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Can the financial services industry master cryptofinance?

Blockchain technologies have the potential to revolutionise the financial sector by transforming business models, connecting new counterparties and generating sweeping efficiencies, but work needs to be done before the full benefits of the underlying blockchain technology are realised.

IN 30 SECONDS

- Cryptofinance has the potential to revolutionise the financial sector
- It has the power to transform business models, connecting new counterparties and generating sweeping efficiencies but work needs to be done before the technology's full benefits are realised.
- There are risks for banks in being edged out of their current markets but there are opportunities should they successfully engage with the technology based on blockchain.

Why blockchain is delivering a kick to the financial system

The financial markets are ripe for disruption by blockchain innovation. The internet-led peer-to-peer payment process offers huge potential cost and time savings in securities and derivatives transactions especially in clearing.

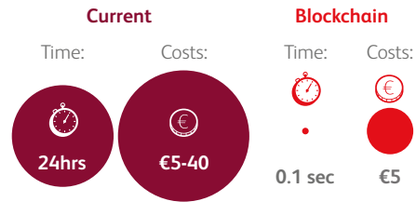
Current transaction and clearing volume of securities and derivatives*

*Total number of security and derivative transactions and clearings within CPMI countries (Committee on Payments and Market Infrastructures) for the year 2013.

Blockchain technology

Cryptofinance payments are made directly between payer and payee (P2P) and remove the need for a central authority. The technology could save billions in margin payments and capital costs, and increase transaction speed and profits.

Average costs and processing time
(Custodian expert estimation)



€13bn-18bn p/a

Estimated potential saving in banking infrastructure costs by 2022 through the rollout of blockchain technology to optimise cross-border payments, securities trading and regulatory compliance.

€4bn p/a

Estimated potential saving in collateral management costs through blockchain optimisation of valuation accuracy and autonomous monitoring of collateral handling.

Sources: *Statistics on payment, clearing and settlement systems in the CPMI - Figures for 2013, http://bit.ly/1NPkySo ; BearingPoint Institute estimates

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If there is one idea guaranteed to generate a buzz of excitement in financial circles at present it is the complex but intoxicatingly cutting-edge technology known as 'blockchain'.

Few in financial markets claim to fully understand how blockchains work, but that has not prevented an explosion of interest over recent months, leading to talk of a once-in-a-generation shift that could be a game changer for global financial markets.

According to some usually sober voices, the forthcoming blockchain revolution is likely over the coming decade to mirror the impact of the internet in the previous one, transforming business models, connecting new counterparties and generating sweeping efficiencies that might reverse the fortunes of the post-crisis financial sector.

'Any conversation in financial circles nowadays is likely to move very quickly onto the subject of blockchains,' says Dr Philip Godsiff, Senior Research Fellow at the Surrey Centre for the Digital Economy at Surrey Business School. 'We may be moving away from an internet of entertainment, shopping and advertising to a new era in which the technology is actually doing serious business' (see interview below).

'The first time I heard about the blockchain, it reminded me of when I heard about a company in New Jersey that was doing electronic trading in ways nobody had done before – the feeling that something was fundamentally changing.' – CRISTÓBAL CONDE, FORMER CEO OF SUNGARD DATA SYSTEMS AND FINTECH INVESTOR[1]

A blockchain is a distributed, secure and transparent system of record comprising a log of transactions shared across a digital network. Its best-known application is the payment system or so-called crypto-currency 'Bitcoin', which uses peer-to-peer technology to make and record payments without the need for a trusted intermediary such as a bank.

In enabling peer-to-peer contracts and direct transfers of value, the blockchain technology has the potential to undermine the banking system and may present a significant opportunity for banks and other market participants to cut costs, boost efficiency and marshal data. Its untapped potential to inspire new models is evidenced by the current surge of interest across the financial services industry, whereby its manifold usage options have meanwhile also sparked the interest of players from industrial and public services backgrounds.

Blockchains are genuinely new in that they are the first systems to overcome limitations of synchronising databases, so that individuals and companies can store data and run applications with 100% reliability. That is particularly valuable in the financial markets, which are among the most computationally trust-intensive industries in the world.

The potential cost savings presented by a single global digitised ledger are significant, with early estimates putting medium-term efficiencies for Tier 1 banks at around a fifth of the GBP 3 billion a year spent on IT, arising from streamlined operations and faster processing and settlement.

An equally important benefit is that the ledger will produce a golden source of data; useful for business owners, auditors and regulators alike.

However, the key driver of the current gold rush is the potential for secular change to the status quo, in which every

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player perceives an opportunity to play a new role in the global financial system.

As awareness of cryptofinance has grown over the past year, banks have launched numerous initiatives to explore these opportunities. The industry as a whole is set to spend USD 1 billion on blockchain initiatives by 2017, with leading organisations already implementing up to 20 individual projects, often working alongside start-ups[3]. In addition, there are moves to collaborate on a common architecture, notably under the auspices of New York-based innovation firm R3 CEV.

Regulators, meanwhile, appear to be cautiously optimistic. The Bank of England has said the approach used by bitcoin could be applied to 'the majority of financial assets such as shares or bonds [that] already exist only as digital records, stored on centralised databases'.[4]

Still, it is too early to know what role in financial markets blockchain is set to play. It may be restricted to database management and transaction processing, but most likely some wider and more disruptive future awaits.

'You have to be respectful in the face of new technologies like bitcoin, but you don't capitulate.'
– JAMES GORMAN, CEO MORGAN STANLEY, 2014[2]

HOW DO BLOCKCHAINS WORK?

Blockchains require complex algorithms to ensure they are secure, but their application is relatively straightforward. Ledgers, or blocks, are represented as cryptographic codes, or hashes, which record the transactions in the system.

In the intermediated world transactions are validated by banks, which in the case of payments guarantee ownership of money and ensure it is not spent more than once. Blockchains achieve the same through a network of participants, who validate and clear transactions by solving complex algorithmic puzzles.

Conformance is enforced by checking transactions against the present state of the ledger, and the effect is the elimination of much of the credit, liquidity and operational risks inherent in the intermediated system.

A major advantage of blockchains is their security: they are impossible to modify and entries cannot be deleted from the database. However, they also have limitations, for example in respect of scalability and compliance. In particular, the notion of public ledgers sits uncomfortably with duties of confidentiality, and it is not surprising that private versions of blockchains are attracting increasing interest.

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DISRUPTIVE TRENDS: A WORLD WITHOUT CENTRAL BANKS?

Whilst the early impact of blockchains will likely be felt the strongest in technology circles, their influence in the coming years is likely to reshape the financial landscape.

Banks have been enthusiastic early adopters of blockchains, with most large lenders developing internal test cases, joining consortia and running programmes to support start-ups. However, if they adopt the consensus that blockchains are primarily a type of cost-saving IT upgrade, they may significantly underestimate its potential.

Banks understand that blockchains can be used to integrate ledger and processing systems, and the focus has been primarily on reducing reconciliation work, streamlining clearing and settlement and innovating payments. However, the end game could be the almost complete disintermediation of the parts of the banking system.

The current thinking is that banks might together run shared ledgers, with access restricted to clients and trusted counterparties. However, that may be the thin end of the wedge, and further down the road shared ledgers may enable all types of financial and securities transactions without the need for banks, clearing houses and today's complex protocols.

In a blockchain-enabled world transacting and paying become one and the same act, so the payment goes with the transaction, rather than the assembly of processes currently called the banking system.

Meanwhile, as counterparties become accustomed to transacting directly with each other it will make sense for them to store and manage their own financial data. In that case banks and other providers may need to ask permission to access and use it, undermining the big data opportunities currently seen as a potential generator of earnings.

It's entirely imaginable that once companies and individuals decide they don't really need banks they will realise they also don't need central banks, replacing current government-controlled currencies with some form of digital payment.

We are very much at the beginning of the journey, and blockchains may provide the heavy lifting that eventually becomes an existential threat to the financial system.

Dr Philip Godsiff *is a Senior Research Fellow at the Surrey Centre for the Digital Economy at Surrey Business School. He is the author of 'Bitcoin: bubble or blockchain?', a paper that aims to progress the debate around bitcoin beyond the technical and towards legal and ethical issues and the nature of money and memory itself.*[5]

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Inefficiencies in the current financial system

The current financial system, based on trusted intermediaries, represents financial contracts (cash deposits, bonds, stocks, derivatives etc.) as digital records in thousands of cascaded proprietary ledgers of individual banks, exchanges or securities depositories.

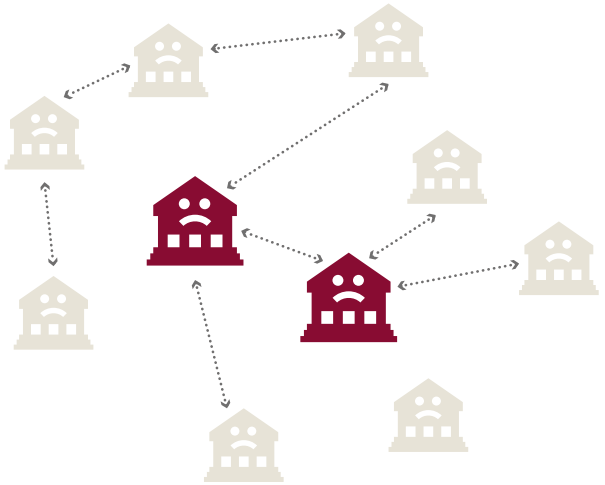
Contracts are agreed and confirmed via signatures including telephone calls, emails, papers or proprietary user identification systems.

Information pertaining to those contracts is contained in the independent ledger systems of individual institutions, and the clearing and settlement of transactions requires sophisticated confirmation and reconciliation procedures to synchronise the transaction-related information in the ledgers.

Similarly, securities are only linked to their owners via a cascaded network of individual ledgers operated by custodian banks.

Figure 1: Current multi-ledger transaction today

The current financial system is based on a historically grown multi-ledger transaction architecture resulting in high costs, risk, transaction times and market inefficiencies.



Source: BearingPoint Institute

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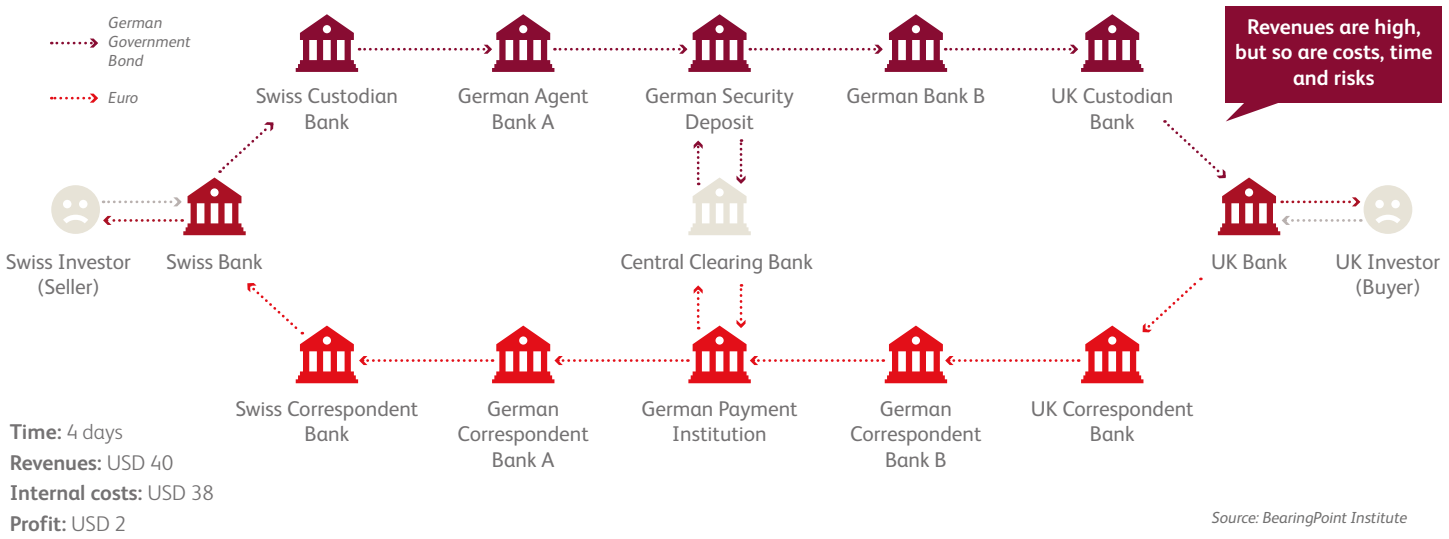
The result is highly interdependent, serial processes in the mid and back office, characterised by multi-day transaction times, high costs, and credit and liquidity risks.

Not only does the current system rely heavily on trust between market participants, it is threatened by diverse environmental conditions and characterised by a significant amount of operational activity.

Despite a high level of industrialisation and process sophistication, the system is highly risk-prone and costly, with banks' global back office expenditures estimated to add up to as much as USD 800 billion per year.[6]

Figure 2: Current transaction architecture example



Source: BearingPoint Institute

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How blockchain can overcome the current system's weaknesses

The inefficiencies in global markets, argue advocates of cryptofinance, can be resolved via a distributed system based on two pillars.

Pillar 1: Cryptographically signed, self-contained agreements

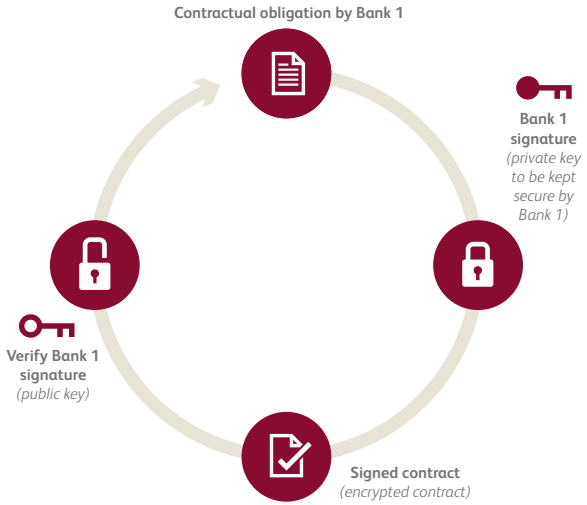
Cryptographic signatures are accepted by regulators[7] and can be applied to any type of contractual agreement and transaction order. With the signature, transactions are truly bilaterally agreed upon and can be verified at any time without having to reach out to a centralised authority.

Pillar 2: Decentralised ledgers (such as processors)

The key characteristic of a decentralised ledger is that it is operated by non-cooperating participants, copies of the ledger are shared between all participants and a process is established by which participants agree on changes to the ledger (for example, on which transactions are valid). Consensus is the process by which the entire network agrees on the same ledger: this is what keeps everybody on the same page.

Figure 3: Crypto-contract signing and verification

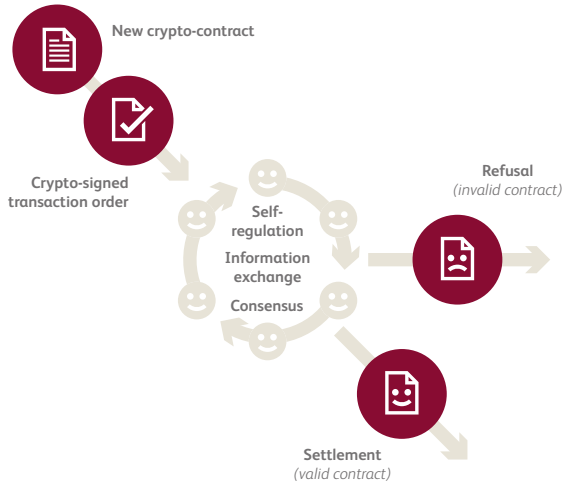
The first pillar of a distributed transaction systems is cryptographic signatures. They do not require centralised user accounts or passwords. Any kind of contract or transaction can be confirmed with a cryptographic signature.



Source: BearingPoint Institute

Figure 4: Shared ledger

The second pillar of a distributed transaction system is a shared global ledger. Multiple copies of the same ledger are simultaneously recorded by multiple independent validations. The validators reconcile their ledgers and validate new transactions in a consensus process.



Source: BearingPoint Institute

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In principle, the consensus process is based on concepts derived from game theory: the study of mathematical models of conflict and cooperation between intelligent rational decision-makers. Theoretically, neither a single validator nor multiple cooperating validators could ever effectively control the ledger and that means the system is tolerant for any failures of single institutions.

Likely applications and benefits of cryptofinance

Cryptographic solutions – of which Bitcoin is currently one of the most well-known – can handle interbank payment flows related to virtually any transaction in real time by means of highly standardised cryptographic contracts.

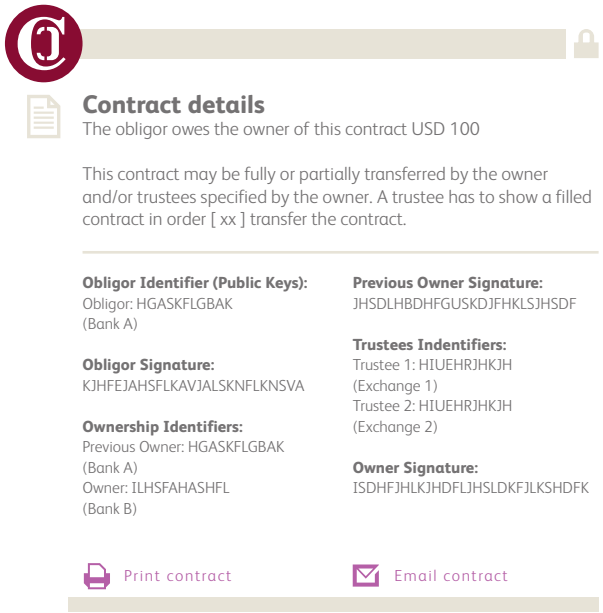
Basically any contractual claim including currencies, investment products (bonds, options, stocks, derivatives) as well as credit contracts can be represented by crypto-tokens, and those tokens can be exchanged peer-to-peer, eliminating intermediaries such as banks, exchanges and clearing houses that add additional costs to the current financial system.

On platforms such as Ethereum[8], so-called smart contracts can operate without interruption or censorship, fraud or third-party interference. In a recent trial, UBS produced a smart bond, in which risk-free interest rates and payment streams were fully automated, creating a self-paying instrument.

Other possible benefits include speedier clearing and settlement (reducing settlement times to minutes or seconds from days), also cutting costs, diminishing counterparty risk and the potential for fraud.

A key advantage of blockchains is that they generate a golden source of data, which cannot be edited and is censorship resistant, meaning that if a transaction conforms to the ledger protocol no person or authority can prevent it from being added. The blockchain creates a time stamp and an audit, a useful tool in respect of regulatory compliance.

Figure 5: A typical cryptofinance contract



Source: BearingPoint Institute

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Once the concept of the decentralised ledger has been accepted in one market, there is the possibility it can be rolled out to others.

Whilst banks, market infrastructure providers and regulators can all potentially benefit from cryptofinance, and in some cases face disruptive forces based on the technology, there may be different motives for experimentation depending on the size and orientation of the institution.

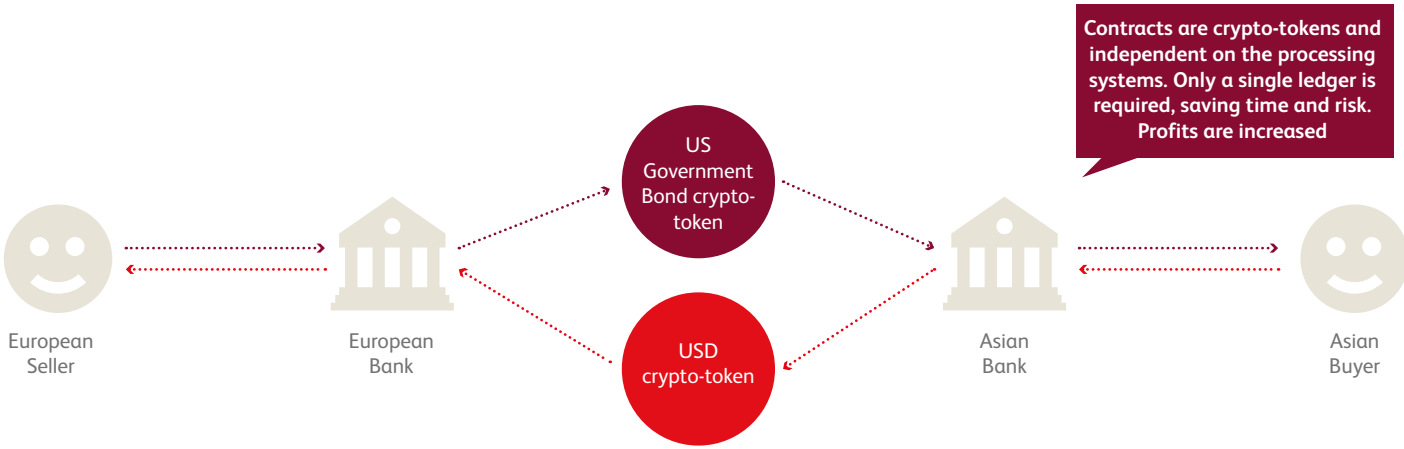
Small market participants may wish to reduce their reliance on larger bank intermediaries, leading to:

- *Reduced mid and back office costs* – move from highly interdependent, serial processes with sophisticated confirmation activity to instantaneously synchronised and reconciled ledgers
- *Increased speed* – move from securities settlement periods of two or more days and credit/ trade finance payment periods of up to several weeks to settling in seconds for domestic and cross-border transactions including faster reconciliation.
- *Mitigated risk* – move from multiple failure points to straight-through processing and insulation against counterparty and liquidity risk

Larger companies, meanwhile, may wish to generate revenues: trading, liquidity providing, risk management and transaction processing. They may find opportunities across the whole transaction value chain:

- *Liquidity provision* – act as market maker, offering dealing desks
- *Match making* – engage as exchange or broker
- *Processing* – offer clearing, custody, legal, notary, transaction register, data provision, sourcing, operations services

Figure 6: How disruptive technologies could work within banking architecture



Time: 0.1 second
Revenues: USD 10
Internal costs: USD 1
Profit: USD 9

Source: BearingPoint Institute

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Among projects currently underway, the Commonwealth Bank of Australia has started testing technology from Ripple Labs to transfer funds between its subsidiaries[9], whilst banks including UBS, Citigroup and State Street have set up blockchain innovation labs. Barclays and UBS are working on smart contracts on Ethereum. Santander has announced 25 use cases, while JP Morgan created its own digital currency.

Away from banks but operating in the same space, Digital Asset Holdings (run by former JP Morgan banker Blythe Masters) is working on blockchain solutions for corporate syndicated loans (which currently have 20-day settlement times), Nasdaq has a project to help small companies pre-agree equity allocations, while London-based Clearmatics is developing clearing solutions for over-the-counter derivatives.

Alternatives to public blockchains

The question of private or public networks is an important one, and market players such as banks as well as exchanges, clearing houses and central securities depositories must weigh the advantages of tightly controlled network access against undermining the disintermediation concept that has driven bitcoin's relative success.

> 'Bitcoin gives us, for the first time, a way for one Internet user to transfer a unique piece of digital property to another Internet user, such that the transfer is guaranteed to be safe and secure, everyone knows that the transfer has taken place, and nobody can challenge the legitimacy of the transfer. The consequences of this breakthrough are hard to overstate.'
> – MARC ANDREESSEN (FOUNDER AND PARTNER OF ANDREESEN HOROWITZ)

Banks' preference in early-stage experimentation appears to be for permissioned solutions, i.e. a blockchain in which transactions are performed by a predefined list of subjects with known identities. This is primarily due to compliance concerns in respect of public blockchains. In many jurisdictions the identity of transaction processors must be known, an impossibility under open protocols such as bitcoin. There are also serious concerns over client confidentiality in a public environment.

Permissioned ledgers overcome some of those issues and can be more efficient, increasing throughput and reducing costs. Large networks such as bitcoin are expensive to validate and have limited capacity at present in any event.

However, there are challenges, not least that restricted networks appear to undermine the key concept of the decentralisation project by reintroducing the idea of intermediaries. In fact, they may simply be the traditional system with cryptography.

A middle ground between a private blockchain and a public model might be a consortium blockchain, where the consensus process is controlled by a select group of – for example – ten financial institutions.

In that case, consensus would be required to validate transactions (as opposed to majority on bitcoin), and the right to read the ledger may either be public or permissioned. Because the validators are known, there is no chance that a majority of participants may attempt a fraud, as is a theoretical concern with public blockchains.

At present, permissioned solutions seem to be winning the debate. However, industry leaders have warned market participants not to dismiss public ledgers out of hand. Scaled up solutions for the bitcoin blockchain are already being discussed, and many argue that the power of censorship-resistant digital cash is too disruptive a technology to ignore.

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Technical challenges faced by banks in applying cryptofinance

Market players face numerous challenges in applying cryptographic distributed ledgers to existing frameworks and replacing legacy systems with a single peer-to-peer platform. These arise from the technology itself, as well as from established stakeholders and ways of working.

From a technology perspective, a key challenge relates to scalability. On the bitcoin blockchain, blocks, or individual books of transaction records, are currently restricted in size to one megabyte, equivalent to six seconds of CD audio, and the network is capable of processing just seven transactions per second. In terms of today's financial markets, that makes the blockchain drastically underpowered. The issue remains under debate.

Another challenge relates to the fact the blockchain ledger cannot be amended after the fact. Instead, another opposite transaction must be put in place before the first corrected transaction is resubmitted. A related weakness is in respect of netting, which is not possible currently. That severely undermines propositions such as clearing.

Computational power is also an issue, particularly for large public blockchains such as bitcoin. Such is the scale of computing power required to harvest bitcoins that companies are increasingly locating in the Arctic Circle to take advantage of the cooler temperatures.

Developers are now looking for ways to cut the computational demands of ledger verification, but the system is a long way from being able to handle the millions of daily transactions conducted across financial markets.

CHALLENGES FOR MARKET PARTICIPANTS

- Achieve regulatory compliance and transparency, for example, meeting Anti-Money Laundering (AML) rules
- Develop distributed protocols, algorithms and software
- Implement contract management by means of appropriate scripting language
- Determine fall-back scenarios in case of ledger fail including an option to withdraw contracts to other ledgers
- Accommodate game theory design principles to allow for fault tolerance and efficiency at the same time
- Create pricing strategy related to transaction fees
- Allow for identity management, contract management, recovery mechanisms
- Establish transparency for counterparties and transaction (sub-) processors
- Ensure secrecy of transactions, especially secrecy of transaction details and IDs with respect to distributed processing (ledger, clearing)
- Design and implementation of distributed processing, for example, as regards trading, clearing and settlement, data feeds, exchange or market making functionality
- Set up interfaces to legacy up-/downstream systems to facilitate interoperability of new technology with existing infrastructure

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The regulatory playing field

Blockchain regulation is one area that remains relatively unexplored. Regulators are beginning to show a positive interest, but not yet unalloyed enthusiasm.

Among recent references, US Securities and Exchange Commission Chief Executive Kara Stein in November 2015 warned banks to ignore the hype surrounding blockchain technology and distributed ledgers[10].

Whilst acknowledging that blockchain applications in settlement, payment processing and clearing could increase quality and trust in the financial system, Stein stopped short of endorsing the technology:

'One can imagine a world in which securities lending, repo and margin financing are all traceable through blockchain's transparent and open approach to tracking transactions,' she added.

'Music, retail, and media have transformed over the past decade. Why has that disruption not happened in finance?' – ANSHU JAIN, CO-CEO OF DEUTSCHE BANK

The European Securities and Markets Authority in April last year issued a call for evidence on distributed ledger technology, in which it invited market participants to submit opinions on the risks and benefits, and on how it may be applied to the issuance, distribution, trading, recording and ownership of securities[11].

Among the many responses, Deutsche Bank wrote: 'Whilst the technology associated with distributed ledgers is still in its infancy (albeit evolving very quickly) we believe that it presents a potential opportunity to realise a number of important benefits including: more stable and resilient systems, faster processing of transactions and lower costs for bank customers. There is also scope for this technology to be deployed by banks to make their operational and reporting process flows more efficient and secure and to meet regulatory requirements, including knowing your customer and anti-money laundering registries and surveillance.'[12]

It is probable that regulators may make use of licences for blockchain use cases, as proposed by New York regulators[13]. Those licences might conceivably also be based on cryptography, potentially revolutionising regulation. Regulatory costs could be lowered through a simplified and digitised shared ledger framework.[14]

'It can be the new TCP/IP underlying financial transactions. We just need agreement on some standards, and [blockchain] will be off to the races.' – CRISTÓBAL CONDE, FORMER CEO OF SUNGARD DATA SYSTEMS AND FINTECH INVESTOR[1]

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Why only a systematic analysis will help banks determine their role

Blockchains may be the technology that transforms financial services, removing many of the middle and back office functions currently necessary to validate and service transactions, replacing them with a fraud-resistant and totally reliable Internet-based alternative.

Many of the companies that form the current financial market infrastructure have taken their first steps in investigating blockchains. Banks, trading platforms, clearing houses and central securities depositories (CSDs) are actively exploring opportunities and gauging how blockchain technology may impact their revenue flows and business models.

The potential impact of crypto-contracts and distributed ledger technology is likely to be much broader than payment flows, and a likely scenario would be a gradual migration of existing infrastructures to a variety of decentralised systems, reshaping the financial industry over a period of time.

As banks and exchanges ponder the implications and invest in a variety of incubator programmes, they must resist the temptation to view blockchains as a solution across the business. Whilst that may eventually turn out to be the case, the more rewarding immediate path forward is likely to be based on analysis of the value chain and focused application of blockchain technologies.

Current projects around payments, FX trading, as well as syndicated loans (where settlement times can be as much as 20 days), repo markets and smart bonds (in which coupon and maturity payments are automated) are evidence of the likely best way forward.

In addition, given the technology's limitations in respect of capacity, a gradualist approach makes sense. A key enabler for banks and others will be the ability to attract the right expertise from the more informal fintech community.

As executives consider the way forward, an important strategic question is how much they should collaborate. The numerous innovation labs springing up in London, Zurich, San Francisco and New York suggest the venture capital mentality is in rude health. However, a deeper question is to what extent banks should work closely with peers or established market infrastructures.

The logic of networks suggests knowledge sharing makes sense, but protocols must be established in respect of confidential information, and the rush to join R3 CEV shows banks understand the importance of establishing protocols for decentralised data management.

Evidently, the technologies that underpin blockchains hold enormous potential for innovation in financial services, and an awareness of the likely direction of travel should be a bare minimum requirement. Indeed, if traditional banks fail to see the opportunities, fintech start-ups and others might well do – leaving a gap for another major player in the financial marketplace.

'It was Bill Gates who said we tend to overestimate the impact of technology in the first few years and underestimate the impact in the next ten,' says Surrey Business School's Godsiff. 'On blockchain, we are on the verge of that next ten.'

Right now, blockchains represent an opportunity for the sector to overhaul existing banking infrastructure. Understanding what the organisation of the future looks like will be key to deciding how to interact with what is fast-becoming the IT and data story of the decade.

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KEY TAKEAWAYS

- Blockchain will have a significant impact on the core of the financial industry. It will change established principles of governance and value creation.
- Bitcoin has proven the concept of blockchain and was the starting point for all current activities around this technology. The fact that the bitcoin software is open source enables all players to forge new solutions.
- Blockchain is not a phenomenon to herald the end of the banks and other financial market players through innovation driven by start-ups. Whilst some start-ups are threatening established business models of financial organisations, there are also players to defend their role.
- Beside their efforts to achieve a higher efficiency, financial organisations including exchanges, clearing houses and central securities depositories are also chasing new opportunities through experimental work with blockchain technology. Numerous banks already have actionable approaches.
- Retrofitting of established technologies by blockchain principles will lead to no significant benefits because of the disparate structure on which the technologies are based on.
- Conclusion: embracing digital technology, in an actionable way, leads to improved decision-making. To achieve this, there needs to be a breakthrough in thinking from the top of the organisation.

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