

# Smart Contracts in Financial Services: Getting from Hype to Reality



## Executive Summary

The potential of smart contracts – programmable contracts that automatically execute when pre-defined conditions are met – is the subject of much debate and discussion in the financial services industry.

Smart contracts, enabled by blockchain or distributed ledgers, have been held up as a cure for many of the problems associated with traditional financial contracts, which are simply not geared up for the digital age. Reliance on physical documents leads to delays, inefficiencies and increases exposure to errors and fraud. Financial intermediaries, while providing interoperability for the finance system and reducing risk, create overhead costs for and increase compliance requirements.

In this report, we aim to cut through the speculation and hype around the potential of smart contracts. We have conducted detailed discussions with financial services industry professionals, prominent smart contract startups, and academics (see Research Methodology at the end of this paper). Our study confirms that smart contract adoption will lead to reduced risks, lower administration and service costs, and more efficient business processes across all major segments of the financial services industry. These benefits will accrue from technology, process redesign as well as from fundamental changes in operating models, as they require a group of firms to share a common view of the contract between trading parties. Consumers will benefit from more competitive products, such as mortgage loans and insurance policies, along with simpler processes that are free of many of the hassles of today's customer experience.

To realize those benefits – and build a smart contract strategy and approach – executives will need to answer a number of questions.

- What are the potential benefits of smart contracts for financial institutions and their customers?
- What groundwork is required for smart contracts to enter the mainstream?
- When will smart contracts become a reality?
- How can banks and insurers realize the true potential of smart contracts?

### What are the potential benefits of smart contracts for financial institutions and their customers?

There are inherent benefits to smart contracts, as specific use cases highlight<sup>a</sup>:

- **Investment banking:** In trading and settlement of syndicated loans, corporate clients could benefit from shorter settlement cycles. Rather than the current 20 days or more, smart contracts could bring this down to 6 to 10 days. This could lead to an additional 5% to 6% growth in demand in the future, leading to additional income of between US\$2 billion and \$7 billion annually. Investment banks in the US and Europe would also see lower operational costs.
- **Retail banking:** The mortgage loan industry will benefit significantly by adopting smart contracts. Consumers could potentially expect savings of US\$480 to US\$960 per loan and banks would be able to cut costs in the range of US\$3 billion to \$11 billion annually by lowering processing costs in the origination process in the US and European markets.
- **Insurance:** Usage of smart contracts in the personal motor insurance industry alone could result in US\$21 billion annual cost savings globally through automation and reduced processing overheads in claims handling. Consumers could also expect lower premiums as insurers potentially pass on a portion of their annual savings to them.

### What groundwork is required for smart contracts to enter the mainstream?

Smart contracts require a number of technical, legal, and organizational enablers to be in place:

- There are challenges with the security and privacy of data stored on public blockchains and permissioned ledgers, which a number of startups are trying to tackle. Interoperability with legacy systems and the scalability of transaction processing needs resolving.
- Regulation and legal frameworks will need to catch up. In the US, the state of Vermont is taking initial steps to recognize blockchain contracts in a court of law.
- Recent hacks of smart contracts on public blockchains, such as The DAO<sup>b</sup>, have highlighted the technical complications with smart contracts in general and the critical need for strong governance that protects the interests of lawful participants.

### When will smart contracts become a reality?

Considering the scale of this digital upheaval, it will be at least three years before smart contracts enter the mainstream. Yet, industry practitioners who are leading blockchain and permissioned ledger initiatives at financial institutions are upbeat about smart contract adoption. Smart contracts that do not require distributed ledgers could be viable by the end of 2017. We anticipate mainstream adoption to begin in the early years of the next decade.

### How can banks and insurers realize the true potential of smart contracts?

Financial institutions must start preparing themselves for the arrival of smart contracts, readying existing systems and processes and experimenting with the basic functionality offered. Financial organizations need to carefully evaluate the business need and then take a strategic and portfolio approach, launching a range of collaborative initiatives such as labs, incubators, and startup partnerships.

<sup>a</sup> Indicative estimates based on our analysis of the cost elements existing in today's technology, process and regulatory environment. As the system evolves, these estimates are likely to change as well.

<sup>b</sup> The Decentralized Autonomous Organization

# Will Smart Contracts Reshape Financial Services?

**Over 4 million**  
Number of  
faxes received  
by syndicated  
loan custodians  
in 2012

When Royal Bank of Scotland decided to sell Williams & Glyn in 2009, it anticipated a traditional closure period of a few months. Seven years later, the sale is still hanging. A complicated technology infrastructure, largely made up of a patchwork of systems from multiple decades, is partly to blame<sup>1</sup>. This is not an exceptional or rare story in the industry. Take the case of State Street Corporation. This more than 200-year-old financial services company still has over 20,000 manual interventions on trades every day. It receives over 50,000 orders every month on a technology that has largely been abandoned almost everywhere else – the fax machine<sup>2</sup>.

This context of fragmented and inefficient systems partly explains why there is so much interest in the potential of blockchain and smart contracts. Smart contracts are, in their simplest form, contracts that can also execute part of the functions of the contract itself. And when these smart contracts are put on the blockchain or a distributed ledger, there is a strong element of permanence and immutability attached to them.

The industry's interest is piqued by this potential. In recent months, a Smart Contract Alliance has formed<sup>3</sup>, banks and industry consortia have introduced prototypes<sup>4</sup>, and technology firms have launched working groups to bolster technology<sup>5</sup>. Bank executives have started taking it seriously as well. Roberto Mancone, MD and Global Head Disruptive Technologies and Solutions, Private Wealth & Commercial Clients Division, Deutsche Bank AG, is upbeat about smart contracts. "Smart contracts technology has great potential and could transform the business model of many segments of the banks, solving many of the problems banks and regulators are facing," he says. But he also warns of the need to cut through some of the hype around the topic, saying: "The industry still has to test and ensure that these are as robust, autonomous and secure as they are promised to be and the adoption will vary according to geography, regulatory frameworks and complexity of assets managed."<sup>6</sup>

## Many Limitations to Physical Contracts

### Existing Commercial Contracts Unfit for the World of Real-Time Commerce

In the trillion-dollar syndicated loan market, it is still common for participants to communicate via fax machine, with more than four million faxes received by loan custodians in 2012<sup>7</sup>. For Fabian Vandenreydt, Global Head of Securities Markets, Innobridge and The SWIFT Institute, this is a significant shortcoming. "There are still large parts of the securities industry, such as syndicated loans and others, that haven't transformed to digital and operate mainly via faxes and physical documents," he says. "I think it is time for industry players to break out of this inefficiency and consider new technologies (like smart contracts) as an opportunity to first digitize in the short term and also leverage reduced operational costs and new business models in the long run."<sup>8</sup>

Inefficient and opaque processes entrap market participants and lock up capital. For example, investors committed \$1.2 billion in October 2013 to fund a loan for a junk-rated firm. They did not receive any interest for 10 months<sup>9</sup>. This example reflects the growing problems that the industry is facing with traditional financial contracts (see Figure 1).

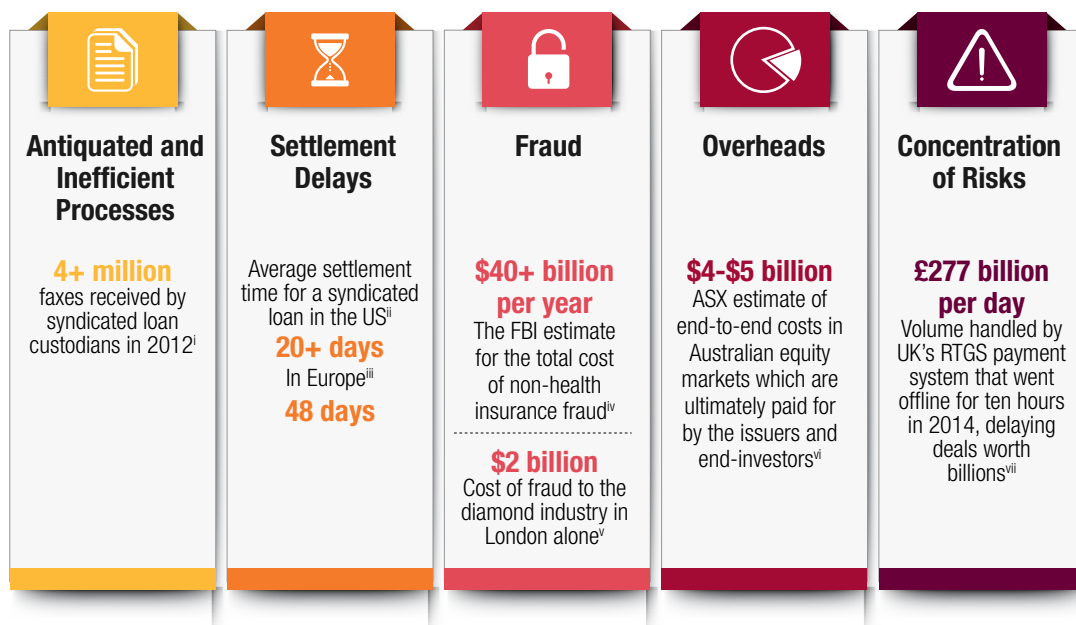
## Centralized Authorities like Clearinghouses Introduce Delays and Concentrate Risks

Following the 2007-09 financial crisis, central counterparties have increasingly taken positions between market participants to reduce the risk of contagion and a domino effect of institutional failures. Although this serves to make the financial system interoperable and reduces risks, it also leads to delays in clearing and settlement of financial contracts – plus increased compliance requirements.

For instance, settlements of contracts other than FX (foreign exchange) rarely happen in real-time. In addition, there are costs related to the administration and servicing of central institutions in the market. ASX, the leading stock exchange in Australia, estimates that Australian equity markets have about AUD \$4 billion to \$5 billion of end-to-end costs, which are ultimately paid for by the issuers and end investors<sup>10</sup>.

**Smart Contracts**  
 Programmable contracts which are capable of automatically enforcing themselves upon occurrence of pre-defined conditions

**Figure 1. Examples of Rising Problems with Traditional Financial Contracts**



ASX = Australian Securities Exchange located in Sydney; RTGS = Real-Time Gross Settlement – a fund transfer system where the transfer of money between banks takes place on a real-time basis.

<sup>i</sup> Bloomberg, "With Loan Market Still Using Faxes, Settlement Times Trail Goal", April 2015; <sup>ii</sup> Bloomberg, "Dirty Secret of \$1 Trillion Loans Is When You Get Money Back", September 2014; <sup>iii</sup> Markit, "Markit European loan volume survey", October 2015; <sup>iv</sup> FBI, "Reports and Publications: Insurance Fraud", Accessed May 2016; <sup>v</sup> TechCrunch, "Everledger Is Using Blockchain To Combat Fraud, Starting With Diamonds", June 2015; <sup>vi</sup> J.P. Morgan, "Australia Quantitative and Derivatives Strategy", March 2016; <sup>vii</sup> The Telegraph, "Mark Carney launches investigation after real-time payment system crash delays house purchases", October 2014

**What Would Smart Contracts Change?**

Smart contracts are programmable contracts that are capable of automatically enforcing themselves when pre-defined conditions are met (see Figure 2). Smart contracts can be implemented in a distributed ledger as well as a non-distributed ledger system.

Blockchains are one type of such distributed ledger systems that, when sufficiently secured, make it impossible for a single party or group of

parties to reverse transactions once recorded on this database. This eliminates the need for trusted intermediaries to authenticate and settle transactions. As a result of these properties, smart contracts on distributed ledgers could have a high degree of immutability and security, guaranteeing execution based on coded terms. While Nick Szabo coined the smart contracts concept in the 1990s<sup>11</sup>, implementing smart contracts on distributed ledgers came to the fore with the advent and maturing of the Bitcoin blockchain post 2009.

## What do smart contracts enable today?

Smart contracts have been designed to automate transactions and allow parties to agree with the outcome of an event without the need for a central authority. Key features of smart contracts are: programmability, multisig authentication escrow capability and oracle inputs:

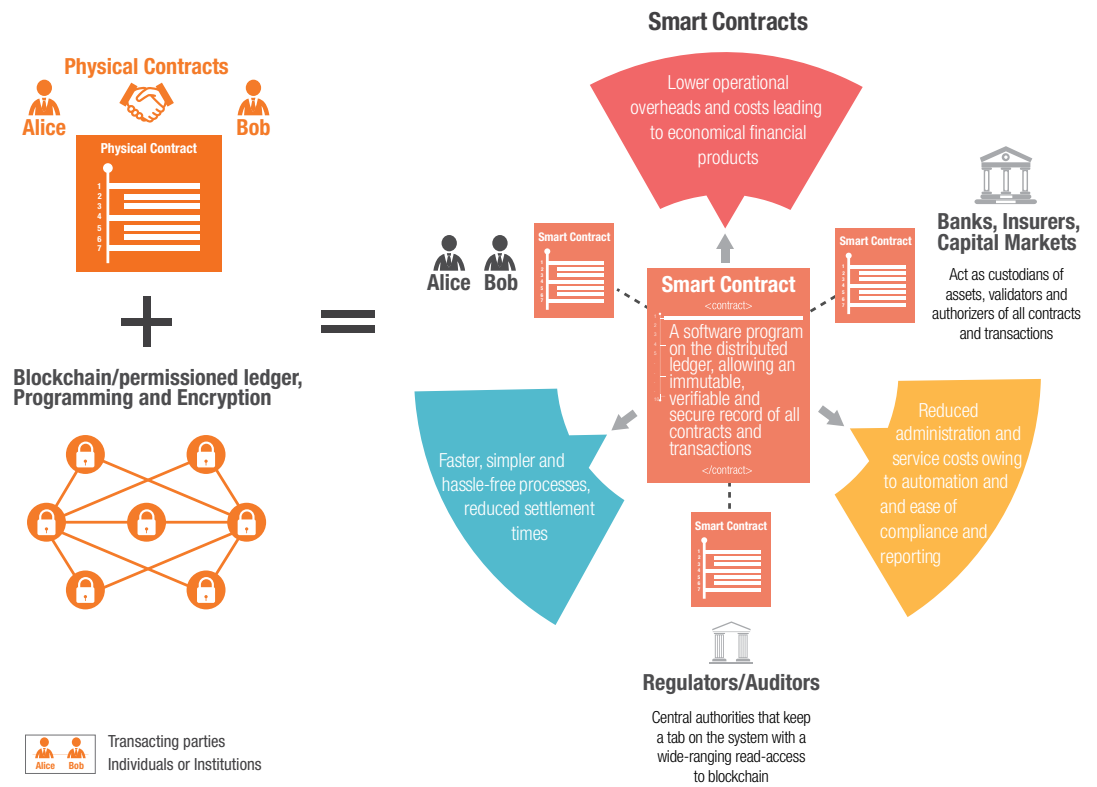
- A smart contract automatically executes based on programmed logic
- Multisig allows two or more parties to the contract to approve the execution of a transaction independently – a key requirement for multi-party contracts
- Escrow capability ensures the locking of funds with a mediator (e.g. a bank or an online market) which can be unlocked under conditions acceptable to contracting parties. Sometimes, external inputs such as prices, performance, or other real-world data may be required to process a transaction, and oracle services help smart contracts with inputs such as these.

*Source: Coincenter.org, "What are Smart Contracts, and What Can We do with Them?", December 2015; Ethereum and Bitcoin Community Forums*

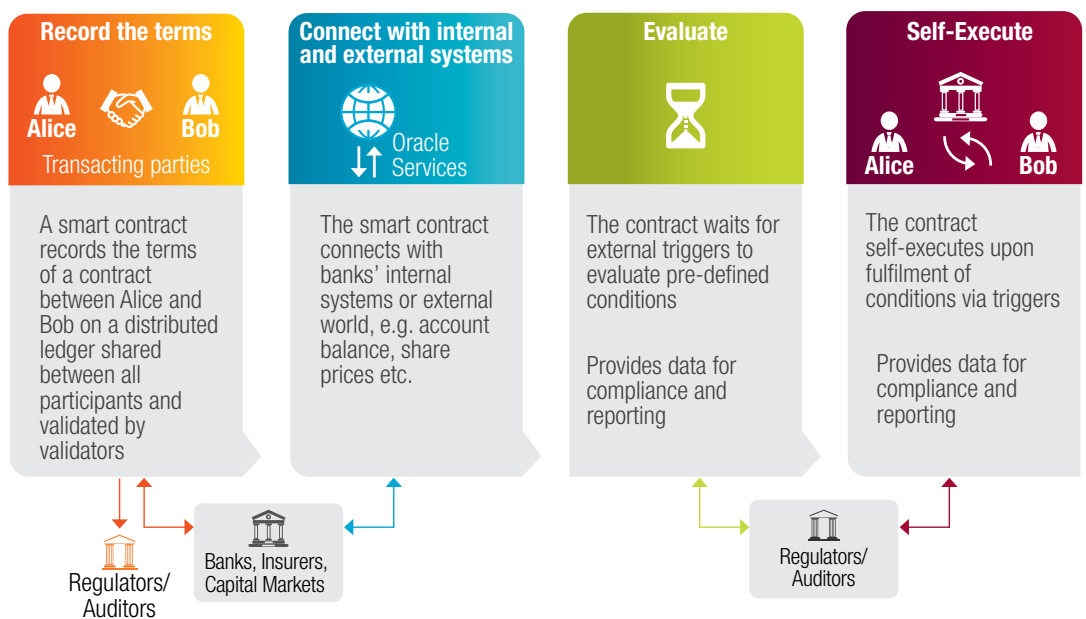
We believe that a permissioned, distributed ledger<sup>12</sup> smart contract system would make most sense for the financial services industry in the majority of cases (see Figure 2). It assures a secure, private, and scalable platform connecting all key stakeholders:

- The transacting parties: they can be individuals or institutions that intend to enter into a contract
- Banks, capital markets players and insurers: they can get involved depending on the use case, and act as custodians of assets and validators of all transactions
- Regulators: they can obtain access to read records of all transactions to keep a watch on the system

**Figure 2. How Smart Contracts Work in a Permissioned Blockchain System**



**Smart Contract Lifecycle**



Source: Capgemini Consulting Analysis

## 3 Key Benefits:

- Risk reduction
- Costs Savings
- Enhanced Efficiencies

The benefits of this model will extend to all major segments of the financial services industry, across value chains, and drive significant value in three key areas: risk reduction, cost savings, and enhanced efficiencies.

### Distributed Ledgers offer a higher degree of trust and reduced risks

Contracts or records stored on blockchains or permissioned ledgers eliminate the need for a central intermediary to provide trust in the system. For markets that do not use intermediaries, it still a higher degree of trust than current operations:

- **Corporate Finance and Investment Banking:** Distribution of private equity of small and medium businesses in a crowdfunding or an IPO sale
- **Structured Finance:** Trading and settlement of large, collateralized loans such as syndicated loans between a group of banks, mutual funds, and pension funds
- **Insurance:** Automated processing of travel insurance claims in case of events that can be automatically verified, such as flight delays or cancellations.

### Positive bottom line impact through reduced administration and service costs

By automating parts of business processes in the short run and possibly entire processes in the long run, smart contracts would significantly reduce the costs associated with areas such as compliance, record keeping, and manual intervention.

“The real benefit and power of the technology is more around reducing costs, risks, error rates and reconciliation processes while allowing everyone to have a shared mutualized infrastructure. It frees up capital and aids with compliance and regulatory reporting.” Dan O’Prey, Chief Marketing Officer, Digital Asset<sup>13</sup>

### Smart contracts and distributed ledgers have the potential to weed out inefficient business processes

Most securities, for instance, have a delayed settlement, with settlement times of T+2 or longer being common. Smart contracts have the potential to bring this down to minutes. This would also free up capital in the system by reducing mandatory collateral requirements for the trading of loans and derivatives and would thereby improve return on capital.

Thomas Hardjono, CTO Connection Science at MIT, sees significant potential benefits in this approach. “It takes, two to three days for the actual trade to settle and the process involves a lot of paperwork in the back room,” he explains. “With smart contracts, we could make that workflow more efficient by providing each of the people or stations in the workflow with greater visibility into the state of a particular asset in the workflow. At the next level, we could make this happen among a group of companies with proper governance. Ultimately, when these smart contracts become admissible in courts, it would make the entire system operational and efficient.”<sup>14</sup>

## Smart Contracts: The Legal Perspective

Technology often outpaces regulatory frameworks and the law – a trend that is borne out in the area of smart contracts as well. To make smart contracts interoperate with the existing legal system, designers of smart contract systems are actively working on several nuances from a legal standpoint:

**Immutability** – Smart contracts written as software programs on distributed ledgers would mean that the contracts, once agreed upon, cannot easily be modified. This would cause practical problems in many real-world scenarios and Cornell University Professor Ari Juels is exploring how the terms of the contract could be modified once it is in place. “Contract law makes provisions for the modification, amendment or annulment of contracts. Technical mechanisms in smart contracts can achieve analogous goals,” he says. “One possible approach is what we often refer to as an ‘escape hatch,’ a preprogrammed way of changing the terms of a smart contract. Ensuring that the right permissions are incorporated into the escape hatch itself is tricky, though, as is ensuring its correct implementation.”

**Contractual Secrecy** – Normally, a copy of smart contracts executed on a blockchain or a permissioned ledger is shared with the chain’s members. The anonymity of the parties can be secured, but the secrecy of contract execution is not necessarily secured. Thomas Hardjono, CTO Connection Science at MIT, believes that this is an area that is receiving attention and where progress will be made. “MIT Enigma is a project that is trying to solve the problem of privacy-preserving data sharing within organizations, and between organizations, by use of advanced cryptographic structures,” he says. Similarly, a concept known as “zero knowledge proofs” is being explored to devise a way to separate the way of verifying a transaction from seeing the content of that transaction.

**Legal enforceability and adjudication** – The financial services industry is highly regulated, and specific licenses and approvals are issued to firms to participate in a distributed ledger-based market. For instance, the US Securities and Exchange Commission recently approved the internet retailer Overstock.com to issue company stock on a platform on top of the Bitcoin blockchain. However, the legality of financial smart contracts is yet to be established. Initial steps have been taken in the US, by the State of Vermont, to recognize distributed ledgers in the state courts. Accurate translation of legal terms and conditions into software logic is another key aspect to consider. Startups such as CommonAccord are working on a system that auto-translates legal documents into smart contracts, simplifying their interpretation by both lawyers and developers.

Legislators, regulators and governments have begun to realize the potential for distributed ledgers in increasing transparency and ease of compliance and reporting. The push from these authorities will be instrumental in soon overcoming legal and administrative hurdles.

*Source: Capgemini Consulting Interviews, June-July 2016; American Banker, “Yellen Reportedly Urges Central Banks to Study Blockchain, Bitcoin”, June 2016; CoinDesk, “UK Government Highlights Benefits of Blockchain Tech”, October 2015; Oded Goldreich, “Zero-Knowledge: a tutorial by Oded Goldreich”, Accessed August 2016; Bloomberg, “Overstock Wins SEC’s Nod To Upend How Companies Issue Shares”, December 2015; STEP, “US state of Vermont to recognize blockchain data in courts”, May 2016*

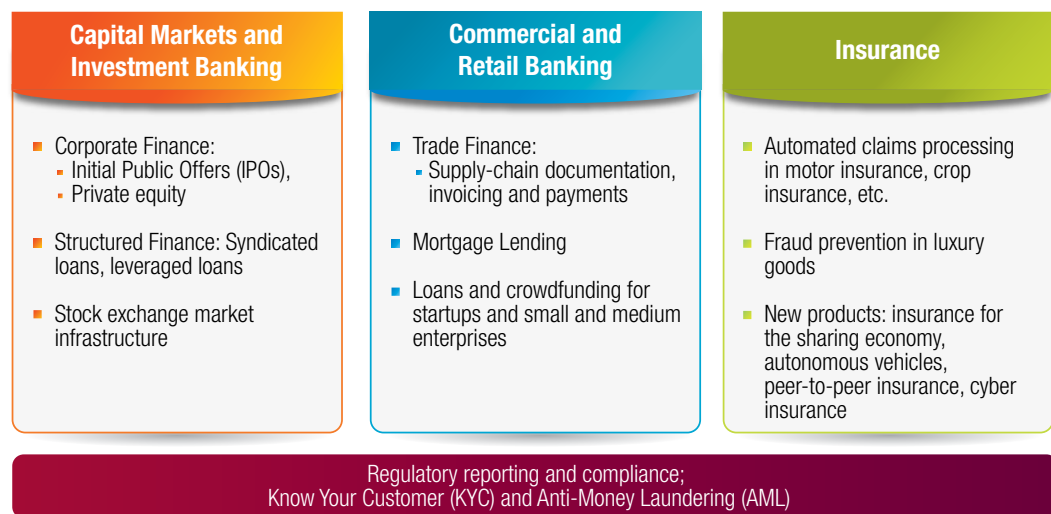


# What do Banks, Insurers and their Customers Stand to Gain from Smart Contracts?

Smart contracts will likely find early application in at least ten specific use cases across sectors in financial services (see Figure 3).

**Figure 3. Smart Contracts' Key Use Cases for the Financial Services Industry**

**Over 10  
specific  
use  
cases**



Source: Capgemini Consulting Analysis

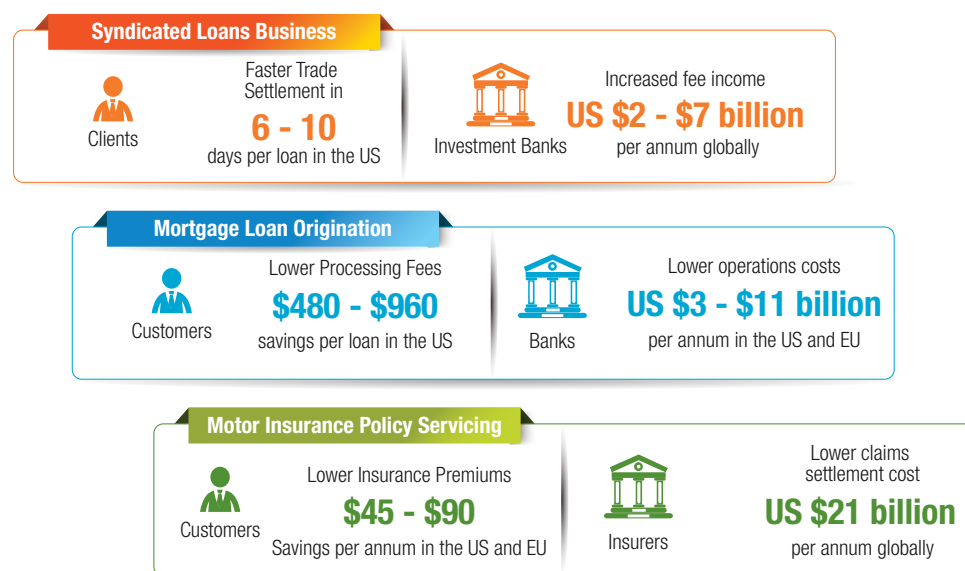
“We have been looking at the applications of distributed ledger technologies and the big picture of what can it mean in terms of smart contract use cases. Crowdfunding for private equities stocks in startups is one of the key blockchain use cases that we are prioritizing.” Philippe Denis, Head of CIB Blockchain Initiatives, BNP Paribas<sup>15</sup>

“We are currently working on clearing and settlement use cases. Specifically, we are working with the ASX for the clearing and settlement of cash equities, with the DTCC on US Treasury repo and SIX Securities Services on security lifecycle processes”. Dan O’Prey, Digital Asset<sup>16</sup>

To model the size of the prize, we have analyzed three use cases that we believe will generate the most impact. Our business case analysis estimates that automation using smart contracts adoption, and associated process and organizational changes<sup>17</sup>, could be able to generate substantial benefits (see Figure 4). These are only indicative and rough estimates based on our analysis of technology, processes and regulatory cost elements that exist in today’s environment. As the system evolves, these estimates will change as well.

**\$149 billion**  
**Additional leveraged loan volume growth with a reduction in settlement times**

**Figure 4. Smart Contracts Could Offer Substantial Benefits to Customers and Financial Services Firms**



Source: Capgemini Consulting Analysis

### Example Use Case 1: Savings and upsides from reducing syndicated loans settlement time

The Leveraged Loan market faces acute settlement issues. While the High-Yield Bond trades are settled in T+3 days<sup>18</sup>, the settlement period for Leveraged Loans often extends to almost 20 days<sup>19</sup>. This creates greater risk and a liquidity challenge in the Leveraged Loan market, hampering its growth and attractiveness. Since 2008, the global Leveraged Loan market has witnessed negative growth, whereas the High-Yield Bond market grew by 11%<sup>20</sup>. We believe that smart contracts could reduce the delay in processes such as documentation, buyer and seller confirmation and assignment agreement, and KYC, AML and FATCA checks, with the help of a permissioned ledger<sup>21</sup>. The settlement period for Leveraged Loans could thus be reduced to the range of T+6 to T+10 days, making the Leveraged Loan market more liquid than it is currently.

We estimate that with the reduction in settlement times, if the growth of Leveraged Loans can be at least half that of the High-Yield Bond market growth (i.e. between 5% and 6%), it would amount to an additional \$149 billion of loan demand in the market. These loans typically carry 1% to 5% arranger fees, translating into additional income of \$1.5 billion to \$7.4 billion for investment banks<sup>22</sup>. In addition, operational costs,

regulatory capital requirements and costs associated with delayed compensation payments during the settlement of Leveraged Loans will be reduced with the shortening of the settlement cycle<sup>23</sup>.

### Example Use Case 2: Mortgage industry to benefit from adoption of smart contracts

The mortgage loan process relies on a complex ecosystem for the origination, funding, and servicing of the mortgages, adding costs and delays. Roberto Mancone, MD and Global Head Disruptive Technologies and Solutions at Deutsche Bank AG, says that it is high time that some of the systemic issues in mortgage processing are resolved. "The loans are one of the main drivers of growth, but at the same time also of operational complexity in the retail banking industry," he says. "This creates an enormous need to enhance the efficiency of internal services and processes."<sup>24</sup> Smart contracts could reduce the cost and time involved in this process through automation, process redesign, shared access to electronic versions of physical legal documents between trusted parties, and access to external sources of information such as land records.

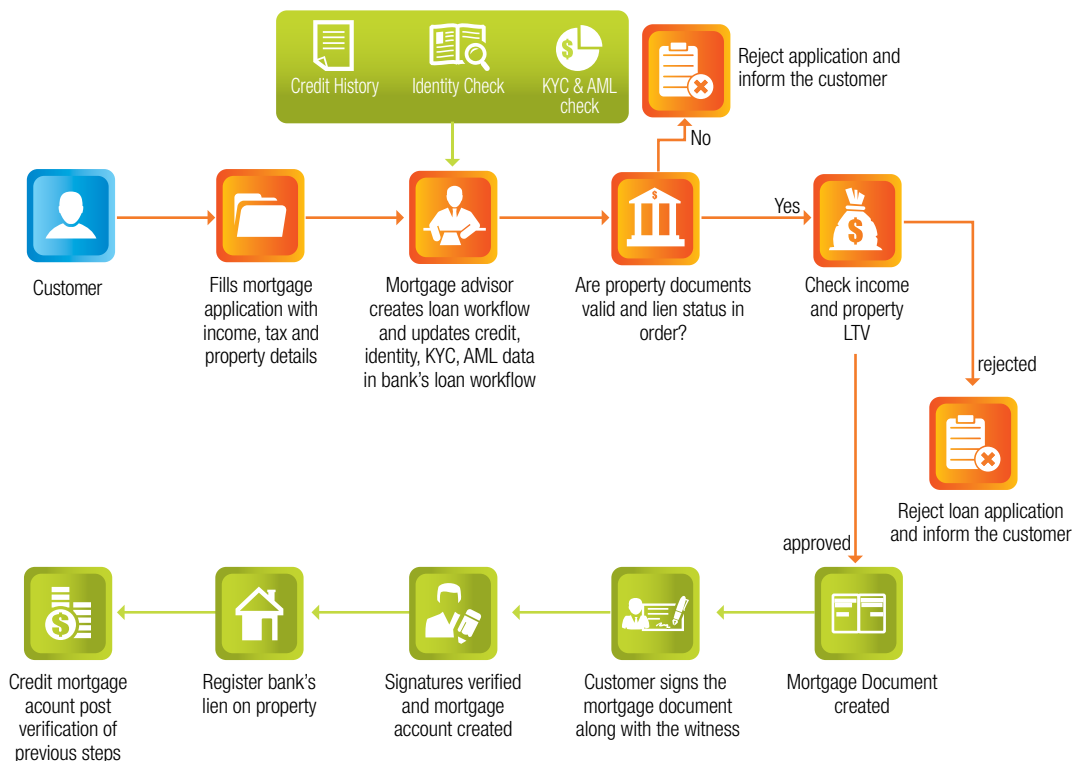
Our earlier research on banking back-office automation<sup>25</sup> suggests that mortgage lenders can expect savings between 6% and 15% from Business

Process Management systems, core banking platforms, and document management systems. These numbers, coupled with our experience and discussions with industry experts, helped us estimate expected savings for each of the processes involved in loan origination. For instance, in the US housing market, nearly 6.1 million homes were sold in 2015<sup>26</sup>. Based on historical averages, 64% of these were purchased by home owners with a mortgage<sup>27</sup>. We estimate that minimum savings of \$1.5 billion could be achieved by loan providers through the automation of tasks within their organizations (see Figure 5). Further, savings of \$6 billion could be achieved once external partners such as credit scoring companies, land registry offices, and tax authorities become accessible over a blockchain to facilitate faster processing and reducing costs.

We also estimate that mortgage customers could expect a 11% to 22% drop in the total cost of mortgage processing fees charged to them in case smart contracts are adopted. In absolute terms, this amounts to savings of \$480 to \$960 on the average processing fees of \$4350 on every mortgage loan<sup>28</sup>. The total of outstanding mortgage loans across the US and European Union countries in 2014 was valued at \$20.98 trillion<sup>29</sup>. Based on the US mortgage market case, smart contracts could potentially save between \$3 billion and \$11 billion in the new mortgage origination process across the US and EU<sup>30</sup>.

**\$6 billion**  
Maximum savings that can be generated by the US mortgage banks through the use of smart contracts

**Figure 5: Potential Cost Savings for Mortgage Lenders from the Use of Smart Contracts**



**Calculation of the cost savings potential from the use of smart contracts in the US mortgage industry**

	Mortgage Loan Origination Cost US\$	Minimum Savings US\$	Minimum Savings US\$
Per loan processing cost for an average loan of \$200,000 in the US (2015)	4,349.5	396.3 (9.1%)	1,528.4 (35.1%)
Opportunity for mortgage origination based on sale of 6.1 million homes of	17 billion	1.5 billion	6 billion

Source: Capgemini Consulting Analysis; Capital One, "Home Loans - Be in the know about your closing costs", Accessed June-July 2016

**\$1.67 billion**  
**Maximum savings that can be generated by the UK motor insurers through the use of smart contracts**

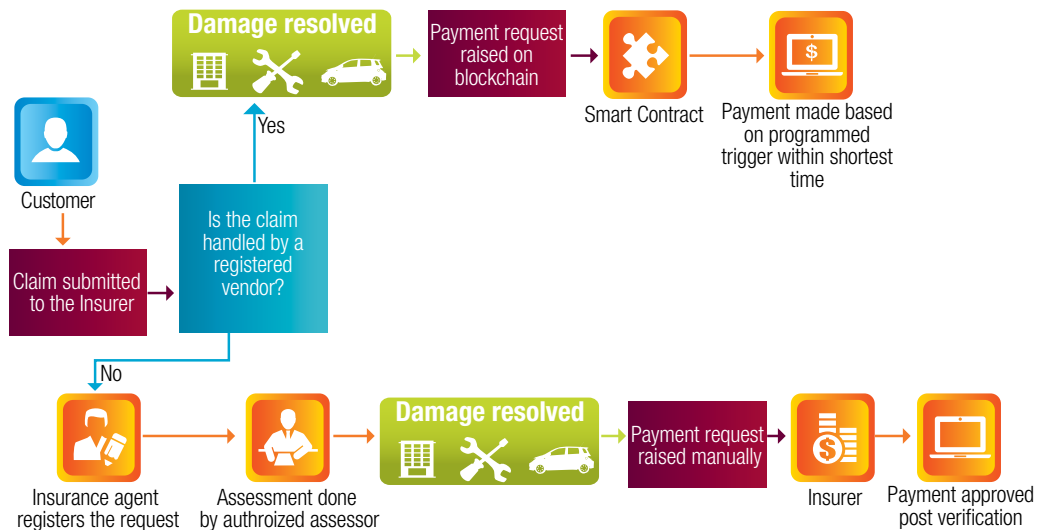
### Example Use-Case 3: Claims processing cost savings in the motor insurance industry

We believe that, in the motor insurance industry, smart contracts that bring insurers, customers and third parties to a single platform will lead to process efficiencies, and reduced claim processing time and costs. Also, third-parties such as garages, transport providers and hospitals – once they are part of the distributed ledger – will be able to provide quicker support against claims to customers and can expect faster settlement of claims.

The UK motor insurance industry processed 3.7 million claims and spent \$13.3 billion in claim costs and expenses (see Figure 6)<sup>31</sup>. We calculate that approximately \$1.67 billion, or 12.5% of the total costs, could be saved by adopting smart contracts. Based on the UK motor insurance market, we estimate that annually \$21 billion could be saved by the global motor insurance industry through the use of smart contracts<sup>32</sup>.

A percentage of savings could be passed on to the customers via lower premiums on motor insurance policies. We estimate that the cost savings amounts to a reduction of \$90 on average on every premium payment if the insurers pass on all of the savings generated from smart contracts adoption to consumers, and \$45 per premium in case the insurers choose to pass on only 50% of savings<sup>33</sup>.

**Figure 6. Potential Savings in the Motor Insurance Claims Settlement Process with the Use of Smart Contracts**



#### Calculation of the cost savings potential from the use of smart contracts in the UK motor insurance industry

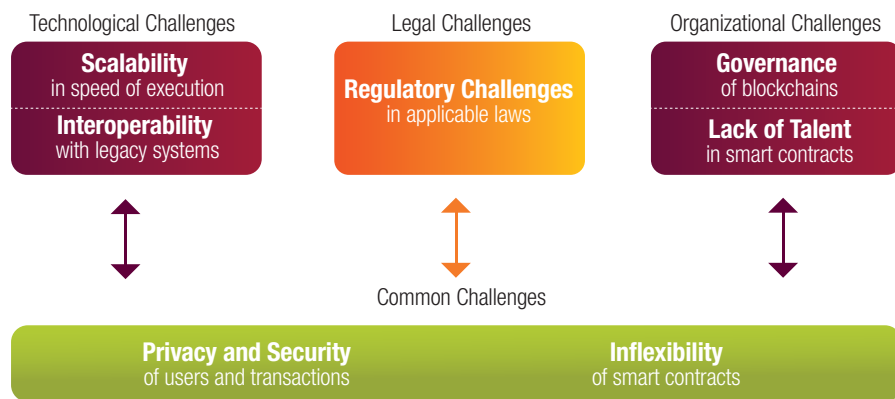
Year-2015	Number of Motor Insurance Claims in the UK (A)	Claims cost and Expenses in \$ million (B)	Total Expected Savings in Claims Costs and Expenses \$ million (C)	% Savings (C/B)
Total	3,733,000	13,320	1,665	12.5%

Source: Capgemini Consulting Analysis

# What Needs to Happen Before the Financial Industry Adopts Smart Contracts?

The technology behind smart contracts is evolving rapidly. Basic smart contracts with functionalities such as multi-signature payments, escrow services, and so on are already in place (see “What do smart contracts enable today?”). However, there are several challenges that need to be overcome before complex smart contracts can become mainstream (see Figure 7).

**Figure 7. Key Challenges Hindering Smart Contracts Adoption**



Source: Capgemini Consulting Analysis

## Interoperability with Legacy Systems and External Data

Smart contracts need to be integrated with the industry’s existing systems, raising significant questions about the effort involved and the investment that will be required. Thomas Hardjono, CTO at MIT Connection Science, believes that it is a key cost component that needs to be factored in early on. “When a company, a big bank or a big company is trying to bring in new technology, this integration is a cost item,” he says. “And people evaluate the ROI by also building in this cost of integration. So, with blockchain technology how is this going to work? What is the capital cost to businesses running this? Is it worth it?”<sup>34</sup> Smart contracts will also need to be able to work with

trusted external data sources if they are to utilize external information. Smart contracts can achieve this with the help of oracles – programs providing smart contracts with the data they need from the external world or carrying the commands they need to send to other systems. Sergey Nazarov, Co-founder and CEO, smartcontract.com – a startup specializing in building oracles – outlines how connectivity with real-world data will be key. “We have been focusing on creating smart contracts that are able to deal with real world data,” he says. “Most contracts have something to do with data that comes from the external world – shipments, weather, temperature, customs etc. To handle that data, a smart contract network is going to need Oracles to connect smart contracts with secure and reliable data sources.”<sup>35</sup> There are substantial challenges in connecting to such external oracles in a reliable way.

## BitLicense A custom-made regulatory framework established by New York for bitcoin and digital currency businesses

### More flexible contracts

Smart contracts are programmed logic and are immutable during the course of execution of a transaction. However, real-world contracts can be modified as long as the parties in the contract agree. Techniques need to be explored to upgrade contracts as necessary during the term of a contract.

### Scalability of transactions

For transactions such as syndicated loans or mortgages, where high speeds are not an issue, permissioned blockchains are, certainly for now, the preferred path. This is because there tends to be fewer participants to the consensus, decreasing the time needed for consensus on transactions and, hence, execution time. However, as transaction volumes grow, this is an area that Professor Ari Juels believes needs attention. “Established industry players are likely to use permissioned blockchains, rather than permissionless ones, for several reasons,” he says. “First, permissioned blockchains make it easier to achieve regulatory compliance. Second, they provide more robust consensus and governance mechanisms. Finally, high throughput is essential for many applications. While new techniques will be needed to scale both permissioned and permissionless blockchains up to throughputs required for many applications, permissioned blockchains today already have a considerable performance advantage.”

In addition, experiments are underway in consensus mechanisms that allow for parallel processing of transactions. Thomas Hardjono, CTO at MIT Connection Science, says: “We need a new consensus algorithm for blockchain systems that are geared for smart contracts. That is a challenge. One of the areas of research that we are very interested in here in MIT is future consensus algorithms for blockchain technology and smart contracts”.<sup>36</sup>

### Talent Pool

There is a dearth of smart contract and blockchain talent and capabilities within financial services firms. For example, companies may need to recruit “coder-lawyers” – a very rare combination of skills that combines a solid understanding of both law and computer programming. Organizations need to put in place skills development programs for their existing

resources, and some startups have started to provide training support on their platforms, as Brian Crain, Head of Business Development at Eris Industries, outlines. “Acquiring knowledge and skills is crucial at this stage. We designed training for developers to understand blockchain, smart contracts and how to build enterprise-grade smart contract applications.” he says<sup>37</sup>. Working with academia to further research and talent growth is a potential solution. Leading universities such as Stanford<sup>38</sup>, Oxford<sup>39</sup>, MIT<sup>40</sup> and Cornell<sup>41</sup> have dedicated research groups focused on smart contracts and blockchain, and some of them have also begun to offer courses in this field.

### Mature Regulation

The regulatory environment will need to catch up with the speed of development in smart contracts and distributed ledgers. For example, in the US, states such as New York have already enacted regulations for digital currency businesses. Its BitLicense is a custom-made regulatory framework for bitcoin and digital currency businesses, which has been established by its Department of Financial Services<sup>42</sup>. For contracts to be enforceable, the identity of the parties has to be confirmed to a degree that the legal system and regulators consider appropriate, and electronic signatures need to be considered valid (see “Smart Contracts: A Legal Perspective” for more legal aspects). Regulators ought to favor increased adoption of smart contracts as they stand to gain from simplified regulatory compliance and reporting.

### Contract Secrecy and Security Needs

Secrecy of contracts may be a challenge for enterprise-related smart contracts depending on the type of permissioning put in place on blockchains. Since transaction records can potentially be visible to all participants, banks will be reluctant to collaborate on a common smart contract platform if security and privacy of data are not taken into account. Cryptographic key management is crucial to hide transaction details from unknown parties. Security hacks at, for example, Bitfinex (2016), Mt. Gox (2013) and The DAO (2016)<sup>43</sup> have raised industry concerns. There are therefore a range of questions that need to be answered. What data should be shared with all participants? How do we ensure the authenticity and security of data supplied by oracle services? And so on.

**Early  
2020s**  
Estimated start  
of mainstream  
adoption  
of smart  
contracts  
in practical  
applications

## Governance

Smart contracts on distributed ledgers eliminate the need for a trusted intermediary, as the required authority is provided by the transparency and the consensus among the participants (see “The DAO Incident: Governance Lessons for the Financial Services Industry”). This model requires that multiple banks, consumers and potentially regulators come together on one platform and agree on aspects of data access, dispute resolution and limitations of liability<sup>44</sup>. Gideon Greenspan, CEO and Founder of MultiChain, a private blockchain platform says, “In a shared resource such as a distributed ledger, you need rules about who owns and accesses which piece of data and what kinds of transactions are permitted.”<sup>45</sup> He adds, “For private blockchains, several prominent startups like R3CEV and Digital Asset Holdings are working on ‘contract description languages’ to allow the conditions of a complex financial contract to be represented formally and unambiguously in a computer readable format, while avoiding the shortcomings of Ethereum-style general purpose computation.”

## How soon can smart contracts become mainstream within financial services industry?

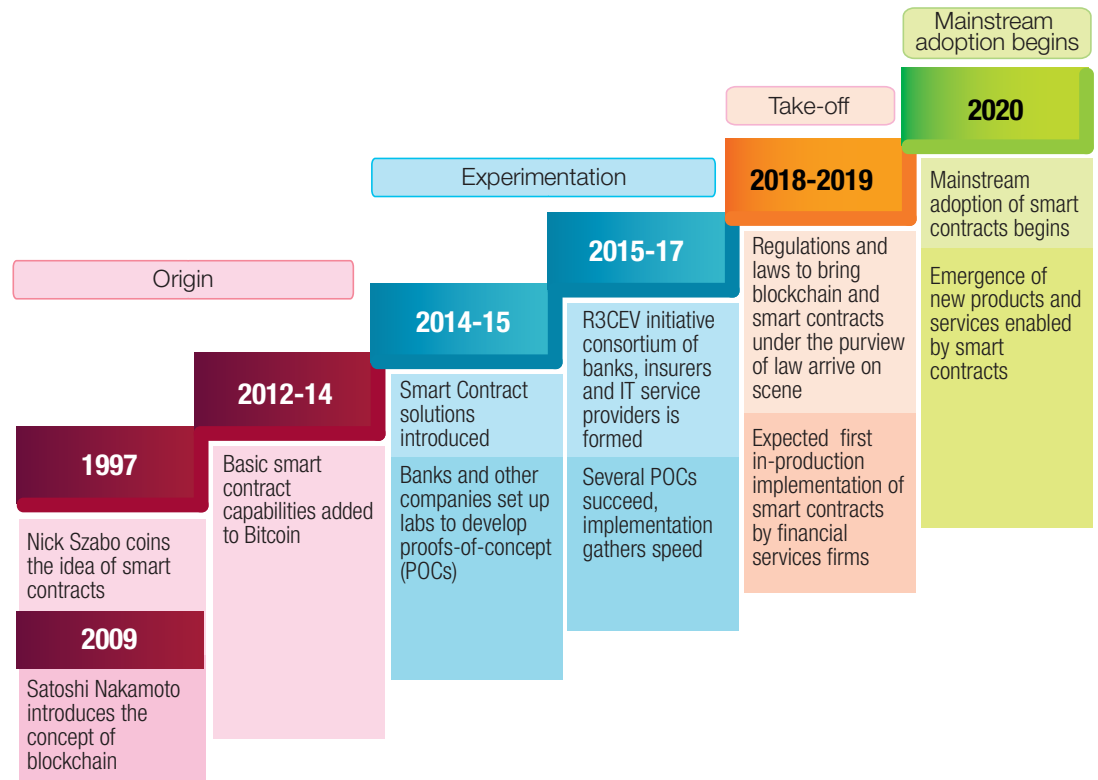
Based on our discussions with industry experts from major banks, startups and academia, we estimate that mainstream adoption is a few years away (see Figure 8). Industry experts leading distributed ledger initiatives at their firms are positive about a quick emergence of early applications:

“I think any product that a smart contract can manage, can be developed without waiting for readiness on a distributed ledger technology (DLT), and it could be viable by the end of 2017. For instance, smart contracts can record loan originations through contract digitization, self-execution of contracts and reduction of operational overhead in the internal business processes during its entire life cycle. After this stage, when the financial industry will have consensus on the DLT, the smart contract used for the origination can be further extended for repackaging and trading of these loans in a capital market environment that will be ready for a DLT environment.” Roberto Mancone, MD and Global Head Disruptive Technologies and Solutions at Deutsche Bank AG<sup>46</sup>

“We’re a couple of years away from in-production systems in a bank or a group of banks. We may see some small pilot-scale implementations in the next 12 months, but for mainstream we are two to three years away.” John Whelan, Director of Innovation, Banco Santander<sup>47</sup>

While mainstream adoption may well be at least 3 years away, financial services companies should not stand still. They ought to begin by identifying the changes that will be required, including to IT systems, processes and change management policies. They should also begin the process of carefully building their external ecosystem, choosing critical new players in the value chain. Our recent research on innovation centers<sup>48</sup> found that the financial services industry has overtaken other industries in terms of opening new innovation centers and that Fintech is one of the top focus areas for new innovation centers. The industry must capitalize on this momentum and focus on smart contracts as part of the broader Fintech innovation ambit.

**Figure 8. Timeline of Blockchain Evolution and Smart Contract Implementation**



Source: Capgemini Consulting Analysis

## The DAO Incident: Governance Lessons for the Financial Services Industry

On 17 June 2016, a smart contract on Ethereum’s public, permissionless blockchain was hacked and a share of investors’ funds, valued at nearly \$50 million, was moved to a sub-contract controlled by the hacker. While the funds could not be immediately accessed by the hacker because of checks built into the contract, the hack has had far-reaching implications. While such an attack is less likely to occur in a permissioned ledger network, the incident has served as an alarm for smart contract practitioners. Amidst highlighting the technical complications and difficulties with implementing smart contracts, the event also highlighted the significance of strong governance. For instance:

- **Roles of participating institutions:** The financial institutions that come together to operate on one smart contract platform must have clearly defined roles and responsibilities and ensure that all norms related to creation, execution and annulment of smart contracts are well-defined. According to Trent McConaghy, Founder and CTO of BigchainDB, “**Governance shouldn’t be an afterthought. It should be at least 50% of the conversation. When you don’t design for governance, the result is not no governance. The result is bad governance.**”
- **Checks and balances:** Due to a security feature of the Ethereum smart contract, the hacker was not able to move the hacked funds for 27 days, giving the community precious time to act, rewrite the rules and rollback the attack. Economic impact of failures should be proactively gauged and features need to be built-in to ensure corrective action can be taken by authorities to avert or limit losses to the transacting parties. These checks will have to be designed while keeping in mind the need for seamless execution.

Source: Ethereum and Slock.it blogs; Capgemini Consulting Interviews, June-July 2016



# How can Banks and Insurers Realize the Full Potential of Smart Contracts?

## Be Prepared for the Arrival of Smart Contracts

The financial services industry is following developments in the smart contracts space with a keen eye. Innovators among banks and insurers have started experimenting with smart contracts and several of them are optimistic about the evolution and mainstream adoption of smart contracts within the next few years. Philippe Denis, Head of CIB Blockchain Initiatives, BNP Paribas, says, “Now is the time to start experimenting with smart contracts in a sandbox environment. By 2017, we will begin to see early-stage contracts enabling practical use-cases and also connecting to legacy platforms. And by 2019, we might even begin to see consumer adoption ramping up.”<sup>49</sup> Sergey Nazarov, Co-founder and CEO, smartcontract.com says, “Now is a good time to get your existing infrastructure ready to interact with smart contract based securities. The scenario a large organization doesn’t want to be in is having to quickly modernize its entire financial infrastructure in order to keep up with the rapid adoption of a smart bond, or smart contract derivative as a preferred security by a large part of their clients.”<sup>50</sup>

## Critically Evaluate Your Needs – Do We Really Need Smart Contracts?

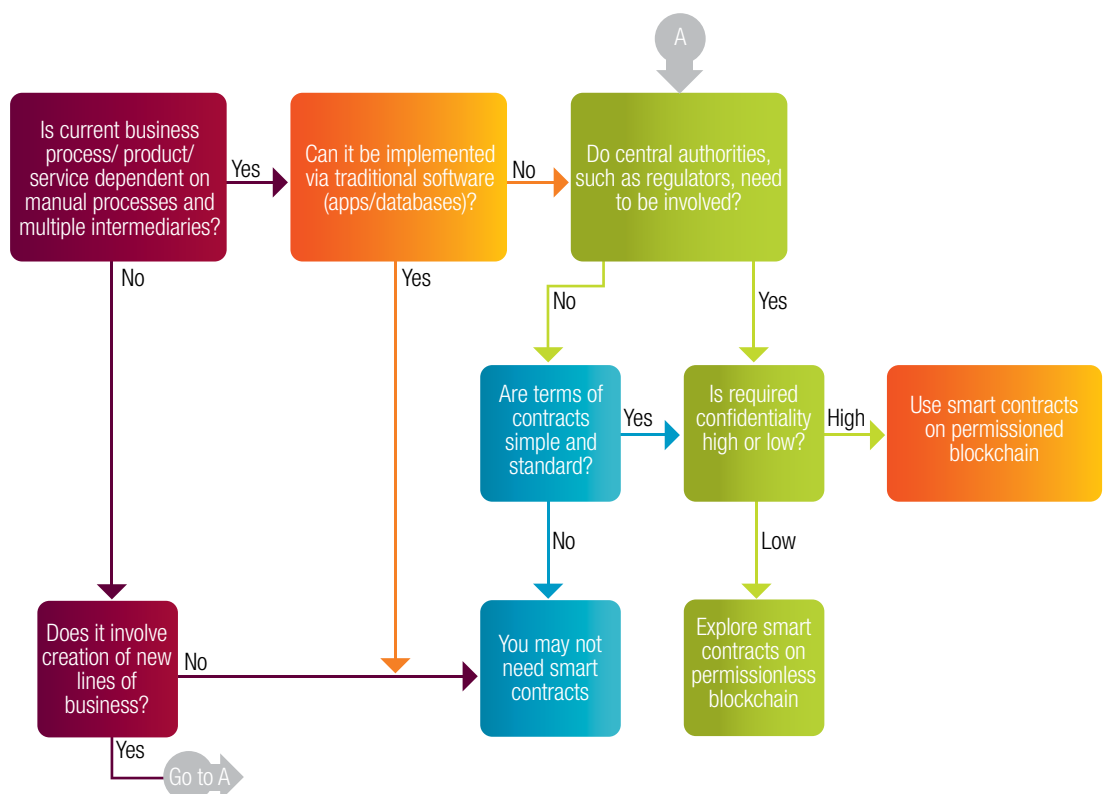
The hype around smart contract technology should not cloud the thought processes behind whether smart contracts are needed in the first place and what purpose they will serve (see Figure 9). Gideon Greenspan, CEO and Founder of MultiChain, a private blockchain platform, highlights the importance of use case selection. “Use-cases must be carefully evaluated as many proposed blockchain use-cases can be implemented efficiently via traditional or distributed databases as well,” he says<sup>51</sup>. “We see clear applications for banks and other financial institutions. Respectively, these are: small trading circles, provenance for trade finance, bilateral contract notarization and the aggregation of AML/KYC data.”

“ [...] many proposed blockchain use-cases can be implemented efficiently via traditional or distributed databases as well.



Gideon Greenspan,  
CEO and Founder,  
MultiChain

Figure 9. Critically Assess Your Needs Before Embarking on a Smart Contract Use Case



Source: Capgemini Consulting Analysis

## **AXA Factory Accelerator where AXA conducts its cryptocurrency and blockchain related experiments**

### **Conceptualize New, Smart Contract-Enabled Products and Services**

Banks and insurers can also focus on conceptualizing entirely new products and services that are underpinned by smart contracts. For instance, one of the startups we spoke to has been working with an insurer on a cybersecurity insurance product. In this case, the smart contract between an enterprise client and the insurer monitors the client's digital properties (websites, apps) and dynamically calculates the cybersecurity risk to adjust the payable premium amount. New products and services lend themselves to early experimentation and an agile process of tests, trials and rapid iterations. Also, minimal or no contact with legacy systems can avoid integration and interoperability challenges.

### **Build Capabilities and Fast-Forward Smart Contract Innovation with Strategic Partners**

It is imperative that the financial institution moves beyond challenges related to talent and smart contract innovation by forging strategic partnerships with experts in the space. To make an informed decision on partnering with the smart contract startup ecosystem, it is crucial that banks and insurers develop an understanding of the smart contract landscape (see Figure 10).

### **Take a Portfolio Approach to Smart Contract Experimentation**

The best results are likely to accrue from a range of collaborative smart contract initiatives. Collaboration between innovation labs, incubators, startups and industry consortia is as crucial as proprietary innovation efforts. For instance, Deutsche Bank, in addition to its labs in London, Berlin and Silicon Valley, is also involved with the R3 banking consortium to further research on distributed ledger technology<sup>52</sup>. Similarly, AXA conducts cryptocurrency and blockchain related experiments at its accelerator – AXA Factory<sup>53</sup>, while its venture arm – AXA Strategic Ventures – invests in disruptive blockchain startups<sup>54</sup>. AXA has also taken part in an industry consortium – CDC – where 11 leading financial institutions have come together and launched a blockchain innovation lab with an aim to “pool the exploration measures and eventually evaluate the potential of actual uses of this technology”<sup>55</sup>.

### **Conclusion**

Smart contracts present an exciting, transformative opportunity for the financial services industry. However, as with all breakthrough innovations, organizations need to be careful about differentiating between what is hype and what is reality in the smart contracts space. By focusing time and energy on understanding the potential of smart contracts, and plotting a long-term, robust and pragmatic strategy, organizations can realize the potential on offer to reimagine financial contracts for a digital age.

**Figure 10. Smart Contracts Industry Landscape and with Select Startups and Technology Providers**



Source: Capgemini Consulting Analysis

## Research Methodology

**Focus interviews** – We conducted detailed discussions with banking and insurance industry professionals who are leading blockchain and smart contract initiatives at their firms, as well as academics focused on this field. We also interviewed 19 startups that have experience and credentials in smart contracts. We shortlisted these startups from databases such as CB Insights, CrunchBase and Iterate. Our interviews included executives from:

Financial Services Industry	Smart Contracts Startups	Academics
AXA Banco Santander BNP Paribas BPCE Deutsche Bank The SWIFT Institute	Augur, BigchainDB, BitShares, Blockchain Tech Ltd., BrainBot, Chain, CoinPrism, CommonAccord, ConsenSys, Credits, Digital Asset Holdings, Epiphyte, Eris Industries, Everledger, HitFin, Inspheer, MultiChain, SmartContract, Symbiont	Bar-Ilan University (Israel) Cornell University ESILV (Paris) Harvard University MIT

**Quantitative Analysis** – We also undertook comprehensive web-based research of the smart contracts space to complement the findings of the primary research with overall industry trends. This research also involved an in-depth analysis of the markets and processes in the highlighted use cases of syndicated loans, mortgage loans and motor insurance. We analyzed individual sub-processes that make up each of these use cases and analyzed the potential for cost savings and upsides upon the introduction of smart contracts for each of them. This allowed us to arrive at a rough estimate of savings given the current state of cost technology, processes and regulation. As the system evolves, these estimates will as well.

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2) Cost structures for mortgage lenders are assumed to be similar across the US and European markets  
Analysis – We estimate that the customers can expect between 50% to 100% of the average savings of 22.1%  $((9.1\%+35.1\%)/2)$  generated by lenders to be passed on to them. Hence, customers can expect to save between 11%  $(\$480=\$4,350*22.1\%*50\%)$  and 22.1%  $(\$960=\$4,350*22.1\%*100\%)$
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Analysis - In the US market , minimum savings  $\$4,350 \times 9.1\% \times 6.1 \times 10^6 \times 64\% = \$1.5$  billion, maximum savings  $\$4,350 \times 35.1\% \times 6.1 \times 10^6 \times 64\% = \$6$  billion  
Comparing the outstanding mortgage industry of EU28 (\$9.2 trillion) and US (\$11.8 trillion). The savings for EU28 area is estimated to be between \$1.17 billion (minimum) and \$4.7 billion (maximum).  
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Assumption – We are assuming that insurers will pass between 50% to 100% of these savings (12.5%) on to the customers  
Analysis - Average premium paid by customers across US (\$905), UK (\$707.8), 10 European countries (\$637.3) in 2014 was \$726 in 2014.  
Calculation – Based on the average premium of \$726, savings for customers will be between  $\$45(12.5\% \times 50\% \times \$726)$  and  $\$90(12.5\% \times 100\% \times \$726)$
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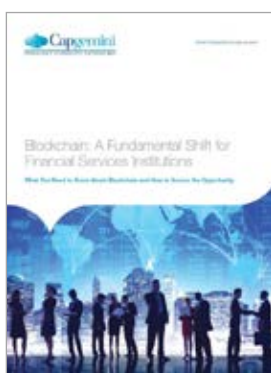
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