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Blockchain Technology in financial services industry: applications and challenges

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Abstract: In the past few years, Blockchain technology has emerged as an innovative fintech innovation with a wide range of applications. There is a tremendous potential for usage of Blockchain technology in financial services industry. This paper aims at analyzing the innovative power of Blockchain digital technologies in financial services industry, along with the challenges of adopting this technology in the latter industry. We will deal first with Blockchain technology and smart contracts. Then, we will discuss the potential applications of Blockchain in the financial industry. at the end, the paper will shed light on the main challenges that face the adoption of Blockchain technology. The study concluded that Blockchain technology will bring a range of advantages: quicker transactions, less friction, greater robustness and more transparency and immutability, reduction of costs and administration burdens on both banks and customers, decreasing disputes' rate and the need of third party, and consequently saving time and cost for the consumers.

Key words: Blockchain, Distributed Ledger Technology, Smart Contracts, Ethereum, Financial Industry services.

Jel Classification Codes G15

الملخص: ظهرت تقنية البلوك تشين في السنوات الأخيرة كابتكار رائد في قطاع التكنولوجيا المالية يمكن تطبيقه في قطاعات ومجالات عديدة. وتعد صناعة الخدمات المالية من بين أهم هذه المجالات. تهدف هذه الورقة إلى تحليل القوة الهائلة لهذه التكنولوجيا في قطاع صناعة الخدمات المالية من خلال التطبيقات المختلفة لها، والتحديات التي تواجه تبني هذه التقنية؛ حيث تستعرض الورقة في القسم الأول منها تقنية البلوك تشين والعقود الذكية، ثم تتطرق إلى مختلف التطبيقات الممكنة في قطاع الخدمات المالية، ثم تتطرق في الأخير إلى التحديات المختلفة والتي تواجه تبني هذه التقنية في قطاع صناعة الخدمات المالية. وقد توصلت الدراسة إلى أن تقنية البلوك تشين ستوفر مجموعة من المزايا:سرعة المعاملات ، زيادة الشفافية ، تخفيض التكاليف والأعباء الإدارية على كل من البنوك والعملاء ، تقليل معدل النزاعات والحاجة إلى الطرف الثالث، وهو ما يوفر الوقت والتكلفة للمستهلكين.

الكلمات المفتاحية: بلوك تشين (سلسلة الكتل)، دفتر الأستاذ الموزع، العقود الذكية، الإثيريوم، الخدمات المالية.

تصنيف JEL : G15

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1. Introduction:

In the aftermath of the financial crisis of 2008, the term 'Blockchain' has emerged when Satoshi Nakamoto, whose true identity is still unknown, released the white paper *Bitcoin: a Peer to Peer Electronic Cash System* that described a "purely peer-to-peer version of electronic cash". This latter has been used for the first time in 2009 for the digital cryptocurrency Bitcoin, Blockchain technology will has an enormous impact on the financial services industry. Banks and other financial institutions will use Blockchain to reduce expenses, identify new markets and compete effectively with fintech start-ups and other non-traditional players.

Blockchain also threatens that some traditional players like banks will be disintermediated in financial markets. The fundamental changes that will occur put the financial services industry at the forefront of the Blockchain revolution (Cognizant report, 2017).

The emergence of cryptocurrencies and Blockchain technologies is considered as apart of a broader wave of technologies that facilitate peer-to-peer (P2P) commerce, individualization of products, and flexibilization of production methods. For a variety of reasons, this wave gained traction after the global financial crisis a decade ago (world Bank; 2018).

In this paper we will emphasise the ways Blockchain is going to innovate financial services industry. We will focus on potential applications of Blockchain technology in financial services industry.

There are many existing and developing use cases to implement Blockchain like: KYC, reduction of fraud, payment clearing system, payments and settlements, insurance industry. At the end, the paper will study also the main challenges that face the adoption of Blockchain technology like: unclear regulations, privacy, and lack of experience

2. Blockchain fundamentals:

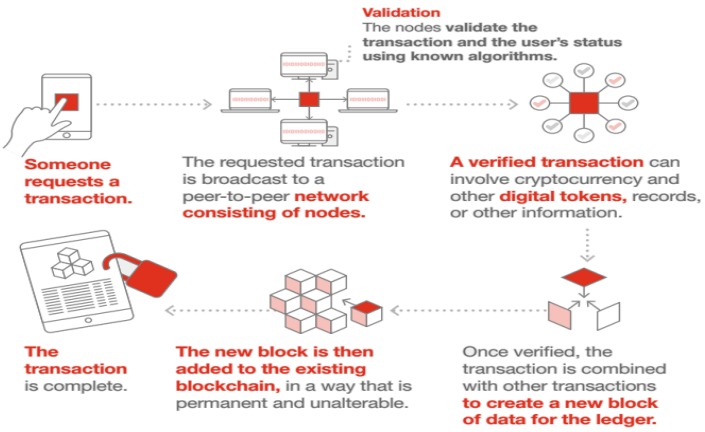
2.1 Blockchain Technology

The Blockchain technology is an algorithm which was invented to create the Bitcoincrypto currency around 2009. Its significance lies in the fact that it has made it possible for aconsensus to be reached (at a practical level) about the evolution of data on an open online network (Koji Takahashi, 2017). It is a data structure that makes possible to create a digital ledger of data and share it among a network of independent parties (tiana Laurence, 2017). The main feature of Blockchain is that it allows untrusted participants to communicate and send transactions between each other in a secure way without the need of a trusted third party.

Blockchain is an ordered list of blocks, where each block is identified by its cryptographic hash. Each block refers to the block that came before it,

resulting in a chain of blocks. Each block consists of a set of transactions. Once a block is created and appended to the Blockchain, the transactions in that block cannot be changed or reverted. This is to ensure the integrity of the transactions and to prevent double-spending problem. (Maher et Aad van Moorsel1, 2018).

Figure1. How does a Blockchain work



Source: (PwC US,2019).

2.2 Types of Blockchains

There are three primary types of Blockchains, which do not include traditional databases or distributed ledger technology (DLT) that are often confused with Blockchains.

- **Public Blockchains:** Public Blockchains, such as Bitcoin, are large distributed networks that are run through a native token. they are open for anyone to participate at any level and have open-source code that their community maintains.
- **permitted Blockchains:** Permissioned Blockchains, such as Ripple, control roles that individuals can play within the network. They are still large and distributed systems that use a native token. Their core code may or may not be an open source.
- **Private Blockchains:** Private Blockchains tends to be smaller and does not utilize a token.Their membership is closely controlled. These types of Blockchains are favored by consortiums that have trusted members and trade confidential information (Tiana Laurence, 2017).

2.3 Smart Contracts:

The history of smart contracts can be traced back to the 1990s when Wei Dai, a computer engineer created a post on anonymous credits, which described an anonymous loan scheme with redeemable bonds and lump-sum taxes to be collected at maturity. Szabo et al. later discussed the potential form of smart contracts and proposed to use cryptographic

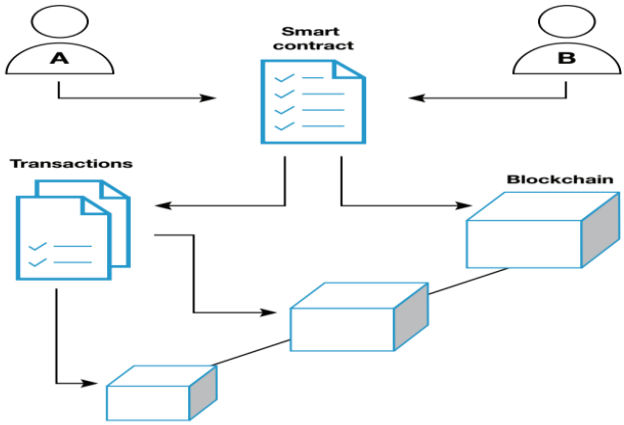
mechanisms to enhance security. Nowadays, with the development of Blockchain technology, smart contracts are being constructed as computer programs running on Blockchain nodes and can be issued among untrusted, anonymous parties without the involvement of any third party. The first successful implementation of a Blockchain-based smart contract was Bitcoin Script (Yining Hu, 2019).

Smart contracts are the key element of Ethereum. Any algorithm can be encoded. Smart contracts can carry arbitrary state and can perform any arbitrary computations. They are even able to call other smart contracts. This gives the scripting facilities of Ethereum tremendous flexibility. (Sebastián E. Peyrott,2017).

Smart contract is executable code that runs on the Blockchain to facilitate, execute and enforce the terms of an agreement. The main aim of a smart contract is to automatically execute the terms of an agreement once the specified conditions are met. Thus, smart contracts promise low transaction fees compared to traditional systems that require a trusted third party to enforce and execute the terms of an agreement. The idea of smart contracts came from Szabo in 1994.

However, the idea did not see the light till_the emergence of Blockchain technology. A smart contract can be thought of as a system that releases digital assets to all or some of the involved parties once arbitrary pre-defined rules have been met (Maher et Aad van Moorsel1, 2018).Figure 2 below illustrates how Blockchain (or another form of DLT) could be used for smart contracts. In the diagram, parties A and B agree a smart contract, the terms of which are recorded in a “block” on the distributed ledger, or Blockchain. The parties then enter into individual transactions (or individual contracts) under the smart contract, each of which is also recorded in a block on the Blockchain. Once each block is confirmed as valid according to the relevant consensus method, it is linked or “chained” to the previous blocks in the Blockchain. (European bank for reconstruction and development, 2018).

Figure 2. Using Blockchain for smart contracts



Source:(European bank for reconstruction and development, 2018).

Smart contracts inherit properties of underlying Blockchains which include an immutable record of data, and the ability to mitigate single points of failure. Smart contracts can also interact with each other via calls. Unlike traditional paper contracts that rely on middlemen and third-party intermediaries for execution, smart contracts automate contractual procedures, minimize interactions between parties, and reduce administration cost (Yining Hu, 2019).

3. Potential applications of Blockchain technology in financial services industry

Blockchain technologies have the potential to radically change the face of manufacturing industry. It is largely associated with the financial sector but its distributed ledger functionalities can be extended to other industries as well. Its successful approach to security has made it a valuable asset to companies that are looking for technologies that help them maintain data securely. The following section sheds the light on the potential applications of Blockchain technology

3.1 KYC: know your customer

Know Your Customer ("KYC") requests currently can cause delay to banking transactions, typically taking 30 to 50 days to complete to a satisfactory level. Current KYC processes also entail substantial duplication of effort between banks (and other third party institutions). While annual compliance costs are high, there are also large penalties for failing to follow KYC guidelines properly (Chris Mager, 2018). Furthermore, customers are typically required to provide a batch of documents each time they are on-boarded by a financial institution. To alleviate this need, customer documentation can be maintained centrally by an authority (e.g., a regulator or state organization). However, this

solution is vulnerable to cyber-attacks and data breaches. Blockchain solutions can alleviate the above listed challenges, through decentralizing and securing the KYC process. In particular, by keeping customer data in a distributed ledger, Blockchain participants will be able to update customer information as needed, while being able to access an up to-date picture of the customer's profile at all times. In this context, Blockchain solutions offer some significant advantages,(Ariana Polyviou et al, 2019) such as:

• Decentralization: Customer records are stored in a decentralized fashion, which reduces the data protection and cyber-crime risks of centralized storage. Apart for increased security, decentralization boosts consistency in the recorded KYC/KYB information.

• Improved Privacy Control: Customer information is no longer handled by a single trusted third party. Rather it is processed by decentralized applications such as smart contracts. The latter contracts handle customers' data on behalf of the entire financial ecosystem. Furthermore, accessing to customer information for KYC (or other) purposes can occur only by following the customer's consent, which provides a sound basis for fine-grained privacy control.

• Immutability: Once recorded in the Blockchain, customer information stays forever and cannot be changed. This enables accurate tracking of customer information at all times and based on information available to all financial institutions that participate in the Blockchain (. However, there may be a needed for erasing customer information following a customer's account closure, in which case, customers are entitled to enjoy the "right to be forgotten" one of the core principles of the GDPR (General Data Protection Regulation). Despite an on-going debate about how this principle could be supported on Blockchain data, stakeholders seem to be converging on a solution. We will be analyzing ways for ensuring GDPR compliance in a Blockchain in future posts.

3-2 **reducing Fraud:**

It is commonly acknowledged that one of the main challenges facing the banking industry today is the growth of fraud and cyberattacks. Traditionally, bank ledgers have been created within a centralized database. In contrast, as Blockchain is decentralized, it is less prone to this type of fraud. By using Blockchain, there would not only be real-time execution of payments but also complete transparency, which would enable real-time fraud analysis and prevention.

A Blockchain is checked at every step of a transaction by independent miners, with all data being open and publicly available, there is a real-time analysis and verification of every bit of data and all

information during the transaction. The Blockchain ledger can provide a historical record of all documents shared and compliance activities undertaken for each banking customer. Malicious attempts to view or change the data becomes part of the data itself, making third-party hacks immediately obvious (Mohamed Hazik, 2019).

3.3 Going International: GlobalFinancial Products:

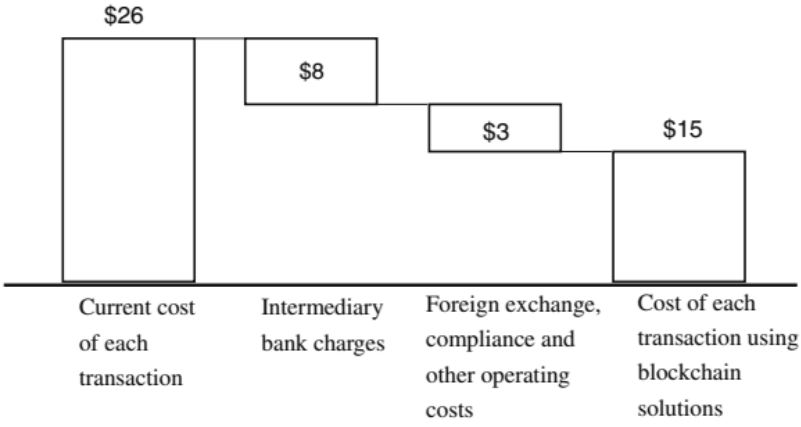
Blockchains will usher in many new types of securities and investment products. New markets will be opening with more efficient ways of calculating risk because collateral will be a lot more transparent and fungible across institutions when they accounted for it within a Blockchain back system. Hernando de Soto, the famous Peruvian economist, estimates that by providing the world's poor with titles for their land, homes and unregistered; businesses would unlock $9.3 trillion in assets. This is what is meant by the term dead capital. It is imaginable that countries that can free their dead capital, the unfinanceable real property they own, they will be able to bundle and sell these interest in these assets across a global marketplace. This would be things like transparent mortgage-backed securities for new real estate developments in Colombia or Peru. In the future, countries will be able to free up their dead capital. Owners of properties, undeveloped land, and un-financeable properties will now have the opportunity to sell the interests in these assets across a global marketplace (tiana Laurence,2017).

3.4 Payment clearing system:

distributed clearing mechanism Interbank payments often rely on processing by intermediary clearing firms, which involves a series of complicated processes, including bookkeeping, transaction reconciliation, balance reconciliation, payment initiation, etc. Therefore, the process involved is lengthy and costly. Using cross-border payments as an example, as the clearing procedures for each country is different; a remittance requires nearly 3 days to arrive. This demonstrates the low efficiency and immense volume of occupied funds involved. Point-to-point payment can also be implemented using Blockchain technology, thus eliminating the intermediary link of third-party financial institutions, which will greatly improve service efficiency and reduce the transaction costs of banks. This will also enable banks to satisfy the requirements for rapid and convenient payment clearing services for cross-border commercial activities. McKinsey has made an estimation which shows that the cost of each transaction in Cross-Border business can be greatly reduced due to the application of Blockchain. Currently, a number of financial institutions started to test transactions on Blockchain platforms Standard Chartered uses Ripple, an enterprise-level Blockchain platform, to implement its first

cross-border transaction. For example, the platform took 10 s to complete a settlement process that currently takes the banking system and network 2 days to complete.(Guo and Liang, 2016).

figure.3 Application of Blockchain in Cross-Border Payments



Source : Guo and Liang, 2016.

3.5 Payments and Settlements:

The main use case that is focused on when looking at the possibilities of Blockchain for banking is that of payments. Blockchain could be used as another way of paying each other, not depending on SWIFT and other payment schemes. There is a potential role for Blockchain in payments and that Blockchain could have benefits for not only bank customers, but this could also lead to operational efficiencies and cost savings for banks themselves. As of December 2017, many banks have partnered with Ripple to use Blockchain technology in making payments to customers and cross-border transactions. Ripple has said that its technology could give banks a 33% reduction in their operating costs during the international payment process and allow lenders to move money "in seconds." Ripple is a "real-time gross settlement system" (RTGS), currency exchange and remittance network. Blockchain can be used to make payments in real-time globally, with real-time execution, complete transparency, real-time fraud analysis and prevention at a reasonable cost. The main issue with Ripple now is that it is a proprietary Blockchain network that cannot yet connect with other systems. (Mohamed Hazik, 2019).

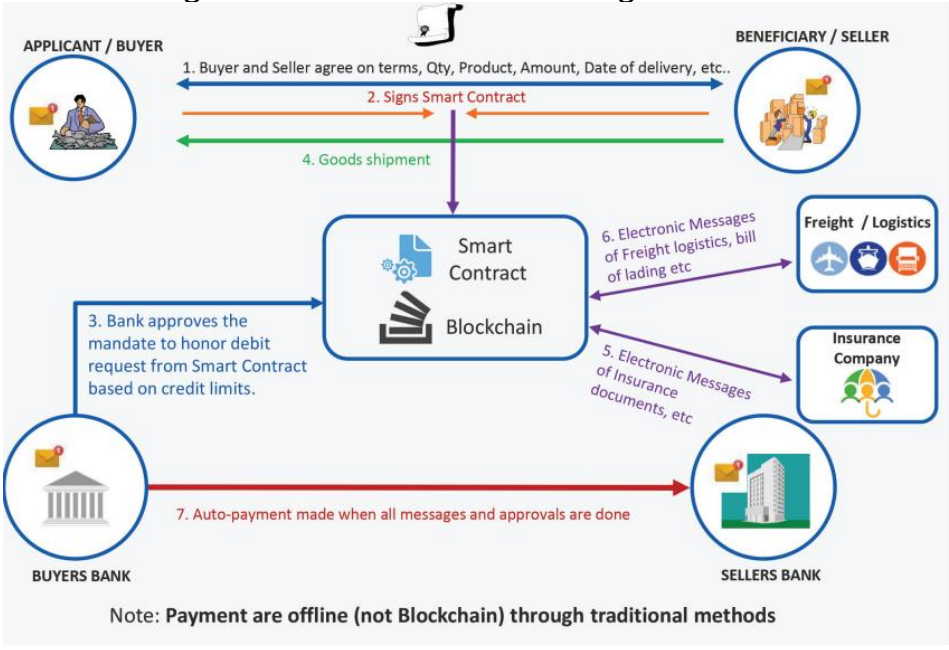
3.6 Trade finance:

One of the most frequently suggested examples of where Blockchain can be applied is in the trade finance area (IBM,2016).

Corporate banking Trade Finance is facing challenges on how to utilize technology to re-engineer existing processes and create new business opportunities and business models. Trade finance has traditionally **f**aced issues of manual operations like document management, LC processing, etc. Managing cross-border payments can also be slow and expensive. Trade Finance business processes resonate well with the capabilities of Blockchain. Trade Finance aspects like: multiple jurisdictions, mistrusting parties, audit trail requirements compares well with Blockchain features like immutability, provenance, smart contracts and asset transfer using wallets.

The diagram below gives a simplified view of how Blockchain could be used in Trade Finance. The Trade Finance use-case is a Sight-Bill flow. Blockchain simplifies process steps, brings transparency to the parties in the transaction and lowers the overall cost of the transaction (virtusa, 2017).

Figure 4. Trade Finance flow using Blockchain



Source: virtusa, 2017.

3.7 Guaranteed payments:

Guaranteed payments that are permitted through Blockchain-backed transactions will increase trade in places where trust is low. Poorer countries can compete on the same playing field as wealthier nations within these types of systems. As this happens over the next ten years, the

global economies will shift. The cost of commodities and labor may increase.

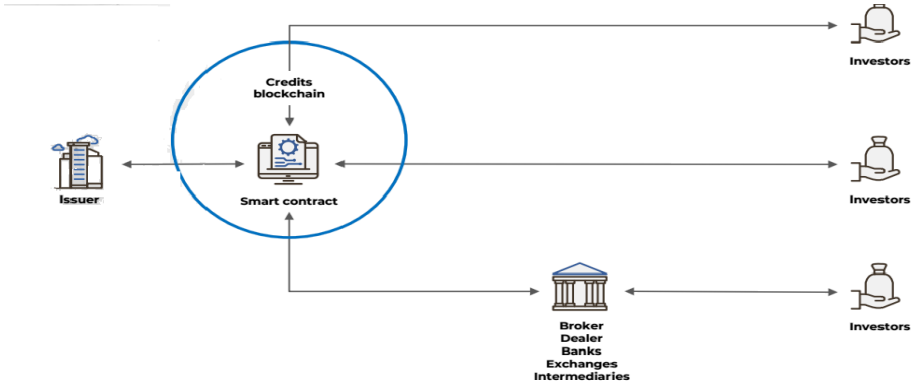
Global companies pay their employees based on competitive pricing, as well as on employees' previous salaries. If Blockchains allow for equality across economic divides, it won't happen overnight. Developers and other knowledge workers would be the exception because it will be easier for them to support themselves based on anonymous work (Tiana Laurence, 2017).

3.8 Smart Bonds:

A smart bond is a specific type of an automated bond contract that uses the capabilities of Blockchain databases that can operate as cryptographically secure yet open and transparent general ledgers. It is one of a class of financialknown as smart contracts, "a computerized transaction protocol that executes the terms of a contract. (Tapscott Alex et Don, 2016, p72). In the new model, companies, banks and even states can issue obligations in the form of token bonds using technological solutions based on the Credits Blockchain platform. There is no central administrator in Credits. This is a service platform with a public registry of all accounts and transactions for the issue and management of financial assets through smart contracts. Due to this, the maximum stability of the financial asset and the universality of its movement is achieved.

The main difference from traditional solutions is that bonds do not operate using traditional depositories (traditional custodians), but by issuing bonds and storing them in the decentralized Credits Blockchain network. The sale (asset transfer) happens not with the use of clearing participants, but with the help of Credits solutions for moving the issued bonds between accounts inside and outside the Credits platform. Bonds are issued as a record in the Blockchain. This is a token commitment. By physical properties and technical characteristics, the bond becomes similar to a crypto currency or a token. The issuer uses smart contracts as a technological solution for managing the quantity, denomination, name, start and end dates, interest accruals and coupon payments, the suspension of applications dates and other parameters.

Figure5. issuing smart bonds via blcockchain



Source: credits, 2019.

1. Initially, the investor sends a request to the address of the smart contract.
2. A smart contract conducts the necessary checks (AML, KYC and others).
3. The parameters of the bond instance are calculated, the smart contract verifies that all conditions are met and conducts the transaction between the issuer and the investor.
4. A copy of the bond is created and an exchange is made for the digital currency.
5. A smart contract informs the investor about the success of the transaction. (credits,2019).

World Bank has issued $160 million AUD ($108 million U.S.) of these bonds, which run on a private version of the ethereum Blockchain. It is “the first bond created, allocated, transferred and managed through its life-cycle using distributed ledger technology. (Nathan Dicamillo, 2019).

3.9 Insurance Industry:

Blockchain technologies paired with smart contracts exhibit the potential to transform the global insurance industry. The recent evolution of smart contracts and their fast adoption allows to rethink processes and to challenge traditional structures (Ronny Hans et al, 2017) Blockchain has huge potential to improve many aspects of this industry. The new model features all data that are recorded into the Blockchain with any user being able to start and end individual insurance coverage anytime. The advantages include the decentralised system as irreversible, immutable and impartial to ensure self authentication and fairness. The decentralised system also removes the need for the middleman (agents and insurance

company) which ensures efficient utilisation of the fund (David Lee, Linda low, 2016).

Insurance claims take many weeks, and so much paperwork at the moment. A Blockchain-based system can have smart contracts which can have rules and regulations that can trigger some action once some conditions are met. A customer can upload documents of some insurance claim, and the Blockchain can then verify and instantly process that claim. By eliminating human intervention, this also saves logistics costs. Moreover, increasingly, our devices are connected with Internet. IoT will surely improve over time. With so many devices connected to the cloud, a Blockchain can have constant flow of information from many types of devices, improving insurance industry's prediction power which is needed to predict risk. For example, in car insurance, the car can be connected to the cloud, and constantly feeding vital signs to the Blockchain. Once an incident happens, the company will have full information to process the claim, which can be executed with a smart contract running on the Blockchain. Fraudulent claims are another aspect because of which insurances are expensive. With a shared Blockchain, data for each fraudulent claim can be inspected by all companies, reducing risks (Kazuki Ikeda, Md-Nafiz Hamid, 2018).

Major insurance companies started to put effort into evaluating possible ways of adopting Blockchain to support and enhance their core businesses. This includes an extended analysis of which type of Blockchain systems can be used. Further, different consensus protocols have emerged to overcome the Byzantine General's problem, where a group of people is required to agree upon common information (Ronny Hans et al, 2017).

4.Challenges:

The Blockchain industry is still in the early stages of development, and there are many kinds of limitations. The technology still holds many challenges before it can be successfully implemented.

4.1 Unclear Regulations:

As long as the position of regulators is not clarified, confusion and uncertainty will continue to exist for everyone involved in the Blockchain space. The Blockchain is a blockbuster technology that affects so many areas, and it is likely that different flavours of regulation will come at it from a variety of directions. A fundamental paradigm shift that regulators will need to come to grips with is that trust which is now more open, and "free from central controls" who they typically regulated. The nature of trust is changing, but regulators are used to regulating the "trust providers." Will they learn to adjust when the trust provider is a Blockchain, or a new

type of intermediary that didn't fit the previous model of central choke point regulation? Specifically, the Blockchain is decentralized by default, so it's more difficult to regulate decentralized entities than central ones. Therefore, we will need to see innovation in regulations. Maybe Blockchains can get certified for example. (HusseinElasrag, 2019).

4.2Industry standards:

As a core, underlying technology, more caution is required in the regulation of Blockchain technology. Although the Bitcoin system has not been hacked in the 7 years sinceits establishment, the hacking attack on the DAO raised alarms. Several companies arenow researching Blockchain technology, and the security of this technology still needs to be tested using authoritative standards. Recently, Standards Australia has submitted a request to the International Organization for Standardization to develop global standards for Blockchain technology. The R3 Blockchain consortium is also exploring the formulation of industry standards for interbank applications. In China, the Blockchain technology research group of the Interbank Market Technology Standards Workgroup was established in August 2016. This workgroup is to conduct prospective research on interbank market Blockchain technology, regulations, and legal framework. (Ye Guo, and Chen Liang, 2016).

4.3Scalability:

Scalability of Blockchains is an issue that will continue to be debated. Scaling technical systems is a never-ending challenge. It is a moving target, because the needs for scale evolve as you grow; therefore you do not need to solve a problem you do not have yet. Scaling Blockchains will not be different than the way we have continued to scale the Internet, conceptually speaking. There are plenty of smart engineers, scientists, researchers, and designers who are up to the challenge and will tackle it. What complicates the scalability of Blockchains even further is the required balance that needs to be preserved between decentralization and security. Scaling a decentralized network with an economic model that is tied to its security is a new frontier that has not been attempted before. (HusseinElasrag, 2019).

4.4 Privacy Challenges:

There are many issues to be resolved before individuals feel comfortable storing their personal records in a decentralized manner with a pointer and possibly access via Blockchain. The potential privacy nightmare is that if all your data is online and the secret key is stolen, lost (forgotten) or exposed, you have little recourse. In the current cryptocurrency architecture, there are many scenarios in which this might happen, just as today with personal and corporate passwords being

routinely stolen or databases hacked. Any comprehensive solution must include a biometric measure that forms a bridge across the physical-cyberspace boundary. For complex, high value Blockchain transactions, this legally reliable biometric connector will require a third party to confirm that the biometric measure is indeed the one belonging to the physical-space identity (Mohamed hazik, 2019).

4.5 Lack of Blockchain talent:

Whenever a groundbreaking technology emerges, the developer community needs time and resources to accommodate the new demand. Blockchain is currently still in its infancy, as a result, there is an acute shortage of developers proficient in this technology. The fact that educational institutions have just recently begun to introduce Blockchain-related courses, will alleviate the market demand but the results will become palpable only after students will finish their training.

A research conducted by Glassdoor indicates that the demand for Blockchain-related jobs has increased by 200% between 2017 and 2018. Having a sufficient pool of qualified developers is a top industry concern. The gap in market demand and current availability of skilled developers is reflected by the higher than average salaries a company is willing to pay to a Blockchain professional. (modex,2019).

5. Conclusion:

Blockchain technology has the potential to revolutionize financial services industry. It offers a platform that could be used for many potential applications (KYC, Reduction of Fraud, payments and settlements, Going International, payment clearing system, insurance industry…). It offers as well, a range of advantages: quicker transactions, less friction, greater robustness and more transparency and immutability, reduction of costs and administration burdens on both banks and customers , decreasing disputes' rate and the need of third party, consequently saving time and cost for the consumers.

While Blockchain applications are being widely deployed, many issues have yet to be addressed. In fact, the Blockchain technology is facing many challenges that to be solved before large scale deployment, like: Unclear Regulations, Industry standards, Scalability and privacy challenges.

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