infrastructure that do not move quickly might find it challenging to cope with this technological revolution, whereas green-field players do not need to break their current patterns and refactor major parts of their application and process portfolios.

Examining these costs carefully and funding them on a total cost of service (not on a true cost of ownership) basis is a key CIO responsibility throughout the IT process life cycle.



If we survey today's technological landscape, we find a number of technologies likely to be equally transformative, each in its own way. In an enterprise context, we think that the most important are artificial intelligence (AI) and machine learning, big data, IoT, and edge computing.¹⁹

AI, machine learning, big data, and IoT

AI and machine learning algorithms need big data to learn. IoT devices will need AI capabilities to interpret their environment and make intelligent, autonomous decisions.

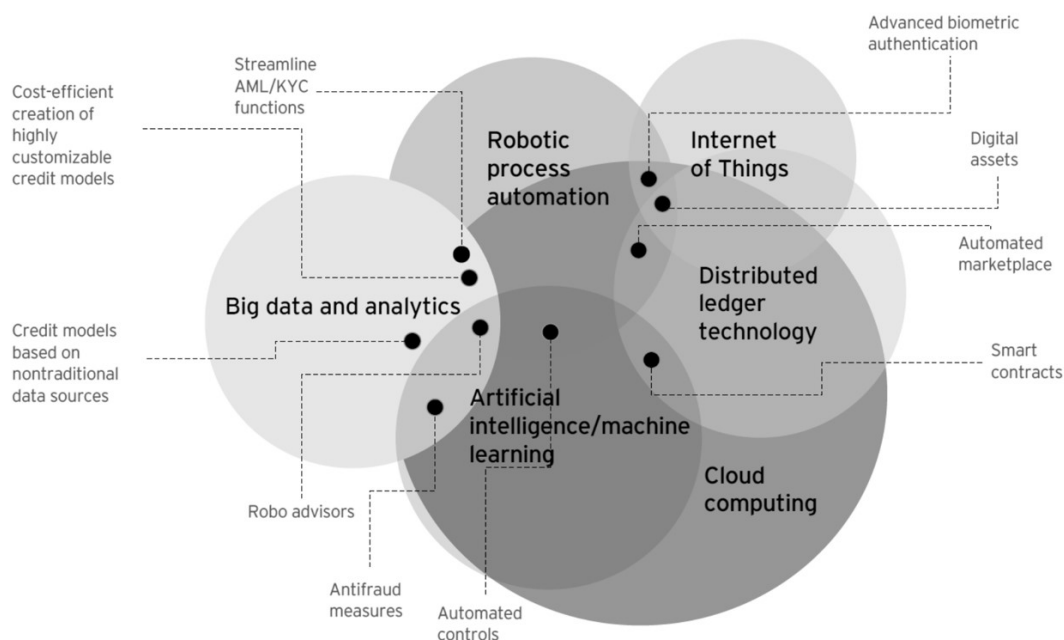
AI and machine learning can facilitate radical process automation. Big data will make companies smarter and more aware of their surroundings. IoT devices will revolutionize how we gather data, interact with customers, and deliver products.

While advances in each of these fields represent interesting new technological capabilities in themselves, they become more powerful when they work together. In many cases, they depend on each other. AI and machine learning algorithms need big data to learn. IoT devices will need AI capabilities to interpret their environment and make intelligent, autonomous decisions. To do so quickly and efficiently, they will need edge computing, which will enable them to hold and process large amounts of data themselves.

To work both independently and in concert in large-scale decentralized networks, all of these technologies will need to be able to share data easily, securely, autonomously, transparently, traceably, and quickly—precisely what blockchain technology was invented to do.

Figure 5: Convergence of existing technologies

Convergence of emerging technologies will change market infrastructures and blur the lines of industries in a highly connected real-time world.



Source: Ernst & Young, 2016.



The IOTA tangle is a quantum-resistant directed acyclic graph; its digital currency iota has a fixed money supply with zero inflation.

Therefore, in the coming convergence, blockchain technology will serve as a critical communications, trust, and auditing hub.²⁰ From this convergence will grow wholly new, highly connected, real-time market infrastructures in which the lines separating traditional industries begin to blur. These new market infrastructures will enable new kinds of business models (Figure 5).

Consider IOTA, an open-source distributed ledger protocol launched in 2015. Its approach is unique in that it goes “beyond blockchain” through its core invention of the blockless *tangle*. The IOTA tangle is a quantum-resistant *directed acyclic graph*; its digital currency *iota* has a fixed money supply with zero inflation. IOTA offers zero-fee transactions and no fixed limit on the number of transactions confirmed per second. Throughput grows in conjunction with activity—the more activity, the more transactions processed, and the faster the network—and so it has removed scaling limitations: Further, unlike blockchain architecture, IOTA has no separation between users and validators (miners); rather, validation is an intrinsic property of using the ledger, thus avoiding centralization. IOTA’s focused use case lies in the emerging machine-to-machine economy of the IoT, data integrity, micro- and nanopayments, and other applications warranting a scalable decentralized system.²¹

We see convergence in action in Ambrosus, a project dedicated to building a blockchain-based ecosystem for supply chains for life-essential products like food and medicine.²² What makes Ambrosus interesting is how it combines blockchain technology with IoT technology and smart contracts to provide the basis for complete food or pharma ecosystems. On the Ambrosus platform, sophisticated IoT sensors monitor and report on the status of individual items, send their verified data to a blockchain, and allow stakeholders to monitor the quality of an item from its origin to its place of usage. The platform not only provides an unprecedented level of security and trust in supply chains, but also opens up possibilities for new kinds of decentralized markets—for example, direct transactions between farmers and consumers.²³

Enabled by dramatic improvements in processor power and storage, edge computing describes the post-cloud phase of computer networks where the nodes do most, if not all, of the computation on the “edge” of the network.

Edge computing

Before exploring these decentralized marketplaces, we need to look more closely at edge computing, perhaps the least familiar of the aforementioned emerging technologies. *Edge computing* is a phrase used to describe the coming post-cloud phase of computer networks enabled by dramatic improvements in processor power and storage. In edge computing, the nodes (such as self-driving cars or drones) in a network do most, if not all, of the computation on the “edge” of the network. Through edge computing, self-driving cars or drones will become full “data centers with wheels or wings”—able to act and interact autonomously with each other over blockchains.²⁴ It will boost the radical automation that will be a defining characteristic of our world in the near future.



The formation of new ecosystems

Blockchain technology will foster the convergence of a number of emerging technologies, but what will they converge into? For business, convergence will support the growth of ever larger and more diverse ecosystems.

This collaboration in business networks is a function of the decentralized nature of the underlying technologies and is vital for the governance of these ecosystems.

Because of its properties as a decentralized data-and-transaction platform, blockchain technology naturally facilitates collaboration among market participants. It also tends to lower the barrier to entry for new participants, be they partners or competitors. Consider the growing blockchain ecosystem in financial services, which encompasses banks and other financial institutions, fintech companies, industry associations and consortia, non-bank financial services providers, and, increasingly, regulators and central banks; or collaborations across horizontal business networks in the global trade sector, such as the Digital Trade Chain consortium, where enterprises are starting to use smart contracts in trade finance transactions.²⁵

This kind of collaboration in business networks and consortia is a function of the decentralized nature of the underlying technologies: no central parties are creating and maintaining these platforms. More importantly, this collaboration is vital for the successful management of these ecosystems.²⁶

We can expect today's nascent blockchain-based ecosystems to continue expanding and growing ever more integrated. These technologies will also begin to transform into new ecosystems based on full horizontal integration, ecosystems that will replace traditional industries over time.

The need of broad-based public platforms

As we move along this path in the enterprise world, we should be able to observe two important trends that will help define the future state.

One is the move from closed, permissioned enterprise blockchains to broad-based, open platforms. The original Bitcoin blockchain has succeeded partially because it is a global, public, permissionless platform that anyone can join, thus making mass adoption relatively easy.

Despite the allure of Bitcoin's underlying blockchain technology for enterprise users, the public nature of blockchain technology appeared to be a major barrier to adoption in the business world. That is primarily because the technology required for a public blockchain to function (so-called proof-of-work consensus) is also responsible for a number of significant issues in speed, security, privacy, cost, and programmability.

Over the long term, CIOs will find broad, open, public platforms—once they have dealt with speed, privacy, programmability, and other issues—to be the better option over private ones.



The simplest solution to most of these concerns in the enterprise space is to allow only trusted or permissioned users onto the platform. However, over the long term, the enterprise will find broad, open, public platforms to be the better option, provided that they deal with the speed, security, and other issues—and, over time, permissionless blockchain technology is expected to evolve in such a way that these issues will no longer exist.

While solving these technical issues for public blockchains will take time, once they are solved, we should be able to construct public platforms that are more scalable, more flexible, more interoperable, more extensible, and more accessible—to both humans and devices—than privately owned and maintained platforms. For businesses looking to cater to the largest possible markets, public blockchains will have a natural appeal.²⁷

Breaking down of industry siloes

The other major trend in blockchain-based business platforms is the gradual but inevitable breaking down of industry silos into connected ecosystems. This will be a product both of hyperconnectivity as well as the ease of exchanging data on blockchains on both B2B and business-to-consumer levels.²⁸ As these silos come down, business verticals will blur. Segregating businesses and systems along industry lines will make less and less sense.

By 2025, we can expect new ecosystems, comprised of related clusters of industries, to replace many traditional groupings. In trade finance, for example, blockchain technology connects all stakeholders in the chain, from the exporter and his bank to the carrier to the importer and her bank and to other participants in the process (Figure 6, next page).²⁹

We will see ever-more sophisticated and ever-more integrated ecosystems along these lines. Imagine trade finance banks offering such services as warehousing for commodities—something not traditionally part of the banking industry but, because of blockchain technology, relatively easy to bring to the market, should it make business sense.

Hyperconnectivity and the ease of exchanging data on blockchains will inevitably break down industry silos into connected ecosystems.

These developments will be disruptive, not frictionfree. As with the rise of fintech in the financial industry, new technologies like blockchain bring new partners with new capabilities to share and new competitors on the scene. As an enabler of radical decentralization, blockchain technology also brings new mindsets, both in terms of how to conceive IT infrastructure and how to transact business with it.

CIOs will need to adopt these new mindsets and help decision-makers in their organizations to embrace them as well. Changing leaders' mindsets will be a very important part of the CIO role, and one not to be underestimated. Those who resist or hesitate too long risk missing the boat.



New business models

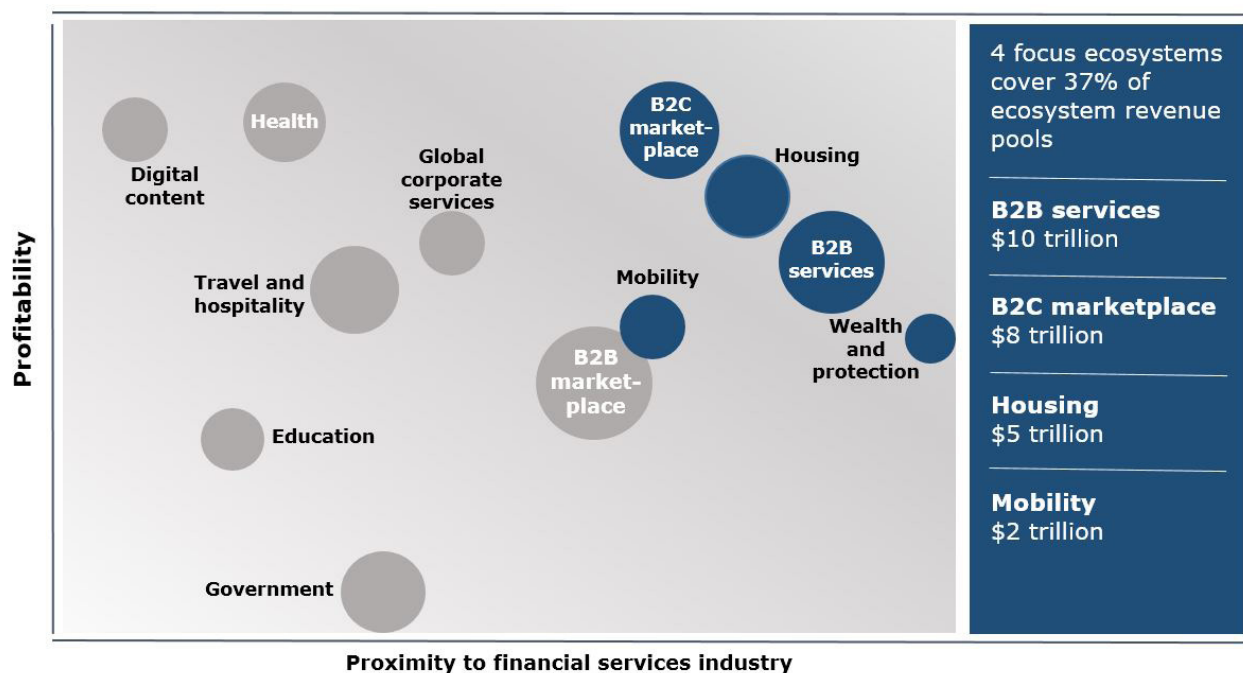
These new marketplaces will be completely new environments in which to do business and that encourage—or even demand—new kinds of business models. A number of fundamental characteristics of blockchain technology will help to enable these models, and so CIOs must be well-acquainted with them and their implications for business strategy:

Immutability, transparency, autonomy, and decentralized structures will help to realize new marketplaces and new business models.

- » **Immutability:** Blockchain transactions provide a historical single version of the truth, eliminating the need for reconciliation—a profound change from today’s business environment, where information lives in silos and every entity has its own database with no shared version of the truth.
- » **Transparency:** Transactions occurring on the blockchain eliminate levels of asymmetric information—a hallmark of today’s computing environment—among market participants. Transparency also allows for increased cooperation between regulators and regulated entities.
- » **Autonomy:** Autonomous transactions help overcome the lack of trust between counterparties. Smart contracts ensure that agreements are executed to agreed-upon business outcomes, rendering third-party intervention unnecessary.

Figure 6: Positioning of ecosystems for financial services industry

New ecosystems are likely to emerge in place of many traditional industries by 2025.



Source: McKinsey & Company, 2017; Oliver T. Bussmann, 2017.



- » **Decentralized structures:** Without need for third-party intervention, blockchain eliminates the need for central authority oversight in contract execution. Whereas most business models are closed ecosystems today, there will be no central controlling company in the future, and all involved entities will share contributions and ownership.

We are in early days and only beginning to see where all this might lead. We can, however, observe new business models taking shape in some areas, and these can serve as early indicators of transformations to come.

The rise of initial coin offerings

Take the *initial coin offering* (ICO), for instance. Also known as a *token sale* or *token-generating event*, an ICO is a new model for start-ups to raise capital by issuing and selling their own cryptotoken to parties interested in their platform.³⁰ If we put aside the associated token economics and regulatory issues, we can see ICOs as a means of democratizing venture capital: projects can raise funds directly from investors. ICOs are similar to crowdfunding but carried out peer to peer, not through crowdfunding platforms, and offer greater flexibility and new options to both issuers and investors.

Initial coin offerings or token-generating events are new means of democratizing venture capital: start-ups can raise funds directly from investors, not through crowdfunding platforms.

- » Tokenization can also enable new models of sharing. Storj Labs, for example, uses blockchain-based tokens for people to share space on each other's hard drives. The Storj initiative features decentralized cloud storage, crowdfunding through the storjcoin token, and shared contributions and ownership. Storj has no central operator and features a unique end-to-end encrypted cloud for distributed object storage.³¹
- » Lykke Wallet demonstrates how blockchain technology will foster automated, decentralized business models in finance. Among its innovations, Lykke built a global notary service with blockchain technology so that users can log all transactions and ownerships in a universally accessible distributed ledger. Using blockchain technology, Lykke offers immediate settlement and zero percent commission.³²
- » SkyCell is an interesting project in terms of both new business models and convergence. SkyCell manufactures containers for medication and fruit. These smart IoT-enabled containers can keep their contents to a temperature of between two and eight degrees Celsius without any power source. They are equipped with sensors that transmit the location of the containers and can report on any damage or tampering and even announce delivery. By putting this information on a blockchain, SkyCell users can seamlessly integrate these devices with other parts of the supply chain such as insurance or trade finance. With these autonomous processes, we can also create a large-scale mesh network that covers all hubs and spokes in the chain.³³



- » TEND is using blockchain technology and smart contracts to build the sharing economy 2.0. Its platform allows for the shared investment and enjoyment of high-value assets and experiences. These technologies simplify the creation of co-ownership arrangements and provide counterparties full transparency and a high degree of confidence and trust. TEND users also have a high degree of confidence in the assets they are sharing because their vetted and verified data is saved to the tamper-proof ledger and viewable by all. We can say the same of the transaction history. By integrating investment, experience, risk mitigation, and the various stakeholders in a single platform, TEND exemplifies blockchain technology's ability to connect various parts of an ecosystem in a trusted, decentralized way.³⁴

We encourage CIOs to explore other innovative blockchain technology models such as Jamii Crop Insurance, an automated decentralized insurance model, or LaborX, a decentralized marketplace of professional services. The common denominator underlying all these projects is their use of blockchain technology to provide a product or service that they could not as easily or similarly do without it.

Roadmap to the future

When will all this happen? This is an important question for CIOs as they contemplate their future blockchain strategies. It is also a difficult question to answer.

To get clues to the future, we can look to the past. Certainly, the history of technology and innovation can give us some guidance as to how blockchain technology will likely develop in the enterprise context. Consider financial services (Figure 7).

Figure 7: Blockchain from proof of concept to mainstream adoption

Blockchain technology adoption in the financial services industry, from proof of concept, piloting, and consortia to mainstream. (FCA: Britain's Financial Conduct Authority; MAS: Monetary Authority of Singapore.)



Source: Oliver T. Bussmann, 2017.



Organizations wanting to exploit new technological capabilities need talented individuals and teams to develop the vision and then build, test, and implement it. As “chief technologist” of the enterprise, the CIO plays a crucial role in this process.

In 2015, the financial services industry was in the exploration and development phase of blockchain technology as banks assessed initial use cases. In 2016 and 2017, it has been in an early adoption phase, with the buildup and consolidation of consortia, the growth of enterprise ecosystems, and implementation in such use cases as payments and trade finance. Regulators have begun examining the technology, developing regulatory sandboxes, and writing initial rules.

From 2018 to 2024, we can expect a growth phase as industry silos come down and new products and services driven by smart contracts are developed and slowly become ubiquitous. We can also expect new kinds of service providers and service models to emerge and the deployment of blockchain technology to go viral across all asset classes.

More definite regulatory guidance and final rule-making will also characterize this period. Up from 2025, we can expect to enter the maturity phase, in which blockchain technology in financial services will have become completely mainstream and integral to the capital markets ecosystem.³⁵

The progression might not be as linear or neatly segregated as this projection, but because we have seen similar trajectories before, we have good reason to believe that blockchain technology will follow a similar path.

The changing role of the CIO in the age of blockchain technology

Now we shift from blockchain’s impact on enterprise architecture and industry structure to its effect on the role of the CIO and what CIOs can do to navigate and thrive in the blockchain era. The CIO’s changing role is an important subject. New technologies do not deploy themselves. Organizations wanting to exploit new technological capabilities need talented individuals and teams to develop the vision and then build, test, and implement it. As “chief technologist” of the enterprise, the CIO plays a crucial role in this process.

Blockchain and related technologies are laying the groundwork for completely new marketplaces and business models. Considering how technology is shaping the world, we can appreciate why the role of the CIO, whose main job is to shepherd these changes, is expanding.³⁶



The expansion of the CIO role will be a challenge not only for those in the position, but also for the rest of the C-suite. The CIO will need to be a diplomat.

New skills for a new state of affairs

This is a new state of affairs. In the past, organizations called on their IT departments to find the best technological means to implement the business' predefined strategy. In a world where technology increasingly dictates business models, the CIO will increasingly participate in that strategy discussion—and perhaps even lead it.

Not all CIOs will be prepared for these new responsibilities. CIOs will need not only to keep on top of ever more complex and pervasive technological developments but also to understand deeply what makes the business tick and what these technological developments mean for their business models, ecosystems, and enterprise architecture. This remit is very different from, and much broader than, what the typical CIO must do today. The CIO will have far more direct responsibility for the business's success or failure.

Nor will it be just business strategy. Technology shapes and transforms society and, to a certain extent, all of us as individuals. It is changing the external environments in which companies do business and customers live their lives. Therefore, the CIO might have an increasing role in helping the business to understand how these technologies will transform its markets and the expectations of its customer base.

The expansion of the CIO role will be a challenge not only for those in the position, but also for the rest of the C-suite, as managers accustomed to making decisions in the old world begin to feel at sea in the new one and potentially resentful of the CIO's expanding importance. For this reason, we add diplomacy to the new CIO skill set.

CIO roles specific to blockchain technology

To introduce blockchain technology into the enterprise, CIOs will need a set of new skills, among them the following.

Futurist

As we have said, the broad-based platforms catalyzed by blockchain and related technologies will bring new types of business models, often radically different from the ones deployed today. In this transition, the responsibility for understanding and explaining the firm's opportunities will fall to the CIO.

To do this, the CIO will need to be a blockchain technology "futurist," both in the broad sense of the technology at large and in the narrow but essential sense of how the technology can transform a given organization's business.

Looking at the big picture, the CIO must not just keep on top of developments in blockchain technology but also make well-informed

The responsibility for explaining the firm's opportunities to catalyze new marketplaces and test new business models will fall to the CIO.



CIOs will also be responsible for understanding the applicability, practicality, and enablement of blockchain technology to their industry and specific business.

predictions about the most important trends and the general direction the technology is taking. To do this, the CIO could create a small, dedicated, in-house research team tasked to monitor developments, absorb the vast amounts of information available in the blockchain world, analyze these data, and report on findings.

The blockchain community is very vibrant and rapidly growing. Taking an active role in this community can be one of the best, most efficient means for CIOs to remain on the pulse of events. That can mean everything from joining consortia and trade or local associations to participating in or sponsoring events and meetups. Despite all the data at their fingertips, CIOs will often find that nothing substitutes for being physically present and engaged in conversations.

No matter what they do, CIOs will want to experiment with the technology as quickly as possible. They should certainly download a few wallets, purchase coins, and experiment as users of various blockchain platforms. As with community involvement, nothing substitutes for hands-on experience. For those contemplating building user-facing blockchain solutions, using other platforms can generate important user insights.

Looking more specifically, the CIO will want to understand the applicability, practicality, and enablement of blockchain technology to his or her specific industry and specific business. In doing so, he or she should look to understand the applicable short-term use cases—the low-hanging fruit where blockchain technology can create value immediately—as well as the broader, more longer-term platform trends.

Those CIOs who can creatively probe the future and identify the opportunities for value creation that others are overlooking, will be best placed to help their enterprises take the lead in the new environment.

Evangelist

Change is both enticing and frightening. Therefore, the CIO will need both to generate excitement and allay concerns. For this reason, he or she must be both a great technologist and a gifted communicator, helping to shape new mindsets and negotiate any hurdles that might arise.

This means being an evangelist for the technology, explaining its concepts and preaching its merits to different audiences, from C-suite colleagues to IT and operations departments and, potentially, to the organization at large.

CIOs should not underestimate the importance of this storytelling role. A technology evangelist can be effective only if he or she can leave the details of the technology behind and instead paint a coherent, easily understandable picture of what the new technology does and the changes it will bring.



When spreading the word on the merits of transformative new technology, the CIO should prepare to face resistance from some quarters. C-suite colleagues might feel threatened by the CIO's expanding role, the IT and operations departments by blockchain technology's new mindsets and skill sets, and the rest of the organization by the radical rethinking of business models and, in many cases, reorganization of the business itself.

CIOs will have explicit or de facto responsibility for coordinating change from ideation to market.

Innovation orchestrator

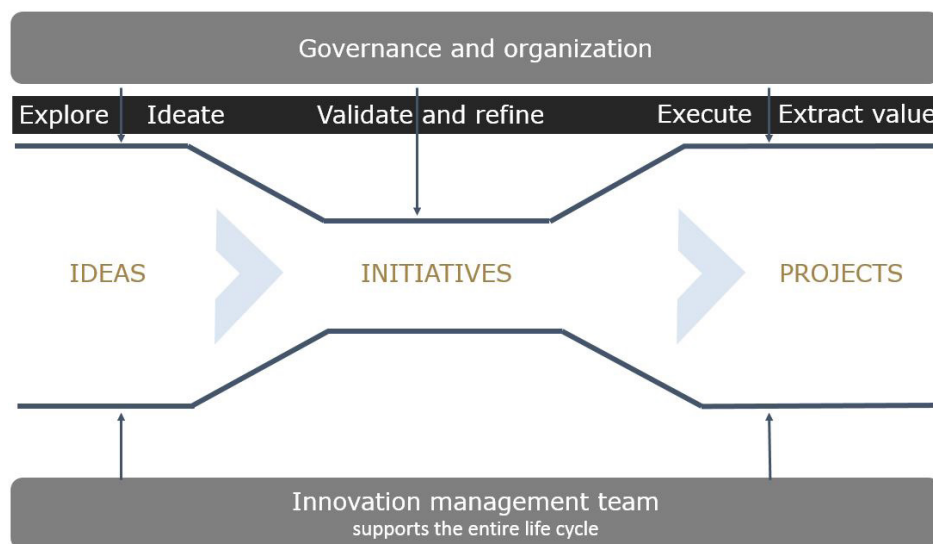
The futurist and evangelist roles are about laying the groundwork. A more central function of the CIO will be to implement the new technology as efficiently and seamlessly as possible. A key skill will be orchestrating innovation effectively, with explicit or de facto responsibility for coordinating change from front to back, from ideation to market (Figure 8).

Orchestration requires a mix of different skills. Modern CIOs will need to combine a start-up mentality with the resources and experience of their existing enterprise. They will also need to generate a large pool of ideas and validate them efficiently and thoroughly through testing. This often works best in a dedicated, small laboratory environment, ideally separate from the main organization. The CIO will then need to look more closely at the most promising ideas through proofs of concept and prototypes.

For development and implementation, the CIO will need to produce a robust and workable plan, share it with the rest of the organization, and integrate the new project seamlessly into the enterprise's normal development and production environment.

Figure 8: Orchestrating end-to-end innovation

End-to-end innovation and business-driven framework as part of the strategic business development.



Source: Ricardo Wehrhahn, Oliver T. Bussmann, 2017.



As blockchain approaches 15 percent of market share, CIOs should watch for a sudden massive acceleration in adoption of the technology, often referred to as a tipping point.

Success will require a convergence of job profiles, with some IT roles taking on more of a business character, and some business roles taking on more of an IT one.

CIOs will want to work openly with a strongly collaborative spirit, not in isolation behind closed doors. Organizations must be part of an ecosystem in which everyone shares ideas and, where appropriate, collaborates or even partners with others. Collaboration will be a new skill for many. It is certainly an essential one.

Managing the tipping point and business-driven innovation

CIOs will want to be mindful of timing. While being too early on the scene can be problematic in some circumstances, enterprises are generally at an advantage if they can leverage first-mover capability, which prepares them for rapid change.

That's important when we consider that new technology adoption is seldom linear. Far more often, it follows an S-curve: there is an early period in which ideas are generated and tested and a few early adopters begin to implement and use the technology. But the time and effort spent on the technology is not necessarily commensurate with the value received, and so organizations can easily justify not being active.

That's unwise. Experience has shown that when a new technology achieves between 13 percent and 15 percent of market share, there is a sudden massive acceleration in adoption, often referred to as a *tipping point*—and it can catch CIOs unawares.

The consequences can be unfortunate. Companies ill prepared for the tipping point will have trouble catching up because they might struggle to find talent and resources. Not managing the tipping point means running the risk of falling behind.

Similarly, CIOs need to manage business-driven innovation. As we have been arguing, blockchain is about transforming both technology and business processes. In such an environment, driving blockchain adoption solely from the IT function makes no sense. The CIO must work closely with the business heads, to drive the technology and business process change together. That means close collaboration to conceive and prototype the new business models as well as the technological architecture, and working together to drive business innovation and value creation.

Success will require new job profiles. For example, during early development, we will need talent for technological ideation, design, and prototyping. In the standardization phase, we will need business model prototyping as well as technological valuation and standardization skills. In the value creation phase, we will need people who can generate business value through technological applications. We can see these profiles as a convergence of roles, with some IT roles taking on more of a business character, and some business roles more of an IT one. Finding the right talent to meet these profiles will be a major priority as well as a very difficult challenge.



Talent development and acquisition

Some estimate that there are fewer than 20,000 blockchain developers globally. CIOs must address the dearth of talent in cryptography, blockchain integration, and smart contract creation.

When undertaking an endeavor as transformative as blockchain, CIOs must acquire and retain the best talent possible and appropriate to their situation and phase of technology innovation, whether they develop talent internally or recruit new talent outside the enterprise. Ensuring that the company has the right blockchain talent on board is a top business imperative because of the scope of the technology's capabilities and its disruptive potential.

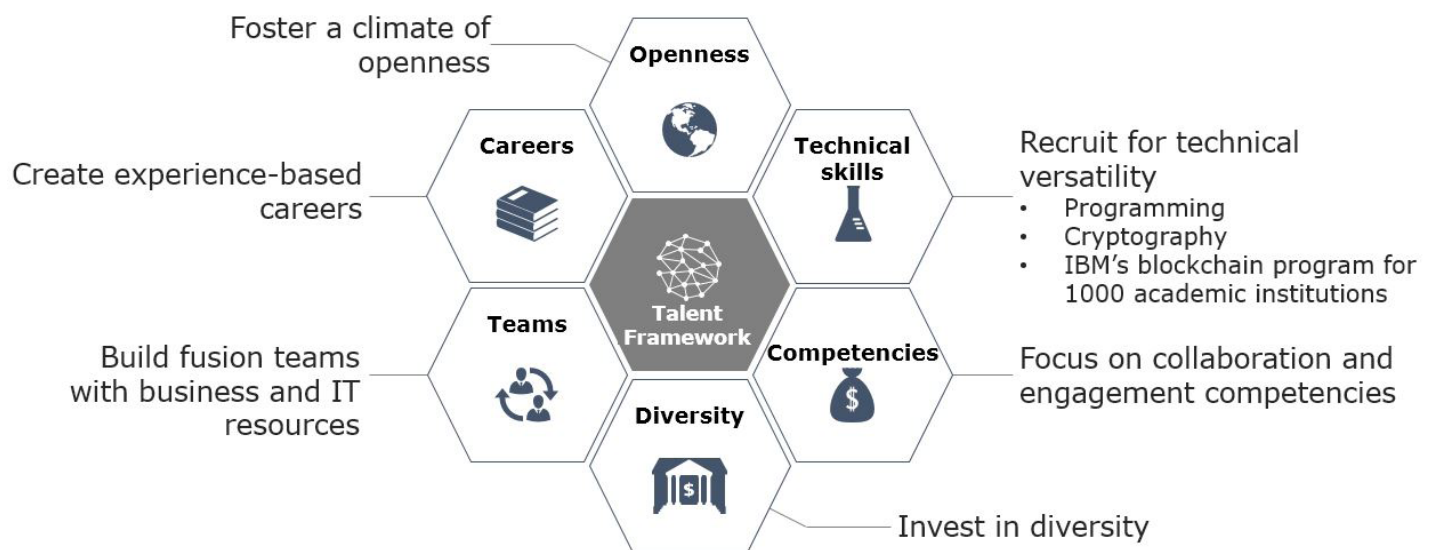
Of the challenges CIOs face in their enhanced C-suite roles, coping with the talent requirements should therefore be high on the priority list at the earliest stage of investment.

The talent shortage

CIOs working with blockchain technology must address the dearth of blockchain developers and experts in, for example, blockchain integration and smart contract creation (Figure 9). Some estimates suggest that there are fewer than 20,000 blockchain developers globally. CIOs can bridge this talent gap and begin their blockchain initiatives by hiring or transitioning key blockchain talent within the enterprise.³⁷

To ensure that their companies get access to the best talent, CIOs must base a talent framework on certain priority areas. Potential hires must be capable developers, knowledgeable in cryptography, and with sound technical skills and versatility. They must be eager to collaborate and work in teams. CIOs must ensure that the company invests in diversity, thus fostering a climate of openness. CIOs must

Figure 9: Priorities for blockchain talent strategy



Source: Oliver T. Bussmann, 2017.



The most effective CIOs will identify existing jobs that will disappear, foresee new jobs that will appear, and act to develop and maintain a robust pool of talent.

also focus on building *fusion teams*, converging business and IT expertise in single units where increased collaboration will yield big payoffs. To attract the best talent, CIOs would be wise to create experience-based careers, as the sharpest talent is also subject to the highest rate of attrition if personal goals are not addressed.

CIOs must also recognize that the skill, style, and nature of the blockchain innovators will vary across ideation, prototyping, growth/institutionalization, standardization, operating, and value-harvesting phases. These styles are often not fungible.

Digital competency framework and seeing the future

To manage the talent environment effectively, a CIO should consider implementing a digital competency framework that differentiates market transformation and company transformation. This framework requires the CIO to understand the company's strategic pivot toward digital and to assess and develop employee competencies to meet digital transformation demands.

When it comes to talent, the most effective CIOs can identify existing jobs that will disappear, foresee new jobs that will appear, and act to develop and maintain a robust talent base. To ensure the hiring of the best blockchain talent, CIOs must aim to predict future requirements and pinpoint the new skills necessary. To stay ahead of the curve, they must define future skills required for existing jobs as well as the skills required for future digital jobs. They must also assess the competencies, strengths, and weaknesses of current employees. To prepare their companies for the digital transformation, CIOs can start developing the skill sets necessary or even procure the talent needed through hiring experienced teams from competitors.

Technology challenges presented by blockchain

CIOs will also need to deal with blockchain's current limitations in an enterprise context, even as they prepare to exploit its full potential as the technology matures. Some of these limitations include:

- » **Immaturity:** At ten-years old, blockchain technology is still immature. Considering its overall success, we might lose sight of the truth that many platforms are still in an early stage. That means, among other things, a lack of standards, the potential for the elimination of players and, depending on the circumstances, interoperability.
- » **Scalability:** Many blockchain platforms do not scale well and can creak under heavy loads. As we have seen with Bitcoin, scalability issues can lead to intense debates and even schisms among stakeholders of public platforms.
- » **Governance:** Community-governed platforms like Bitcoin might not always come to consensus on major decisions.

Enterprise CIOs will need to deal with these current limitations of blockchain: immaturity, scalability, governance, speed, cost, risk, and process.



That can introduce uncertainty. While public blockchains are supposed to be immutable, we witnessed with the Ethereum DAO that a community can vote to fork a blockchain and rewind transactions, which also introduces uncertainty. On private blockchains, the platform owner and/or its members or stakeholders handle governance, thereby minimizing uncertainty.

- » **Speed.** Public blockchains are slow. Private blockchains, while faster, struggle to meet the performance levels of traditional payment systems like Visa. As adoption grows, the speed and performance challenges will grow exponentially.
- » **Cost.** Transaction fees on public blockchains like Bitcoin are variable. In peak periods, they can be significant.
- » **Risk.** We are just beginning to understand the risks that blockchain technology will involve.
- » **Process.** Consistent, scalable, secure service performance requires finely honed policy, process, practice, observation, behavior, and compliance. We hope these will emerge as our experience with blockchain advances. The IT historical landscape is littered with high-potential technologies, such as the three-tiered client server that became unmanageable.

Conclusion and recommendations

We have looked closely at blockchain technology from the perspective of the enterprise CIO and sketched what it means for businesses and the CIO role. Blockchain technology will be driving significant change to digital marketplaces and business models. Enterprises that want to compete will have to prepare for these changes.

The CIO must be a technologist, a business strategist, a futurist, an evangelist, a diplomat, an orchestrator of innovation, and an attractor and developer of talent.

Against this backdrop, the role of the CIO is changing, too. In an age where technology drives so much business innovation, the CIO must be not just a technologist but also a business strategist, a futurist, an evangelist, a diplomat, an orchestrator of innovation, and an attractor and developer of talent. To sum up our findings, we offer today's CIOs working with blockchain technology the following pieces of advice.



Act now. The blockchain space is moving rapidly even if it doesn't always appear so. If you can, leverage your first-mover capability, and position yourself and your organization to manage the tipping point because, when mass adoption begins, it will move quickly.



No matter what they do, CIOs will want hands-on experience with the technology as quickly as possible. They should download a few wallets, purchase coins, and experiment as users of various blockchain platforms.

For those who are contemplating building end-user-facing blockchain solutions, being a “user” on other platforms can bring important insights, too.



Form a taskforce to stay ahead of the technology.

In your role as futurist, consider creating a small in-house research team dedicated to monitoring developments, absorbing the vast amount of data available in the space, analyzing these data, and reporting on findings.



Identify your use cases. Blockchain technology is applicable in many areas of the enterprise. If there is low hanging fruit in your industry, grab it. Early adopters can gain valuable experience even if working with limited applications.



Examine what blockchain technology will mean for your enterprise stack. Blockchain-based platforms will allow you—or even oblige you—to reimagine the enterprise IT stack. As CIO, you need to know how the blockchain enterprise stack is designed and how it differs from the traditional IT setup.



Study how blockchain and related technologies will affect your business models. We have talked repeatedly about new business models. As a CIO these days, you need to be thinking in terms of business strategy as much as technology. For many CIOs, thinking this way will be a new experience. Take it as a learning one.



Engage with the blockchain community to understand these new technologies. Decentralized marketplaces and platforms have properties different from centralized ones. Understand what makes them tick by taking an active role in the blockchain community and joining the conversation. If you have not already, try the technology yourself by downloading a wallet and trading cryptocurrencies.



Participate in the formulation of industry standards. Since blockchain is a young technology, industry standards are not settled. Take part in the conversation and contribute to the broader decision-making process.



Advocate for policies or regulations of blockchain technology applied to particular industries. The usage of blockchain technology will soon have a formal regulatory framework. As a CIO today, you need to identify policies that will affect your industry and play a role in shaping them.



Prepare your enterprise for new marketplaces. The future is likely to be one of large, open, broad-based public platforms. You should prepare your enterprise to compete in such settings, even if it seems a long way off.



**Develop a clear plan and roadmap for your organization.**

If change is coming, people will be grateful to know exactly how and when. A clear plan and roadmap for your organization will help. Such a map should include talent acquisition and skills development.

**Anticipate resistance to change.**

C-suite colleagues might feel threatened by your expanding role. IT and operations departments might resist blockchain mindsets and skill sets. The organization might fear such radical rethinking of business models and the potential for reorganizing the business itself and displacing jobs. Exercise diplomacy.

**Embrace your new role as a CIO in this increasingly tech-driven world.**

Today's CIO has a far broader remit than in the past. Understand your role as the company's "chief technologist" in the broadest possible sense as a guide to the imminent transformations. Demonstrate both tech and business savvy, and communicate the technological change clearly and vividly to both technical and nontechnical audiences.

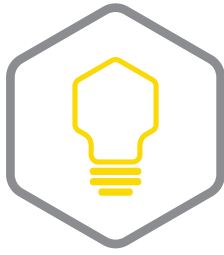
**Get ready to manage the adoption process.**

When the time comes for your enterprise to adopt blockchain technology, you will need to manage the process. This involves combining a start-up and enterprise mentality, and working in an open, collaborative way—sharing insights with other members of the community and avoiding developing new capabilities behind closed doors.



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About the author

Oliver T. Bussmann is a globally recognized technology thought leader and driver of large-scale transformation at multinational organizations. The founder and managing partner of Bussmann Advisory, he advises enterprises, top-tier consultancies, and financial services companies looking to stay ahead of the digital disruption curve. He also holds important mandates in industry associations, including as president of the Swiss Crypto Valley Association, global ambassador for UK-based Innovate Finance, and as a board member of Identity 2020.

From 2013 to 2016, Bussmann was group chief information officer of UBS, where he successfully led a major IT transformation effort, instituted a new group-wide innovation framework, and established UBS as a pioneer in the development of blockchain for use in financial services. Prior to joining UBS, Bussmann was global chief information officer at SAP, where he also spearheaded significant technological transformation; and before that, he was CIO for North America and Mexico at Allianz. Previous roles have included executive positions at Deutsche Bank and IBM.

Bussmann's achievements have been widely recognized. He was named COO/CTO of the year by *Financial News/The Wall Street Journal*, European CIO of the Year by INSEAD/CIONET, received the Elite 8 Award, given to the most innovative leaders in technology in capital markets by *Wall Street and Technology* magazine, and has twice been included on the *Financial News* "FinTech 40" list of innovators shaping the future of finance.

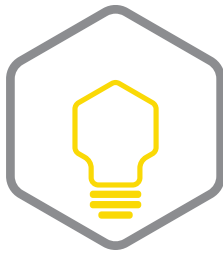
Disclosures

Oliver T. Bussmann has several relationships in the blockchain space, namely: president, Crypto Valley Association; global ambassador, Innovate Finance; board director, Identity 2020; founding member, Global Blockchain Council; member, Technology Advisory Council, Financial Service Roundtable; affiliate, Webb Investment Network; mentor, Level39; strategic advisor, Ambrosus; strategic advisor, Tend; strategic advisor, Deon Digital; strategic advisor, IOTA; strategic advisor, Ripple; strategic advisor, Melonport; and strategic advisor, Lykke.

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About the Blockchain Research Institute

Co-founded in 2017 by Don and Alex Tapscott, the Blockchain Research Institute is a knowledge network organized to help realize the new promise of the digital economy. It builds on their yearlong investigation of distributed ledger technology, which culminated in the publication of their critically acclaimed book, *Blockchain Revolution* (Portfolio|Penguin).

Our syndicated research program, which is funded by major corporations and government agencies, aims to fill a large gap in the global understanding of blockchain technology and its strategic implications for business, government, and society.

Our global team of blockchain experts is dedicated to exploring, understanding, documenting, and informing leaders of the market opportunities and implementation challenges of this nascent technology.

Research areas include financial services, manufacturing, retail, energy and resources, technology, media, telecommunications, healthcare, and government as well as the management of organizations, the transformation of the corporation, and the regulation of innovation. We also explore blockchain's potential role in the Internet of Things, robotics and autonomous machines, artificial intelligence, and other emerging technologies.

Our findings are initially proprietary to our members and are ultimately released under a Creative Commons license to help achieve our mission. To find out more, please visit www.blockchainresearchinstitute.org.

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