Blockchain Technology: Between High Hopes and Challenging Implications

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Imagine a technology that eradicated poverty, stopped human trafficking, tracked the origin of tuna from the seas to your plate, significantly lowered the amount of fraud in the insurance industry, and fastened the settlements in an interest rate swap? What you are imagining is blockchain technology. Since the internet, no other technology has shown such revolutionary promises.

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“When you get too many people talking about the same thing, it tends to clutter up things”
Bob Dylan

1. The views expressed in this article are those of the author and do not necessarily represent the views of, and should not be attributed to, HSBC.

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The Origins of Blockchain

It all started with an article published by an individual or group writing under the names of Satoshi Nakamoto entitled “Bitcoin: A Peer-to-Peer Electronic Cash System.” The paper contained the following description:

“A purely peer-to-peer version of electronic cash would allow online payments to be sent directly from one party to another without going through a financial institution. Digital signatures provide part of the solution, but the main benefits are lost if a trusted third party is still required to prevent double-spending. We propose a solution to the double-spending problem using a peer-to-peer network. The network timestamps transactions by hashing them into an ongoing chain of hash-based proof-of-work, forming a record that cannot be changed without redoing the proof-of-work. The longest chain not only serves as proof of the sequence of events witnessed, but proof that it came from the largest pool of CPU power. As long as a majority of CPU power is controlled by nodes that are not cooperating to attack the network, they’ll generate the longest chain and outpace attackers. The network itself requires minimal structure. Messages are broadcast on a best effort basis, and nodes can leave and rejoin the network at will, accepting the longest proof-of-work chain as proof of what happened while they were gone.”

The above abstract of the article contains characteristics related to the absence of intermediation, timestamping, hashing, chain, minimal structure, and unchangeable records. For any industry, those characteristics are revolutionary.

Over the last three years, blockchain has become the next big thing in technology, and many have warned that missing this technology would be like missing the internet revolution in early 1990s.

Whether considered as a technology in hype with inflated expectations or a revolutionary technology that will shape our future, blockchain cannot be ignored and should be studied. This paper attempts to clarify the ideas surrounding blockchain by presenting the current regulatory landscape, exploring the huge potential that this technology offers to different industries (especially to the financial sector), and discussing the overall implications and challenges to be addressed for wider use of the technology.

What Blockchain is

“What the first generation of the digital revolution brought us the internet of information. The second generation – powered by blockchain technology – is bringing us the internet of value; a new platform to reshape the world of business and transform the old order of human affairs for the better.”

Blockchain is a digital, distributed transaction ledger with identical copies maintained on multiple computer systems controlled by different entities. The software allows the data to be transmitted, processed, stored, and represented in human readable form.

Through consensus, each user or participant on a blockchain sees and maintains a copy of the ledger, but the overall details of the transaction are kept and maintained by the miners, who can to certify the transactions in consultation to the distributed ledgers. There is therefore no single database, but multiple copies of the same database shared among its users, which add to the security of the technology. A cyber-attack will theoretically be successful only if all of the copies are simultaneously attacked. Security is further enhanced through the use of a public key and a private key. A public key is a type of encryption involving an identifier code that is known to others, i.e., a public address. The private key is a code known only to the user. The user must possess both the public and private keys for any transaction.

Transactions in a blockchain are secured through the use of cryptography and are grouped together in a “block”. Each block contains the contents of the block, for example in bitcoin, it is the bitcoin transactions, and the miner incentive reward (currently 25 BTC) and a “header” includes technical information about the block, a reference to the previous block, and a fingerprint (hash) of the data contained in this block, among other things. Each block also references the previous block, not by block number, but by the block’s fingerprint and the fingerprint itself is determined by the contents of the block.

Blocks are usually created and processed by a “miner”. Miners process transactions according to strict protocols set by the consensus mechanism to ensure accuracy and security. As transactions are broadcast through a network, miners group those transactions into blocks. The consensus mechanism will verify and validate any addition of a new block to the chain.

Each block on a blockchain further includes a cryptographic hash (reference point) to the last block and any attempt to change a prior block has a flooding effect on each subsequent block. Hence, transactions held in a blockchain are considered to be immutable, as they cannot be altered, cancelled, or revoked.

What Blockchain is Not

Blockchain is not Bitcoin. Bitcoin is a type of unregulated digital currency also known as “cryptocurrency,” that was launched with the intention of bypassing government currency controls and simplifying online transactions by getting rid of third-party payment processing intermediaries. Bitcoin was the first blockchain application, but blockchain is much wider, leveraging assets over cryptocurrency, identity over anonymity and selective endorsement over proof of work. While its implications for the financial sector and cryptocurrencies might seem apparent, any industry or organisation in which recording and oversight of transactions is necessary could benefit.

4. bitcoin.org/bitcoin.pdf.
6. The following are the main consensus protocols as found in practice and already in use: (i) proof of work; (ii) proof of stake; (iii) ripple; and (iv) proof of elapsed time.
Examples of blockchains created for non-financial industries include platforms for granting e-votes in Annual General Meetings, energy trading, and health care.

**Blockchain is not a database.** The difference between a traditional database and a blockchain begins with architecture, or how the technologies are orchestrated. Blockchain technology, for all its merits, is not a new technology but rather a combination of proven technologies applied in a new way. It was the particular orchestration of three technologies (the internet, private key cryptography, and a protocol governing incentivisation) that bitcoin used.

Unlike a database, blockchain requires each participant to maintain, calculate, and update new entries into the database, with all nodes working together to ensure they are all coming to the same conclusion and providing inbuilt security for the network. Consensus is then used to determine over time which state of the database is considered valid. In this way, the datasets constantly evolve.

**Blockchain is not a product and it’s not needed when there is no business network.** Blockchain is a technology that can be used to build multiple business solutions for different industries and the existence of a business network is the mandatory test for a blockchain use case. In the absence of a business network, blockchain will not add value.

### Types of Blockchain

Any blockchain purpose and operation is clearly determined and shaped by the underlying algorithm used. The algorithm used determines the type of blockchain being public, private, or hybrid.

**A. PUBLIC BLOCKCHARNS**

The key characteristic of a public blockchain is that no one individual or company controls the information which is contained on the blockchain or the rules governing the blockchain. The network is fully decentralised, so not controlled by a central point or single organisation. The “owner” of the blockchain itself can’t unilaterally change the rules of the public blockchain. There is no need for a trusted third party, and any user of a public blockchain can trust the blockchain itself. Anyone can read, participate in the consensus and send transactions. Users are anonymous and transactions are secured by the cryptocurrency.

However, a public blockchain needs a huge amount of computing and other resources, and is energy-consuming. Defenders of the public blockchain believe that it is a necessary evil, as only a massive network can create the required level of security and trust between participants.

**B. PRIVATE BLOCKCHARNS**

Unlike public blockchains, private or permissioned blockchains are centralised. They are operated by an organisation or consortium of organisations only accessible to individuals or organisations that have been granted permission to use the blockchain by its operator. The access permissions are controlled and defined to write, validate,
Developers are known, transactions are faster, and there is no express need for cryptocurrencies. The nature of a private blockchain is an advantage for some companies and organisations because of the level of confidentiality it provides, especially for sensitive information. Permissioned blockchains are popular with financial institutions, as they provide some control over the blockchain.

Private blockchains use fewer computing and energy resources, as there is no need to conduct the elaborate cryptographic verification and synchronisation of each node. Defenders of public blockchain believe that private blockchains, by adding a controlling party and preserving confidentiality, are killing the purpose and mission of blockchain technology created by Nakamoto in 2008.

C. HYBRID BLOCKCHAINS

Hybrid blockchain lies between the two extremes of public and private. As the name implies, the hybrid ledger possesses a combination of public and private ledger characteristics. Its network members or governing body can determine which transactions remain public, and which must be restricted to a smaller group of members.

Hybrid blockchain could be perfectly adapted, for example, to cross-border trade finance transactions in the financial and banking industry, where not only customers and banks from different countries are involved, but also insurance companies, borders, ports, and customs authorities.

Regulatory Landscape

As with any new technology, there are regulations. Blockchain is currently undergoing a huge exploratory phase where initiatives are being launched by different sectors and entities, making any regulation challenging. As a result of the evolution of the technology, regulators have decided to take each aspect of the distributed ledger technologies (sometimes referred to as DLT) separately.

Cryptocurrencies, as the first appearance of the distributed ledger technologies, have gained the interest and attention of regulators. Validity, taxation, use of cryptocurrencies for illegal activities, and finally Initial Coin Offerings are the main topics that regulators have debated and addressed in some countries. Regulators are now considering other aspects, such as the blockchain technology or the more exhaustive distributed ledger technologies. Working groups and taskforces have been created at different levels. It is a challenging environment for regulators in their run to catch the fast growing and evolving distributed ledger technologies.

A. FAST EVOLVING LANDSCAPE

Europe: It is natural that central banks were initially interested in cryptocurrencies. In 2014, the European Banking Authority recommended that “national supervisory authorities discourage credit institutions, payment institutions, and e-money institutions from buying, holding, or selling virtual currencies.” With the rapid development, including the expansion of custodian wallet providers (CWP$s) and virtual currency exchange platforms (VCEPs), central banks were obliged to look closer at virtual currencies due to the money-laundering and terrorism financing risks.

In 2016, Central Banks in various European countries launched initiatives to regulate virtual currencies and blockchain in general. The European Parliament resolution of 26 May 201610 on virtual currencies presented the opportunities and risks of virtual currencies and distributed ledger technologies in the rapidly evolving technological landscape of payments, and called for employing DLT beyond payments and for smart regulation towards fostering innovation and safeguarding integrity.

In November 2016, Sweden’s central bank announced an initiative to analyse the possibility of introducing a digital currency to supplement cash in the country, given that people are increasingly cutting their use of coins and notes. In the coming years, the central bank will have to assess the technological, legal, and policy implications of such electronic money. It will also need to decide whether the money should be booked in accounts or some form of digitally transferable unit that doesn’t need an underlying account structure, like cash. In France, the Banque de France launched an experimental project in December 2016 on the interbanking blockchain.11

United States: The first national financial bodies to discuss the issue in the United States were FinCen (Financial Crimes Enforcement Network) in March 2013 and CFPB (Consumer Financial Protection Bureau) in August 2014. Both focused on virtual currencies and not on the underlying technology, and highlighted the risks associated to their use.

All formal regulatory initiatives have been driven by individual states. The New York Department of Financial Services (NYDFS) published BitLicense regulations for virtual currency businesses in June 2015. According to these regulations, firms engaged in “Virtual Currency Business Activity” that involves New York or a New York resident are required to apply for a BitLicense within 45 days of the effective date of the regulation. Applicants for a BitLicense are required to have, among other things, anti-money laundering/know-your-customer, consumer protection and cybersecurity programs.

The most advanced step was made by the State of Vermont, where authorities decided to go beyond the licensing schemes and to give strong legislative signals towards the utilisation of blockchain technology for state registries, smart contracts, and other applications, with the aim of becoming a leader in the field. In May 2016, Vermont adopted legislation to recognise blockchain data in the court system. The House Bill H.688 defined blockchain as “a mathematically secured, chronological, and decentralized consensus ledger or database,” and formally recognised blockchain-notarised documents as having legal bearing in a court of law.12

On 8 June 2017, Vermont Governor signed into law legislation13 that would, among other things, allow for broader business and legal application of blockchain technology to promote economic development. Additionally, the legislation requires the Center for Legal Innovation at Vermont Law School, the Commissioner of Financial Regulation, the Secretary of Commerce and Community Development, and the Vermont Attorney General to prepare a joint report for the General Assembly on “findings and recommendations,” as well as


policy proposals and “measurable goals and outcomes” concerning “potential opportunities and risks presented by developments in financial technology.”

United Arab Emirates. As many other jurisdictions, the UAE Central Bank was the first authority to look to the virtual currencies.

After a long period of consultation, on 1 January 2017, the Central Bank issued the Regulatory Framework for Stored Values and Electronic Payment Systems (Electronic Payment Regulation).14 The Electronic Payment Regulation’s key message was that all eligible participating institutions (whether they are banks, payment networks, telecommunications companies, government entities, or non-issuing commercial entities) must maintain necessary licences as well as governance and operational controls to ensure the integrity of the payments system and provide a minimum level of consumer protection and clarity on consumer rights.

The focus of the Regulations was “to facilitate robust adoption of digital payments across the UAE in a secure manner,” but the Regulations contained the following statement which initially caused some concern among the cryptocurrency community in the UAE:

“D.7.3. Provisions for Virtual Currencies – All Virtual Currencies (and any transactions thereof) are prohibited.”

This was understood as a ban of bitcoin and all virtual currencies in the UAE.

On 1 February 2017, the Governor of the Central Bank issued a statement:

“these regulations do not cover ‘virtual currency’ and “these regulations do not apply to bitcoin or other cryptocurrencies, currency exchanges, or underlying technology such as blockchain.”

He further added that virtual currencies are under review by the Central Bank and that new regulations would be issued as appropriate. In a statement from the Supreme Legislation Committee in the Emirates of Dubai about the present and future of legislative and legal frameworks of Bitcoin, it was specified that:

“there is an urgent need to spread awareness about ‘Bitcoin’ (the first-of-its-kind currency which has become popular among the cryptocurrencies over the internet) and to focus on the highest level of security and privacy within the virtual world. Considering its differences from traditional currencies on several levels, including the lack of central regulatory authority, we look forward to support officials at government bodies nation-wide with detailed information about the optimal use of this virtual currency. This will acquaint them with the ways international law deals with ‘Bitcoin’, which is now officially recognised worldwide due to the accelerated pace of the smart transformation.”

In a recent move, two of the leading financial services free zones in the MENA region moved towards encouraging the development of financial services technology and FinTech solutions. In January 2017, the Dubai International Financial Centre (DIFC) launched the FinTech Hive Accelerator programme, providing a platform for financial services and technology firms to build solutions for the financial sector.15 The Dubai Financial Services Authority (DFSA – the regulator for the DIFC) has also proposed that FinTech businesses meeting certain qualifying criteria receive an “Innovation Testing Licence.” The restricted financial services licence would allow qualifying FinTech firms to develop and test innovative concepts from within the DIFC without being subject to the regulatory requirements that normally apply to regulated firms. The DFSA have been working with applicants to understand the business proposal and establish the appropriate controls for the safety of any customers involved, on a case-by-case basis.

The Financial Services Regulatory Authority (FSRA) of the Abu Dhabi Global Market (ADGM) launched in 2016 the Consultation Paper No. 2 of 2016 regarding a proposed regulatory framework to support participants deploying innovative technology within the financial sector. The Consultation Paper proposed the creation of a “regulatory laboratory” or “sandbox”, intended to provide a safe environment within controlled boundaries for businesses to test, develop, and provide innovative FinTech products.

In November 2016, the FSRA issued its FinTech Regulatory Laboratory Guidance, which sets out the FSRA’s approach to the RegLab framework. The ADGM had approved its first batch of RegLab participants in May 2017, comprising five FinTech startups with various innovative offerings. Participants will be granted a “Financial Services Permission” by the FSRA to carry on the regulated activity of developing financial services technology within the RegLab.

In August 2017, ADGM announced that it had successfully closed the second batch of ADGM RegLab applications. For its second batch, the ADGM RegLab attracted 22 local and international FinTech startups and innovators, doubling the number of applications compared to its first cohort. The applicants’ solutions cover an array of innovation from virtual currency applications and payments solutions to crowd funding, robo-advisory, InsurTech, and RegTech. With ready solutions for testing, the 22 applicants seek the opportunity to be accepted into ADGM RegLab programme to advance and launch their innovations and become part of the FinTech community in the UAE and the region.

Finally, in October 2017, it was announced that the FSRA has set out in Guidance its approach to Initial Coin/Token Offerings (ICOs) and Virtual Currencies under its Financial Services and Markets Regulations (FSMR).17 Consumer protection was the key motivation behind the release of the guidance but we can read in the statement that:

“Distributed Ledger Technology (DLT) has extraordinarily wide application to financial services and markets as a whole. Virtual tokens, at their most basic, are pieces of information recorded on a DLT network. Among others, tokens can represent a medium of exchange such as a virtual currency, a regulated financial instrument such as a share, or a person’s identity record. A "one size fits all" approach to virtual tokens is therefore inappropriate. In this Guidance, FSRA sets out its approach to ICOs and virtual currencies to offer regulatory clarifications on using such technology in its jurisdiction.”

It is important to emphasise, however, that the above-mentioned UAE free zone entities (ADGM and the DIFC), must still be licensed in the jurisdictions in which they want to provide products and services. The free zones do not currently provide a passport to any other jurisdiction. Only the UAE Central Bank has published onshore regulations, but the licensing scope remains uncertain, because entities established there must still be licensed in jurisdictions in which they want to provide products and services. FinTech entrepreneurs will still have to navigate a number of different regulations onshore in the UAE. For example, it is not clear if these regulations cover all payment service providers, such as website payment gateways (acting purely as intermediaries between merchants and regulated credit card acquirers), or only those offering stored value facilities, such as issuing e-credits.18

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Blockchain - Aspirations and Applications in Different Industries

Each industry sees blockchain technology as a real opportunity to transform the shape of the industry. It all started with bitcoin. The banking industry was therefore the first to monitor this technology. Other industries followed and what was considered as a FinTech solution was widely welcomed, challenging the way of doing things in many industries such as real estate and healthcare.

A. FINANCIAL INSTITUTIONS

Financial institutions were challenged by Satoshi Nakamoto in his paper “Bitcoin: A Peer-to-Peer Electronic Cash System”, when it was specified that the online payment system allows transactions to be made "without going through a financial institution". Whereas an international payment through classic channels of financial institutions may take hours if not days, the disruptive technology of blockchain can complete the same transaction within seconds. Obviously, this presented a challenge to financial institutions, as it could result in a loss of business opportunities, but it could also present an excellent opportunity for transformation, leveraging on blockchain technology for the speed of execution.

Blockchain technology must not be seen as a replacement to financial institutions for the operation of the financial system, but rather a technological tool that can be used by major financial institutions and regulators to share information and transact more easily while maintaining control over their information.

The three principal drivers behind the quick adoption of the blockchain technology by the financial institutions are:

(i) Cost reduction, which is the first important driver, as the current system is heavy for time and cost with intense layers of data entries, verification, sharing, and reconciliations. Blockchain with its instant data entry in digital format and its sharing at the point of transaction will probably ring the bell of the end of heavy back offices and operational processes.

(ii) Risk Management - with all the pressure from regulators, blockchain provides a standardised framework for recording even complex transactions such as derivatives. Financial institutions can make it much easier to manage their risks and positions in real time. Settlement, credit, market, and operational risks are drastically reduced, enhancing controls not from the board of directors but also from regulators contributing to the stabilisation of the financial system and increasing trust of depositors.

(iii) Compliance - in a world where financial institutions are constantly monitored by regulators and governments through a huge increase in complex and overlapping regulations, blockchain can enhance reporting and ensure compliance with various requirements of multiple regulations governing financial institutions.

Blockchain technology can be used successfully in different ways by financial institutions, and defenders of the technology advise to start with the quick wins, which are principally (i) trade finance; (ii) capital markets; and (iii) syndicated lending.

I. Trade Finance

The trade and commodity finance world is cumbersome, governed by heavy paper documentation, multiplication of stakeholders, handoffs, paper documents, and manual processes involved in even a single shipment. With poor customer service, increasing cost pressure, and substantial regulatory burden, it has been identified as an outdated process with built-in vulnerability and many pain points.

"a delay in payment, for example, can tie up working capital that could otherwise be used more strategically. Delays can also force suppliers to seek additional, and more expensive, financing. The disconnect between the supply chains of financial and physical goods and the manually intensive nature of trade finance heighten the potential for error. Moreover, because the trade finance process is paper-based with no integration in the decision workflow, when delays in shipments and/or payments do occur they tend to create a cascade effect that requires additional steps throughout the process."20

Blockchain technology provides the emergence of a new business model. The complexity will be replaced by a much simpler and more efficient process. In an industry where bank-intermediated short-term trade finance alone has been estimated to be USD 6-8 trillion worldwide, the advantages of the blockchain technology are indisputable. For this reason, major institutions are innovating to reduce risk, streamline processes, and improve financing.

Smart contracts will allow blockchain stakeholders to automate manually intensive processes and enable secure inter-operation and communication with other internal systems and the auto-updating of clauses through "smart templates." At the same time, the technology: 

"provides every party in a transaction with access to the same data at the same time, embedding complete transparency and accountability in every transaction. Changes can be confirmed in real time. It enables effective monitoring and auditing by participants, supervisors, and regulators, it creates a single point of truth, and it provides shared audit trails that streamline dispute resolution at the enterprise level."21

Established banks22 as well as FinTech have launched many projects in areas that include bills of lading and letters of credit, documents that haven’t typically been shared or stored in digital form. As explained by IBM Institute for Business Value, these modernisation efforts are creating immediate efficiencies, but the bigger benefit may be to the heightened visibility that banks will have. With greater access to historical data and real-time trade transactions, banks stand a good chance to greatly improve the profitability of financing as well as the acquisition of new clients.

It is worth mentioning that any successful new system will depend on the involvement of other stakeholders, such as shipping companies, shipping agents, and freight providers, as well as ports, customs authorities and insurers.

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22. www.ft.com/content/bbb4f678-5a8c-11e7-b553-e2df1b0c3220?mhq5j=e5
In 2017, IBM teamed up with Maersk, the world’s biggest container shipping line, to launch a blockchain platform designed to digitize the supply-chain process by tracking shipments around the world. IBM has also been selected to build and host a new blockchain system for providing small and medium-sized companies with cross-border trade finance from Deutsche Bank, HSBC, KBC, Natixis, Rabobank, Société Générale, and UniCredit.

For the UAE, where trade finance is a vital component of the economy, banks have moved to the use of blockchain technology in trade finance transactions. In 2016, Emirates NBD and ICICI Bank reported that they have partnered with a subsidiary of Indian technology company Infosys on a pilot blockchain solution for trade finance. It will be an excellent move for the UAE economy if blockchain technology is used for all local trade finance transactions as a first step.

II. Capital Markets

Capital markets are based on clearing and settlements. Goldman Sachs Investment Research explained in a report that capital markets can save USD 6 billion on an annual basis by implementing the blockchain technology. The report indicated that this projection is further limited to cash securities – specifically, equities, repo, and leveraged loans – and that the savings could be greater. For example, Goldman Sachs foresees applications of the technology eliminating significant additional costs across the foreign exchange (FX), commodities and OTC derivatives markets.

Blockchain technology transactions could therefore radically transform capital markets, given they are generally based on standardised definitions using ISINs and identified set of properties such as maturity date, face value, expiry date, coupon details, and payment dates therefore having such aspect, they can be transformed into smart contracts. By definition, smart contract is a term used to describe computer program code that is capable of facilitating, executing, and enforcing the negotiation or performance of an agreement using blockchain technology. The entire process is automated and can act as a complement, or substitute for the ISINs. They are also termed as self-executed contracts, blockchain contracts or digital contracts in the blockchain terminology.

When it comes to derivatives and swaps and other derivatives, smart contracts can play a highly efficient role. The derivatives contracts which are created based on specific parameters like tick size, symbols, can be created with smart contracts with inbuilt algorithms for computation of Mark to Market, margins, and expiry processing. In the case of swaps or OTC derivatives where every contract is unique by it, their specific algorithms can be inbuilt into separate smart contracts.

Blockchain technology will not only help on the front desk side, it has the capability to redefine reconciliation, recordkeeping, and reporting, which are the fundamentals of the new regulatory framework of derivatives, for example following the last crisis:

“With the introduction of blockchain, using distributed ledger, the records are stored locally by participants and for every update of the transaction on the stream, updates are done on all the nodes at the same time on a real-time basis. This removes the whole concept of messaging, update of status and balances. Also, as it happens on the real-time basis, it make is more efficient way of data management and record keeping. The alignment of balances and transactions across the systems and participants is achieved in a more efficient cost-effective manner.”

With such technology and the different ledgers that could be created, the whole process of clearing and settlement, issuance and corporate actions, and reporting and reconciliations will be revolutionised. Capital markets will gain in terms of efficiency, transparency, robustness, and performance, reducing the various risks associated with high-volume transactions, and allowing regulators to have a clearer overview.

The application of blockchain in securities safekeeping and settlement could also yield substantial benefits related to the reduction of settlement latency and hence reduction of the operational and custody risk, the increased transparency to issuers, investors and regulators, the reduction of the intermediation and recordkeeping and an increased data security.

III. Syndicated Lending

Financial institutions have started only recently to look to opportunities offered by blockchain technology in the syndicated and corporate lending areas, despite the fact that the technology can essentially offer a strong and unique value proposition to banks looking to expand their global footprint.

Syndicated loans are typically offered by a group of lenders to a single borrower, such as a corporation or government with a large project to fund. Syndication allows banks to diversify, expanding their lending to broader geographic areas and industries. In addition, the structure allows banks constrained by their capital-asset ratios to participate in loans to larger borrowers.

Using blockchain’s distributed ledger architecture, banks can spread out tasks like local compliance, know-your-customer, or anti-money laundering, and link them to a single customer block. While individual banks in the syndicate may address different regulations, and data and privacy laws based on local or regional requirements, all banks can benefit by accessing the data through blockchain. This lowers the cost of meeting regulatory requirements for syndicated lending, since banks can take advantage of compliance already completed by others in the syndicate.

The closed loop between syndicate and customer allows banks to efficiently track services provided at various touchpoints such as regional drawdowns, limiting utilisation or distribution of fees and charges in local syndicate banks. In addition, since all syndicate banks have access to a customer’s digital documentation, they can avoid data duplication and pull down required data for local country activities as needed. The blockchain distributed ledgers are updated in real time to enable business growth and improved profitability.

With blockchain’s distributed ledger, syndicated banks can significantly reduce the complexity and efforts required to comply with local taxation and regulatory rules, since local disbursements are accounted for in the distributed ledger. Banks also have a single view of statements and collections made locally which can enable real-time reporting. With blockchain, syndicated banks can launch business quickly and provide new value propositions, improve spreads

28. According to Thomson Reuters’ Global Syndicated Loans review, global syndicated lending reached USD 2 trillion during the first half of 2016. This was down 9% compared to the same period in the previous year and was the slowest start to the year since 2012. Syndicated lending fees are down 17%, Syndicated loan volume in the United States amounted to USD 699 billion, which is 34% of global volume. Europe accounted for 18%. share.thomsonreuters.com/general/PRLoan_2Q_2016_E.pdf.
and margins, and hence reduce operational risk and costs while complying with regulations and performing real-time accounting, gaining a 360-degree view of each customer.

B. REAL ESTATE

Blockchain was recently presented as the future of land registries around the globe. Blockchain technology can play a leading role in digitising real estate records in land registries by creating unique identifications for properties, linking them to a unique block and minimising fraud. Blockchain can also play such important role in accelerating the processing of transactions. More particularly, blockchain technology will improve time-stamping of transactions, disaster recovery as the system doesn’t rely on a single centralised data center, immutable ledger of historical transactions. In other words, the blockchain technology in real estate would bring a more straightforward and dynamic system by having different ledgers certification transactions without the need of the intermediary or for brokers, agents or real estate consultants, because the information would be available to all the relevant stakeholders. With regard to land administration, property title can be attributed to a token – which can include public registry details such as size, GPS coordinates, year built, etc. – and the exchange of the token can be tracked every time it changes hands through a series of transaction outputs.

The concept of a transparent, decentralised public ledger perfectly fits land information management, where the land registry serves as a database for all property rights and historical transactions. The most prominent benefit of using blockchain technology is migrating away from centralised databases adding more levels of security, auditability, and transparency that blockchain technology provides. A blockchain land registry would be less vulnerable to misuse by system administrators and record destruction.

HM Land Registry in the United Kingdom plans to test a live "Digital Street", which will allow property transactions to take place almost instantaneously. This is all part of the UK government’s commitment to make Her Majesty's Land Registry the “world’s leading land registry for speed, simplicity and an open approach to data.” In Ukraine, the government has entered into a partnership with a blockchain provider, and passed a new law to allow foreign ownership of real estate in the hope that foreign investment will drive up a market. The view is that before foreign investors are willing to invest in Ukraine, it is vital that the state be seen to be modernising and combating corruption. Blockchain, with its greater transparency and potential to reduce fraud, is therefore viewed as a vital component of Ukraine’s intended real estate revival. Sweden believes blockchain could save the Swedish taxpayer over USD 100 million by speeding up transactions, reducing paperwork, and minimising fraud. This is an example of blockchain being utilised by an already well-established and competent land registry.

The Dubai Land Department announced in October 2017 that it will use the blockchain system it has created to create a secure database that records all real estate contracts, including lease registrations, and that links them to other authorities such as Dubai Electricity and Water Authority or the telecommunication system. The Platform also incorporates a tenant database, including Emirates Identity Cards, and even online certification of residence visas. This will allow tenants to make electronic payments at any time and from everywhere around the world, eliminating the need to visit any government entity.

C. HEALTHCARE

The healthcare industry, like many others, is considering blockchain technologies to deliver more efficient ways to share and use data and transact business in secure environments. The industry involves many stakeholders, including hospitals, patients, vendors, and supply chain management companies, but it is clear that the processes within the healthcare industry remain costly and time-consuming. Many complex and overlapping regulatory issues have limited the progress of the closed operating system within the healthcare industry, including confidentiality, medical record portability, medical identity, and protection of private life.

Blockchain applications can promote efficiencies by reducing administrative costs and delay in multiparty contractual processes. There is also tremendous promise in the potential for blockchain-enabled technologies to support innovative payment models. The use of blockchain to create a common platform to administer payments and adjudicate claims would address the roadblocks of trust and payment administration costs currently inhibiting these efforts.

Furthermore, such a system could bind an individual’s benefits to the payment mechanism itself. The idea of programmable payments opens the door to new payment models and new, value-based market concepts. A distributed platform could become an enabler of self-organising care teams taking clinical and financial responsibility for managing conditions and delivering care. Payments could be tied to quality gates. Such payment models are not limited to our current concept of “bundles,” and they can serve to support the physician-focused models emerging as a priority of the new administration.

Blockchains provide a much more powerful common transactional platform through the implementation of smart contracts. Costly and inefficient functions like settlement, clearance, and management of counterparty risk can be undertaken automatically via software operating atop the distributed transactional layer. These features would allow healthcare entities to transact without the need for duplicative (and error-prone) systems or costly intermediaries. Such smart contracts also could streamline the processing of medical, dental, and pharmaceutical claims as well as the complex administration of supply contracts, rebates, and discounts for patients, manufacturers, and pharmacy benefit managers.

Blockchain solves these issues by decentralising the control of registration, verification, and ownership, chronologically tracking activities from each device. Filtered device data can be translated to blockchain application program interfaces and business rules established by participating peers, which can then trigger real-time workflows, alerts, invoicing, or payment. Current tracking methods, if tied to a blockchain in the future, could register delivery of a product and automatically trigger requests for payment. Device wallets could enable machine-to-machine transactions that are not possible in today’s centralised systems. The result would be improved trust, accountability, transparency, and automation between devices.

Another area of potential for blockchain is data liquidity, enabling data to flow easily and securely across the healthcare ecosystem and enterprises. Employing public key cryptography, blockchain solutions could enable secure and encrypted transactions involving sensitive data.

Further, immutable distributed ledgers can serve as vital road maps of data flow and ownership, providing a key enabling feature of universal data interoperability. The applications include enterprise master data management, new methods of collecting patient reported outcome measures (PROMs), and self-sovereign consumer health data wallets.

Multiple countries started to look thoroughly at the possibility of using blockchain technology in the healthcare system. In the United States, where the healthcare system remains inefficient and expensive, blockchain technology can easily streamline the process, reducing costs and adding efficiency. IBM, for example, announced a partnership with the US Food and Drug Administration to determine
The Challenges that Face Blockchain Technology

Outside of blockchain technology being studied, it does still remain the preserve of the "tech savvy" and faces a series of challenges.

A. LEGAL AND REGULATORY CHALLENGES

Blockchain is a technology that is challenging the legal and regulatory framework as it has done earlier. It is legitimate to inquire if blockchain should be regulated separately with new legal avenues to be developed or should we just adopt our current legal framework to the technology.

I. Legal Challenges

Lawyers can't imagine a contractual relationship without debating the applicable law and the relevant jurisdiction. Given the characteristics of the blockchain technology, the question of what law should apply and which judge has the jurisdiction immediately comes to the minds. In the absence of explicit choice by the parties, should we apply the lex loci delicti? The lex loci contractus? The lex loci rei sitae (the place where the server on which the digital property virtually exists?)? The lex loci protectionis? Or should we use other criteria? Blockchain by definition is not subject to a specific location as every node of the network can be subject to a different law. The issue is amplified by the absence of a central party responsible for the ledger whose nationality could serve as an "anchor" for regulation. For permissionless blockchain, the question is really important. For permissioned or hybrid blockchains, the question will depend on the presence of a company, consortium, or legal entity created to manage the ledger.

There remains a lack of legal recognition of blockchains as immutable and tamper-proof sources of truth and as of today, no court decision is available and confirming the same. In a technology based on the immutability, the recognition of such aspect is critical.

II. Regulatory Challenges

We have chosen to present two main regulatory challenges. The first one is related to the validity of financial instruments issued on the blockchain. Blockchain is used more and more for crowdfunding and the issuance of financial instruments for small and medium-sized enterprises. The most important financial instrument issued on blockchain remains money. Some regulators are trying to put in place various regulations related to virtual currencies and the Initial Coin Offerings. Others are thinking to embrace the change by issuing governmental cryptocurrencies. In all cases, a common regulatory approach is needed, as blockchain challenges cannot be faced on a national level only. The Bank de France has already taken a step forward, for example, recognizing certain mini-bonds issued directly on the blockchain, but it's clear that a harmonised approach by international regulators is needed, as these mini-bonds can be purchased by any individual around the world.

The second main regulatory challenge is linked to tax issues. Blockchain can improve tax systems through better control of provenance, traceability, and transparency of transactions but blockchain is also challenging tax systems. Virtual currencies started first and in 2014, the US Internal Revenue Service was obliged to give its position by considering bitcoins as property and not a currency. Hence, changes in the value of the virtual currency will result in gains or losses and will have the corresponding tax treatment. The internet is already challenging tax systems due to the cross-border aspect, but blockchain could accelerate such challenges by pushing regulators to adopt a common international approach. In the absence of a global tax approach and because of the breadth of applications of blockchain and the current uncertainty surrounding its tax treatment, applications will need to be evaluated on a case-by-case and jurisdiction-by-jurisdiction basis.

B. TECHNOLOGICAL CHALLENGES

Blockchain is facing four clearly identifiable technological challenges.

I. Scalability

Blockchain technology is not scalable at this point. In the example of bitcoin, blockchain has exceed 100 GB storage, and given the fact that all transactions have to be stored for validating the transaction
combined with the original restriction of block size and the time interval used to generate a new block, the bitcoin blockchain can only process nearly seven transactions per second. This is far away from the presented advantage of millions of real-time transactions. Probably large block size will help but also will have implications on the speed. To solve the scalability problem, it was proposed that old transaction records are removed by the network and a database named account tree is used to hold the balance of all non-empty addresses. In this way, nodes do not need to store all transactions to check whether a transaction is valid or not.

II. Interoperability

Blockchain solutions will need to interoperate with existing infrastructures in all the different industries. There will be also created of different ledgers for different asset types and also for industries that will need to interact with one another. The adoption of common standards in blockchain is a real challenge. ISO created a technical committee called ISO TC 307 for blockchain and electronic distributed ledger technologies to set the future course of standardisation in this area forming study groups for specific aspects such as trust and interoperability, security and privacy, identity and smart contracts.

In addition to these priority aspects of standard development, the proposed work of the technical committee shall include defining the standard, creating the mechanism to be a gateway to multiple blockchains, creating a governance framework, ensuring interoperability and compatibility with existing financial standards, providing legal and regulatory compliance to each transaction across blockchains, and working towards a regulatory framework that provides a mix of legal and technical rules.

This move from ISO is important as international standards will allow for interoperability and implementation and use of multiple blockchain related protocols. The development of blockchain and electronic ledger standards through ISO will assist this new emerging technology to be rolled out and deployed with greater clarity, certainty and market confidence.

III. Reversibility

As explained, blockchain creates immutable shared ledgers, in which transactions cannot be modified, cancelled or revoked. The immediate question is about how to handle potential mistakes from a technological and also governance perspective: who would be entitled to flag errors, which correction mechanism would then apply and according to which timeframe. The reversibility issue becomes more important in case of security breaches where reverting previous actions in the decentralised chain will be challenging if not impossible.

IV. “Selfish Mining”

Selfish mining is an attack on the integrity of the bitcoin network. This is where one miner, or mining pool, does not publish and distribute a valid solution to the rest of the network. The selfish miner then continues to mine the next block and so on maintaining its lead. When the rest of the network is about to catch up with the selfish miner, the selfish miner then releases the portion of solved blocks into the network. The result is that the chain and proof of work is longer and more difficult, such that the rest of the network adopts their block solutions and the selfish miner claims the block rewards. With this selfish mining strategy, selfish miners are mining their

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**BIOGRAPHY**

**FELIPE C. LAGO** is a qualified lawyer in Brazil, with intense experience in banking both from the legal and corporate governance standpoints. Mr Lago is currently located in Dubai as Deputy Company Secretary for the Middle East, North Africa and Turkey. He has previously worked as Deputy Company Secretary for HSBC Brazil and as Private Equity Lawyer for Santander Brazil amongst other roles in law firms in Brazil. Mr Lago is post-graduated in corporate law at Pontificia Universidade Catolica de Sao Paulo (PUC-SP) and is currently an executive MBA candidate at Cass Business School. He has an extensive list of academic publications around corporate governance, corporate law and financial markets.

**DR. SOUHAYEL TAYEB** has an extensive and solid legal experience of more than 15 years in the banking and finance sectors. In 2012, he relocated to the United Arab Emirates joining the Legal Department of Masreqbank as Vice President and Senior Legal Advisor. He joined the Commercial Bank of Dubai in December 2013 as Group General Counsel and Company Secretary, prior to which he started his legal career in Tunisia working for The Financial Markets Authority and also for BNP Paribas Tunisia until 2003, when he decided to move to Paris where he worked in the Legal Department of BNP Paribas, Corporate and Investment Banking as In-charge of legal advise and negotiation of capital market and derivatives transactional documentation related to corporate, financial institutions and sovereign entities in the EMEA region. Dr. Tayeb holds a Ph.D in Law from the Panthéon Assas University in Paris. He is also acknowledged by the Bar Associations in Paris and Tunis. He is fluent in Arabic, English, French and Italian.