



# Upgrading blockchains:

## Smart contract use cases in industry

By John Ream, Yang Chu, and David Schatsky

Paper contracts can take weeks to travel around the globe, while digital documents are uncomfortably easy to forge. Is there a way to automate transactions to make them smoother, more efficient, and more secure for all parties? Leaders are looking at blockchain and smart contracts as a viable solution.

**B**LOCKCHAIN technology is generating significant interest across a wide range of industries. As the field of applications for blockchains grows, industry leaders are customizing and tailoring the technology to fit very particular uses.<sup>1</sup> Blockchain-based smart contracts—self-executing code on a blockchain that automatically implements the terms of an agreement between parties—are a critical step forward, streamlining processes that are currently spread across multiple databases and ERP systems. Smart

contracts in the commercial realm have not yet been proven, but we believe that permissioned blockchains (those that are privately maintained by a small group of parties) in particular will find near-term adoption. Two blockchain-based smart contract use cases—(1) securities trade clearing and settlement and (2) supply chain and trade finance document handling—carry important lessons for business and technology leaders interested in smart contract applications.

## Signals

- Smart contract VC-related deals totaled \$116 million in Q1 2016, more than twice as much as the prior three quarters combined and accounting for 86 percent of total blockchain venture funding
- An Ethereum-based organization has raised over \$150 million to experiment with and develop smart contract-driven applications<sup>2</sup>
- The Australian Securities Exchange is developing a blockchain-based post-trade solution to replace its current system<sup>3</sup>
- The Post-Trade Distributed Ledger Group, an organization launched to explore post-trade applications on the blockchain, has 37 financial institutions as members<sup>4</sup>
- Five global banks are building proof-of-concept systems with a trade finance and supply chain platform that uses smart contracts<sup>5</sup>
- Barclays Corporate Bank plans to leverage a smart contract bill-of-lading platform to help its clients reduce supply chain management costs<sup>6</sup>
- The state of Delaware announced initiatives to utilize smart contracts for state-recognized “distributed ledger shares” and to streamline back-office procedures<sup>7</sup>

## What are blockchain-based smart contracts?

Smart contracts represent a next step in the progression of blockchains from a financial transaction protocol to an all-purpose utility. They are pieces of software, not contracts in the legal sense, that extend blockchains’ utility from simply keeping a record of financial transaction entries to automatically

### WHAT IS BLOCKCHAIN TECHNOLOGY?

The protocol for blockchains allows multiple parties that do not know or trust each other to maintain consensus as to the state of and changes made to a shared database. Bitcoin has leveraged this technology to enable payment transactions between strangers without need for a third-party financial intermediary (that is, a bank). The range of potential applications is broad and extends to almost every industry, sparking wide interest and investment in blockchain technology over the past year. For a detailed discussion of the technology, see [\*Beyond bitcoin: Blockchain is coming to disrupt your industry.\*](#)<sup>8</sup>

implementing terms of multiparty agreements. Smart contracts are executed by a computer network that uses consensus protocols to agree upon the sequence of actions resulting from the contract’s code.<sup>9</sup> The result is a method by which parties can agree upon terms and trust that they will be executed automatically, with reduced risk of error or manipulation.

Technology leaders envision many applications for blockchain-based smart contracts, from validating loan eligibility to executing transfer pricing agreements between subsidiaries.<sup>10</sup> Importantly, before blockchain this type of smart contract was impossible because parties to an agreement of this sort would maintain separate databases. With a shared database running a blockchain protocol, the smart contracts auto-execute, and all parties validate the outcome instantaneously and without need for a third-party intermediary.

But when should companies employ blockchain-enabled smart contracts rather than existing technology? They can be a worthwhile option where frequent transactions occur among a network of parties, and manual or duplicative tasks are performed by counterparties for each transaction. The blockchain acts as a shared database to provide a secure, single source of truth, and smart contracts automate approvals, calculations, and other transacting activities that are prone to lag and error.

## Blockchain-based smart contract benefits

For a wide range of potential applications, blockchain-based smart contracts could offer a number of benefits:

**Speed and real-time updates.** Because smart contracts use software code to automate tasks that are typically accomplished through manual means, they can increase the speed of a wide variety of business processes.

**Accuracy.** Automated transactions are not only faster but less prone to manual error.

**Lower execution risk.** The decentralized process of execution virtually eliminates the risk of manipulation, nonperformance, or errors, since execution is managed automatically by the network rather than an individual party.

**Fewer intermediaries.** Smart contracts can reduce or eliminate reliance on third-party intermediaries that provide “trust” services such as escrow between counterparties.

**Lower cost.** New processes enabled by smart contracts require less human intervention and fewer intermediaries and will therefore reduce costs.

**New business or operational models.** Because smart contracts provide a low-cost way of ensuring that the transactions are reliably performed as agreed upon, they will enable new kinds of businesses, from peer-to-peer renewable energy trading to automated access to vehicles and storage units.<sup>11</sup>

## Smart contract use cases

To determine high-impact areas of potential, Deloitte’s analysis of smart contract use cases considered a number of factors, including: a sizable market opportunity; the presence of active, relatively well-funded start-ups targeting the opportunity; the participation of prominent investors; technical feasibility and ease of implementation; and evidence of multiple pilots or adoption by corporations. The lowest-hanging fruits today are applications in which contracts are narrow, objective, and mechanical, with straightforward clauses and clearly defined outcomes.

We have identified a range of applications—ranging from smart health records to pay-as-you-go insurance—that companies are piloting right now (see table). Using the criteria above, two use cases stand out for their immediacy to market: trade clearing and settlement and supply chain and trade finance.

Table 1. Range of use case applications for smart contracts

	Use case	What the smart contract can do
Financial services	Trade clearing and settlement	Manages approval workflows between counterparties, calculates trade settlement amounts, and transfers funds automatically
	Coupon payments	Automatically calculates and pays periodic coupon payments and returns principal upon bond expiration
	Insurance claim processing	Performs error checking, routing, and approval workflows, and calculates payout based on the type of claim and underlying policy
	Micro-insurance	Calculates and transfers micropayments based on usage data from an Internet of Things-enabled device (example: pay-as-you-go automotive insurance)
Life sciences and health care	Electronic medical records	Provides transfer and/or access to medical health records upon multi-signature approvals between patients and providers
	Population health data access	Grants health researchers access to certain personal health information; micropayments are automatically transferred to the patient for participation
	Personal health tracking	Tracks patients' health-related actions through IoT devices and automatically generates rewards based on specific milestones
Technology, media, and telecom	Royalty distribution	Calculates and distributes royalty payments to artists and other associated parties according to the contract
Energy and resources	Autonomous electric vehicle charging stations	Processes a deposit, enables the charging station, and returns remaining funds when complete
Public sector	Record-keeping	Updates private company share registries and capitalization table records, and distributes shareholder communications
Cross-industry	Supply chain and trade finance documentation	Transfers payments upon multi-signature approval for letters of credit and issues port payments upon custody change for bills of lading
	Product provenance and history	Facilitates chain-of custody process for products in the supply chain where the party in custody is able to log evidence about the product
	Peer-to-peer transacting	Matches parties and transfers payments automatically for various peer-to-peer applications: lending, insurance, energy credits, etc.
	Voting	Validates voter criteria, logs vote to the blockchain, and initiates specific actions as a result of the majority vote

## Trade clearing and settlement

Blockchains provide a single ledger as the source of truth, and smart contracts offer the ability to automate approval workflows and clearing calculations that are prone to lag and error—thus reducing errors, cost, and the time to settlement. Trade clearing and settlement often entails labor-intensive activities that include various approvals and/or complex internal and external reconciliations. Banks maintain substantial IT networks, but independent processing by each counterparty causes discrepancies that lead to costly resolutions and settlement delays.<sup>12</sup>

The opportunity to streamline clearing and settlement processes with the blockchain and smart contracts is immense. In 2015, the Depository Trust & Clearing Corp. (DTCC) processed over \$1.5 quadrillion worth of securities, representing 345 million transactions.<sup>13</sup> Santander Bank's innovation fund, Santander Innoventures, expects blockchain technology to lead to \$15–20 billion in annual savings in infrastructure costs by 2022.<sup>14</sup> Seven start-ups, retaining funding of over \$125 million, have platforms or services targeting this space: The list of more than 35 investors behind these companies is equally impressive; it includes not only major venture funds such as Khosla Ventures and SV Angel but also large banks such as Citigroup, JP Morgan, and Santander, and other organizations such as NASDAQ and the DTCC itself.<sup>15</sup>

Wall Street has also been busy exploring this space. More than 40 global banks within the R3 consortium participated in testing that included clearing and settlement activity,<sup>16</sup> and many of those banks have pursued further trials individually. The Australian Securities Exchange is also working on a smart contracts-based post-trade platform to replace its equity settlement system,<sup>17</sup> and four global banks and the DTCC recently ran a successful trial of a smart contracts solution for post-trade credit default swaps.<sup>18</sup>

## Supply chain and trade finance documentation

Blockchains can make supply chain and trade finance documentation more efficient, by streamlining processes previously spread across multiple parties and databases on a single shared ledger. All too often, supply chains are hampered by paper-based systems reliant on trading parties and banks around the world physically transferring documents, a process that can take weeks for a single transaction. Letters of credit and bills of lading must be signed and referenced by a multitude of parties, increasing exposure to loss and fraud.<sup>19</sup> Current technologies haven't addressed this issue because digital documents are easy to forge; even current IT systems at banks simply track the logistics of physical documents for trade finance.<sup>20</sup> A blockchain can provide secure, accessible digital versions to all parties in a transaction, and smart contracts can be used to manage the workflow of approvals and automatically transfer payment upon all signatures being collected.<sup>21</sup>

Because current paper systems drive \$18 trillion in transactions per year,<sup>22</sup> there's an attractive opportunity to decrease costs and improve reliability in supply chain and trade finance. Four start-ups have emerged in this area, all of which have noted engagement with banks in proof-of-concept activities.<sup>23</sup> Funding has not been disclosed, but backers include three respected venture funds in addition to Barclays.

A number of corporations have also shown mounting interest in this area. Seven banks have revealed proof-of-concept testing, and the numbers noted by start-ups indicate more that haven't been publicly revealed. One start-up in particular noted implementation roadmaps with five banks as well as a major insurer.<sup>24</sup> Barclays Corporate Bank recently partnered with one of the start-ups, Wave,<sup>25</sup> a platform that stores bill-of-lading documents in the blockchain and uses smart contracts to

log change of ownership and automatically transfer payments to ports upon arrival.<sup>26</sup> Bank of America, Standard Charter, and the Development Bank of Singapore are also among the banks pursuing proof-of-concepts of their own.<sup>27</sup>

## What to watch

Smart contract technology is still in its early stages. Business and technology leaders who want to stay current on implications of smart contracts should track both technology and business developments surrounding smart contracts.

On the technology side, certain advances will help broaden the applications and adoption of smart contracts.

**Scalability.** Smart contract platforms are still considered unproven in terms of scalability.

**External information.** Because smart contracts can reference only information on the blockchain, trustworthy data services—known as “oracles”—that can push information to the blockchain will be needed. Approaches for creating oracles are still emerging.

**Real assets.** Use cases that effectively link smart contracts to real assets are still in their infancy.

**Flexibility.** The immutability of blockchain-based smart contracts today means that developers must anticipate any conceivable scenario necessitating changes to the contract.

**Privacy.** The code within smart contracts is visible to all parties within the network, which may not be acceptable for some applications.

**Latency.** Blockchains suffer from high latency, given that time passes for each verified block of transactions to be added to the ledger. For Ethereum, the most popular blockchain for smart contracts, this occurs approximately every 17 seconds—a far cry from the milliseconds to which we are accustomed while using non-blockchain databases.

**Permissioning.** While excitement for smart contracts is growing in the realm of both permission-less and permissioned blockchains, the latter is likely to see faster adoption in industry, given that complexities around trust, privacy, and scalability are more easily resolved within a consortium of known parties.

Watch for major trials or deployments that achieve new milestones in scalability, or technologies that successfully address issues of privacy or enable greater trust of oracles. These are key signs of maturity, signaling that smart contracts are positioned for wider adoption.

On the business side, new capabilities and business models that extend beyond the digital realm driven by smart contracts will emerge in the coming months. For instance, start-ups have already paired smart contracts with IoT devices to provide access via smart locks or automatically enable electric vehicle charging stations. Pushing IoT sensor data to the blockchain will also open up countless possibilities; among them, look for new business models that are based on usage rather than time, and applications that employ micropayments automatically.

Revised legislation that accommodates smart contracts or recognition of smart contracts by legal authorities will also be critical for some applications of smart contracts. This will be another signal to watch for that indicates the technology is positioned for wider adoption.

## Considerations for corporations

Business leaders who may not be closely following blockchain developments should consider examining the technology and evaluate how it can be paired with smart contracts to drive efficiencies or new business capabilities.

Operations executives should look to their own processes to evaluate where smart contracts may be applicable. Some factors to look for include complex and manual work flows, multiparty agreements, lack of trust between parties, and interdependent transactions.

Likewise, ideating on new capabilities that could be made possible by smart contracts should be considered in the context of current strategy or innovation efforts.

Given that smart contracts represent a new model of computing, software development teams and IT leaders should consider exploring the implications of this approach. Implementing smart contracts on a blockchain will require significant integration work, and it will be important to understand the new protocols and considerations when evaluating these applications for the enterprise.

# Endnotes

1. Deloitte, *Blockchain: Enigma. Paradox. Opportunity*, 2016, [www2.deloitte.com/content/dam/Deloitte/uk/Documents/Innovation/deloitte-uk-blockchain-full-report.pdf](http://www2.deloitte.com/content/dam/Deloitte/uk/Documents/Innovation/deloitte-uk-blockchain-full-report.pdf); David Schatsky and Craig Muraskin, *Beyond bitcoin: Blockchain is coming to disrupt your industry*, Deloitte University Press, December 7, 2015, <http://dupress.com/articles/trends-blockchain-bitcoin-security-transparency/>.
2. Nathaniel Popper, "A venture fund with plenty of virtual capital, but no capitalist," *New York Times*, May 21, 2016, [www.nytimes.com/2016/05/22/business/dealbook/crypto-ether-bitcoin-currency.html](http://www.nytimes.com/2016/05/22/business/dealbook/crypto-ether-bitcoin-currency.html).
3. Samburaj Das, "Australian Stock Exchange confirms upcoming blockchain for settlements," *CryptoCoinsNews*, January 22, 2016, [www.cryptocoinsnews.com/australian-stock-exchange-confirms-upcoming-blockchain-for-settlements/](http://www.cryptocoinsnews.com/australian-stock-exchange-confirms-upcoming-blockchain-for-settlements/).
4. Pete Rizzo, "Post-Trade Distributed Ledger Group grows to 37 members," *CoinDesk*, May 3, 2016, [www.coindesk.com/ptdl-group-37-members-post-trade-ledgers/](http://www.coindesk.com/ptdl-group-37-members-post-trade-ledgers/).
5. Phone interview with Skuchain, April 25, 2016.
6. Pete Rizzo, "Wave brings blockchain trade finance trial to Barclays," *CoinDesk*, October 15, 2015, [www.coindesk.com/wave-blockchain-trade-finance-barclays/](http://www.coindesk.com/wave-blockchain-trade-finance-barclays/).
7. Luke Parker, "Delaware to 'embrace the emerging blockchain and smart contract technology industry' with distributed ledger shares," *Brave New Coin*, May 4, 2016, <http://bravenewcoin.com/news/delaware-to-embrace-the-emerging-blockchain-and-smart-contract-technology-industry-with-distributed-ledger-shares/>.
8. Schatsky and Muraskin, *Beyond bitcoin*.
9. Kevin Delmolino, et al., *Step by step towards creating a safe smart contract: Lessons and insights from a cryptocurrency lab*, University of Maryland, November 18, 2015, <https://eprint.iacr.org/2015/460.pdf>
10. A use case Deloitte is currently developing for clients.
11. Ian Allison, "RWE and Slock.it—Electric cars using Ethereum wallets can recharge by induction at traffic lights," *International Business Times*, February 22, 2016, [www.ibtimes.co.uk/rwe-slock-it-electric-cars-using-ethereum-wallets-can-recharge-by-induction-traffic-lights-1545220](http://www.ibtimes.co.uk/rwe-slock-it-electric-cars-using-ethereum-wallets-can-recharge-by-induction-traffic-lights-1545220); Giulio Prisco, "Blockchain technology could enable next-generation, peer-to-peer energy microgrids," *Bitcoin Magazine*, April 25, 2016, <https://bitcoinmagazine.com/articles/blockchain-technology-could-enable-next-generation-peer-to-peer-energy-microgrids-1461596932>; Giulio Prisco, "Slock.it to introduce smart locks linked to smart Ethereum contracts, decentralize the sharing economy," *Bitcoin Magazine*, November 5, 2015, <https://bitcoinmagazine.com/articles/slock-it-to-introduce-smart-locks-linked-to-smart-ethereum-contracts-decentralize-the-sharing-economy-1446746719>.
12. Ignatius John, "Trade break pain—feeling unsettled?," *TABB Forum*, October 5, 2015, <http://tabbforum.com/opinions/trade-break-pain-feeling-unsettled>.
13. DTCC, "Performance dashboard," [www.dtcc.com/annuals/2015/index.php#performance-dashboard](http://www.dtcc.com/annuals/2015/index.php#performance-dashboard), accessed May 27, 2016.
14. Santander Innoventures with Oliver Wyman and Anthemis Group, *The Fintech 2.0 paper: Rebooting financial services*, 2015, <http://santanderinnoventures.com/wp-content/uploads/2015/06/The-Fintech-2-0-Paper.pdf>.
15. Deloitte analysis from *CoinDesk.com* and *Crunchbase.com*.
16. Ian Allison, "R3 completes trial of five cloud-based blockchain technologies with 40 banks," *International Business Times*, March 3, 2016, [www.ibtimes.co.uk/r3-completes-trial-five-cloud-based-blockchain-technologies-40-banks-1547260](http://www.ibtimes.co.uk/r3-completes-trial-five-cloud-based-blockchain-technologies-40-banks-1547260).
17. Daniel Palmer, "ASX details blockchain strategy in financial update," *CoinDesk*, February 12, 2016, [www.coindesk.com/asx-blockchain-strategy-financial-results/](http://www.coindesk.com/asx-blockchain-strategy-financial-results/).
18. DTCC, "DTCC and Digital Asset to develop distributed ledger solution to drive improvements in repo clearing," March 29, 2016, [www.dtcc.com/news/2016/march/29/dtcc-and-digital-asset-to-develop-distributed-ledger-solution](http://www.dtcc.com/news/2016/march/29/dtcc-and-digital-asset-to-develop-distributed-ledger-solution).
19. *CoinDesk*, "Trade finance and supply chains," April 20, 2016, [www.coindesk.com/research/supply-chains-report/](http://www.coindesk.com/research/supply-chains-report/).



20. Ibid.
21. Phone interview with supply chain and trade finance start-up, April 25, 2016.
22. World Trade Organization, *International Trade Statistics 2015*, 2015, [www.wto.org/english/res\\_e/statis\\_e/its2015\\_e/its2015\\_e.pdf](http://www.wto.org/english/res_e/statis_e/its2015_e/its2015_e.pdf), p. 41.
23. Luke Parker, "Blockchain tech companies focus on the \$40 trillion supply chain market," Brave New Coin, February 2, 2016, <http://bravenewcoin.com/news/blockchain-tech-companies-focus-on-the-40-trillion-supply-chain-market/>; Hans Lombardo, "Skuchain Intersects with IoT and blockchain-enabled trade finance," AllCoinsNews, April 3, 2016, <http://allcoinsnews.com/2016/04/03/skuchain-intersects-with-the-iot-and-blockchain-enabled-trade-finance/>; Rizzo, "Wave brings blockchain trade finance trial to Barclays."
24. Phone interview with supply chain and trade finance start-up, April 25, 2016.
25. Giulio Prisco, "Chainalysis and Wave showcase blockchain fintech products at New York Barclays accelerator, sign deal with Barclays," *Bitcoin Magazine*, October 21, 2015, <https://bitcoinmagazine.com/articles/chainalysis-and-wave-showcase-blockchain-fintech-products-at-new-york-barclays-accelerator-sign-deal-with-barclays-1445454899>.
26. Evry, *Blockchain: Powering the Internet of Value*, 2016, [www.evry.com/globalassets/insight/bank2020/bank-2020---blockchain-powering-the-internet-of-value---whitepaper.pdf](http://www.evry.com/globalassets/insight/bank2020/bank-2020---blockchain-powering-the-internet-of-value---whitepaper.pdf). For additional information on blockchain and smart contract applications in trade finance, see Eric Piscini et al., *Blockchain: Disruptions and opportunities in banking*, Deloitte, forthcoming in June 2016.
27. Pete Rizzo, "How Standard Chartered is using Ripple to rethink trade finance," CoinDesk, February 29, 2016, [www.coindesk.com/how-standard-chartered-is-using-ripple-to-rethink-trade-finance/](http://www.coindesk.com/how-standard-chartered-is-using-ripple-to-rethink-trade-finance/).

# Acknowledgements

The authors would like to acknowledge the contributions of **Peter Gratzke**, **Ragu Gurumurthy**, and **Craig Muraskin** of Deloitte LLP; **Eric Piscini** of Deloitte Consulting LLP; **Pavan Murali** of Deloitte AERS India Pvt Ltd.; and **Swagatam Chakraborty** and **Ramya Kunnath Puliyakodil** of Deloitte Support Services India Pvt Ltd.

# About the authors

**John Ream** is a manager at Deloitte LLP focused on evaluating emerging business and technology trends. His background comprises more than a decade of experience across management consulting and investment research.

**Yang Chu** is a senior manager at Deloitte & Touche LLP. She is a specialist in strategic, financial, operational, technological, and regulatory risk and focuses on exploring emerging trends for opportunities and threats for clients and for Deloitte.

**David Schatsky** is a senior manager at Deloitte LLP. He tracks and analyzes emerging technology and business trends, including the growing impact of cognitive technologies, for the firm's leaders and its clients.

# Contacts

**John Ream**  
Manager  
Deloitte LLP  
+1 816-802-7339  
jream@deloitte.com

**Yang Chu**  
Senior manager  
Deloitte & Touche LLP  
+1 415-783-4060  
yangchu@deloitte.com

**David Schatsky**  
Senior manager  
Deloitte LLP  
+1 646-582-5209  
dschatsky@deloitte.com

Deloitte member firms help clients capture the opportunities offered by blockchain by identifying viable, feasible, and desirable use cases; recognizing industry business processes where blockchain technology is applicable; assisting clients in effectively sourcing fintech suppliers; providing regulatory and compliance guidance relevant to blockchain applications and constraints; and building and integrating blockchain technology solutions. For more information please contact Eric Piscini [[episcini@deloitte.com](mailto:episcini@deloitte.com)].



Follow @DU\_Press

Sign up for Deloitte University Press updates at [DUPress.com](http://DUPress.com).

#### **About Deloitte University Press**

Deloitte University Press publishes original articles, reports and periodicals that provide insights for businesses, the public sector and NGOs. Our goal is to draw upon research and experience from throughout our professional services organization, and that of coauthors in academia and business, to advance the conversation on a broad spectrum of topics of interest to executives and government leaders.

Deloitte University Press is an imprint of Deloitte Development LLC.

#### **About this publication**

This publication contains general information only, and none of Deloitte Touche Tohmatsu Limited, its member firms, or their related entities (collectively the "Deloitte Network") is, by means of this publication, rendering professional advice or services. Before making any decision or taking any action that may affect your finances or your business, you should consult a qualified professional adviser. No entity in the Deloitte Network shall be responsible for any loss whatsoever sustained by any person who relies on this publication.

#### **About Deloitte**

Deloitte refers to one or more of Deloitte Touche Tohmatsu Limited, a UK private company limited by guarantee ("DTTL"), its network of member firms, and their related entities. DTTL and each of its member firms are legally separate and independent entities. DTTL (also referred to as "Deloitte Global") does not provide services to clients. Please see [www.deloitte.com/about](http://www.deloitte.com/about) for a more detailed description of DTTL and its member firms.

Deloitte provides audit, tax, consulting, and financial advisory services to public and private clients spanning multiple industries. With a globally connected network of member firms in more than 150 countries and territories, Deloitte brings world-class capabilities and high-quality service to clients, delivering the insights they need to address their most complex business challenges. Deloitte's more than 200,000 professionals are committed to becoming the standard of excellence.

© 2016. For information, contact Deloitte Touche Tohmatsu Limited.