

# Blockchain: Emergent Industry Adoption and Implications for Accounting

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**ABSTRACT:** Blockchain is a distributed ledger technology poised to transform the accounting practice. In this paper, we provide an initial examination of the technology itself and discuss the associated opportunities and limitations. We also present an overview of the current blockchain-related practices in large accounting firms and trace significant milestones in this technology's emergence. Finally, we discuss some potential areas that future research could address.

**Keywords:** blockchain; distributed ledger technology; smart contracts; accounting.

## INTRODUCTION

This paper is motivated by the need for accounting academics and practitioners to become familiar with cutting-edge technologies for both the accounting information systems research and education to parallel practice (J. Coyne, E. Coyne, and Walker 2016). Blockchain is one such cutting-edge technology poised to transform invoicing, payment processing, contracts, and documentation with significant implications for accountants, finance professionals, and regulators (Baron 2017; Dai and Vasarhelyi 2017). The goal of this paper is to provide an initial understanding of this emerging technology through the lens of challenges and opportunities: to analyze what makes blockchain technologically possible, to trace the milestones surrounding the evolution of blockchain, to examine the applications of blockchain in accounting, and to investigate current blockchain-related practices in large accounting firms.

Blockchain technology has received much press coverage in the last few years. It has been called a “game changer” (Deloitte 2016), a foundational technology that can result in new economic and social systems (Iansiti and Lakhani 2017), and “the fifth pillar of the IT revolution,” after mainframes, personal computers, the internet, and social media (Thakkar 2017). Having originally gained recognition as the technology that underpins the cryptocurrency bitcoin, blockchain is notable for its potential to provide trust in a network without a central authority.

Because no central authority is required, the technology could be a democratization force in a variety of industries and has the potential to reduce transaction costs at a scale at which the internet reduced communication costs (Lundy 2016). It is predicted that the blockchain market for enterprise applications will grow from \$2.5b in 2016 to \$19.9b by 2025 (Tractica 2016), and that 10 percent of global GDP will be on a blockchain (World Economic Forum 2017). The financial services industry has been leading the efforts to realize the potential of the new technology (e.g., Shubber 2015; A. Tapscott and D. Tapscott 2017), but today the technology is also finding numerous other applications including in supply chain management, maintaining government records such as land ownership, and healthcare. Such changes could have big implications for the accounting profession.

## LITERATURE REVIEW

### How Does Blockchain Work?

Blockchain is a digital ledger—a collection of records with verifiable integrity. It uses a global distributed network of computers to record transactions in such a way that they cannot be altered once approved: it relies on participating computers’

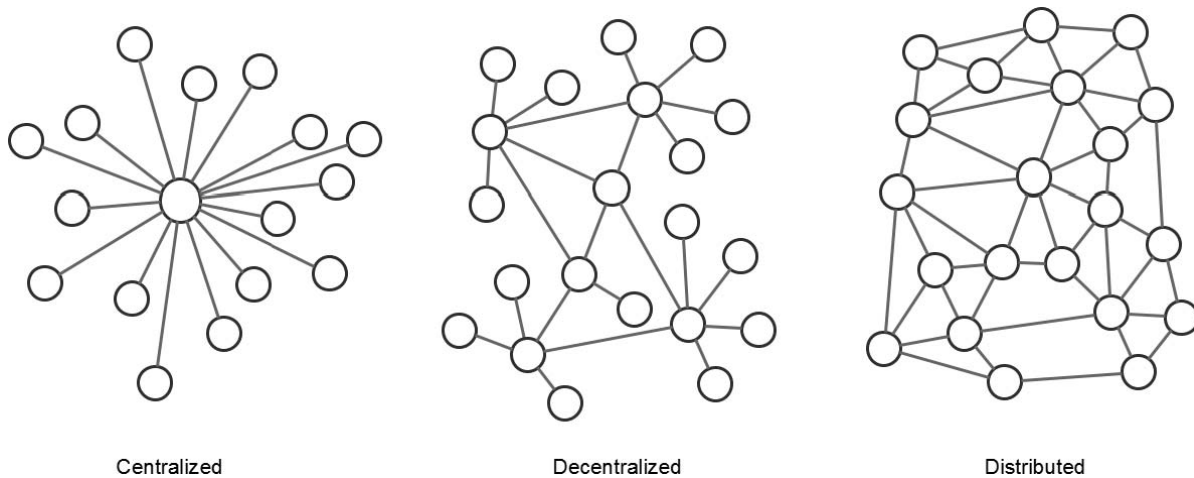
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The authors greatly appreciate comments and suggestions by the editors and three anonymous referees, which improved the paper.

Editor’s note: Accepted by Dan Palmon.

Submitted: July 2017  
Accepted: August 2017  
Published Online: September 2017

**FIGURE 1**  
**Network Structures**



Source: Adapted from Baran (1964).

processing power to verify transactions using protocols in a process dubbed mining. The nodes (i.e., users)—called miners—are incentivized to participate in the creation and verification of blocks.

The blockchain system facilitates trustless and distributed consensus, without the need for a trusted third party to verify the transactions. The use of a distributed network also ensures that the blockchain system is resilient to disruptions. Figure 1 compares a distributed network to decentralized and centralized networks. Many implementations of blockchain technology (e.g., Bitcoin) use a permissionless approach, in which anyone can become a miner in the network.

The blockchain entries, called “blocks,” are added and can be seen by any part of the network. Each block—the information it contains—is validated by the nodes in the blockchain network before it is approved. When the nodes arrive at a consensus, the block is verified and added to the chain of blocks in chronological order to establish the record (i.e., each block contains the identifier of the previous block in the chain). The decentralization of the blockchain system, without a central authority approving the transactions, means that the blocks cannot be tampered with and that the behavior of the system cannot be changed.

### ***Blockchain Technology Ensures the Integrity of the Records***

The transactions stored in a block of the blockchain cannot be altered. This is achieved using a hash function: a mathematical formula that processes the content of the block (the transactions) and generates a hash or digital fingerprint for it. Some characteristics of the hash function are as follows:

- Any change to the content of a block will result in a completely different hash.
- The output of the hash function is unpredictable, almost unique, and looks like a random sequence.
- Hashes are short and have a predefined length.
- The hash of a block is added to the next block in the blockchain, affecting its hash.
- The original content of the block cannot be obtained from its hash (hash functions are one way).

In reality, the hash function is applied iteratively to different parts of the content of the block in what is called “the Merkle Tree.” The result of the process is a final root hash, the Merkle root, or “hash of hashes” that serves to identify the content of the block.

Yermack (2017) and Dai and Vasarhelyi (2017) provide an accessible introduction to some of the concepts described in this section. A detailed, more technical description of the protocol in relation to Bitcoin is available from <https://bitcoin.org/en/developer-guide>.

### ***The Creation of Blocks Requires Solving a Puzzle***

Before a block can be incorporated into the blockchain, it needs to be solved. The task of solving a block requires more than simply calculating the hash of the block: it calls for the identification of an arbitrary number, called a “nonce,” resulting in

a hash of the block header that meets certain criteria; the hash of the header has to be smaller than a given target. The identification of an adequate nonce requires multiple attempts and computing processing power. The header, in addition to the nonce, includes the hash of the previous block, the Merkle root or hash of the transactions it contains, and a timestamp. Once a miner finds a suitable nonce, its validity is verified by (a majority of) the miners in the blockchain and it is added to the network.

### ***Blockchain Can Use Smart Contracts***

A “smart contract” is a set of software-driven rules that encapsulate the terms agreed to by the parties involved. Although it is not an inherent requirement of blockchain technology, smart contracts can be incorporated into the blockchain and executed when certain conditions are met, without the need for trusted intermediaries to participate in the process of verifying and executing the contract. In general, as the contract becomes part of the blockchain, it is visible to anyone, but there are technological solutions to hide the information of the contract code (Buterin 2016). Watanabe et al. (2015) discuss in detail the implications of recording contracts in a blockchain.

As a simple example, blockchain technology with smart contracts can be deployed to allow the use of a resource in a peer-to-peer lending network (e.g., car sharing). If the conditions for the use of a particular resource are met (e.g., a car is available on the terms provided by the requester), then its execution would result in the completion of the transaction and exchange of payment for the resource (Reuters 2017).

### ***Many Possible Blockchain Implementations***

The principles of blockchain technology, first developed for Bitcoin, can be subject to many variations. Parties implementing a blockchain-enabled exchange can design it as a permissionless system to which anyone can join, or to restrict who can participate in the transaction or verification processes. The latter private model is being researched in particular by financial institutions and accounting firms. Also, new blockchain implementations can make use of a variety of protocols to determine miner rewards for the creation and verification of blocks (Castor 2017). The two main protocols used as part of a blockchain are proof-of-work and proof-of-stake.

**Proof-of-work (PoW).** To create transactions as part of a block, miners solve a computing-intensive task (e.g., identifying a nonce that makes the hash smaller than a given parameter). In exchange, the miner solving each block problem announces the solution to the network and receives a prize reward. Once verified by the network, the block with transactions is stored in the public blockchain. The PoW protocol deters denial-of-service attacks on the network by imposing work from the service requester (i.e., consumption of computer resources, electricity), while still making it possible for members of the blockchain to participate in exchanges. Bitcoin is a PoW cryptocurrency (Bitcoin 2017).

**Proof-of-stake (PoS).** The miners (denominated “forgers” when using this protocol) do not receive rewards for solving a block, but for verifying transactions. Blocks are assigned for solving by a participant using a probabilistic algorithm that accounts for the wealth (i.e., stake) of participants in the network in a process denominated “forging.” Those who are highly invested in the network are expected to have the greatest interest in protecting it to preserve the value of their investment.

### ***Limitations and Challenges of Blockchain Technology***

There are limitations and challenges associated with the implementation and use of blockchain technology.

The design of the blockchain and use of a consensus protocol have implications for the trust in the decentralized and unregulated system, and security is a limiting factor in the adoption of blockchain implementations. A blockchain implementation needs to result in a large distributed network in order to be successful, which implies that the protocol should provide the right incentives to the participating agents. Blockchains designed as public systems (i.e., permissionless), allowing anyone to join, are susceptible to the “51 percent attack,” or the manipulation of addition of new blocks to the blockchain by a majority of agents participating in the distributed network (Witte 2016). However, blockchains designed as private systems (i.e., permissioned), primarily for the financial industry, lack transparency and the incentive structure to benefit from the decentralization, and they serve more as sophisticated transactional databases.

Blockchain does not necessarily prevent theft of property when used for payments. To understand this, it should be noted that bitcoin and other cryptocurrency transactions are stored in the blockchain as the public keys of cryptographic public/private key pairs. Individual users retain the private keys for the transactions, which can be used to access a Bitcoin address to spend the funds. (See [https://en.wikipedia.org/wiki/Public-key\\_cryptography](https://en.wikipedia.org/wiki/Public-key_cryptography) for an introduction to public-key cryptography and Witte [2016] for an accessible explanation of how this process works in the case of bitcoin.) These private keys are stored in “wallets” (<https://www.coindesk.com/information/how-to-store-your-bitcoins/>). However, the information stored in a wallet can be stolen (Witte 2016), for example, by cracking insecure passwords or phishing scams. In addition, the anonymity of

**TABLE 1**  
**Important Blockchain Concepts**

| <b>Block</b>                                                                                                                                  | <b>Miner<br/>(Forger under PoS)</b>                                                                                                                                                                              | <b>Hash Function</b>                                                                                                                                                                                       |
|-----------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Bundle of transactions that has to be verified by the miners to be incorporated into the chronological sequence of blocks (i.e., blockchain). | Node in the distributed and global blockchain system that provides computing power to create blocks and verify transactions, and stores the blockchain.                                                          | One-way function that produces a hash from digital content (i.e., a block; <a href="#">Witte 2016</a> ). SHA-256 is a common function used in blockchain implementations ( <a href="#">Bitcoin 2017</a> ). |
| <b>Hash</b>                                                                                                                                   | <b>Consensus Protocol</b>                                                                                                                                                                                        | <b>Smart Contract</b>                                                                                                                                                                                      |
| Fixed-length output of the hash function that is used to uniquely identify each block in a blockchain.                                        | Set of rules that specified how miners utilize their computing resources to create blocks, arrive at consensus (i.e., verify blocks), and the type of prize the miners receive ( <a href="#">Bitcoin 2017</a> ). | Terms of agreements stored in a blockchain that will be executed once pre-specified conditions are met ( <a href="#">Stark 2016</a> ).                                                                     |

bitcoin users “opens up opportunities for dishonest traders to scam during transactions” ([Sas and Khairuddin 2017](#)). This also makes cryptocurrencies the currency of choice for online extortion (e.g., payments requested by ransomware) and fraudulent online payments. A list of examples of large “bitcoin heists” is compiled by [Estes \(2014\)](#).

The use of smart contracts raises additional issues. Smart contracts are computationally expensive, as miners have to complete the calculations to trigger the execution of the contract, and the lack of central authority raises issues about regulation and who is responsible for solving software-related problems if they were to arise. In addition, smart contracts may introduce vulnerabilities in the system. The DAO attack, in which a hacker managed to drain millions by exploiting a “recursive call bug” in the smart contract code, is one such example. (See [Siegel \[2016\]](#) for an excellent summary of the incident.)

From a technical perspective, the scalability of blockchain is an issue, as blockchain is purposefully computationally intensive. For example, Bitcoin can handle up to 7 tps (transactions per second) ([Gilbert 2016](#)). Although under-development implementations can scale multiple orders of magnitude that number ([Croman et al. 2016](#)), the current capacity of blockchain is insufficient for financial institutions, such as payment and settlement networks, which process thousands of transactions per second ([Gilbert 2016](#); [Cochrane and Sands 2017](#)). For example, Visa Inc. processes 4,000 tps, and Depository Trust and Clearing Corporation’s (DTCC) Universal Trade Capture processes 47,000 tps ([Cochrane and Sands 2017](#)). The Lightning Network (<https://lightning.network/>) is one of the most promising blockchain implementations, with the capacity to handle millions of transactions per second.

Finally, of particular relevance to the role of the accountant, consulting companies have yet to create the tools and design the protocols to audit blockchain-stored transactions ([Smith 2017](#)). Table 1 summarizes some of the important terms associated with the blockchain technology covered in this section.

### Blockchain Milestones and Applications

Reviewing the milestones for blockchain’s adoption is important for understanding the complicated landscape of its applications today and for anticipating significant industry trends. This section reviews the timeline for the development of the blockchain technology, summarizing entry points for various adaptors of the technology.

In 2008, Satoshi Nakamoto’s (a pseudonym for an unknown person or group) white paper introducing the world to Bitcoin was published ([Nakamoto 2008](#)). Blockchain was the technology underlying Bitcoin. The financial industry was the first to realize the distributed database technology potential as something separate from Bitcoin. Five years after, in 2013, Fidor Bank began experimenting with digital currency exchange and bitcoin trading. Fidor Bank also partnered with Ripple (at the time called OpenCoin) to implement money transfers in a digital currency system that relied on members of the network to verify transactions instead of the mining process used by Bitcoin ([https://en.wikipedia.org/wiki/Ripple\\_\(company\)](https://en.wikipedia.org/wiki/Ripple_(company))).

Ripple is an example of a company that offers private blockchain solutions for financial settlements, and there are other competing projects in the blockchain space. In 2014, R3 (R3CEV, LLC), a blockchain technology company, was founded, and since then it has formed a consortium for research and private development of blockchain database usage in financial services of over 80 major financial firms and technology companies, including Barclays PLC, Banco Bilbao Vizcaya Argentaria, S.A.

(BBVA), Commonwealth Bank of Australia, Credit Suisse Group, The Goldman Sachs Group, Inc., JPMorgan Chase & Co., Royal Bank of Scotland, State Street Corporation, and UBS AG (Lang 2015). Some of the members (Goldman Sachs, Banco Santander, S.A., JPMorgan) have since left; however, the \$107 million in financing R3 received in May 2017 from major investors such as SBI Group, Merrill Lynch Bank of America Corporation, HSBC, Intel Corporation, and Temasek Holdings Private Limited reflect strong support for the consortium (Shieber 2017; Kharpal 2017). The members that left did not necessarily leave because they gave up on the technology; instead, some invested in competing blockchains. For example, JPMorgan is investing in its own distributed ledger, called Quorum (Higgins 2017a). JPMorgan is also one of the backers of the Enterprise Ethereum Alliance (Higgins 2017a). The Enterprise Ethereum Alliance supports Ethereum, a blockchain-based platform that first incorporated smart contract (scripting) functionality and now provides a popular alternative cryptocurrency token to bitcoin, “ether” (<https://en.wikipedia.org/wiki/Ethereum>). Ethereum was proposed by Vitalik Buterin in a white paper in 2013, and has soared in value since then (Durdin 2017).

A push for standardization in the blockchain technology space is the Hyperledger project, led by the Linux Foundation. The project was announced on December 17, 2015, and was backed by 17 founding members. It now has over 130 members, including technology companies such as IBM, consulting and professional services companies such as Accenture PLC, and financial services companies such as JPMorgan and the Depository Trust and Clearing Corporation (DTCC). The goal of the project is to support open source blockchain-based distributed ledgers and advance cross-industry blockchain technologies. (See, also, <https://en.wikipedia.org/wiki/Hyperledger>.)

According to the results of a 2017 Chartered Financial Analysts’ survey (CFA Institute 2017), finance professionals do not envision blockchain as transformative within the next year. However, a third believes that it will be the technology with the greatest impact on the industry within five years. Perhaps more importantly, other industries are beginning to realize that the application of the blockchain technology is not limited to digital currency and financial services, as the technology can be used for open collaboration and exchange of any information. For example, Guardtime, a software security company, has developed a digital signature system based on blockchain technology. In the healthcare space, Gem Co and Philips have partnered to explore how the blockchain technology can help develop a patient-centric approach to healthcare (<https://gem.co/health/>).

A major potential area of application for blockchain is in supply chain management, where “intermediaries like distributors, retailers, transporters, storage facilities and suppliers stand between the consumers and the products they use” (Thakkar 2017). Traditional supply chain processes are often based on multiple bilateral links. Instead, Consensus Systems (ConsenSys) is attempting to use blockchain technology to build a “supply circle” that allows consumers to become “prosumers,” that is, “consumers that are also producers” (Thakkar 2017).

The ability to track, through a distributed ledger, the true value of the products and services that customers purchase as well as factors such as environmental damage, child labor, and criminal activities that potentially go along with the manufacturing of products, can be disruptive for the industry and lead to the formation of an open ecosystem for collaboration. According to Bill Fearnley, Jr., a research director at International Data Corporation, “By creating a permanent record that can’t be altered, blockchain is well-suited for tracking diamonds and other goods where buyers want to know the origins and previous owners” (Nash 2016). For example, Everledger Ltd. uses blockchain technology to provide provenance in the diamond trade (Hutt 2016). Assetcha.in uses blockchain technology to create a secure marketplace for valuables and art (Lundy 2016).

IBM has become one of the greatest supporters of the blockchain technology, “developing code and hosting labs where customers can experiment with blockchain software” (Nash 2016). Everledger was one of IBM’s first clients in this space. Another one of IBM’s clients is Indian conglomerate Mahindra & Mahindra Limited. IBM and Mahindra have formed a partnership to enable trade finance transactions from suppliers to manufacturers. Mahindra is also researching how to apply blockchain in the auto and agritech industries (Thakkar 2017).

Governments are embracing the blockchain technology, a curious development given the technology’s origins as a platform for which no central authority is needed. Sweden, Georgia, and Honduras have been exploring using blockchain for land registries (Hutt 2016), and Dubai wants “distributed ledgers to power its entire government by 2020” (Ryder 2017).

Blockchain is a platform that enables peer-to-peer transactions and a true “sharing economy” (De Filippi 2017; Lundy 2016). Some predict that the blockchain technology will eliminate the middleman in a variety of industries. As Lundy (2016) argues, real estate, legal services, and e-commerce can all be replaced with lower-cost blockchain-based services, and “rather than use Uber, Airbnb or eBay to connect with other people, blockchain services [will] allow individuals to connect, share, and transact directly.”

### Applications of Blockchain in Accounting: Current Initiatives at the Big 4 Accounting Firms

As explained earlier in this article, blockchain represents a distributed ledger system that is a shared collection of synchronized ledger records that can be seen by all the participants in the network (Vaidyanathan 2017). A change made by a participant in this network would be validated and reflected in everyone’s view of the ledger in one shared record

(Vaidyanathan 2017). Significant efficiencies can be achieved when performance of a transaction occurs as a single event with the recording of the transaction. This process eliminates the need to enter and reconcile the information in multiple databases, which saves time by increasing the speed of transactions and substantially reducing human error or fraud.

The discussion in the previous section illustrated that distributed ledger technology applications are an emerging area with the power to disrupt digital transaction processing, contracting, and stock trading (Watson and Mishler 2017). The benefits of blockchain in accounting can be found in auditing through the establishment of a detailed audit trail, and the ability to review exceptions generated from a population of transactions rather than a sample. Also, distributed ledgers could provide an opportunity to conduct audits on a more frequent or even continuous basis with an increased sense of trust, because the technology would make it impossible to modify any transactions before an audit (Vaidyanathan 2017). Some of the areas in accounting and auditing that would benefit from blockchain applications are (Baron 2017):

- “Traceable audit trails;
- Automated audit processes;
- Authentication of transactions;
- Tracking ownership of assets;
- Development of “smart contracts”; and
- Registry and inventory systems for any asset, ranging from raw materials to intellectual property.”

To understand better the application of distributed ledger technology in accounting, we explore the current blockchain-related practices in the largest players in the accounting industry. Each of the Big 4 accounting firms (Deloitte, PricewaterhouseCoopers [PwC], Ernst & Young [EY], and KPMG) has engaged in research and development within the blockchain space. In August 2016, the four major accounting firms met with the American Institute of Certified Public Accountants (AICPA) to assess the potential establishment of a distributed ledger consortium with the goal to examine blockchain solutions for the accounting industry (Del Castillo 2016). The accounting industry’s response has been similar to that of the financial services industry, where R3, the distributed database technology company, leads a consortium of financial institutions working on blockchain solutions for the financial sector. The accounting industry consortium was hosted by the Ethereum-focused startup ConsenSys and generated substantial interest from the large accounting firms, which view blockchain as an opportunity to create additional revenue streams through assurance services and to explore the potential efficiencies it can provide (Del Castillo 2016). More recently, in June 2017, the Accounting Blockchain Coalition Conference (ABCC), an organization that educates its members on blockchain-related innovation in the accounting industry, hosted a “Blockchain, accounting, audit, and tax conference” (Accountingblockchain 2017). The outcome of the conference was the creation of five working groups with the goal of working with the standard setters and assisting in developing accounting standards to regulate blockchain use (Del Castillo 2017a).

As blockchain and other disruptive technologies such as artificial intelligence and cloud computing enter the accounting profession, the AICPA has been closely following state legislative agendas in the U.S. to determine how they would influence the way CPA firms operate and use technology (AICPA 2017). States like Arizona, Illinois, and Nevada have proposed legislation covering blockchain in the course of 2017 legislative sessions (AICPA 2017). Moreover, the AICPA has created the Assurance Services Executive Committee (ASEC), comprised of industry and academic leaders, with the goal to develop guidance and support innovation and incorporation of emerging technologies to address developing assurance and advisory needs (ASEC 2017).

Deloitte has set up a team, Deloitte Rubix, which is working solely on blockchain applications in Deloitte’s Toronto offices. The focus so far has been on payments, rewards programs, and digital banking (Das 2017). In January 2017, Deloitte announced the opening of its first blockchain lab in New York City, and its second blockchain lab in Dublin, Ireland, shortly after. In February 2017, Deloitte announced that it had performed a blockchain audit in which it successfully applied existing auditing standards to examine a permissioned blockchain application (Das 2017). In total, Deloitte’s blockchain practice consists of nine development teams with over 500 community members from 30 countries that have developed over 30 blockchain use cases (Deloitte 2017).

More recently, EY launched EY Ops Chain, which focuses on pricing, digital contract integration, shared inventory information, invoicing, and payments (Prisco 2017). EY has also set up a blockchain lab in New York City to develop blockchain-based solutions for its clients. The areas where blockchain could have an impact are, “clearing and settlement, trade finance and supply chain management, closed economies and loyalty points, insurance claims management, and Internet of Things (IoT) applications” (Prisco 2017).

PwC, through its DeNovo platform, offers proprietary blockchain content covering the latest developments in the FinTech industry. PwC also offers guidance on how best to implement blockchain in organizations by conducting detailed strategy assessments and creating customized proof-of-value tests to show the viability of blockchain before full implementation (PwC 2016). During implementation, PwC provides support with designing, developing, and testing of blockchain solutions, and

provides third-party integration assistance (PwC 2017). Grainne McNamara, a principal with PwC, stated the following about blockchain applications: “Supply chain is getting the most attention. Every single client we sit down with we can absolutely find a [supply chain] use case that provides value to the client and their customers” (Del Castillo 2017a). Further, she summarized PwC’s blockchain practice as follows (ABCC 2017):

We have already demonstrated that a combination of blockchains and smart contracts are incredibly useful to people in finance and operations functions. We have done field proof of concepts where, for example, in the order-to-cash process we are able to demonstrate using a blockchain on a smart contract infrastructure that we could track from physical assets to the Internet of Things all the way through to cash. It is too early to say that PwC itself has been transformed by blockchain, that would be quite a statement. Of course, we are talking to our clients about how might we use blockchain and associated technologies like smart contracts to help make finance functions more efficient. We are also looking, of course, what it means for our audit business—there is a disruption effect obviously. We are looking and asking how might we use technology to audit this technology, what would constitute some of the controls that we are looking for. We are also working with accounting standards bodies. Did anything in my internal system of controls move to the blockchain, and what do I need to do to demonstrate that I am still actually in compliance with accounting regulations? Those are some of the activities that we have ongoing.

In March 2017, PwC announced the backing of the Crypto Valley Association, a nonprofit organization in Switzerland created to engage in blockchain research and public policy outreach (Higgins 2017b). In June 2017, PwC sponsored the ID2020 event hosted by the United Nations, where representatives from both public and private sectors convened to examine how blockchain startups could attempt to solve an issue of over a billion people with no legal identity (Del Castillo 2017b).

In February 2017, KPMG announced the creation of Blockchain Nodes in Frankfurt and Singapore in partnership with Microsoft Corp. The goal of the nodes is to “create and demonstrate use cases that apply blockchain technology to business propositions and processes” (KPMG 2017). The focus is on creating prototype models to address blockchain implementation challenges in the financial services industry, as well as healthcare and the public sector.

The blockchain-related milestones in accounting and how they are positioned relative to the milestones in blockchain adoption in different industries that we discussed in the previous section are shown in Figure 2.

## DISCUSSION AND OPPORTUNITIES FOR FUTURE RESEARCH

Some of the most interesting issues surrounding the distributed ledger technology can be found in the space of data sharing. Even though the use of blockchain in accounting is still in its infancy, it is important to monitor the progress of blockchain implementation in organizations in order to examine how organizations determine whether to place data in a shared environment or to encrypt them; or how organizations achieve a balance between data transparency and privacy. As Jake Benson of Libra stated at the ABCC conference, “This is one of the most interesting things about this space. There will be new best practices on what type of data and processes belong on blockchain and what types do not” (ABCC 2017).

Another area that future research could explore is the efficiencies achieved through blockchain use. Where do blockchain applications create the greatest efficiencies, prevent fraud, or reduce waste? For example, in a supply chain, goods entering the blockchain could be marked with an identifier that would provide for an opportunity to check those goods against their initial values throughout the entire process and identify any discrepancies (Benson 2017). How would increased transparency in the supply chain and ability to monitor transactions in real-time change managerial accounting practices? How would systems of operational performance management and measurement change because of blockchain?

In the context of auditing, accounting researchers should examine how to develop a triple-entry accounting system that enables blockchain technology to be an intermediary that automates transaction storage and verification (Dai and Vasarhelyi 2017). Auditing researchers should also examine ways to develop internal controls for blockchain applications and understand their auditability and ways to incorporate internal control protocols, “smart controls,” into smart contracts (Dai and Vasarhelyi 2017). In the context of forensic accounting, an interesting area of exploration would be to examine whether public blockchains bypass any of the anti-money-laundering regulations (ABCC 2017). In the area of taxation, the application of blockchain in transfer pricing seems to be the most promising (ABCC 2017). From the regulators’ perspective, it is important to understand the emerging governance structure surrounding the blockchain ecosystem and explore ways to regulate resulting products, services, activities, and entities, while promoting responsible innovation practices (ABCC 2017). Also, it is important for researchers to monitor how blockchain and other emerging technologies alter the nature of accountants’ jobs over time. What new tasks will this technology enable accountants to perform and which tasks will disappear? How will accountants work alongside this technology? Accounting firms appear optimistic about the potential of the distributed ledger technology and foresee that its impact will be noticeable in the near future.

**FIGURE 2**  
**Milestones of Development and Adoption of the Blockchain Technology**



Source: Compiled from [Hewlett Packard Enterprise \(2016\)](#), [Mann \(2016\)](#), and various online sources.

Medium gray = major technological advances; light gray with light border = major developments in adoption in the financial sector; light gray with dark border = major developments in adoption in the supply chain and healthcare sectors; and black = major developments in adoption by accounting firms.

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