How Blockchain can impact Financial Services– The overview, challenges and recommendations from expert interviewees

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Abstract:

FinTech (Financial Technology) and Blockchain are prevalent topics among technology leaders in finance today. This article describes the impact and revolution of FinTech and Blockchain in the financial industry and demonstrates the main characteristics of such technology. Then, we present three critical challenges as well as three ethical issues about using Blockchain technology. Next, we discuss the development of Blockchain for the financial sector. In addition, we describe the real motivations for banks to explore Blockchain, and problems they face. In order to have a good understanding of the industry, a qualitative method was adopted, and sixteen experts were interviewed. It was identified that knowledge hiding in Blockchain was common and the rationale behind was analyzed using the TPB (Theory of Planned Behavior) approach. The analysis results suggested that knowledge hiding was due to affective, behavioral and cognitive evaluations. The interviewees also provided several recommendations and success factors to overcome current issues in Blockchain adoption. Therefore, four important propositions have been developed. Finally, this article suggests how financial services should respond to this new technology and how to manage

knowledge sharing in a more structured way. This article contributes to the literature related to the current entrepreneurial finance landscape for Blockchain.

Keywords: Blockchain; Financial industry; Ethics; Ethical challenges; Blockchain adoption; Recommendation for Blockchain adoption.

1. INTRODUCTION

The key element of the business is trading, and trading activities are dependent on trust (Tang, 2018). Through financial instruments and strategies, trust can lead to successful businesses. A trust-rating platform is one important part of the finance system and it is used to evaluate whether a user can be trusted. It rates a user based on his or her borrowing and repayment history, credit status, and other information to determine whether to approve the loan or credit limit or discount, etc. For example, Alibaba proposes e-commerce platforms, Alipay and its trust-rating platform. Depending on the trusting scores, customers can get discounts, order goods/services and payback (Dong et al., 2015).

Financial technology, also called FinTech, is the "marriage" between technology and finance. When combining both technology and finance, they have a "chemical reaction" and create a multiplier effect, which is more substantial than the sum of the two together. Zetzsche and Bukeley (2017) point out that the current FinTech stands out from two significant trends. The first trend is the pace of change driven by Big Data, machine learning, commoditization of technology and Artificial Intelligence (AI). The second trend is the fact that more new non-financial firms have entered and invested in financial services businesses. Fintech is a key area in the development of Industry 4.0, since it requires the use and integration of different technologies, such as AI and Data Science, and it also provides a platform as a service and software as a service for Industry 4.0 (Dhanabalan, and Sathish, 2018; Mashelkar, 2018).

FinTech can also be understood in two ways, as follows (Tang, 2018). The first dimension is about traditional financial enterprise conducting transformation by using technology. For example, traditional financial enterprises, such as Pingan Group, Industrial and Commercial Bank of China, Morgan Stanley and Goldman Sachs, use big data and other new technologies to upgrade and transform their service. The second dimension is that some technology enterprises try to take advantage of their technologies to develop financial services. For example, the initial aim of Facebook, Apple, Google, Ant Financial (China), Jingdong Finance (China), Tencent (China), was not to involve in the financial transaction. But finally, they decided to develop their own versions of financial services to cover their customer's needs and create new forms of entrepreneurial finance landscape.

FinTech has impacted the traditional financial industry. After the Credit Crisis of 2008, the landscape of the financial sector has changed due to overall financial regulation and financial technology innovation (Anagnostopoulos, 2018; Brem et al., 2017). FinTech has three primary breakthrough directions. The first one is mobile payment, such as WeChat payment, Alipay, and Apple Pay. The second is based on "smart contract", including Chinese brands such as "Ant Xiaodai", "Jingdong Baitiao" and "Huabai". P2P lending is also considered as part of the smart contact category. The third one, which is particularly popular, is called the Blockchain. The main characteristics of these three major topics of the FinTech industry are instant contact, live data, credit ratings and updates.

The reason why the financial industry is fascinated by Blockchain technology is that the characteristics of the Blockchain allow people to build trust faster and have the potential to change the financial infrastructure (Pilkington, 2016).

However, the development of Blockchain is not mature yet. Some challenges have arisen, such as scalability, security, privacy, latency, etc. It is important for financial markets to have a better understanding of the Blockchain industry and find robust solutions. Therefore, this paper can demonstrate an overview of the Blockchain and its development in the financial industry and investigate challenges for their development of Industry 4.0. During the overview, critical challenges, as well as ethical issues about using Blockchain technology, were identified as well. After the overview, a qualitative method based on sixteen interviews with experts in the Blockchain industry was conducted in order to have a good understanding of the industry. Information from experts was analyzed by the method of the Theory of Planned Behavior. Based on the analysis results and experts' recommendations, three important propositions were developed.

2. BLOCKCHAIN

2.1 Background

Blockchain has become popular due to the rise of bitcoin. However, this technology is not limited to the financial area. A Blockchain originally means blocks of cryptocurrencies linked by chains. This new concept has received significant attention in FinTech (Mu, 2016). Each block, bound by cryptography, contains a cryptographic hash of the previous block, a

timestamp, and transaction data. The first Blockchain was conceptualized by Satoshi Nakamoto in 2008, who used a Hash cash-like method to add blocks to the chain without a trusted third party (Narayanan et al., 2016). Blockchain, a rapidly evolving financial technology, revolutionizes the way people are dealing with businesses (Antonio and DiNizo, 2018).

Blockchain attracts attention as an underlying technology for bitcoin and other cryptocurrencies (Nguyen, 2016) since it is seen as a new foundation for transactions in the world (Staples et al., 2017). A Blockchain is a continuous account database, which is complete, distributed and unalterable (Yoo, 2017). The most excellent value of Blockchain is a decentralized system, whose security chain is very long. The essential advancement is the distributed trust offered by Blockchain technology – (1) removing the trusted third party to facilitate transactions and (2) decreasing the cost of trading and (3) reducing the time (Staples et al., 2017). Thus, Blockchain is expected to set off the industrial and commercial revolution and promote economic reform worldwide (Underwood, 2016). Figure 1 shows a view of how Blockchain supports the transaction between the two parties. Firstly, Blockchain uses encryption to produce a digital security code. Then the users can validate the transaction without private information. Because the record in the Blockchain is immutable, the transaction will be completed automatedly and distributed. Tapscott and Tapscott (2017) point out the five main principles of the Blockchain: (1) Computational Logic, (2) Peer-to-Peer Transmission, (3) Irreversibility of Records, (4) Distributed Database, (5) Transparency with Pseudonym. Another approach is to use a conceptual framework to integrate important components together. For example, Pazaitis et al. (2017) use a Back-feed concept to illustrate how to integrate production, record and actualization of value together that can match both industrial and information economy.

1how Blockchain promotes transactions

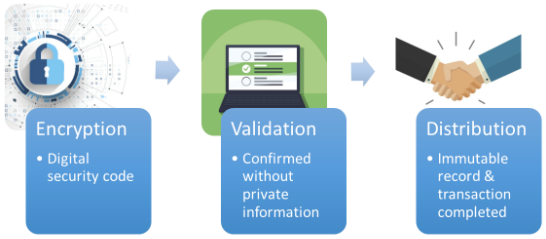

Figure 1: How Blockchain promotes transactions

2.2 Key Characteristics of Blockchain

Blockchain has the four main characteristics as follows.

Decentralization: Zheng et al. (2018) state that in a traditional centralized transaction system, each transaction needs to be verified by a central trusted agent (such as the central bank). Each party on the Blockchain can access to the database and check the history of the transaction without the third party (Tapscott and Tapscott, 2017). The main advantage of this chain is its replication over a distributed network. Therefore, if a criminal or abusive government organization plans to remain undetected, they have to simultaneously change all copies of the Blockchain. Besides, distributed ledgers record transactions automatically and in real-time, reducing the opportunity for fraud (Rennock et al., 2018). Decentralized infrastructures, with its limited boundary conditions, can be proven effective in managing Blockchain and its related activities (Pereira et al., 2019).

Users' anonymity: Transactions occur between Blockchain addresses. Each user on a Blockchain has a unique alphanumeric address, and they can decide to keep it secret or open to others (Tapscott and Tapscott, 2017). Users can use the generated address to interact with the Blockchain network, and there is no longer any central party to store users' private information (Zheng et al., 2018). This mechanism preserves some privacy. However, due to inherent constraints, Blockchain cannot guarantee perfect privacy protection.

Consensus mechanism: As there is no central trusted agent in the whole network, a consensus mechanism is introduced into the network. Its purpose is to achieve a unified agreement on the validation of every record. It is possible to forge a non-existent record by managing to control more than 51% of the accounting nodes in the entire network. Hence, any distortion is easy to detect (Huang et al., 2019).

Execution: Users can make use of algorithms and rules to trigger transactions between nodes (Tapscott and Tapscott, 2017). Blockchain can also execute programs if certain conditions are met. This can be referred to as a smart contract. A managing director of a Blockchain firm, H says, "*It is not merely one or two characteristics of Blockchain that render this technology*

creative and attract individuals' attention. The integration of property of Blockchain, such as decentralization, anonymity, immutability, makes this new technology valuable."

2.3 Development

Blockchain technology has gone through three generations of technological development: Block 1.0, 2.0, and 3.0. Block1.0 is a currency, and its successful project is bitcoin. Block 2.0 not only includes cash transactions but also covers mortgages, bonds, loans, futures and smart contracts. Blockchain 3.0 is a universal application and platform used by government, science, health, culture, art, and literacy (Swan, 2015).

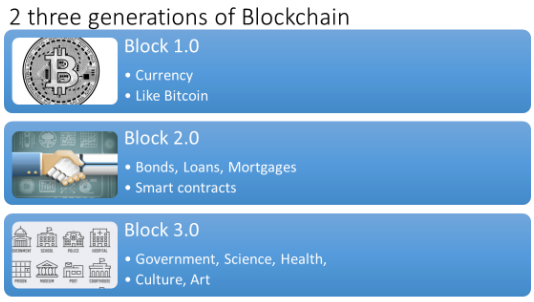

Figure 2: Three generations of Blockchain

According to Feng et al. (2018), there are three levels for Blockchain: P2P network, databases and its applications. As shown in Figure 2, the Global ledger level contains blocks connected. Each block includes the transactions and smart contracts and then linked to its related one. At the application level, different services can query, analyze and interpret the meanings for each block of transactions, smart contracts and financial updates.

2.4 Challenges associated with Blockchain

Blockchain has great potential but must face numerous challenges, which potentially stop the wide usage of Blockchain. The Blockchain is a distributed peer-to-peer system that everyone in the network can read the transaction records and add new data to the database. The openness and the absence of central coordination are the foundation of the system, which has negative impacts and limits the use of Blockchain (Drescher, 2017). In this section, we

also interviewed two experts on Blockchain who could address interesting challenges in this area. Interviewee A is a professor of Computer Science and Interviewee B is a specialist in Blockchain.

Some issues can be raised, such as scalability, security, privacy, latency and financial markets still struggle to find robust solutions (Underwood, 2016).

2.4.1 Scalability

The Blockchain becomes voluminous with the increasing number of transactions (Zheng et al., 2018). Marr (2018) mentioned that Blockchain transaction takes some time to implement due to their complexity, encrypted and distributed nature.

Ethereum is a well-known computing platform, which is open-source, public, Blockchain-based, and Ether is also generated by the Ethereum platform (Biais et al., 2019). According to Chen et al. (2018), more than one million smart contracts are running on Ethereum. Currently, thousands of entrepreneurs and developers are creating new projects and startups based on the Etherlane platform.

Jackson (2018) reports that while Visa manages 24,000 transactions per second, PayPal manages 193 transactions per second, when Ethereum and Bitcoin can only handle 20 transactions per second. It means that the requirement of processing millions of transactions in a short time cannot be satisfied. The reason is due to the limited capacity of blocks, which often delay some small transactions as miners instead of preferring transactions with relatively high fees ((Biais et al., 2019).

2.4.2 Security

According to Werbach (2018), Blockchain-based systems are vulnerable. Since 2009, the bitcoin and Ethernet platforms with Blockchain as the underlying technology have been stolen successively, with a loss of nearly 600 million yuan. Zheng et al. (2018) state that Blockchain is susceptible to attacks of collusive self-centered miners and many other attacks have shown that Blockchain is not so secure. Price (2018) claimed that all public Blockchain are vulnerable to 51 percent attacks or 34 percent attacks because of the design of Blockchain technology. A

51 percent attack occurs when hackers are the major source of a Blockchain's computing power. Thus, they are the majority in the network and control the entire Blockchain.

Mt. Gox, the earliest and largest bitcoin trading platform in the world, announced on February 28th, 2014 that 850,000 bitcoins, including users' trading accounts and the company's own accounts, have been stolen, resulting in a loss of 467 million US dollars. On June 8th, 2016, hackers stole 3.6 million dollars from the Dao, the world's largest crowdfunding platform, causing a loss of 75 million US dollars. Similarly, on August 2nd, 2016, 120,000 bitcoins were stolen from Bitfinex, the bitcoin exchange, resulting in a loss of $60 million (Blockchain Finance, p229, 2016). Finally, a Japanese exchange noted a theft of half a billion dollars of cryptocurrency in 2018 (Werbach, 2018)

Although Blockchain technology has shown irreplaceable practicability and uniqueness in the capital market, its immature technology status is still a challenge to regulators (Cong and He, 2019). This is also the supported reflected by an interviewee. Interviewee B said, *"Smart contract of Blockchain is different from a paper contract. Smart contracts use a computer language with conditions. As long as these conditions are met, it will automatically trigger the execution. For the time being, traditional paper contracts are more stable and safe."*

2.4.3 Privacy Leakage

The Blockchain can produce many addresses instead of real identity for users to avoid information leakage, which is believed to be quite safe for users. However, the Blockchain cannot prevent transactional information leakage because all information on transactions and balances are shown to the public (Meiklejohn et al., 2013; Kosba et al., 2016). Many examples are reflecting these phenomena, such as Barcelo (2014), demonstrating that his Bitcoin transaction can reflect the user's profiles.

The problem of privacy leakage is quite huge, which involves users' information security. Although multiple methods have been proposed to improve the anonymity of Blockchain, the problem still has not been solved well (Cong and He, 2019).

2.4.4 Energy Consumption

The execution and storage costs of big data programs can be higher than the long-term storage costs of electronic money transfers and transaction data (Staples et al., 2017). Price (2018) claimed that the computing power needed to run Blockchain is rapidly growing. The bitcoin system consumes an enormous level of electricity. Indeed, the amount of electricity required by a single bitcoin transaction needs terawatt-hour. The statistics of bitcoin energy consumption in different countries and the comparison between bitcoin and VISA are listed in Figure 3.

However, for this problem, Interviewee B says: "*It depends on which Blockchain consensus mechanism you choose. If you choose the mining mechanism, it will consume more electricity. If you want the POS equity mechanism, it will not consume electricity*".

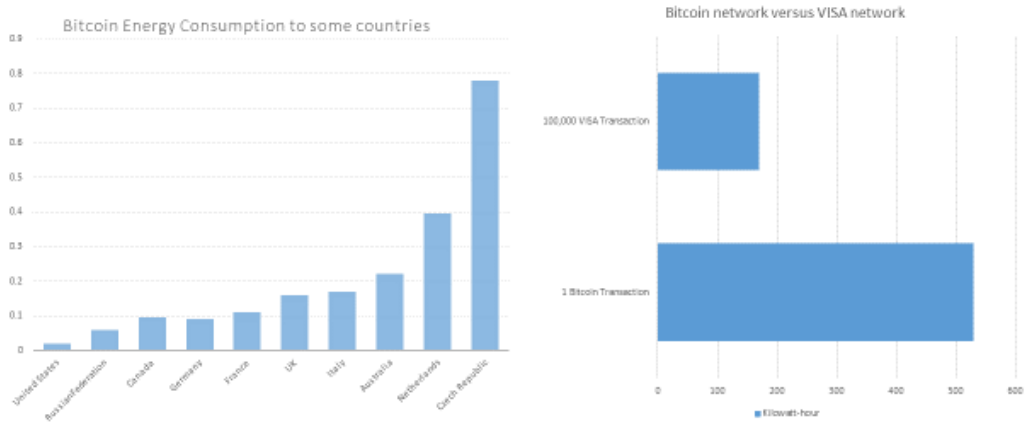

Figure 3: Bitcoin Energy Consumption Relative to several countries and VISA

2.5 Ethical issues for Blockchain

2.5.1 Privacy

Blockchain technology can create permanent and immutable records for participants, but it also increases the privacy risks of some entities (Till et al., 2017). Meanwhile, confidentiality

is challenging to build in public Blockchain-based systems, as information is visible to all participants in the network by default (Staples et al., 2017).

Transparency is needed for clarifying ownership and preventing double-spending, while users require privacy (Drescher, 2017). Feng et al. (2018) described that Blockchain transactions contain participants' addresses, transaction values, timestamps, and sender signatures, which makes it possible to trace transaction flows to extract user information through data mining.

2.5.2 Regulations and Law

With the growing usage of Blockchain, Australia, US, South Korea, Switzerland, China, the UK, Japan, Singapore, Hong Kong, and Canada pay much more attention to regulate Blockchain to avoid fraud and other illegal activities that hurt the interests of consumers and the market (Till et al., 2017). Regulatory uncertainty will have many consequences. Interviewee A said, "The technical challenge of Blockchain is that no matter how perfect the Blockchain technology is, it cannot guarantee the authenticity of offline data. The data in question will be permanently recorded on the Blockchain if there is a problem with the data source. Since Blockchain is decentralized, without the supervision of laws and personnel, and it is difficult to change records on the chain, all of these will cause some problems." Some governments take cryptocurrencies as an illegal coin in their countries. The most popular Bitcoin is only unrestricted in about 110 countries (Price, 2018), as shown in Figure 4.

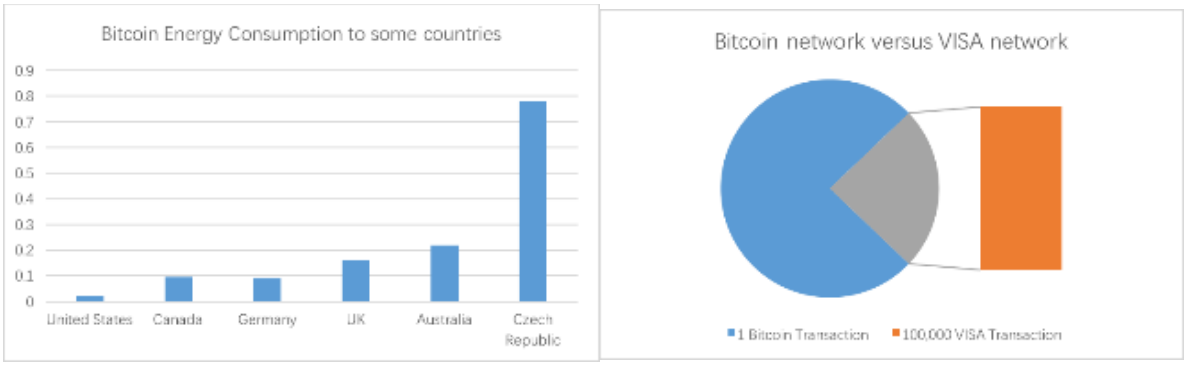

Figure 4: Global Bitcoin Legality

The reason for this phenomenon is that the asset class is so new that governments and banks have not adopted the corresponding policy for them. In cases of fraud, bankruptcy and other failures, the company does not know the laws and regulations. This is particularly problematic for companies operating in multiple jurisdictions (Lewis et al., 2017). Therefore, some risks exist as the taxation status and trading rules of bitcoin could change overnight.

On the other hand, a complete lack of regulation leads to manipulation by some small group of crypto owners. Nguyen (2016) asserted the lack of legal and regulation on Bitcoin and cryptocurrency hindered the full application of Blockchain. H says, *"We are supposed to pay attention to the legitimacy of Blockchain. Although there are no specific regulations on Blockchain until now, relevant laws might be introduced once some new products of Blockchain appear. The award method is one of the intrinsic properties of Blockchain, so how to define the nature of these rewards, whether these conducts violate the law, all of these are needed to be discussed*."

2.5.3 Cybercrime

Public Blockchains promote competition, innovation and productivity, but they also pose challenges to regulation of money laundering, terrorist financing and tax avoidance since they do not require participants to authenticate. (Staples et al., 2017). According to Price (2018), Cybercriminals, also called computer-oriented crimes, conduct illegal activities with the network, causing harmful consequences for victims. Cryptocurrency is the payment method of criminals. Lewis et al. (2017) state that Blockchain is applied to Anti-Money Laundering (AML) and Know Your Customer (KYC) requirements for financial applications, for transactions on a public, Blockchain is open and pseudonymous to all, while private systems have limitations to participants. Every object can be used for good or evil, and it merely depends on who is using it.

3 BLOCKCHAIN'S DEVELOPMENT IN THE FINANCIAL SECTOR

3.1 Blockchain in the financial industry

Drescher (2017) believes that the openness of Blockchain and the absence of any form of central control are the basis for its operation but may also limit its adoption. Andolfatto (2018) asserts that the most important non-technical limitation of Blockchain is the lack of legal recognition and user recognition. Nevertheless, Blockchain (non-cooperative consensus) has a comparative advantage in supporting decentralized autonomous organizations (DAOs). As Carolyn Wilkins points out, Senior Deputy Governor of the Bank of Canada, *"It's hard not to be fascinated by something so transformative. Blockchain technology is being used in ways that have implications for central banking that span all the functions that we have."*

Although the development of this emerging technology is still immature and faces many challenges and limitations, large international banks and other financial giants have rushed to lay out the field and invest resources in technology development and experiment. Based on Interviewee A," *finance is the natural application scenario of the Blockchain, and cryptocurrencies are also by far one of its most successful applications, such as bitcoin. The volatility of bitcoin's price has been widely criticized, but its value cannot be denied."*

However, technology needs time and talents to explore its possibility. McAfee[1] (2018) concludes that the government should deliver relevant Blockchain knowledge to the public and companies, who will benefit from modern Blockchain technology.

Many research papers and projects on the Blockchain are focusing on bitcoin. However, bitcoin is only a small part of Blockchain, which can be applied to many fields. Blockchain can be blend with other technologies to create more significant impacts. According to Interviewee B, she said," The *Blockchain is decentralized, while the bank is a centralized system. If the underlying technology of the Blockchain can be used to make a centralized system, I think the Blockchain technology can be used in the banking industry."*

For example, Blockchain can blend with big data, since transactions on Blockchain can be used for big data analysis. Moreover, users can predict the potential development of trading activities. The only exception is that the improvement of Blockchain technology can create many new opportunities.

[1] McAfee Highlights Blockchain Cybersecurity Risks 2018 Computer Security Update,19(7)

3.2 Influences of Blockchain on the financial industry

With the rise of Internet finance, the forms of Yu 'ebao, P2P and third-party payment platforms have accelerated the process of financial disintermediation. This asset-light and service-heavy model has severely impacted the traditional financial business of Commercial Banks, and the reform of the traditional banking industry is imminent. Affected by user demand and market competitiveness, traditional Banks have begun to layout Internet finance, but the effect is not ideal. It is also driving traditional banks to seek new technologies and ways to speed up the Internet. Blockchain might fundamentally change the existing finance and the FinTech industry due to the innovation in storing and transmitting data (Mu, 2016). Cocco et al. (2017) estimated that Blockchain has the potential to optimize global financial infrastructure or transfer assets more effectively than the existing financial system. Research on the impacts of Blockchain has shown that it can minimize costs and bring changes to the financial field in a long time (Nguyen, 2016).

Under the prevalence of Blockchain, commercial banks actively develop and apply Blockchain technology to improve the current centralized banking system. The financial organizations cut out the middleman by utilizing Blockchain's security, immutability, transparency of the Blockchain (Underwood, 2016). On the other hand, Hassani et al. (2018) state that Blockchain can bring opportunities as well as threats to the banking industry. Banks' attitude to Blockchain is contradictory, and the main reason is the banks play the role of the middleman and get rewards for the trust role for a long time, while the Blockchain is the technology to cut the central role. Hence, what is the real power to attract banks to explore the new technology?

3.2.1 Real Motivation for Banks

Banks are the backbone of the financial system. However, based on Shenzhen Institute (2016)[2], banks are outdated institutions and no longer focus on customer loyalty. Few would agree that

[2] Shenzhen Qianhai Hande Internet Finance Research Institute (2016), Blockchain finance. Beijing: CITIC Publishing House

the current banking system is modern or could be considered an "honest institution", due to recent scandals that have impacted giants such as Goldman Sachs and Deutsche Bank.

According to Heires (2016), major corporations have begun to explore Blockchain technology in the past years. Bank of America has drafted 35 patents related to Blockchain. Barclays, Citigroup, Goldman Sachs and UBS have formed the R3 CEV consortium to explore the Blockchain's potential to reduce costs. The NASDAQ stock exchange and Visa-backed startup called chain have launched Linq, which is based on Blockchain technology.

Blockchain technology has changed the business model and technical characteristics of traditional banks. The real motivations, for international financial giants and local commercial banks, to apply Blockchain are as follows:

First, it reduces costs and value transfers. Commercial banks often need to invest a lot of money in a centralized database, since terminal maintenance and purchase costs are high. On the other hand, many bookkeeping and settlement work add to the labor costs and human operation risk. Blockchain technology can solve these problems, since the use of a decentralized ledger and Blockchain's automation can build a model with low costs and transparency, without spending (Nguyen, 2016).

Second, it can control risks more effectively. Commercial banks emphasize the monitoring and tracking of loan use, but the actual operation is not so reliable and effective. Additionally, global regulation of capital circulation can make it more challenging. The multi-centered feature of Blockchain technology treats each user as a node in the Blockchain, enabling direct peer-to-peer transactions between borrowers and lenders, eliminating the need for credit guarantees by banks as intermediaries. The credit risk, brought by information asymmetry, is considerably reduced and the efficiency of fund management is improved.

Finally, it seeks innovative ways to profit. In the financial sector, more and more industry giants are investing in Blockchain technology startups or working with startups, including banks, as well as investment institutions. In this fiercely competitive environment, banks need to seek innovative profit models to develop financial products and open markets.

Blockchain's innovation and transformation of the traditional financial business of commercial banks are reflected in all aspects. From bank business to transaction participants, including those involved in the optimization of various processes in financial services.

Blockchain technology may systematically solve the whole business chain for banks. As shown in Figure 3, details are as follows. First, Blockchain technology is applied to different lines of business in banks, from payment settlement to bills and supply chain finance. The aim is to understand customers and potential anti-money laundering risk management areas better. Second, Blockchain technology will change the financial business model of all parties involved in the transaction and improve business efficiency. For banks, the application of smart contracts can save labor review and billing costs, a lot of manual work and knowledge-based work will be automated, and talents should fully utilize their cognitive skills. Besides, the Blockchain can address the inefficiencies, high costs, fraud and operational risks of various processes in financial services.

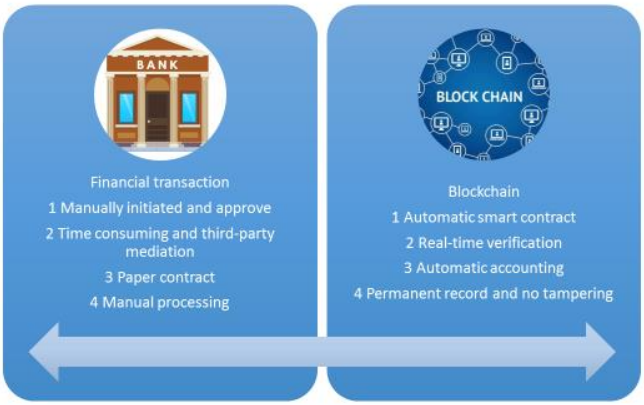

Figure 5: Blockchain solution for the bank's full-service chain

Therefore, the multi-centered Blockchain, public autonomy, and non-tamperable characteristics have fundamentally changed the centralized banking system business model, optimized the bank back-office and infrastructure, improved service efficiency and user experience, and provides a transformation opportunity for the bank from traditional financial business to the internet finance business.

3.2.2 Blockchain Strengthens Risk Management

One area that has made great strides in fighting Anti-Money Laundering (AML) is the use of Blockchain technology to effectively identify suspicious transactions by tracking customer

transactions and activities in real-time (Lai, 2018). AML refers to activities aimed at preventing crimes such as drug-related crimes, terrorist crimes, smuggling crimes, corruption and bribery crimes, crimes against the order of financial management. Nevertheless, the ways the laundering of money is organized are diversified, and the process is complicated, as the internationalization of circulation increases the difficulty of tracing the whereabouts of funds. Once money laundering occurs, it will hugely harm the safety of the international financial system.

Providing relevant and useful services for customers can be expensive. The reason is further explained by the fact that the customers must take more time to process the documents and information. H says, "*It is not merely one or two characteristics of Blockchain that render this technology creative and attract individuals' attention. The integration of property of Blockchain, such as decentralization, anonymity, immutability, makes this new technology valuable*). Know Your Customer (KYC) needs a company to verify the identity of its clients and predict potential risks of illegal intentions for the business relationship.

Blockchain technology is used to optimize the financial institutions' AML and KYC processes, which are also crucial for Industry 4.0 development (Dhanabalan, and Sathish, 2018; Mashelkar, 2018). First, the ins and outs of each fund of financial transactions can be traced back to prevent supervision through the non-tamperable time stamp of distributed ledgers and the characteristics of public autonomy of the whole network. Vulnerabilities, laws and regulations are not perfect, resulting in the flow of illegal. Second, the entire block network data is stored on each node to achieve information shared and reduce the duplication of audit work. Third, the credit history and transaction information of all participants are stored in the general ledger of the Blockchain and shared by each node. When the KFC process is passed, all the new customers' data can be quickly located, saving time and improving efficiency. Blockchain technology can save personnel and technology costs for AML and KYC.

4 DATA AND METHODS

4.1 Data Collection and Management

In this study, the method of the interview was employed. The interview was the most appropriate research method since a large volume of information can be obtained to understand the current status in the Blockchain technical development, marketing and business adoption. Apart from the descriptive information of interviewees, open-ended questions were largely adopted to suit each interviewee's case. The reason this study used this method was that open-ended questions could provide more opportunities and rooms of development for interviewees. Moreover, primary information related to the Blockchain can be obtained from the open-ended questions and it is more direct and valuable than other information.

In order to obtain the primary information from the experts and professionals related to Blockchain, 100 target interviewees were invited and 16 of them accepted the invitation and were willing to provide their knowledge and insights. To protect their privacy, their identities remained confidential. These interviewees are suitable for this research for several reasons. First, they are experts in the area of the Blockchain and the information they provide is a professional and true reflection of current industry status. Second, the background of the interviewees is diverse. Some interviewees come from research institutions and some of them come from the Blockchain industry. Their research or experiences allow this study to collect primary data from diverse backgrounds and learn about the Blockchain challenges across different sectors. Finally, the interviewees live or work in different countries, and their information may allow this study to better understand the Blockchain's world and its impacts on Industry 4.0.

After data collection, this research adopted open coding for interview information, since each institute or business entity may have different focuses. In addition, two of the authors coded the interview transcripts separately to ensure greater reliability. Before concluding the summary of our research, coding results were carefully compared by independent researchers to ensure data consistency.

Respondents' characteristics are presented in Table 1. It can be seen that the interviewees were aged between 25 and 48 years old, with an average age of about 32 years old and an average of 3.9 years of finance or R&D-related experience. The respondents live and work in different

countries (UK, USA, China, France, Australia, New Zealand, India, Korea and Singapore) with a wide range of expertise and demographics.

Table 1 Descriptive Information of Interview Participants

Participant	Age	Gender	Sector	Time worked in the R&D or finance team	The country where the team locates
R1	27	Female	Research	3 years	UK
R2	30	Male	Media	2 years	UK
R3	25	Male	IT	2 years	China
R4	25	Male	Research	3 years	China
R5	27	Female	Finance	4 years	China
R6	38	Female	Higher Education	3 years	India
R7	33	Male	Higher Education	3 years	India
R8	34	Male	Research	5 years	Australia
R9	26	Female	Professional Services	2 years	USA
R10	34	Male	IT/Blockchain	4 years	Korea
R11	32	Female	Professional Services	5 years	USA
R12	38	Male	Higher Education	7 years	France
R13	28	Female	IT	4 years	China
R14	43	Male	IT	8 years	China
R15	48	Male	Higher Education	5 years	Singapore
R16	44	Male	Finance	4 years	New Zealand

4.2 Methods

NVivo 12 was used to analyze all the interview transcripts and coding of the interview transcripts was based on the theoretical framework of the Theory of Planned Behavior (TPB), which includes Attitudes toward the behavior, Subjective Norms and Perceived Behavioral Control. Attitude refers to a person 's positive or negative sense of behavior. Subject norms mean the social pressure that a person feels on whether to take a certain action and perceived behavioral control is used to reflect a person's experience and anticipated obstacles. A person's perceived behavioral control is stronger when the person assumes that he/she has more resources, opportunities, and less anticipated obstacles (Ajzen, 1991). TPB can also be very useful for architects and investors. For architects, they can identify what the popular demands, so that they can design and implement products or services that can get more clients. For investors, they can identify the likely companies that can be profitable and increase their stake. TPB is a suitable method for this research since certain practices (related to a grey area described in Section 8 earlier) are behavioral driven and require interviews to explore the possibilities and rationale behind.

5 RESULTS AND ANALYSIS

In Blockchain's current adoption, knowledge hiding within the company and between collaborating partners was considered an obvious but serious issue since the secret related to the Blockchain advancement may have huge impacts on competitors, investors, and the market. Some information can be revealed in each company, and some cannot be revealed until the product has been released or has passed major tests or milestones, or until the investment deal has been signed officially with all the investors' endorsement. Before the legislation, it could be time for some businesses to take advantage. For example, each business could enter the market with more aggressive approaches, or the products with fewer ethical concerns could be passed for market adoption. Therefore, we identified experts who could provide us insights into this raising concern and their recommendations.

One aim of this research was to identify what constitutes knowledge hiders' attitudes, subjective norms and perceived behavioral control toward knowledge hiding for Blockchain. Authors would like to double-check this is a common cross-sectors and cross-countries issue.

These sixteen interviews could represent important feedback based on their knowledge of their sector or their country or both. An in-depth understanding could be concluded based on the analysis of those three main antecedents of "knowledge hiding intentions".

The findings on knowledge hiders' attitudes toward knowledge hiding for Blockchain is presented in Table 2, which match interview insights into the dimensions related to TBP.

Table 2 *Knowledge hiders' attitudes toward knowledge hiding*

Example Insights	**First-order Concepts**	**Second-order Themes**	**Aggregate Dimensions**
"I feel a sense of superiority for something that I know and own that my teammates do not know. I can stand a better position within the institute. In that way, it can transform into better career development and possible appreciation from senior management or clients, or both."(R1)	Sense of superiority	Affective evaluations	Attitudes toward knowledge hiding
"If I know something important to the collective goals and nobody else knows yet, this would help in improving my sense of achievement, which ultimately gives me more satisfaction toward myself." (R10)	Fulfilling personal satisfaction	Behavioral evaluations	
"I dislike certain people in the institute since they could never accept new ideas. Sharing new knowledge about Blockchain would be a waste of time since they would not accept it." (R9)	Avoiding waste of time		
"Knowledge hiding has more benefits for individuals but harms more for the team. Even so, there are many findings in Blockchain that take so long to know. Giving it out with openness does not get enough rewards." (R16)	Beneficial at the individual levels	Cognitive evaluations	
"We hide because it may avoid internal competitions, not in my favor. Our environment is competition-driven and it helps me for a better position within the team." (R2)			

"I feel more confident to develop my own work in Blockchain and prove more points. Before this, no one can take my findings and possible achievements from me."(R8)			
"I intentionally hide some knowledge because this may stimulate new employees' creativity and abilities to retrieve information, implement and make them happen." (R10)	Beneficial at the team level		
"Someone learns from my knowledge may show off my supervisors. This can be risky for my reputation and job security. Supervisors may underestimate my abilities." (R15)	Perceived risks		
"I have spent a lot of time and energy to come up with new ideas. I don't want others to steal them from me, take the credits and even back-step on me. Knowledge hiding is necessary as a minimum way for self-protection before positive outcomes are available"(R7)			
"Blockchain needs creative ideas and implementations. Sometimes, the innovative concept can be produced while discussing your own knowledge with others, and others may give you some new perspectives of thinking based on your response. When they get positive outcomes earlier than you, then your ideas become theirs" (R14)			

According to R1, a sense of superiority could be installed in her team and the organization, since she feels that she owns certain new knowledge that others do not know. An IT-driven environment gives her the advantage over others, since her supervisor can assign her a higher level of responsibilities. Her sense of superiority can also earn respect from her teammates. Hence, effective evaluations can be the reason for driving her towards knowledge-hiding. This also reinforces views from Kumar Jha and Varkkey (2018). They argue that one major reason for knowledge-hiding is due to the sense of superiority that immediate respect from colleagues and supervisors can be earned and positive acknowledgment from supervisors may have a better chance for career development. The difference between R1 and R2 interviewees is that R2 feels his advanced knowledge can put him in a better position than others. He is not going to show off but feels a more sense of security since IT is a very competitive sector. Thus, this case is more towards "Beneficial at the individual levels". One way or the other, it is easily transferrable depending on the individual's motivation and actual intention of knowing and hiding new knowledge in Blockchain. On the other hand, R10 believes that if he knows

something, others do not know yet, giving him a sense of satisfaction. This is similar to the feeling of being the first person achieving a new task or something challenging. Therefore, it is classified under Behavioral evaluations. On the negative aspect of Behavioral evaluation, R9 thinks it is a waste of time since senior management does not accept new concepts. As a result, he keeps new knowledge to himself.

Knowledge-hiding in Blockchain can be due to “Beneficial at the individual levels" in Table 2. R2, R8 and R16 do not use the advanced knowledge to show off or impress their supervisors; rather, they take a more defensive approach. They fully understand that Blockchain adoption is a very competitive market and that they must be highly skilled and competent in both technology and business areas. Therefore, they need to have deep knowledge, perform in implementation and experiments, and quickly adapt their work due to market changes. They feel that getting that new knowledge can secure their current position. On the other hand, R10 does this intentionally to stimulate new employees to think of solutions and ways to overcome problems rather than relying on "spoon-fed" answers and recommendations. Indeed, Blockchain is an area that can evolve fast, and employees may have to equip the new skills and knowledge that are often attending lecture-based training may not achieve long-term benefits. Experiential learning or problem-based learning can result in better long-term benefits.

R7, R14 and R15 have identified risks of Blockchain adoption in their organizations. They come from the angel that others can steal their ideas directly or in a longer process. Hence, they have been careful in their work and do not reveal much about what they do, until it is confirmed that they can understand that there will be less or no impact on their work. In this case, before the wide adoption of Blockchain in banks and financial services, this ethical concern of knowledge-hiding should be overcome or improved clearly. Recommendations from these interviewees were taken to ensure that Blockchain can be used more widely and more conveniently.

6 RECOMMENDATIONS AND DISCUSSIONS

Each interviewee was asked for recommendations in two areas answering the following questions (Table 2): 1) How to improve current situations in knowledge-hiding for Blockchain adoption; 2) How Blockchain can be better used, accessed and adopted by financial services and other organizations. Their comments were carefully recorded, compared and then divided into three categories as follows.

6.1 How to improve current situations in knowledge-hiding for Blockchain adoption

TPB can be used effectively for this case. In fact, some organizations are aware of this issue and have implemented some actions classified under subjective norms. As an example, within R3's organization, the staff needs to share their knowledge with others during the presentation. However, depending on the potential perception of risk, managers could decide to talk privately with the person in charge, such as in R5's structure. Both R3 and R5 are under descriptive norms since their organization can talk to them about knowledge-hiding for Blockchain openly or privately.

In R4's case, due to the highly skilled area criteria, he was unable to grasp the manager's ability to intervene fully. Then, he decided to adopt a soft and open approach and surprisingly, some employees started to share some "secrets" or tips on improving the Blockchain implementation. R5's organization took a more authoritarian approach to information sharing but did not announce when the change will take place. R13 and R1 face a similar situation where the organization cannot accept knowledge-hiding. All employees in charge of Blockchain topics have been asked to present their work. Indeed, R13's organization makes it a policy to demonstrate their knowledge and work done for Blockchain regularly. R16's organization relies more on the manager to extract knowledge from his team and spread it with others within the company, in changing potentially the internal culture. On the other hand, R6 and R10's organizations will not change their policies regarding knowledge-hiding for the time being due to different reasons. Their motivation for doing so is due to the insecurity of jobs, especially since the Year 2020 due to COVID-19. Job losses and discontinuation of contracts

are common as a result of the scale-down of business activities and travel. Financial services with Blockchain development have been affected due to the economic downturn.

Table 3 *Knowledge hiders' subjective norms surrounding knowledge hiding*

Example Insights	**First-order Concepts**	**Second-order Themes**	**Aggregate Dimensions**
"The manager is aware of this situation and make it a common thing among us. However, every month new discoveries have to be presented or three times in a row, job maybe 'at risk'" (R3)	It is common, let it be, but share some of it periodically	Descriptive norms of knowledge hiding	Subjective norms surrounding knowledge hiding
"Manager understands this issue but often seeks private appointments to know something out of it." (R5)	The manager understands but talks privately		
"Some areas are highly skilled and even manager wants to know, it is not easy for him to fully understand. After some time, he adopts a personal choice approach. It seems to work well for some people who then tell him later on" (R4)	It is a personal choice with the freedom to say or not with the manager's intervention.	Injunctive norms of knowledge hiding	
"The manager said it is a personal choice since it takes a long time to develop a new skill. But he said the company would change this culture soon and he will talk to us individually. It is uncertain whether he will take new actions soon" (R9)			
"The company feels that we are lagging behind competitors and former employees complained about the serious knowledge-hiding issue. The company has taken drastic approaches and has asked employees to share, write up reports or papers, develop patents and present periodically " (R13)	The manager cannot accept this and has taken more drastic approaches.		
"Everyone in our team is open to sharing the knowledge with the supervisor's regular encouragement and meetings, and knowledge hiding is not accepted." (R16)			

"Even managers or senior colleagues know, they possibly also do it to protect themselves. No one seems to ask for any changes as yet" (R6)	It will not be changed for the time being		
"The new managing director has not invested further in Blockchain. Nothing will be changed unless the organization has invested in adoption (that culture will become more towards sharing)" (R10)			

Ten out of sixteen interviewees feel that a certain extent of knowledge sharing can help the development and adoption of Blockchain. However, it should be done in fair and independent ways without forcing employees to devote more than necessary. A more structured, well-balanced and comprehensive way can be developed to achieve better benefits for the organizations, employees and client organizations.

6.2 How Blockchain can be better used, accessed and adopted by financial services and other organizations

The critical success factors identified for the adoption of Blockchain solutions within financial services and research departments are highlighted below:

Enough capitals and good financial management – All the interviewees suggested that companies deciding to implement Blockchain must have enough capital as its implementation is costly and not all organizations can afford this in the long-term.

Align the organization's activities with Blockchain initiatives – The main activities of the financial department should be aligned with the decision to use Blockchain's solutions (research or real services or both). Indeed, if the companies do not specialize in banking investment, they should not take the risk to address this new market.

Sufficient energy and electrical supplies – Blockchain will require a large consumption of electricity and abundant energy supplies can impose a requirement for using or adopting Blockchain.

Reliable high computational power – similarly, Blockchain will require high-end computers nearly at the supercomputers' levels in order to run thousands or millions of calculations per second. Reliable high computational power with suitable cooling, abundant energy supplies, low risk to natural disasters and accidents (e.g., fire), can make all transactions safe and secure.

Intelligent algorithms with mathematical complexity – Blockchain requires the support of complex mathematics running behind high-end computational power. This also needs intelligent algorithms to run behind the scene reliably every second.

Well-trained teams – In this paper, this factor has been discussed in-depth, particularly the issue and fights against the knowledge-hiding. To make Blockchain implementations and services performing well, dedicated teams with different expertise are required.

Security and privacy – Ensuring a high-level of security and privacy has become very important. High-end encryption algorithms, personal identifier removal, a combination of passwords and biometric authentication, plus specialized access control, can all together make Blockchain a safer environment for work.

Analytics and user interfaces – Analytics functions can allow their clients to execute simple Blockchain requests behind the scenes. The operations are easy to do. Results can be returned within minutes. In this way, their clients feel it is accessible and convenient.

Focus on product development, quality assurance, reputation and community building –A lot of financial services focus on the market share or their perceived value by the market. Interviewees say that the first step in the implementation of Blockchain, is to propose a high-quality product, then build up their reputation and, eventually, their own community. This is

a step-by-step process. They said some firms or banks failed due to inferior quality products. Their clients like Blockchain's solution, but still feel its adoption as "risky".

6.3 Proposition

In this section, we sum up the agenda from the overview of Blockchain between Sections 1 and 6, and the challenges and recommendation raised by our expert interviewees, and present them in the form of proposition. These propositions support our contributions based on current industrial research.

Proposition 1: *Blockchain can bring disruptive changes to banks and financial services, with both positive and negative impacts. Banks and organizations that adopt Blockchain should manage technology, change of culture and employees working on Blockchain.*

Our study has identified that banks and organizations that adopt Blockchain have positive aims and objectives. They have been keen to develop new products and services, and aim to enter the market as an early pioneer, with the common plan to get to sufficient market share. Blockchain can offer the dynamic changes to the organization, since it can attract more attention and investment opportunities from the shareholders, and financial services are more willing to scale up the level of services and product development. New teams (including marketing, research and IT) have been formed with more clients and business opportunities available. On the other hand, the impacts offered by Blockchain adoption can also be destructive as follows. First, it has changed the ways that employees work and communicate within the organization. Second, employees are required to learn new skills and knowledge, since the changes in Blockchain adoption can be rapid. It is also difficult to get professional help, since other "experts" are still learning new knowledge themselves. Third, not all the organizations have been entirely ready for the Blockchain adoption. Knowledge hiding and its related issues have been a result of this challenge.

Proposition 2: *Knowledge hiding can be a common issue in organizations that adopt Blockchain. This can be due to affective, behavioral and cognitive evaluations of their behaviors. Acknowledging knowledge-hiding is important since organizations can develop processes and better strategies to manage, monitor, evaluate and fair knowledge-hiding more equally.*

The TPB theory can be used to explain the occurrence of knowledge-hiding in the context of affective, behavioral and cognitive evaluations. Knowledge-hiding can happen for feeling superior in the team, or feeling more secure about jobs, or feeling the need to do so to prevent other employees from overtaking their positions. Organizations that adopt Blockchain should take knowledge-hiding proactively, openly and more honestly. Managers can act as excellent communicators, since encouraging their employees for better motivation and the long-term benefits for "incremental" knowledge-sharing can be more productive. It is also fine for organizations to develop policies in terms of sharing and presenting their findings in advanced skills and knowledge, and make it a rewarding culture rather than a culture that may penalize those with advanced skills. Organizations should also invest in training employees to be equipped with advanced skills in managing destructive technology.

Proposition 3: *A comprehensive Blockchain adoption framework should be developed to manage, evaluate and integrate recommendations from expert interviewees fully.*

Section 9.2 presents recommendations based on expert interviewees and their years of experience in adapting, using and investigating Blockchain. Their valuable recommendations are insightful to provide an effective workaround to overcome knowledge-hiding but improve on accessibility, adoption and efficient use of Blockchain. In summary, three main factors include technological, organizational and people (TOP), with impacts on the current entrepreneurial finance landscape. Technological factors include high-end computational powers, sufficient energy supplies, smart algorithms, analytics, security and privacy. Organizational factors include good financial management and align the organization's activities. People factors include the well-trained teams and its management to overcome impacts due to knowledge hiding, but develop the organization into a culture of incremental

knowledge-sharing and mutual collaboration. The factor “focus on product development, quality assurance, reputation and community building" is the result of effectively exercising these three factors. First, the product should have excellent quality with a vigorous quality process. Second, the organization can develop a culture to use incremental knowledge sharing to gain their positions in the market. When the teams can develop better collaboration and develop good client relationships, a strong community can eventually be established. This will require a TOP Blockchain adoption framework, as our next phase of research, to recommend how the organization can develop and manage Blockchain adoption. Despite the TOE framework has been popular, environmental factors are less suitable in the case of Blockchain adoption.

Proposition 4: Knowledge-hiding can happen before the next wave of a downturn due to economic uncertainties.

The downturn can happen due to various reasons, which may include the scale down of business activities, global recession, and large-scale crises, which is not desirable for the development of Fintech and Industry 4.0. In the Year 2020, the COVID-19 has become a pandemic. It is not only a public health crisis but also an economic downturn. Due to the lockdown of cities, closure of some businesses and scale down of business activities, loss of jobs and discontinuation of contracts have become common in financial services. Therefore, knowledge-hiding can happen due to economic uncertainties. Individuals are doing this to prevent others from getting job opportunities. Businesses are doing knowledge-hiding to avoid other businesses knowing how to attract customers and maintaining their competitiveness. Therefore, swift actions for remedies and stimulations of economic packages should be on offer while tackling the public health crisis.

6.4 The interview sample size

The result of this research is limited by the sample size. Due to the limited resources, the authors were just able to invite 100 target interviewees and only 16 of them accepted the invitation. The small sample size may result in a biased result or that the comprehensive understanding of the status of Blockchain adoption cannot be obtained. However, it was

difficult to get more interviewees, since many of their employers did not allow them to enclose further information. Addtionally, it was common in the financial industry, not to enclose information that could have direct and indirect impacts on their businesses. Therefore, our future work should target more related interviewees with diverse backgrounds and also widen the business sectors, such as IT, Higher Education and Healthcare. We should also get difference compliance and legal requirements, such as General Data Protection Regulations (GDPR) if interviewing Blockchain practitioners and researcher based in European Union.

7 CONCLUSIONS AND FUTURE WORK

This paper highlights the fact that the financial industry is on the edge of a new financial era using a new destructive system based on Blockchain. The previous products and services proposed by the finance sector were considered as costly and inefficient. Consequently, a massive transformation was required. Tang (2018) pointed out that Blockchain could represent credit reconstruction, a cross-time consensus mechanism that enabled people to trust each other without social relations and credit accumulation. Blockchain technology had the power to improve the efficiency and security of financial markets, although there was much work need to solve the underlying problems (Lewis et al., 2017). Therefore, the current status and industrial practices of Blockchain adoption in financial services were discussed in some details. Challenges faced by different countries had little differences and recommendations could be addressed to minimize such impacts.

While the development of Blockchain was not mature yet, we should improve our technology and system supervision to the Blockchain. The government and relevant departments should formulate policies to enable the public to benefit from Blockchain and strictly prevent the illegal use of Blockchain to engage in money laundering, terrorist financing and even capital control activities (Nguyen, 2016). Undoubtedly, Blockchain could be a very competitive and "imaginative" technology that might change the financial and commercial infrastructure of our society in the future. Financial services should take a long-term view and start to explore

the implementation of Blockchain technology to improve their business, otherwise due to the competition, and they could be eliminated eventually. By using interviews as the main research method, it could allow us to identify the most serious problem, knowledge-hiding, which could prevent further development and success of Blockchain adoption. Thus, knowledge-hiding reasoning should be fully understood with ways to minimize its impacts, before resolving other technical challenges such as energy, scalability, security, as well as ethical challenges related to legal regulations and cybercrimes.

However, interviewees still provided valuable insights into the current status of Blockchain adoption. Knowledge-hiding was a rising issue. One of the contributions of this research is that, based on reinforcing the previous research on knowledge hiding, discovered some unique reasons for hiding information in the financial industry using Blockchain. Jha and Varkkey (2018) believed that knowledge-hiding might bring one sense of superiority and help him or her to earn respect from others or achieve a better career development. Anand and Hassan (2019) considered that the reason for knowledge hiding is due to that employees are afraid of losing their current power or position, or their work may be impacted. This research agreed with their views. However, different from them, two other reasons were provided by the interviewees. One reason is that employees think it is a waste of time since senior management often refuse to accept new concepts. The other reason is that some experienced employees believe that in a fast-growing area of Blockchain, experiential learning, or problem-based learning can result in better long-term benefits than lecture-based training. Therefore, it is important for new employees to think of solutions and ways to overcome problems on their own.

For the technical development and advancement in business opportunities, knowledge sharing would be required, but it should be structured, using a step-by-step process, and focused on product development, ensuring a high quality, a good reputation and building a community. Market share was only a reflection of what the company and its products' standing of their past and current performance. It did not guarantee that their products or services or market could stand for long. Their main challenges are to foresee what could happen, whether positive

or negative perspectives and to demonstrate their abilities to adapt their organization to the change of paradigm of the market. All these help us to develop three propositions based on our research and recommendations from our expert interviewees. Recommendations and lessons learned were useful for organizations adopting Blockchain and new ways to manage knowledge sharing and improvement in efficiency better.

Other researchers should investigate if the knowledge-hiding is also an issue within other markets, not only financial services, which tend to disclose their business successes to avoid competitors gaining advantages. Furthermore, a framework can be developed to help and allow knowledge sharing in a more structured and balanced way, so that certain critical knowledge can be hidden for defensive approaches like the "Beneficial at the individual levels". Additionally, other knowledge can be used in order to explain to a general audience the benefits of Blockchain adoption and minimize the perceived risks of Blockchain. Our future work will focus on the development of such a Blockchain adoption framework, focusing on technological, organizational and people (TOP) factors dealing with successful Blockchain adoption and allowing Blockchain to serve different types of business activities and services well enough. We will also investigate how to maximize Blockchain adoption in the post-COVID-19 period and recommend strategies and best practices for businesses and individuals.

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