

# Blockchain Explained and Implications for Accountancy

Blockchain technology underlies cryptocurrencies such as Bitcoin and Ethereum and is capable of storing data that has notably useful characteristics, especially for accounting data. Blockchain technology has been described as a highly secure version of a Google document that can be shared with many, but changes are secure:

*A decentralized archive utilizing the blockchain as a storage mechanism could offer an uncontested space from which records could be accessed. Documents and other sets of data can be validated by the blockchain—even if an application you used to get it there is not working. It is decentralized proof which can't be erased or modified by anyone; competitors, third parties, governments. This is what distinguishes using the blockchain from other forms of data timestamping and authentication [...] The technology potentially offers a means for society—or at least groups within society—to keep their own records with some assurance about inviolability and longevity that was not possible before.<sup>1</sup>*

A large amount of attention and capital currently is being allocated toward virtually anything related to blockchain technology. It is important to examine blockchain first by getting a better understanding of the technology and then examining the accounting and auditing implications.

For an experienced practitioner, blockchain might create a feeling of *déjà vu* recalling the hype and excitement of the World Wide Web in the early 1990s. Many saw resources flocking to it and efforts to develop the best ideas. Blockchain technology development is still in its early stage, fraught with failures and will certainly look very different in a few years. With the World Wide Web, the first websites were rudimentary, but now are deeply embedded in daily lives and economies. So with blockchain, it will likely develop into and become a more prevalent feature of daily and economic life.

The implications mean that accounting data can be stored and accessed in a way that is:

- **Uncontested, unmodifiable and validated**—Are the data error-free with no audit necessary?

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- **Decentralized**—Accounting data can be accessed by anyone possessing proper authorization/permission using different systems and software, therefore, offering enhanced efficiency regarding reporting and other regulatory disclosure requirements.

Broadly speaking, financial systems—especially accounting systems—are being pushed from the physical world to the digital world. Blockchain technology will likely play a role in that transition. To some, blockchain represents a “movement” rather than a technology and describes migration to blockchain technology as a form of risk mitigation to avoid technological obsolescence. To others, blockchain technology is essentially about reducing information risk and providing trust regarding accounting data. The implementation of the technology involves addressing significant challenges, but also has numerous potential advantages.

Addressing blockchain technology with respect to accountancy (accounting and auditing) will eliminate misconceptions, answer questions and, most importantly, look for the true value that blockchain technology can bring to the accounting world.

## Blockchain Technology

So what is blockchain?<sup>2</sup> Blockchain is used to create an immutable, public, distributed ledger that

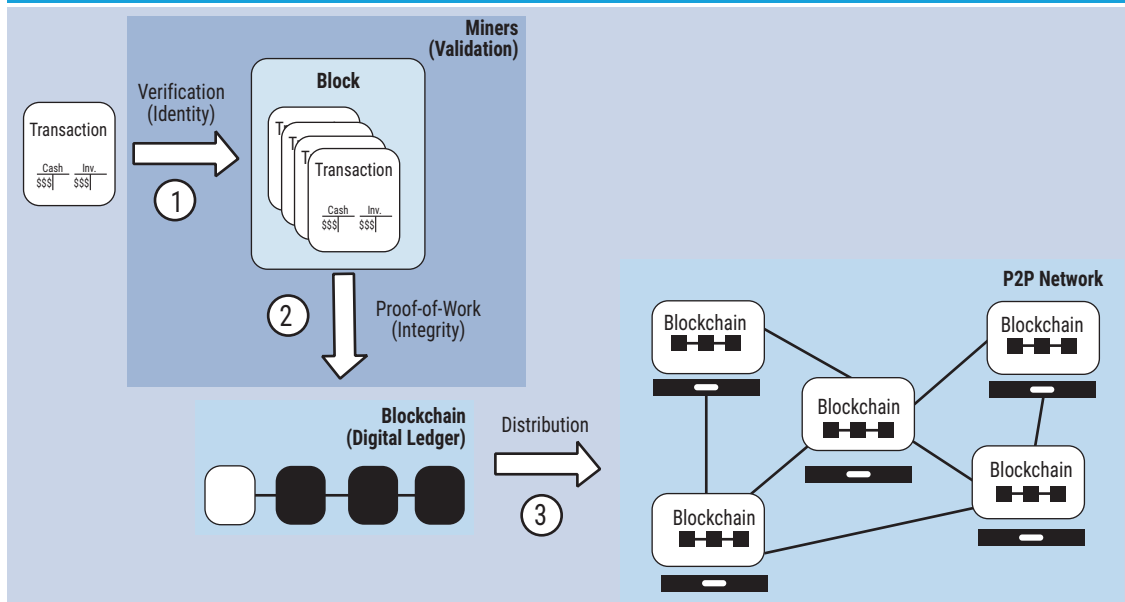


virtually anyone can learn to read or write. It is worth noting that these characteristics may change as blockchain develops. The following process diagram (**figure 1**) describes the steps currently performed:

- Verify the validity of the transactions and the identity of the source.
- “Proof” the integrity of the block containing the transactions to be promoted into the blockchain.
- Distribute the transactions to the peer-to-peer network.

As of June 2018, there are approximately 86,034 blockchain projects on GitHub, approximately 8 percent of those are being actively maintained. Nearly half (48 percent) of the projects that started

**Figure 1—Blockchain Process Diagram**



in 2017 have resulted in failure. Approximately 10 percent are corporate projects that seem more likely to “succeed” because they have greater resources behind them and are narrower in scope. The average lifespan of a project is about one year.<sup>3</sup> Most blockchain proofs-of-concept are designed to achieve benefits that fall into one of these three categories:<sup>4</sup>

- Reduce costs and create process efficiencies
- Create an ecosystem with higher-than-standard levels of trust
- Facilitate digital currency exchange

**Figure 2** compares the two kinds of blockchain projects (public/private).

### Technologies That Make Blockchain Possible

**Figure 3** illustrates the three proven critical legacy technologies that make this innovative new way of creating, storing and sharing records:

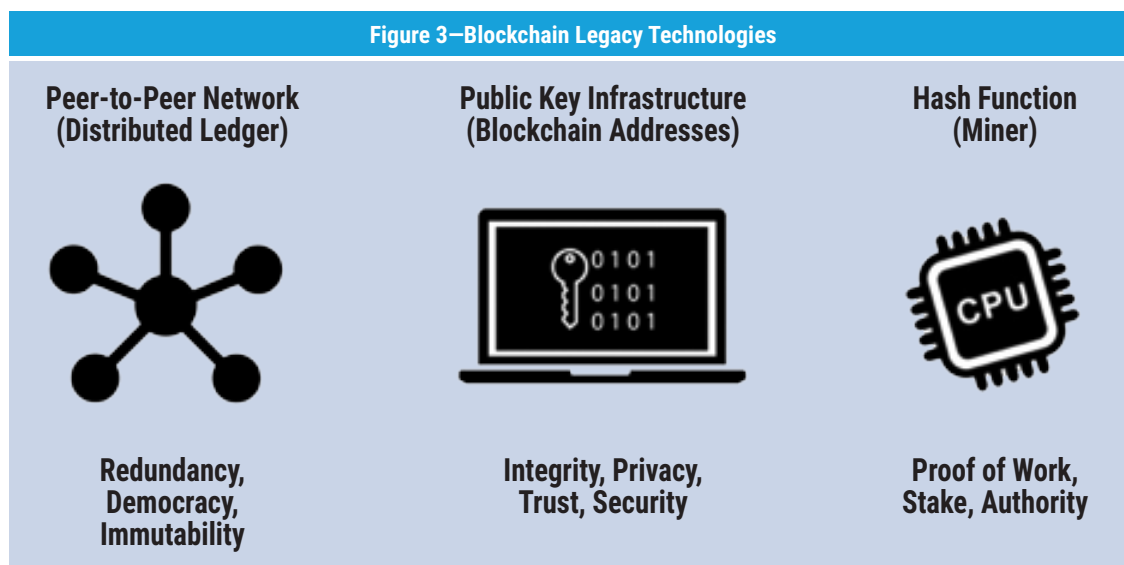
#### 1. Peer-to-peer network (distributed ledger)–

Today, creating and maintaining ledgers requires the use of some third party (i.e., title office, bank, court, voting records, debit cards, checks, contracts). The ledger’s rules can be somewhat vague and require interpretation. Interpretation can cause inconsistency. It is important to trust the third party because the ledger cannot be seen by the enterprise. Such ledgers are centralized and have an authority of their own. In a decentralized ledger, each node is connected to all other nodes and is not reliant on any central

**Figure 2— Blockchain Projects: Public vs. Private**

	Public	Private
<b>Ledger</b>	Open to everyone	Closed to unauthorized users
<b>Identity</b>	Anonymous or pseudo-anonymous	Known
<b>Access to network</b>	Permission-less	Permissioned
<b>Code</b>	Open source	Closed development, often patented or proprietary
<b>Trust</b>	No trust	Trusted
<b>Append to the blockchain</b>	Proof of work, proof of stake	Proof of authority
<b>Examples</b>	Bitcoin, ethereum	Ripple, hyperledger
<b>Authority/ownership</b>	None	Corporate
<b>Miners/validators</b>	Anyone	Approved nodes

**Figure 3—Blockchain Legacy Technologies**



authority. The ledger is “synced” to all nodes and becomes public. Nodes trust adjacent nodes, but verify transactions before recording them (trust, but verify). This is a distributed ledger architecture and is a key component of a blockchain. In a distributed ledger architecture, transactions are read (validated) and written (appended). Peer-to-peer (P2P) networks are easy to manage, but slow and susceptible to attack (such as a denial-of-service [DoS] attack). The use of a P2P network is a critical component of blockchain. A P2P network has no central hierarchy with all nodes maintaining a copy of the entire ledger at all times.

**2. Public key infrastructure (blockchain addresses)**—How does one trust “unknown” parties? Cryptography (an algorithm) is used to create trust in the transaction between untrusted participants. Specifically, public key infrastructure (PKI) is a component of the blockchain. The technology uses asymmetric encryption (compared to symmetric cryptography, which uses the same secret key to encrypt and decrypt data) to identify parties (via digital signature) along with the integrity of the transactions (message digest).

With PKI, a pair of keys (public and private) is generated. The public key is freely distributed. The private key is kept by the owner of the pair. Anything can be encrypted with the public key, but can only be decrypted with the private key. The private key of the sender can also be used to digitally sign the message. It is critical that the

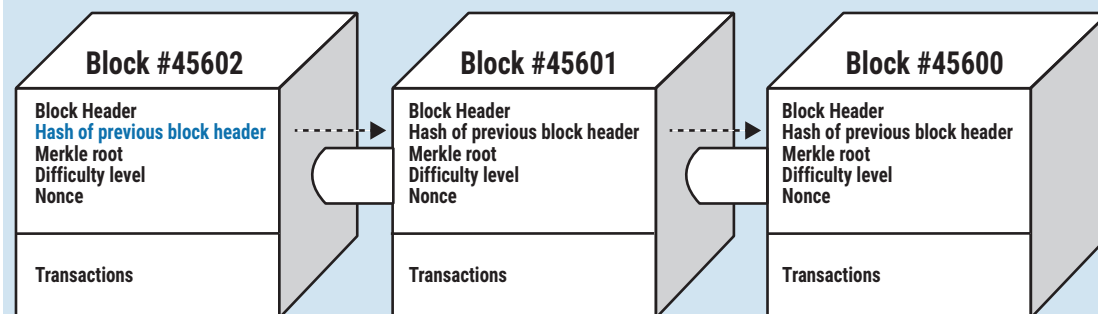
owner of the private key protect it so the corresponding public key can be used to verify the identity of the sender. If the private keys are compromised, the entire system is compromised. Users in the network (all the nodes) must acquire public keys. Parties create a private key to maintain their wallet and a public key to submit a transaction request to the network. Users can have an infinite number of wallets. Wallets can be online exchange, software based, in a secured drive or paper based. Public keys are hashed in multiple iterations to create user addresses called blockchain addresses, guaranteeing the anonymity of the parties. A different address is used for each transaction.

**3. Hash function (miner)**—Hash functions are used throughout the entire blockchain process to guarantee records are not changed, ensuring the integrity of the entire system. A hash function takes an input of variable length and creates a fixed-length output known as a message digest. This is a one-way process, meaning that original input cannot be recreated from the output. This process allows one to check if the input was changed. If so, the process will produce a different output.

Users control the addition of millions of transactions trying to post a sync at once by grouping these into blocks and adding blocks one at a time, in sequence. This process ensures everyone’s wallets match the ledger. Blocks are a critical component of the blockchain ledger.

**Figure 4** illustrates the block/blockchain structure.

**Figure 4—Block/Blockchain Structure**



Source: ISACA, *Blockchain Fundamentals: An Inside Look at the Technology With the Potential to Impact Everything*, USA, 2017. Reprinted with permission.

Blocks are linked creating the so-called blockchain by including in each block header the hash of the previous block header. The first-ever block on the blockchain is called the genesis block.

Inside each block header, the Merkle root represents a summary of all the transactions included in the block in the form of a hash. It is a unique permanent fingerprint of all transactions in the block. To create the Merkle root, hashes of two records are hashed together to produce a hash of the combination, and then the process is repeated moving up the tree until all the records in the block are represented in one hash. **Figure 5** illustrates this process for four transactional records (Trans1, Trans2, Trans3 and Trans4).

A transaction can only be added by consensus agreement (e.g., at least 51 percent of “voting” nodes must confirm a transaction to be entered into a block). Miners are responsible for consensus and are paid in tokens/coins from the requestor for their effort. Only some of the nodes are miners. Proof-of-work (which is a derivation of the Hashcash proof-of-work algorithm originally used to combat spam mail) is a brute-force attack exercise. A miner hashes the block header, creating a digest

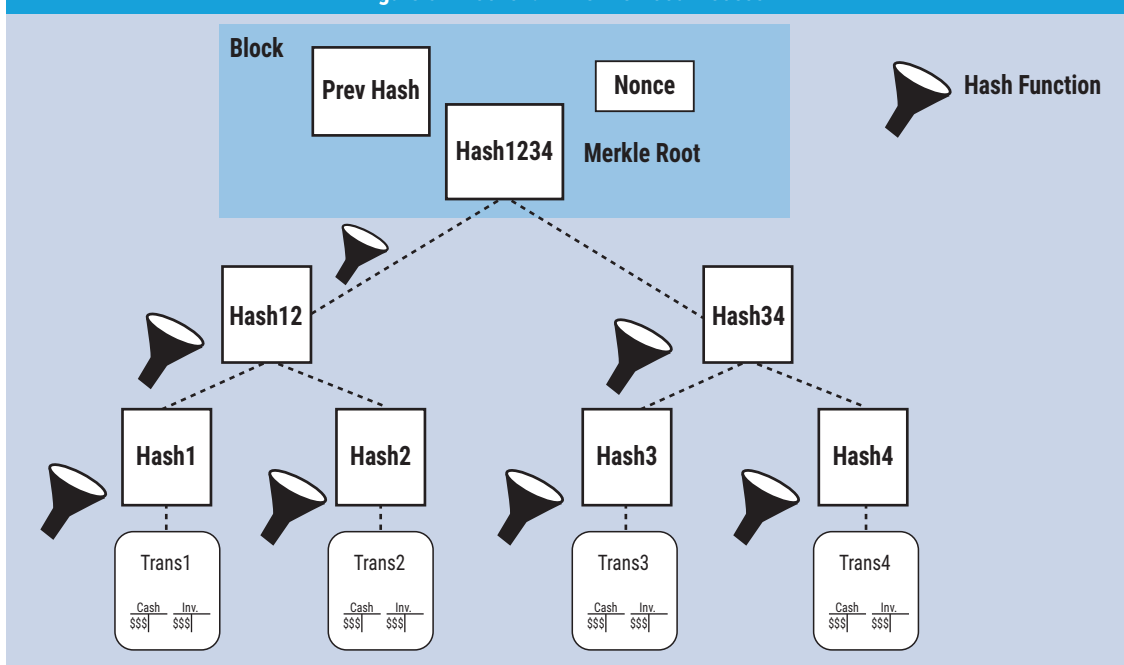
with a nonce. The nonce is a data item unique to each block that can be incremented to find a result meeting the required pattern (e.g., hash resulting in certain number of leading zeros). It is a two-step process:

- **Step 1**—Calculate hash of the block header, which includes a nonce.
- **Step 2**—Check the hash computed in step 1 against a target value (difficulty level).

If the result is greater or equal to the target value (pattern), the nonce is incremented and the hash is recalculated. If the result is less than the target value (pattern), the computed hash solved the proof and the block is added to the blockchain.

In 2009, one could mine 200 Bitcoins with a personal home computer. Using a personal home computer in 2015, it would take about 98 years to mine just one Bitcoin. In 2018, the amount of electricity used to mine cryptocurrency can heat a home. On an aggregate basis, mining would represent the seventh largest country by electricity consumption. Miners cannot change past records; they are permanent. Miners can only append future entries.

**Figure 5—Blockchain Merkle Root Process**



## What Blockchain Makes Possible

Blockchain makes it possible to write verified transactions to a distributed ledger in a secure fashion, without a central authority, between untrusted parties, creating an undeniable past, value for each node and adding value (trust) to those transactions.

### Accounting With Blockchain

Using blockchain technology allows users to integrate accounting into business activities rather than separate accounting from business activities. This is achieved via a triple entry accounting system that, essentially, maintains three ledgers, one each by the seller, the buyer and a public set of (cryptographically authorized) records. The public set represents virtually irrefutable evidence of the underlying transactions. Other areas where the technology can be integrated into business processes are loans/mortgages, asset provenance (e.g., conflict diamonds<sup>5</sup>), interbank and cross-border settlements, private debt/equity issuance, and some “smart” contracts, which can be executed automatically when predetermined “trigger” events occur. It is important to note that organizations can control access to the data, both in terms of who can access the data and what data can be accessed.

“USING BLOCKCHAIN TECHNOLOGY ALLOWS USERS TO INTEGRATE ACCOUNTING INTO BUSINESS ACTIVITIES RATHER THAN SEPARATE ACCOUNTING FROM BUSINESS ACTIVITIES.”

### Auditing With Blockchain

Auditors view financial statements of both public and private organizations and audit them to provide the users assurance that those statements fairly present the financial position and results of operations of the company.

Blockchain represents a unique way to ascertain the validity of the transactional data. Blockchain provides a unique way to store and access this information:

*In its generic form, blockchain technology refers to a fully distributed system for cryptographically capturing and storing an immutable, linear event log of transactions between networked participants. This is functionally similar to a distributed ledger that is consensually kept, updated, and validated by the parties involved in all the transactions within a network. In such a network, blockchain technology enforces transparency and guarantees eventual, system-wide consensus on the validity of an entire history of transactions.<sup>6</sup>*

### Pros

A main benefit of blockchain technology is the inability to fudge—meaning, later modify—numbers. With blockchain, this becomes almost impossible because once the record is created, it can no longer be modified, only supplemented. This approach creates challenges of its own (elaborated in the next section). Following is a list of potential benefits of adopting this technology:

- **Triple verification**—Triple verification limits the ability to falsify accounting data before or as it is entered. As of 2018, there is a double verification system; transactions can be found in both party's records of a transactions.<sup>7</sup>
- **Immutable record**—One of the biggest advantages, many say, of blockchain technology is the idea that the record is immutable. This means that the record cannot be later changed and can always be trusted to contain valid data. This will frustrate efforts to commit fraud by modifying accounting records.<sup>8</sup>
- **Public**—There is debate on whether being public would be a pro or con for blockchain technology. Although being public might make some parts of an auditor's job easier, numerous organizations would be unwilling to reveal sensitive data (such as payroll).<sup>9</sup>
- **Asset (investment) management**—Blockchain technology can be used to improve transparency, accuracy and timeliness of records, and provide a direct linkage between fund managers and



distribution platforms. These improvements will likely drive changes in the validation of securities settlements, transfer agency and fund valuations. Blockchain technology can also help with regulatory requirements regarding “knowing your clients” (KYC, or client onboarding) along with continuous monitoring of client data and transactions.<sup>10</sup>

- **Taxation and tax planning**—The transparency and verifiability provided by blockchain technology have obvious benefits regarding an audit of tax compliance. Blockchain technology may be especially helpful with indirect taxes, transfer pricing and transactional taxes such as value-added tax, withholding tax, stamp duties and insurance premium taxes.<sup>11</sup>

“SOME BLOCKCHAIN APPLICATIONS HAVE PROCESSING SPEEDS THAT ARE TOO SLOW TO SUPPORT BUSINESS OPERATIONS.”

#### Cons

Accountancy practitioners routinely make adjustments to financial records. This includes integrating data from a prior period as those data become available (accounting for subsequent events or adjusting for under/over applied overhead are examples). The ability for a double-entry accounting system to make such adjustments is crucial to its utility in the modern world. Blockchain negates this ability, making substantiation less beneficial than promoters claim. Additionally, just because a transaction cannot be modified, that provides no assurance that it was entered properly in the first place.

As with any new, relatively untested technology, organizations should thoroughly examine the potential risk and challenges to implementation. Some of those challenges include (but are not limited to):

- **Public**—Numerous organizations would be reluctant to have accounting, customer or employee data stored in any sort of public way. Potential loss of any competitive advantage will likely create resistance to adoption.<sup>12</sup>
- **Delays**—Some blockchain applications have processing speeds that are too slow to support business operations. It has been estimated that there are more than 10,000 payment card transactions made every second; blockchain cannot match this speed.<sup>13</sup>
- **Scalability**—Scalability severely limits blockchain’s utility. Currently, the technology is too slow and cumbersome to be of much use. Some theorize that blockchain systems are capable of “...recording just seven transactions per second at most...the average time that it takes Bitcoin to verify a transaction is 43 min. As a result, it is easy to see that it would be impossible to handle the requirements of a single medium-sized firm, in contrast to a large firm or even multiple firms.”<sup>14</sup>
- **Standardization**—Currently, numerous distributed ledger tools exist, which were developed by different organizations under different sets of standards.<sup>15</sup>
- **Feasibility/legacy systems**—Numerous organizations depend on older (legacy) systems that need to be updated before migrating to any sort of blockchain (distributed ledger) system. Experienced members of an organization will recognize the technical and behavioral challenges involved with a systems upgrade(s).<sup>16</sup>
- **Organizational reputation**—A failed implementation of the technology would likely damage the reputation of the entire organization. Managers tend to be risk averse.<sup>17</sup>
- **Power consumption**—Blockchain also poses issues of power consumption. “[T]he power used for Bitcoin was comparable to the country of Ireland’s electricity consumption.”<sup>18</sup> Power consumption on that scale makes implementation of the technology cost prohibitive.<sup>19</sup>
- **Vulnerability to hacking**—As with any computerized technology, blockchain technology

may be vulnerable to hacking and cyberattacks, such as the recent US \$79 million theft of cryptocurrency.<sup>20</sup>

- **Data consumption**—Data costs are also a concern. “[I]f the total number of transactions for some group of firms is N, then firms need computing and network resources to capture 2 N transactions.”<sup>21</sup> This only accounts for the publicly available information of the firms and that firms would also, most likely, require more private data to be stored as well.<sup>22</sup>
- **No counterparty for adjustment entries**—Blockchain technology was designed to support cash flows (of cryptocurrencies) where currency is exchanged for something of value. Blockchain technology was not designed for the adjustment entries required by an accrual-based (e.g., Generally Accepted Accounting Principles [GAAP]) accounting system. With no counterparty for transactions, there is no triple-entry with a corresponding loss of verifiability, trust, etc.<sup>23</sup>
- **Cooperation/competition**—Interested/affected parties would need to cooperate and share information to support effective implementation. Many of these environments are characterized by competitiveness, rather than cooperation, making potential participants reluctant to implement the technology.<sup>24</sup>
- **Interoperability/integration**—To realize the full benefits of the technology, standards must be agreed upon regarding data and policies. Such standards do not currently exist.<sup>25</sup>
- **Errors**—There are currently no provisions in the technology that assure transactions are processed correctly in the first place; there is only an agreement between two parties. Errors can still be introduced into the record.
- **Collusion**—There are currently no provisions in the technology to prevent two parties from colluding to commit financial fraud.

## The Future

Is there a need for new regulations and/or accounting standards? For now, regulators appear to be following a well-worn path of cautious

optimism, with the private sector being left to innovate freely. However, it is worth noting that numerous governmental and regulatory agencies (e.g., the International Monetary Fund, the Bank of England, the Financial Stability Board, Financial Conduct Authority, and the European Parliament’s Committee on Economic and Monetary Affairs) are examining blockchain technology for both threats and opportunities. Some governments are also investigating how blockchain technology can help governments better serve their constituents. Estonia is experimenting with blockchain in various areas of public sector services,<sup>26</sup> and Honduras has a pilot scheme for land registry.<sup>27</sup>

Blockchain technology has the potential to be a useful tool, but should be regarded with skepticism when it comes to its utility and implementability in organizational settings. Many organizations will likely be reluctant to share sensitive data (i.e., contract information, payroll) on a public blockchain and are asking important questions about the nature of blockchain and its future uses. The data requirements would be large compared to a traditional system and is a concern that needs to be addressed if blockchain is to enjoy widespread adoption. It is likely that many enterprises will try to harness this new technology and create value with it. Many are still in their infancy. It is yet to be seen if they will succeed or fail.

Will blockchain make audit unnecessary or change the nature of audit? The implications for audit seem less clear. Will auditors continue to audit transactions or audit the blockchain itself?

- **Audit transactions**—Blockchain technology appears to make verification of the underlying transactions unnecessary. Again, there are no provisions in the technology to assure that transactions are processed correctly in the first place nor any assurance that collusion is avoided. It is worth noting that auditing individual transactions is only a very small portion of an audit. Additionally, traditional auditing will still be necessary for any data stored outside the blockchain, which, for now, is still the vast majority of transactional data. Further, it should be noted that adjusting entries, which rely heavily on accountant and auditor judgment, are unlikely to be stored in blockchain; these often appear



only in audit work papers. Perhaps the future of audit will be streamlined and focus more on internal control and governance, potentially moving auditors further up the value chain.

- **Audit blockchain itself**—In 2018, PricewaterhouseCoopers (PwC) announced a blockchain-auditing service.<sup>28</sup> Additionally, blockchain transactions may still be unauthorized, illegal, fraudulent, executed between related parties, related to kickbacks or other schemes, or misclassified in the financial statements.

Although auditing will continue to evolve (as it always has), auditing is likely to be around well into the foreseeable future. Blockchain is unlikely to make auditing redundant.

## Conclusion

Blockchain represents an opportunity, not a threat, with future accounting and auditing services likely to include some consideration of blockchain. Although the technology is rapidly evolving and will likely have an impact on accounting and auditing, some skepticism is warranted regarding potential benefits and ease of implementation. For now, the benefits are likely being oversold, while the costs and difficulty of implementation are likely being undersold.

Blockchain is still relatively new, with the development of software being rather dynamic; however, **figure 6** lists and briefly describes some of the products in the marketplace that attempt to integrate blockchain technology.

Figure 6— Blockchain Projects: Public vs. Private

	Factom	Tieron	Stampery	TaxToken	Libra	Audit Chain
<b>Type:</b>						
Blockchain add-on		X	X	X		
Full blockchain	X				X	X
<b>Features:</b>						
Secured storage of data	X	X		X		
Data validation		X		X	X	X
Audit trail	X	X	X		X	X
Proof of ownership	X		X			
Proof of existence	X		X			
Proof of integrity	X	X	X			
Proof of receipt			X			
Immutable record	X	X	X	X	X	X
Digital receipts	X				X	X
<b>Country of Origin:</b>						
United States	X	X		X	X	
Estonia			X			
Switzerland						X

## Endnotes

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