Independent Final Report

Adoption of Blockchain Technology by the Indian Banking Industry

by

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Certification Page

I, JOSE Manu (Student ID 52117611) hereby affirm that this Independent Final Report has true and original content to the best of my belief and knowledge, and it does not contain any material that have been presented at any other university or educational institution for the grant of a degree or a diploma.

I also affirm that the intellectual content of this Independent Final Report is the result of my own work. All information's derived from other published or unpublished sources has been properly referenced and acknowledged.

JOSE, Manu

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Summary

The topic for this Independent final report is "Adoption of Blockchain technology by the Indian Banking Industry". Banking industry is one of the most regulated industries in the world. It has the stigma attached to it of being old, boring and resistant to change. However, technological change and innovation has opened up many new businesses to the banks, and also helped them to expand their already existing businesses. To meet the appetite of their consumers and to keep their head above water in today's highly competitive market, banks are looking for new ways to deliver their services and also are trying hard to improve their existing services. Many analysts project that banking industry is about to experience exceptional change as it moves towards a digital industry. Banks are experimenting with a wide array of technologies like Big data, Internet of things, Artificial Intelligence etc. to make their business work efficiently and effectively. Blockchain is one other promising technology that is considered to bring unprecedented change to the banking industry.

This independent final report seeks to discover how innovation with Blockchain technology can revolutionize the Indian banking industry. This research also aims to create insight on the current situation of blockchain technology adoption by various Indian Banks. Other goals of this exploratory study involve identifying the benefits and challenges of using blockchain technology in the banking business and identifying the nature of investments and various initiatives of large Indian banks in blockchain technology. A conceptual background is presented which includes theories on the adoption of innovative technologies and process innovation. The main areas of focus are blockchain technology, Indian banking

industry and potential use case scenarios for blockchain technology in the Indian banking industry. The methodology of this included questionnaire surveys and semi-structed interviews. The two research questions postulated in the beginning to the report were the following: 1) What is the main advantage of blockchain technology over existing systems used by Indian banks? 2) Are Indian banks ready to adopt such a disruptive technology like Blockchain?

The results from this study showed that in order for the successful adoption of blockchain technology by the Indian banking industry, questions around the legal and regulatory framework need to be resolved by the Indian government. Indian regulators will have a big role in determining how well blockchain technology will be utilized by the banks in the country. Engagement with Indian regulators in all aspects of the technology adoption lifecycle is a must for Indian banks to successfully unlock all the potential benefits that is offered by blockchain technology. Engaging with Indian regulators by educating them about the technology, figuring out ways to determine the risks and coming up with tailor-made solutions for their specific problems is the way ahead for Indian banks with respect to blockchain technology.

Chapter 1: Introduction

1. Introduction

Banking industry is one of the most regulated industries in the world. It has the stigma attached to it of being old, boring and resistant to change. However, technological change and innovation has opened up many new businesses to the banks, and also helped them to expand their already existing businesses. Technological developments like internet banking, ATMs etc. have propelled banking to the 21st century. Today's banking consumer expects more from their service provider, and demands it faster, and expects better results. To meet the appetite of their consumers and to keep their head above water in today's highly competitive market, banks are looking for new ways to deliver their services and also are trying hard to improve their existing services.

India's banking industry is the backbone of the world's fastest growing major economy. In order to support the high paced growth of Indian economy, the banking industry in India has no other option than to welcome various technological disruptions with open hands. Many analysts project that Indian banking industry is about to experience exceptional change as it moves towards a digital industry. Some of the major Indian banks are experimenting with a wide array of technologies like Big data, Internet of things, Artificial Intelligence etc. to make their business work efficiently and effectively. Blockchain is one other promising technology that is considered to bring unprecedented change to the banking industry.

1.1. Background & Significance of the study

Accenture consulting estimates that's the global banking industry will save up to $20 billion by 2022 by implementing blockchain for various banking operations (Accenture, 2018). Currently, world over many of the major players in the banking industry are toying with the idea of distributed ledgers. According to a study conducted by IBM in September 2016, this is happening much faster than what was thought of before (IBM Institute for Business Value, 2016). Banks like UBS Group AG are opening new research facilities and piloting R&D projects dedicated to figure out how blockchain technology can be made use to increase efficiency of financial services and how to reduce costs. Blockchain is a promising technology with a network structure that is transparent & decentralized with high levels of safety in the storage & transmission of data. Blockchain technology has the potential to revolutionize the banking sector and we wanted to understand whether it can deliver transformation of Indian banking sector by making it more efficient and effective in performing its functions.

1.2. Conceptual Background

There are multiple factors that will determine whether a specific technology like blockchain will be adopted by a given Industry. One of the most prolific theories that tries to explain the feasibility and likelihood of blockchain technology adoption is known as the diffusion of innovation theory proposed by Everett M Rogers (Rogers, 1995). Diffusion of innovation (DOI) theory considers factors like the compatibility, level of complexity, accessibility and advantages of a new technology to figure about whether its adoption is

going to be widespread. Diffusion of innovation (DOI) theory looks at the big picture view of a particular technology becoming mainstream. Diffusion of innovation (DOI) theory is helpful in understanding what stage the technology is in a current market and how it might gain lots of adopters.

Figure 1: Diffusion of Innovation Theory Model (Source: Stats Land (Huck, 2014))

The final result of the dissemination of a technology is that people belonging to a certain market or any other social system will adopt the new technology. Adoption is said to happen when the old behavior or practices are replaced with new behaviors and practices. The key to adoption of any technology is that people should view the technology as delivering improvements and solving existing problems with ease.

In this research, we focus on the adoption on blockchain technology by the Indian banking industry. We will try to understand how Indian banks can use blockchain technology to transform themselves. Different use cases that are suitable for blockchain technology will be examined in this study to see the benefits that can be achieved because of the adoption

of blockchain technology. Diffusion of innovation (DOI) theory is a simple and elegant framework in assessing the likelihood of mass adoption of blockchain based solutions by various Indian banks.

David O'Sullivan and Lawrence Dooley defined innovation as: "*the process of making changes, large and small, radical and incremental, to products, processes, and services, that results in the introduction of something new for the organization that adds value to customers and contributes to the knowledge store of the organization.*" (David O'Sullivan, 2009). There are different kinds of innovation. When an organization solves an existing problem or improves their existing business processes in a radically different way, and creates huge value for their customers or more profits and cost saving for the organization, it is called as process innovation.

Process innovation is an investment into an organization's competences, skills and resources that will allow the organization to implement not only cost reduction measures in their business activities, but also to implement new technology which permits the creation of an array of new products and services, which are quite different from the prevailing ones. Process innovation gained prominence in the early 1990s with the companies all over the world discovering ways to innovate their businesses with the help of information technology enabled solutions. According to Thomas Davenport who championed the use of process innovation in the early 1990's, only process innovation is capable enough to exploit information technology's full potential (Davenport, 1992). Today's banking industry of India is plagued with issues like rising operational costs, growing vulnerabilities to fraudulent attacks on servers and various challenges in guaranteeing transparency. Even

after the adoption of various IT systems in their business processes, most of the banking transactions in India follows labor-intensive processing and documentation. Current banking operations in India, also involves costly middlemen, and is very tedious since these transactions need to be authenticated by different parties at different points in time. It is more than likely that Indian banks will utilize the capabilities of blockchain to improve their business processes and to gain a competitive advantage.

Indian Banks are always searching for new ways to make transactions faster for an improved customer experience, also while maintaining cost efficiency in their business operations and guaranteeing transparency to clients and regulators. Blockchain technology has the potential to deliver a game changing solution for banks because it can get rid of the need for various middlemen, keep immutable transaction logs and also enable instantaneous execution of transactions. For Indian banks, selecting the right use case is vital to utilizing the full value of blockchain technology. According to Moody's Analytics "*problem loans are a key challenge facing the (Indian Banking) sector, the government is taking aggressive steps to shift the banking ecosystem to a higher plateau through promising developments in the Indian political, socio-economic, and regulatory landscape amid the government's efforts to heavily leverage the digital push into the financial services domain.*" (Moody's Analytics, 2018)

On the basis of the current pain points experienced by Indian banking industry and benefits offered by blockchain technology, a simple evaluation framework is used to determine whether blockchain based process innovation can potentially transform the industry. In order for an existing banking operation/process to classify as ready for being transformed

or replaced by blockchain, some fundamental questions need to be answered satisfactorily. This research will focus on answering the basic questions like 'what problem faced by Indian banks does block chain claim to solve?' and 'Is blockchain an effective and efficient solution?' etc.

1.3. Problem definition & objectives of the study

Through this report we intend to discover how process innovation with blockchain technology can reshape key operations in the Indian banking industry today. The objective of the study is to explore areas of process innovation and apply it to aspects of today's Indian banking operations like KYC processes, transfer/payment settlement, insuring deposits & loans with blockchain as the technical tool and facilitator of process innovation. Other goals of this exploratory study involve identifying the benefits and challenges of using blockchain technology in the banking business and identifying the nature of investments and various initiatives of large banks in blockchain technology.

1.4. Research Questions

This research defines two interlocking research questions (RQs) to study the diffusion of blockchain technology in the Indian banking industry, and define potential policy tools to address their potential disruptive effects

RQ1: What is the main advantage of blockchain technology over existing systems used by Indian banks?

H1: Decentralized trust has the potential to replace centralized trust in the Indian banking sector

H2: Cost-effectiveness created by the adoption Blockchain technology is the main attraction of Blockchain technology for Indian banks over existing systems.

RQ2: Are Indian banks ready to adopt such a disruptive technology like Blockchain?

H3: Indian banks will adopt blockchain technology in their business operations in the near future.

H4: Indian regulators will not hinder the adoption of blockchain technology by Indian banks.

Chapter 2: Methodology

2. Methodology

For this research, we are going to apply inductive research logic (Jebreen, 2012). The crux of this approach is to do analysis of the data that has been gathered and answer the research questions. In this research, we utilize various theories on innovation together with many studies that reveal the current growth stage of blockchain technology, and try to figure out the potential of blockchain to transform the Indian banking industry.

In a research that is based on inductive research logic, only few hypotheses are postulated in the beginning of the study. It does not mean that theories on innovation and technology adoption are disregarded when framing research questions and objectives of the study. Inductive research is the opposite deductive research where, theories and concepts and developed and tested by way of conducting empirical observations.

In this research, we would formulate an adoption path for blockchain technology by the Indian banking industry. For the purpose of this research, both qualitative and quantitative data is obtained to strengthen the various arguments and conclusions.

2.1. Data Collection

Qualitative and quantitative data was gathered using various methods. Data collection methods that was utilized for this study were the following.

- Documents and Records (Research Papers, White Papers, News Paper Articles etc.)

- Interviews of bank employees, technology experts and other people who are familiar with the banking sector in India.

- Questionnaire survey of Indians who work in Banking/Financial Services & Information Technology sectors

Both primary data and secondary data were collected. According to Jill Collis (Jill Collis, 2014), when data is gathered from an original source it is called primary data, and when the data is gathered from an already existing source it is called as secondary data. Primary data was collected from interviews conducted through Skype and WhatsApp. None of the interviews were conducted face to face because of physical limitations. All of the interviewees were Indian citizens who reside mostly in India. The format of questions that were used for the interviews are shown in the appendix. Willing participants for interview were sought out through personal networks. The interviews were approximately 30 - 45 minutes in length. Semi-structured interview was used in the interviewing process. In a semi-structured interview, only few predetermined questions are asked. Lot of questions in a semi-structured interview rises out of how the interview progresses. Other primary data that was used was a questionnaire response from different Indian bank employees and information technology experts relating to potential blockchain adoption by the Indian banking industry. The data that was gathered through questionnaire was analyzed using MS excel.

In order to complement primary data, secondary data was utilized. Secondary data used in this research includes relevant literature relating to blockchain, Indian banking system, technology adoption, innovation etc.

Chapter 3: Literature Review

3. Literature Review

Keywords such as "blockchain", "banking", "finance" were used to find research papers and articles.

The research done by Johansen (2016) shows that researchers agree that blockchain has certain features and capabilities that is very promising to the finacial industry as a whole, but it needs to find appropriate large scale use inorder to find legitamcy in the eyes of modern society. From the author's research we find that the most frequently appearing concepts in the literature pertaining to blockchain are New innovation, Digital Innovation and Decentralization. Research finds that the salient technological features of blockchain are the main reasons for potential disruption and innovation in various fields. One of the main issues with application of blockchain technology is the scalability aspect of it. The security of blockchain technology is also called into question because inorder to make a large commercia blockchain to be viable, a large number of full nodes might be required.

In his article examining blockchain use case for crowdfunding in EU, Gebert (2017) argues that crowdfunding is a crucial means of funds raising especially for Small and medium-sized enterprises (SMEs). So, it is important for goverments to make available access to crowfunding. Crowfunding has not been very succesful in the european union because various traditional forms of crowdfunding were blocked by authorities because of the fear of money laundering and fraud. Blockchain can provide great hope for the recovery of crowdfunding in the continent and other parts of the world. Targeted application of

blockchain can reduce bureaucracy and regulations while following the law. Blockchain enhances transparency because it is distributed public ledger. Blockchain also wipes out the problem of information asymmetry, thus benefiting every stakeholder.

According to white paper published by Infosys consulting (Eric G. Krause, 2016), blockchain is able to get rid of the need for trusted third parties, reduce costs and increase revenue for various players across different industries. Eventhough public blockcahins have high levels of data security and transparency, they become slow when lots of transactions needs to be processed. On the other hand private blockchains can provide better transaction speeds and privacy. But, they do not have high security standards compared to public blockchains. The authors are of the opinion that blockchain is still in its infancy and it will take atleast 5-10 years for its broad application in the financial services industry. Blockchain technology has the potential to transform the present payment transactions carried out by commercial and correspondant banks by saving costs and making payment settlement more efficient. When it comes to trade finance, blockchain can offer trusted networks, fast processing, security and low levels of risk. In off-exchange trading, blockchain has the potential to remake the current infrastructure and eliminate outdated market participants. Additionally, it could automate various contracts and enable cost savings by optimizing back office operations. The main challenge associated with the adoption of blockchain and creation of new business models is the trasition from old processes to new processes. To achieve effective adoption of blockchain based solution will definetly require the coopertaion of regulators. That is because they will be in charge of establishing legal frameworks for new business models.

Ranjit Kumaresan etc. (2014) made a proposal to correctly use bitcoin for calculating encryption tasks. In his paper, he mentioned four modes. They are: verification computation, non-interactive bounties, secure computation with limited leakage and fair secure computation. Darcy W. E. Allen (2016) put forth for consideration how various cryptocurrencies and the underlying technology of blockchain will challenge the prevailing global economic order. The authors also make predictions about how governments are going to bring about regulations to curb the proliferation of cryptocurrencies. Susan Kelly (Kelly, 2015) suggested that blockchain based payment systems only require few steps to make a payment, and is very secure when compared to the existing banking system. According to the author, only few numbers of transactions can be processed in a second with blockchain at the moment. Therefore, the author proposed that blockchain can be coupled with other promising technologies like big data and artificial intelligence to bring about transaction efficiency.

Hughes & Middlebrook (Sarah Jane Hughes, 2015) proposed need to regulate the payments using cryptocurrencies. The authors also presented a framework for regulation. Irni Eliana Khairuddin etc. (2016) suggested that there are three main forces that drive the value of bitcoin: bitcoin's potential to cause a monetary revolution, empowerment of users/holders and the perceived real value of bitcoin as an asset. Roman Matzutt etc. (2016) researched the transformation of content that is stored in Bitcoin's blockchain, then divided the stored content into different categories, and drew attention to the consequences of permitting the storage of arbitrary data in blockchain that can be globally replicated. Finally, the author argues that blockchain has various flaws and limitations. Similarly, Ghassan Karame

(2016) also believed that blockchain has many limitations such as vulnerability to coordinated security attacks, scalability and other limits associated with radical decentralization. Claus Dierksmeier etc. (2016) focused on the ethical considerations while using blockchain technology for financial transactions. Lewis Cohen etc. (2016) proposed various ways to apply blockchain technology to various financial instruments like derivatives, asset backed securities, commercial paper etc. Stanley & Buckley (2016) were confident that blockchain technology is useful in preventing money laundering rather than hindering it. Aniket Kate (2016) put forth the possibilities of using blockchain technology in building credit networks.

Ahmed E. Kosba etc. (2015) suggested the application of blockchain technology in constructing smart contract system. Rod Collins (Collin, 2016) is of the opinion that blockchain technology will play a huge role in ensuring privacy and data security. Steve Huckle etc. (2016) advocated for the widespread application of technologies like IoT (Internet of things) and blockchain to build applications based on distributed network. According to the author, this will benefit various models of sharing economy like Airbnb and Uber. Michael Casey, J. C. etc. (2018) proposed that still a lot needs to be done to even consider that blockchain is a viable technology that is about to revolutionize the banking industry. Then, the question is how broad the application and impact of the technology will be and where it fits in the financial system. Comparing the merits of centralized and decentralized systems, the debate suggests that the best systems may lie somewhere along the spectrum, and that we are currently hovering around permissioned blockchains. This

will have to bring together disruptors and incumbents, as well as regulators and central

banks.

Chapter 4: Blockchain & The Indian Banking Industry

4.1. Understanding Blockchain Technology

""There is a lot of hype in the financial sector about blockchain technology. Many analysts are saying that it is going to be the next big thing. I am pretty sure that many entrepreneurs are going to make lot of money out of disrupting the industry."

- Nived Vasukuttan*, DAMAC Properties* (2019)

Blockchain is a growing list of blocks or records, which are connected to each other via cryptography. It is the technology that enables the use of Bitcoin and other cryptocurrencies. Blockchain is *"an open, distributed ledger that can record transactions between two parties efficiently and in a verifiable and permanent way"* (Marco Iansiti, 2017). Blockchain technology gained worldwide recognition with introduction of Bitcoin by the pseudonymous Satoshi Nakamoto (Nakamoto, 2008). But this innovative new technology which has the potential to cause radical disruption like that of Internet, has a startling connection to the days of the medieval treasuries of Europe. According to renowned British historian Michael T. Clanchy, the predecessor to today's blockchain technology was present during the evolution from oral to written modes of preserving memories of peoples, things or events (Clanchy, 1980). During the middle ages, symbolic objects were utilized as evidence of entitlements, transactions and rights. Many things like rings, horns, cups, knives and other objects were regularly used for the conveyance of land or property in the middle ages. Today's blockchain enabled record-keeping systems utilize valuable crypto assets like bitcoin as symbolic representations of real assets like land, gold etc.

One of the key features of blockchain technology is that it is resistant to modification by design. Once a block is recorded in the blockchain, it is very difficult to change it retroactively without changing all other subsequent blocks. Changing the data requires the consensus of the majority in the network. Another key feature of blockchain is that everybody in the network has access to the blocks. These two key features make blockchain a distributed ledger that is open to everyone in the network. These features generate a system of trust that is bottom up or very decentralized in nature.
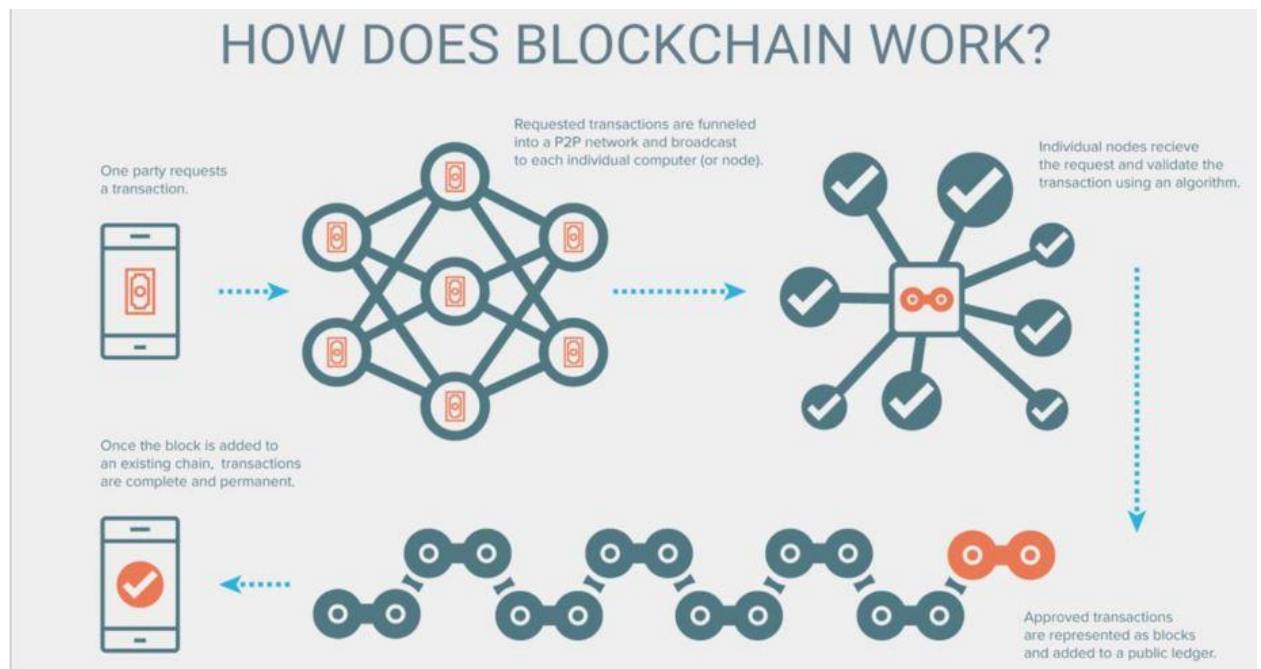

Figure 2: How Does Blockchain Work? (Rosic, 2016)

Figure 2 gives an overview of the workings of blockchain. At first, one party requests a transaction from a device that is connected to the network. Next, the requested transaction is funneled through a peer-to-peer network and broadcasted to all the nodes in the blockchain network. Once the nodes get the request, they will authenticate it with the help

of an algorithm. Authenticated transactions are represented as blocks and added to the blockchain. Finally, when the new block is added to the existing chain of blocks, the transaction is deemed to be complete and permanent.

Blockchain can be divided into private or public. On a public blockchain anyone can input data without getting permission from an authority. On a private blockchain, any person can read the data without permission from any authority. Bitcoin is an example of public blockchain. Blockchain technology was developed to improve on the shortcomings of traditional databases. Before the arrival of blockchain technology, it was difficult to monitor and evaluate asset ownership and its transfer using databases. The biggest advantage in a blockchain is that each party in the blockchain has a ledger of all transactions. This ledger is shared between different users with access rights, resulting in the creation of a shared database. The architecture of blockchain is such that it creates a trusted network on the basis of consensus, provenance and permanency

Benefits offered by blockchain

As discussed above, blockchain technology offers many benefits mainly because of its unique architecture and design. The decentralized nature of blockchain technology creates transparency in processing. Transparency reduces or eliminates the need for manual verification & authorization. Main features of Blockchain technology can be summed up as the following:

- Blockchain facilitates immediate settlement of transactions. It removes any waiting period, and reduces various kind of risks.

- Blockchain eradicates the need for a trusted third party to do transactions. The architecture is based on cryptography that allows any two parties to do secure transactions. One of our respondents strongly emphasized this feature of blockchain technology.

"Most attractive part about blockchain technology is that it gets rid of the need for a third-party. Therefore, blockchain technology permits to curtail or completely eliminate the counterparty risks. Intermediaries like lawyers, brokers, and even bankers might no longer be necessary in the future with the large-scale adoption of Blockchain."

- Ram Mohan, *Toshiba Software* (2019)

- Blockchain functions as a distributed ledger. The transaction that happens within a blockchain are recorded in distributed ledger that is public and maintained by everyone in the network. Blockchain does not usually store the true identities of parities or the true nature/content of the data. The only thing that is stored is the record of the transaction.

- The transactions made on a blockchain is irreversible and immutable. Blockchain maintains verifiable proof of all the transactions till date. This avoids alteration of existing data, fraud, double spending, and all other kinds of manipulations.

- Blockchain can be used to execute binding contracts without the help of a trusted intermediary like a lawyer or notary. The details and conditions for the execution of

the contract can be coded on the basis of an if-then algorithm. The execution of the contract happens when conditions written on the code are met.

4.2. Problems faced by the Indian Banking System

The banking system of India is the backbone of the country's booming economy. The Indian banking industry has become extremely dynamic after the liberalization of Indian economy in 1991. Prior to 1991, Indian government played an active role in tightly regulating banking operations in the country. Reserve bank of India is the central bank of India. Reserve bank of India is in charge of issuing and suppling Indian currency called "rupee". The Reserve Bank of India (RBI) was started as a fully privately-owned bank in 1935. After the Independence of India, RBI was nationalized on 1st January 1949, and was tasked with the responsibility of controlling and regulating all the banking activities in the country. Up until 1991, private banks did not play any significant role in the economy because most banks in the country was nationalized. In 1991, the then government led by Prime Minister Narasimha Rao started giving licenses to few private banks. Also, starting from 1991, the Foreign Direct Investment (FDI) to the banking sector has been relaxed. The voting rights allowed to foreign investors used to be 10% and now it has increased to more than 70% with some restrictions.
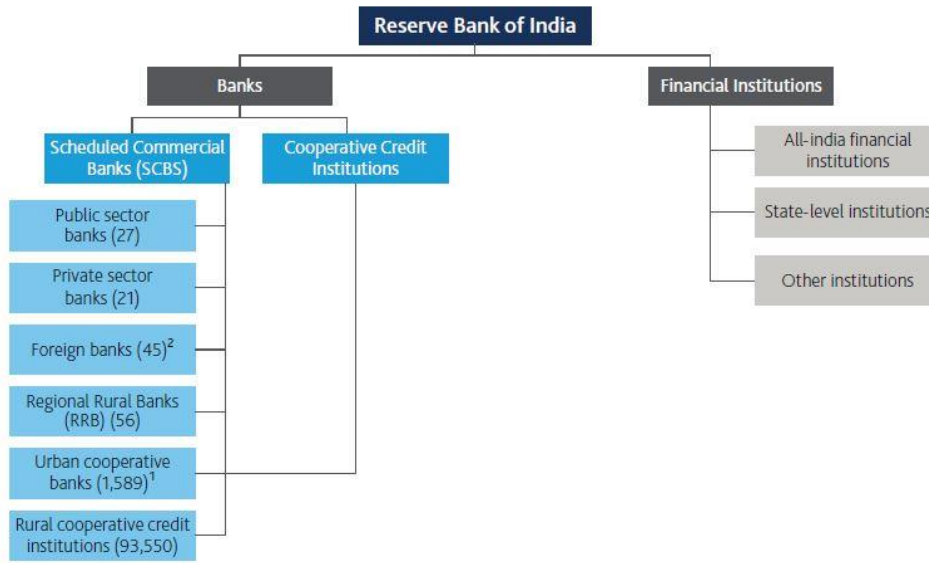
Structure of Indian Banking Sector

Figure 3: Present structure of the Indian banking industry (Moody's Analytics, 2018)

Today, there are 27 public sector banks (PSBs) were the Indian government has a stake of more than 50%. Other than the 27 public sector banks, there are 21 private banks and 49 foreign banks operating in India. There are also hundreds of rural and regional banks which plays an integral part in the Indian banking system. A brief timeline about the major events in the Indian banking history is shown in figure 4.

Year	Significance
1949	Reserve Bank of India (RBI) was nationalized on 1st January. Also, Banking Regulation Act,1949.
1969	14 commercial banks were nationalized by Prime Minister Indira Gandhi. The following banks were nationalized in 1969: Allahabad Bank, Bank of Baroda, Bank of India, Bank of Maharashtra, Central Bank of India, Canara Bank, Dena Bank, Indian Bank, Indian Overseas Bank, Punjab National Bank, Syndicate Bank, UCO Bank, Union Bank, United Bank of India
1984	Committee on Mechanization in the Banking Industry was formed. The major recommendations of this committee were introducing MICR technology in all the banks in the metropolises in India. This provided for the use of standardized cheque forms and encoders.
1988	RBI set up the Committee on Computerization in Banks. It focused on computerization of bank branches and increasing connectivity among branches through computers. It also suggested modalities for implementing on-line banking. The committee submitted its reports in 1989 and computerization began from 1993.
Early 1990s	Then government embarked on a policy of liberalization, licensing a small number of private banks. These came to be known as New Generation tech-savvy banks, and included Global Trust Bank (the first of such new generation banks to be set up), which later amalgamated with Oriental Bank of Commerce, IndusInd Bank, UTI Bank (since renamed Axis Bank), ICICI Bank and HDFC Bank.
2000-2010	Implementation of various internet enabled payment and settlement systems like RTGS, IMPS, NEFT, NECS, Online banking, Telebanking etc.
2016	Deputy Governor Rama Gandhi of RBI "urged banks to work to develop applications for digital currencies and distributed ledgers."

Figure 4: Indian banking industry from Independence till the present day

(Bijoy Bhattacharyya, 2017)

Currently, India is the fastest growing major economy in the world. The need for various banking services in both rural and urban areas are going to skyrocket in the coming years and it will in turn drive the growth of the Indian banking sector. The continuing economic liberalization and IT revolution has brought about many challenges and opportunities for players in the Indian banking system. Today, the uppermost agenda for all India banks is digitization. The main challenge concerning digitization are the security risks associated with it. External security threats include attacks like hacking, spoofing and sniffing. Internal security threats include frauds by employees. In India the literacy rate is about

72 % (Statista.com, n.d.), and because of that, the financial literacy is very poor among the population. Many people do not have the knowledge or ability to use electronic banking facilities. Older customers and customers from the rural areas prefer conventional banking methods because they fear losing money through online transactions because of fraud. Another challenge faced by the Indian banking industry is that they do not have employees who are skilled and knowledgeable about innovative technologies. One of our respondents who is a forex officer had this to say:

"We are still working on core-based solutions in which data is stored centralized and any transaction happens through branch banking, through the help of third-party payment gateways. India is a vast country where a lot of factors govern our economy, we are working on digitalization but still we are naive about lot of emerging technologies and a lot has to be done."

- Shakeb Nazmi, *Indian overseas Bank* (2019)

One of the major large-scale structural issues faced by the Indian banking industry is the burden of high non-performing loans (NPL). Non-performing loan is a loan that is in default or about to be defaulted. Non-performing loans risks not only investors funds but the country's industrial and economic growth. Loan management is plagued with inefficiencies. The collective value of Indian bank's gross non-performing assets (GNPAs) and reorganized assets touched 130 billion US dollars in 2017 (Moody's Analytics, 2018). It has been shooting up since 2013, by roughly 25%.

4.3. Blockchain Use Cases for Indian Banks

As discussed previously, Indian banks face lots of problems in a wide variety of areas. On a macro level, Indian banks are presently suffering from poor performance when it comes to debt risk. Loan management process itself is fraught with inefficiencies. Other major challenges include security risks, customer awareness, lack of skilled employees etc. To overcome many of the thorniest issues plaguing the Indian banking industry, we propose to use blockchain technology. Some of the leading banks in India are already experimenting with blockchain based solutions. One of our respondents who is a bank manager had this to say:

"I've heard the news that many of the leading Indian banks have started using blockchain technology. If I'm not wrong banks like Yes, ICICI and SBI are using it now on a small scale. Banking industry as a whole is only going to adopt it on a large scale only after thorough feasibility tests and regulatory guidance from the central bank of India."

- Deepak Faridabad, *Federal Bank* (2019)

The following are some of the specific use cases, where we believe that blockchain can revolutionize the Indian banking industry.

4.4. Consortium Banking

A consortium bank is a bank created by many other banks to finance a particular project. In India, consortium banking is one of the main ways in which large corporations take on big projects like construction of roads, airports etc. Banks come together as a consortium so

that they can diversify the financial risk among themselves. By coming together banks can

banks can divide the responsibilities of inspection of the credit worthiness of the borrower, verification of borrower's assets etc. In 1996, the Reserve Bank of India relaxed many regulations concerning the practice of consortium banking to make the credit flow to smoother. Though the relaxation of laws concerning consortium banking has been achieved, it is an area of the banking industry which is marred by fraud, money laundering etc. (Lele, 2015). The Central Vigilance Commission, which is the apex anti-corruption body of the Indian government attributes the cause of various malpractices in consortium banking to lack of effective sharing of valuable information like the borrower's credit history.

The inefficiencies of consortium banking are associated time-consuming processes, high intermediary fees, redundancies etc. (Roy, 2018). Currently, the lead arranger, who is generally an investment bank or underwriting institution who leads the consortium has to do the time consuming and tedious work of checking the borrower's financial health, industry expertise, terms and conditions of the contract etc. Agents and intermediaries usually charge large fees. The information technology system used by banks for coordinating activities are obsolete, and has lot of redundancies built unto the system.

Blockchain technology can transform the consortium banking landscape in many ways. By adopting blockchain, selection standards for choosing syndicate members can be coded into smart contracts. Smart contracts are self-executing contracts. This will speed up the process of syndicate formation. Due diligence for things like underwriting of loans can be automated thereby reducing the turnaround time. By digitizing terms and conditions of the contracts, validations are automated. Blockchain gets rid of the need to duplicate

documents because it has the immutability feature. Smart contracts can enable instantaneous loan approvals and payment settlements.

Because of the various merits of blockchain technology, 11 of the major Indian banks decided to use blockchain based funding for small and medium size enterprises. The consortium called as the Blockchain Infrastructure Company (BIC), was put together in January of 2019 (CryptoSlate, 2019). Commenting on this initiate Akhil Handa (Head of fintech and new business initiatives, Bank of Baroda) had this to say:

"All these supply-chain players, banks, logistics partners, customs, etc. have different technological platforms and technical competence… a common blockchain network harmonizes the requirements and lets everyone see the flow of the trade on a single platform."

- Akhil Handa, *Bank of Baroda* (2019)

4.5. Payments

In the years after liberalization of Indian economy, the banking sector has achieved tremendous successes. The banking industry was always very enthusiastic about implementing electronic payments to enhance the operational efficiency of banking system. Traditionally, the Indian payment settlement scene have been dominated by transactions based on paper. After the dawn of the electronic payment system, the banking sector has witnessed tremendous progress. With many of the existing payment services in India, it is difficult to follow the flow of money. With the existing KYC rules, it is hard to connect the

name of a bank account holder to an identifiable party. Also, when conducting transactions of large sums of money, most of the transactions need to done at the local bank branch and not online. One of our respondents who manages a bank branch in India said the following about the problems related to payments.

"Today, customers have very little patience when it comes to making a payment or transaction at the bank branch. It is not enough that the money will reach the other party in a day or two. If immediate payment settlement can be brought about with the introduction of technologies like blockchain it will be a revolutionary change to the banking business in India."

- Renjith Jose, *South Indian Bank* (2019)

Blockchain can create better efficiencies in payment settlement system. Blockchain is a near perfect candidate for reconciling transactions and settlement across all the parties involved in the payment chain. Blockchain is a distributed ledger and this aspect of the technology helps in recording payment transactions and fortifies them using cryptographic algorithms and keys. Decentralized authority and control features of blockchain makes it so that common information is kept with all the parties in the network and it eliminates the need for any kind of financial institution like a central clearing house, which now acts as a mediator between banks for payment settlement. Even though, payments within India has been made swift now, cross border payments still take lots manual processing throughout the lifecycle of the process. Large number of documents need to be presented to bank authorities to send or receive money from abroad. Payment settlement services which are

based on blockchain charge less than a percent in transaction fees today for cross-border payments (Khandaker, 2019). The transactions only take seconds to complete, and therefore it provides boosted customer experience. Some Indian banks are already taking actions to adopt blockchain based payment solutions. Federal bank Ltd., which is a leading private bank in India has partnered with US based payment service Ripple XRP, that uses blockchain technology to facilitate international cross-border payments (Green, 2019).

Blockchain technology offers powerful solutions for Indian banks to remain competitive by lowering fees and delivering instantaneous transactions, thereby creating great customer experience. However, currently the use of blockchain or cryptocurrencies for payment settlement by banking institutions is limited by regulatory power of the Indian state. In April 2018, The Reserve Bank of India (RBI) ordered financial institutions to halt offering services to businesses that are involved with cryptocurrency (Bitcoinst, 2018). Common grounds need to be recognized to realize a sufficient compromise where all stakeholders associated with financial markets can benefit.

4.6. Smart Contracts

"The Indian government is hostile towards cryptocurrencies like Bitcoin and Ethereum. But I believe that they are very welcoming towards the adoption of blockchain technology in various fields, including banking."

- Deepak Faridabad, *Federal Bank* (2019)

Any transfer of financial assets or instruments involves three steps. They are execution, clearing and settlement. Execution is when a seller agrees to sell a financial instrument and the buyer agrees to buy that particular instrument in a lawfully enforceable deal. Next step is the clearing transaction where in the accounts of both the buyer and seller is updated and arrangements for the transfer of money and assets are made. Settlement is the final step in which ownership of assets are changed and money is transferred to the seller. Because of the nature and complexity of these transactions, financial institutions like banks have to pour substantial resources into administrating these transactions. According to a report prepared by Capgemini the adoption of smart contracts by retail banks and insurance companies alone can save 3 to 11 billion US dollars in overhead costs (Capegemini, 2016).

Smart contracts, by only becoming executable when the terms and conditions of the contract are satisfied, are best suited to decrease the complexity and operational costs of clearing and settlements for Indian banks. Smart contracts are contracts that are stored in blockchain that will execute by themselves when the terms and conditions between the parties meet. The terms of the contract exist as lines of code, across a decentralized and distributed blockchain network. They allow anonymous parties to carry out trusted transactions without the necessity of a central authority, arbitrator or any kind of external enforcement mechanism. Smart contracts can make transaction transparent, irreversible and traceable. When two parties who signup for smart contract, the money of one party will stay in an escrow account and it will only be released when the terms and conditions of the contract are satisfied by the other party. Smart contracts can potentially have many use cases for the Indian banking industry. Blockchain networks can register the ownership of

financial and non-financial assets, and also their transfer and sale of rights. Smart contract can be a mechanism of registering and managing intellectual property, digital assets etc. The working of a smart contract is shown in figure 5.
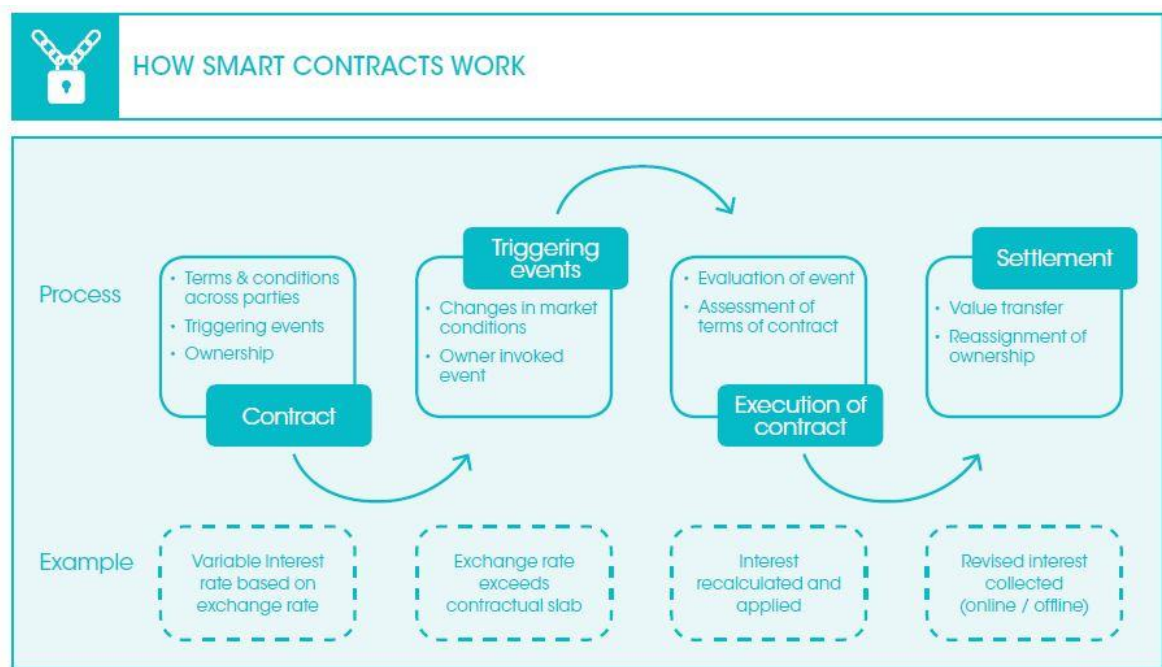

Figure 5: How smart contracts work (Suparna Dhar, 2016)

"I have read about smart contracts. It seems like once a smart contract is made it cannot be forged and there is no need of a third-party enforcer. It might be even applicable to complex long-term contracts and not just to share market and forex market trading. The Indian regulatory authorities will need to catch up with the pace of development in smart contracts and blockchain technology."

- Sachin Dinesh, *Deloitte India* (2019)

4.7. Know Your Customer (KYC)

Blockchain technology-based KYC solutions will be capable of actively monitoring the KYC process from beginning to end, from opening of an account to day to day transactions. Know Your Customer or KYC is a standard operating procedure conducted by banks and other financial institutions to verify the identity of their clients, evaluate the client's suitability for loans, and also to eliminate potential risks or illegal motives that will hinder the banks business relationship with the client. KYC processes done by banks all over the world are generally repetitive, unreliable and duplicated, which leads to high overheads and costs. In India too the KYC is an integral procedure to the operations of banking system. According to the Reserve Bank of India (RBI), KYC is performed in order to confirm three things: the real identity of the customer, whether the client/business is compliant with various statutory regulations concerning taxes, and to know whether the business is legal under the laws of the land (RBI, 2018).

Presently is India, KYC procedure is a very lengthy and laborious task. It contains lots of documentation works, compliance checks and requires different levels of approvals. In lots of cases, a normal KYC procedure can take up to 2 or 3 weeks to complete. It also necessitates an enormous cost to Indian banks. Even though the KYC procedure is a legal requirement for banks and financial institutions, the way it is carried out in India creates an unhappy experience for the clients. Over the years, Indian banks and other financial institutions have made use of various technologies to improve the KYC procedure by automating it. But KYC procedure still is time consuming and costly. Blockchain

technology has the potential to make KYC procedure very simple and cost effective. Preferably, KYC procedure should be something that only requires minimal interaction with the customer to create a great user experience. At present, customers are required to submit various documents to proof their identity, credit worthiness, compliance etc. In India, the documents that are collected through KYC procedure is gathered and stored by banks in their own document management system or database. Indian banks to have access to a centralized database, and they manually verify the documents they have with the centralized database to check and validate the authenticity of the submitted documents.

By adopting blockchain technology for KYC procedure, banks in India can significantly improve the time required to complete the procedure. It will be really easy for Indian banks to access company information like incorporation documents, financial statements, key personnel information etc. Shorter cycle time for KYC procedure means improved customer experience. Not only that, a blockchain based KYC solution will eliminate unnecessary paperwork for both banks and clients. Today in India, KYC procedure is performed with the help of centralized databases. It has got a client/model where the authority of the information is concentrated at one central server. This makes the data stored in the server very vulnerable to cyber-attacks. Since blockchain network is a distributed ledger, it can resist cyber attacks much better than any centralized system that exists today. Jointly with smart contracts, blockchain based KYC procedure will have preprogrammed criteria to stop frauds and send alert banks in case of any wrongdoings. Early and timely detection of fraudulent activities in the KYC procedure would help eliminate many of crimes that the Indian banks face today. The Government will also profit

from the adoption of India banks. The regulators and risk officers will have improved data accessibility, and it will make the relationship between banks and regulators more transparent leading to huge drop in financial crimes in the country. The following is a blockchain based step by step solution to a better KYC process:

Step 1: Client logs into the KYC application on his/her computer or any other device.

Step 2: On the application, the client selects the bank to which she wants to submit her documents for verification.

Step 3: A pending authentication alert will appear on the bank's terminal.

Step 4: Once the due diligence is done by an agent of the bank, the clients KYC application will be approved or denied. On approval, the transaction is sent to the blockchain network for execution.

Step 5: Once the transaction is successfully added to the blockchain, a unique address is generated, where the information is stored. This creates an immutable time stamped record of the client on the blockchain. The client will be notified about this.

Now, the client can get her KYC procedure done and get verified in an instant because she has a unique address from her previous bank. This is how blockchain based KYC solution can save cost and redundancy.
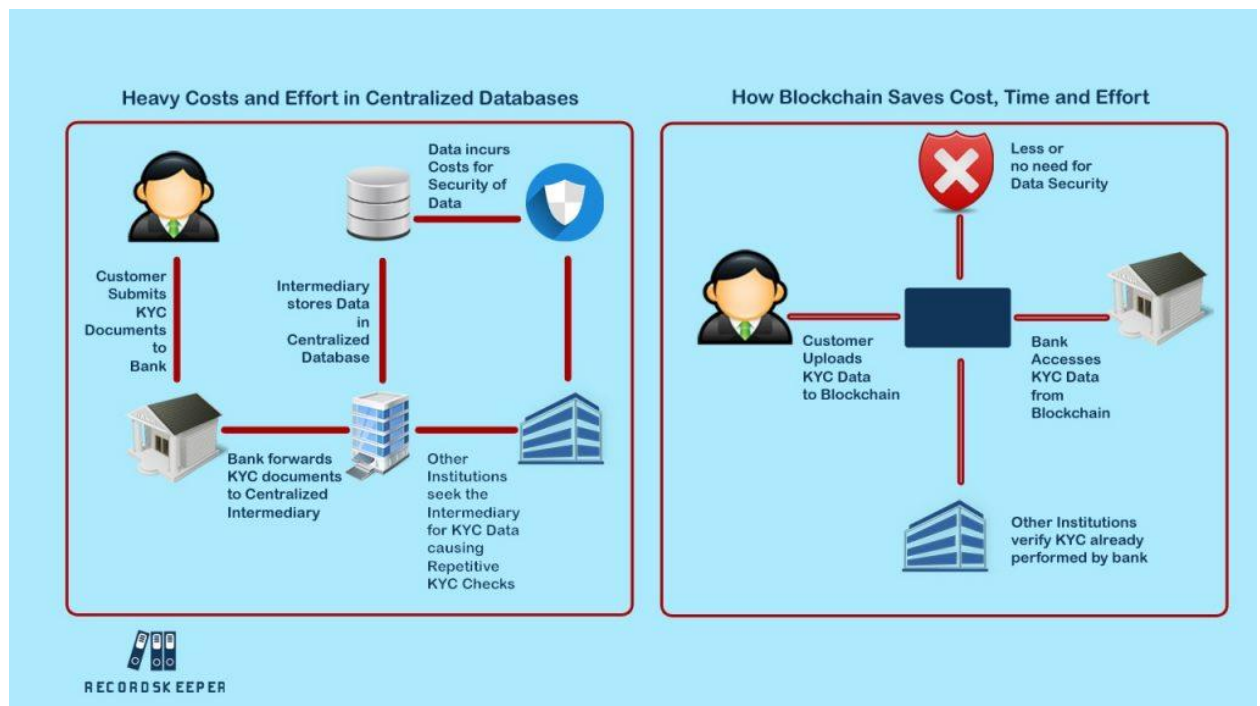
Figure 6: Blockchain based KYC solution (Davies, n.d.)

4.8. Trade Finances

Blockchain technology can lessen the processing rime, get rid of paper and save money in trade financing transactions, all the while guaranteeing trust, security and transparency. Trade finance indicates financing for trade. It deals with import and export trade transactions, both domestic and international trade. Trade financing enables companies to ship and deliver goods even when they do not sufficient cash flow to finance the trade transaction by themselves. Trade financing is facilitated by various intermediaries like banks and financial institutions. In India, small and medium size business often have very inadequate access to loans and other forms of short-term financing for the goods they decide to buy or sell. Even if purchase order is confirmed for products by a foreign entity,

many Indian banks will not offer funds or overdraft facilities for these kinds of transactions. Small and medium size businesses do not want their money to be tied up in shipments of goods for a month or two. It is estimated at over 80 percent of global trade relies on the availability of trade financing. According to the Asian Development Bank (ADB), there is a 1.5 trillion-dollar gap between demand and supply of global trade finance (ADB, 2017). Half of the gap in demand and supply arises in Asia, and 70% of it is related to MSMEs (Micro, small and medium enterprises) units and mid-cap companies (Singhal, 2018).

Currently the main reason why Indian banks are reluctant to finance the trade activities of small and medium size companies is the risk associated with non-payment of funds. Introducing blockchain technology will help to weed out bad actors and compel everyone to abide by the terms and conditions of the trade agreement in a transparent way. This will lead to the reduction of various risks that are associated by the prevailing trade financing methods of Indian banks.

With the integration of blockchain technology to trade finance, the shipment of goods and their present location will be easily traceable. Not only that, the information of related goods could be broadcasted to or from the new owner in real time for possible action. The transparency of blockchain networks can reduce delays in commerce. Details of transactions against the commercial agreements helps to foster further trust. In the blockchain network, each transaction is logged sequentially and indefinitely. It offers an immutable audit trail for the life of an asset between different parties. Each and every transaction will be authenticated within the blockchain network by means of independently verified complex cryptography. There will not be any room to doubt the authenticity of the

information that will be recorded. Blockchain will make the trade financing activities more collaborative by allowing each party to share trade finance related data effortlessly and in a secure manner. The independent trade finance managing systems that are used by many of the Indian banks are very fragmented and unsystematic. With the adoption of blockchain technology, these fragmented systems will be centralized and unified allowing interoperability. Most importantly what blockchain will be doing to trade finance, will be making it more efficient. Trade transactions will be completed directly between without any need of an intermediary and with digitized information. Smart contracts will become operable, and this will help triggering commercial actions automatically when conditions are met.

4.9. Current Applications of Blockchain Technology in India

In present-day India, some governmental agencies and many startup companies have taken a wide variety of initiatives to harness the power of blockchain technology in non-banking sectors. Even though this report focused on the application of blockchain technology in the Indian banking industry, it is very relevant to discuss the present-day application of blockchain technology in the Indian market which deals with industries other than banking.

In 2017, the government of the south Indian state of Andhra Pradesh implemented a blockchain pilot to ensure the authenticity of land records in their state. They wanted to make sure that a particular land belongs to a traceable owner. In the state of Andhra Pradesh, disputes related to property form more than 60% of civil lawsuits. These civil lawsuits happen mostly because of fraudulent land records (Vijaya Kittu Manda, 2018).

Most of the state governments in India still use paper documents to manage land records with little or no digitization. With the help of the newly implemented blockchain pilot project for land property registration and transfer, the government of Andhra Pradesh hopes to conduct effective and efficient governance. The government of Andhra Pradesh also has another blockchain project to streamline vehicle registrations (Haridas, 2018). The state devices to ultimately implement blockchain across the whole administration. The Telecom Regulatory Authority of India (TRAI), which is the regulator of telecommunication industry is in the course of employing blockchain technology to stop unwanted spam telephone calls by telemarketers (Pandey, 2018). TRAI hopes to use distributed ledger function of blockchain technology to control the flow of commercial communication networks.

Many blockchain based Indian startup companies have sprung up in recent years. SOMISH is a product development company that focuses on creating automation systems using blockchain and other cutting-edge technologies (SOMISH, n.d.). They have built up their reputation by working on various blockchain based use cases like peer to peer insurance, aviation maintenance log, various sorts of fund distribution etc. SpringRole is another blockchain based startup company from Bengaluru, India that is building business. They are an employment-oriented networking company similar to LinkedIn (SpringRole, n.d.). SpringRole is a first of its kind professional reputation network that utilizes AI and blockchain technology to eradicate fraud from user profiles. SpringRole uses smart contracts to authenticate work experience and reputation, which solidifies the reputation of the users. Records Keeper in one another innovative blockchain based Indian startup that

offers incorruptible storage facility for digital documents (Records Keeper, n.d.). Records Keeper aims to replace Google Drive and Dropbox as the internet's favorite data storage company. There are many other startups that are working on blockchain based solutions in different Industries in India. Because of the unique characteristics of the technology most of the prominent industries will be dealing with blockchain technology in one form or another. In India, banking industry still tops the list of many proponents of blockchain technology as the industry that will be most transformed by the adoption of blockchain technology.

Chapter 5: Data Analysis (Interview & Questionnaire)

The questionnaire survey was conducted using Google forms between 15th of May 2019 and 23nd of May 2019. A sample of 30 Indian nationals from mainly three industry backgrounds (Information technology, Banking & Finance, Consulting) and varying knowledge of blockchain technology were polled. All of the respondents had good knowledge about the workings of Indian banking industry. But, some of the respondents had only little understanding of blockchain technology. Kindly refer to Appendix A for the questions that were used in the questionnaire. Seven people were interviewed for 30 to 45 minutes. Semi-structured form of interview was used to gather information. The list of interview participants is given in Appendix B and list of questions used in the interview are shown in Appendix C. The questionnaire was designed to understand three things: the knowledge of blockchain technology among participants, the perceived benefits and attributes of blockchain technology with respect to the Indian banking industry, and finally to understand the perceived use case scenarios and adoption challenges for blockchain technology.

5.1. Knowledge of Blockchain Technology among Participants

Of the thirty respondents who answered the questionnaire, fourteen worked in an Information Technology company, five worked for an Indian Bank, three worked for Financial & Insurance Services Company, two worked for a consulting company and six people chose "other" as their employer. The people who chose "other" worked in fields like marketing, media, healthcare etc. Figure 3 shows the breakup of respondents.
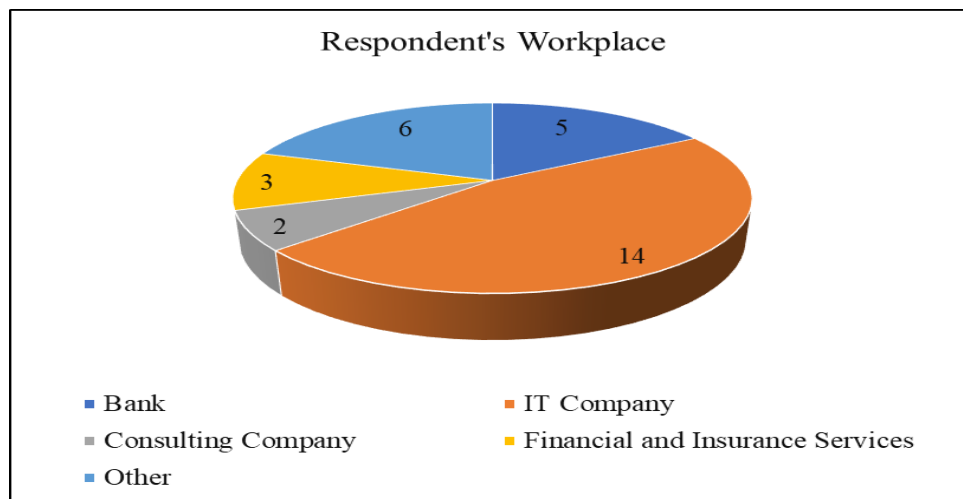
Figure 7. Respondent's workplace

The familiarity regarding blockchain varied widely among the respondents. Only 13.3 % of all the respondents said that they are very familiar with blockchain technology. 46.7 % of the respondents said that they were only somewhat familiar with the technology. 26.7 % of the respondents only heard of the term. 10 % of the respondents had no idea about the technology and 3.3 % of the respondents were generally unfamiliar with it.
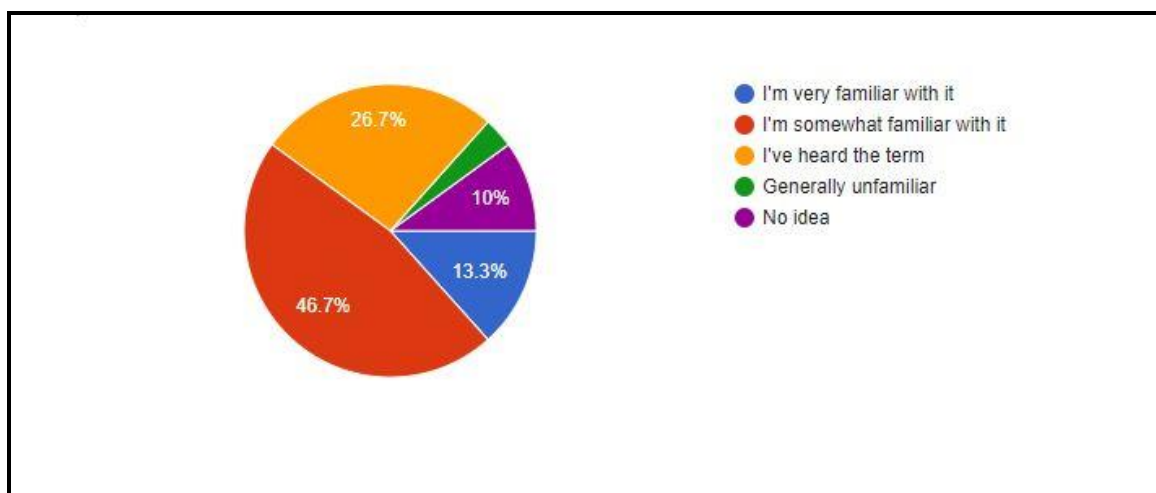

Figure 8. Familiarity with 'Blockchain' Technology

Interestingly, all the people who said that they are very familiar with blockchain technology were working for information technology companies. Of all the five bankers surveyed for the research, three bankers had heard of the term 'blockchain'. One banker answered that he is generally unfamiliar, and another banker had no idea about blockchain technology. One of the respondents who is banker said the following:

"My knowledge of blockchain is very limited. I do understand it as an accounting technology. I also know that blockchain is the technology that enables bitcoin and other cryptocurrencies. Other than that, I do not have any idea about blockchain or how it is going to impact the Indian banking sector. I think bank managers are not well versed about the innovative financial technologies out there"

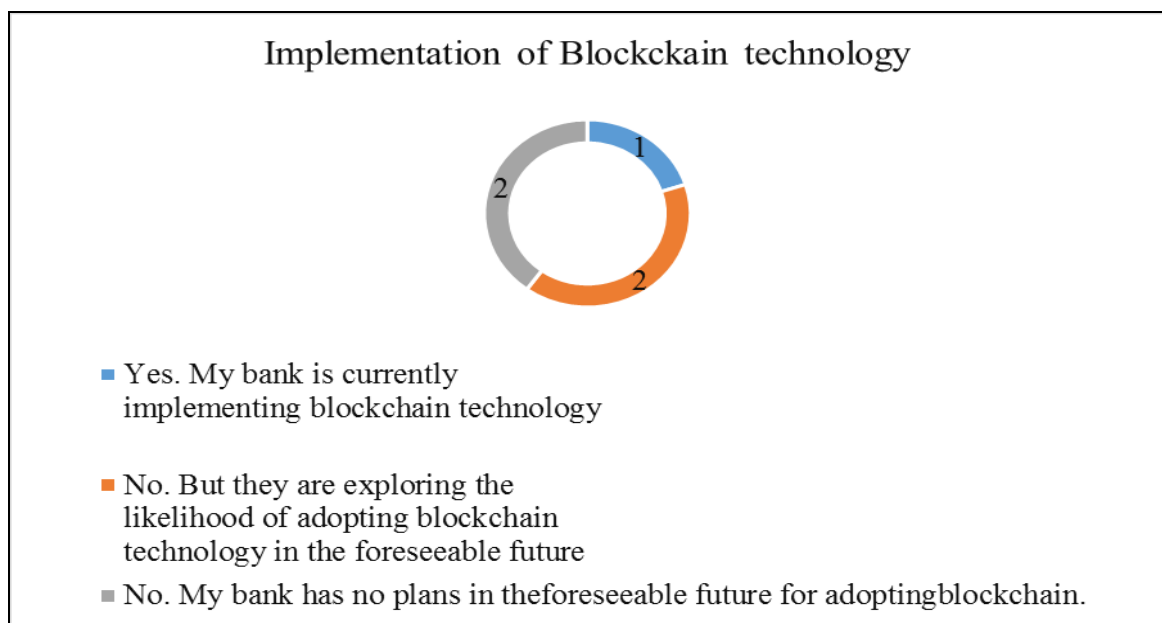- Renjith Jose, *South Indian Bank* (2019)

Figure 9. Implementation of Blockchain Technology

We questioned the five bankers who participated in the survey about whether the Bank they work for currently are implementing Blockchain technology, all but one banker said yes. Of the four bankers who responded in the negative to the question, two bankers said that their banks have no plans in the foreseeable future for adopting Blockchain technology. The remaining two bankers where of the opinion that even though their bank is not implementing Blockchain technology, they are exploring the likelihood of adopting it in the foreseeable future.

5.2. Benefits & Attributes of Blockchain Technology

We asked all respondents about the perceived benefits of Blockchain technology to the Indian banking industry. Respondents were given the choice to select multiple answers for the question. Almost half of the people surveyed chose "Better data protection" and "Improved transaction visibility and integrity" as the main benefits that they expect Blockchain technology will bring to the Indian banking sector.
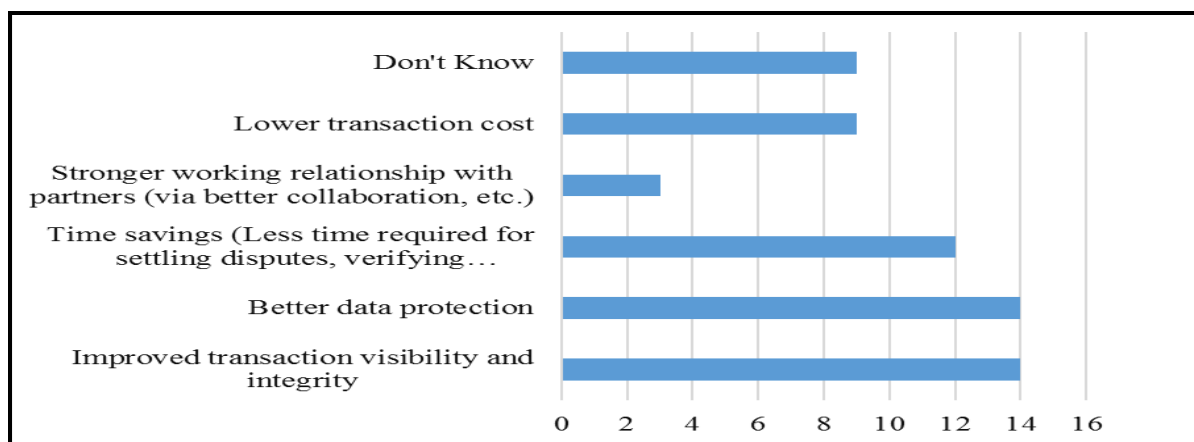

Figure 10. Perceived Benefits of Blockchain Technology to the Indian Banking Industry
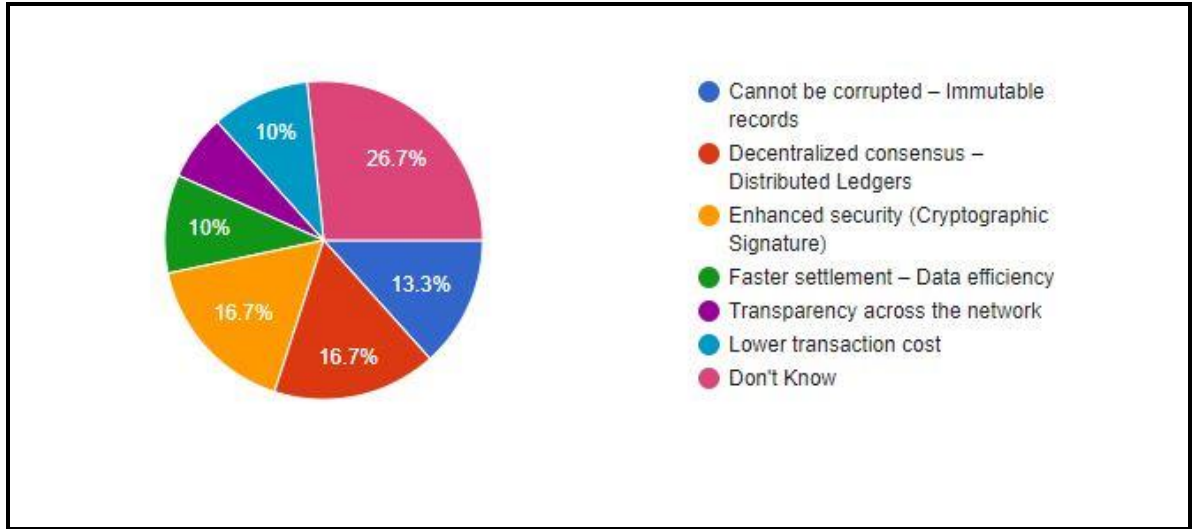
Figure 11. Perceived attributes of Blockchain Technology that makes it attractive to Indian

banking Industry.

We saw that 26.7 % respondents (8 out of 30) did not know which principal attribute/characteristic of Blockchain technology was attractive to the Indian banking industry. 16.7 % of respondents thought that "Decentralized Consensus – Distributed Ledgers" were the most attractive characteristic and another 16.7 % or respondents thought that "Enhanced security (Cryptographic Signature)" was the most attractive attribute of Blockchain technology to the Indian banking industry.

As shown in Figure 12, two respondents said that Blockchain technology will disrupt the Indian banking industry. Ten respondents answered "Maybe" and seven respondents answered "Too early to tell" to the possibility of Blockchain technology disrupting the Indian banking industry. Seven respondents answered "Don't know" to the same question. Only two out of thirty respondents did rule out even the possibility of Blockchain

technology disrupting the Indian banking industry. Twenty-one out of thirty respondents were at least open to the possibility of Blockchain transforming the Indian banking industry.
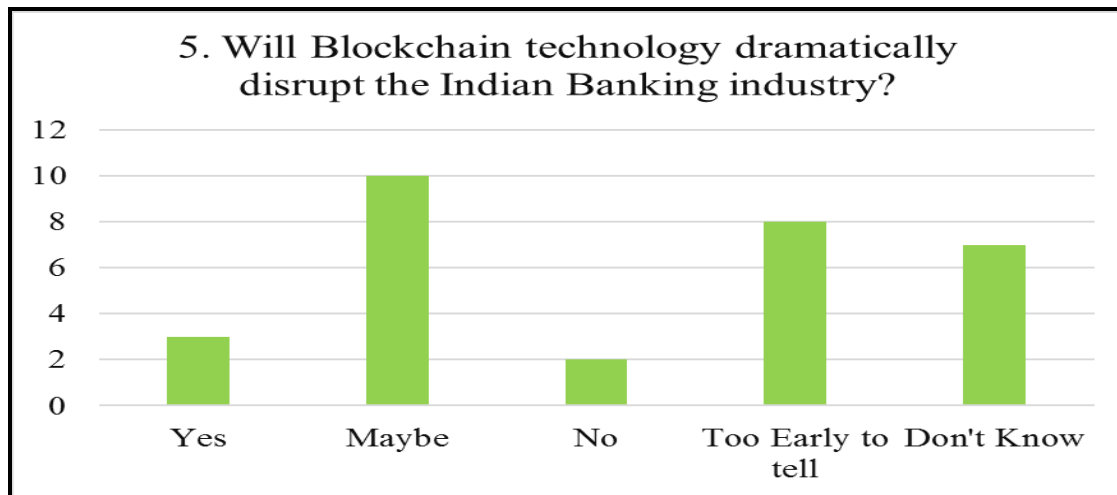

Figure 12. Likelihood of Blockchain technology disrupting the Indian Banking Industry

5.3. Blockchain Technology Use Scenarios & Adoption Challenges

The most voted on Blockchain technology use scenario was "Payment Settlement", followed by "Smart contracts" and "Consortium banking". Nine out of thirty respondents chose "Payment Settlement" as the most likely Blockchain use scenario for Indian banks. As shown in figure 13, eleven out of thirty respondents or 36.7 % of the respondents did not know which was the most likely use case scenario for Blockchain technology in the context of India banking industry.
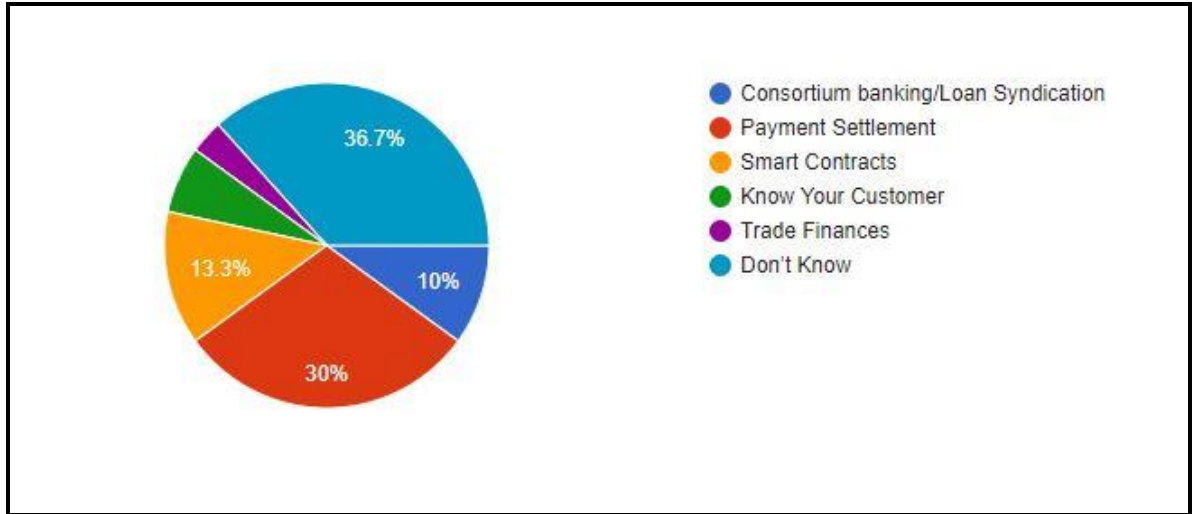
Figure 13. Likely Blockchain use scenario for Indian banks

According to respondents the biggest adoption challenge to Indian bank's efforts to use Blockchain technology was the fact that Blockchains are still an emerging technology. Since it is still an emerging technology, many in the Indian banking industry lack the understanding about the potential usage and benefits of adopting Blockchain for their business purposes. The second most voted on adoption challenge was regarding the regulatory constraints by the Government with respect to Blockchain technology. The third most voted on adoption challenge was the absence of industry standards for Blockchain technology at the moment. As shown in figure 15, when asked about the importance of the development of industry standards and practices for supporting Blockchain platforms/applications/commercial products, most of the respondents answered it is "Very important" or "Important". 43.3 % of the respondents affirmed that standard frameworks and practices have a role to play in the effective adoption of Blockchain technology by the Indian banking industry. And, 26.7 % respondents affirmed that Industry standards &

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practices will be critical for the successful adoption of Blockchain in the Indian banking industry.
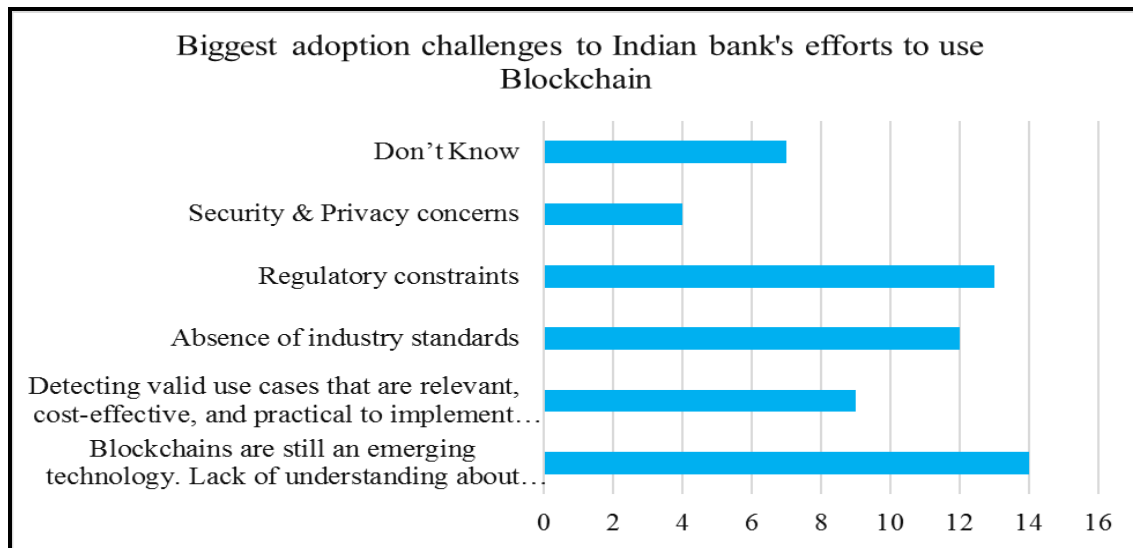

Figure 14. Biggest adoption challenges to Indian bank's efforts to use Blockchain technology
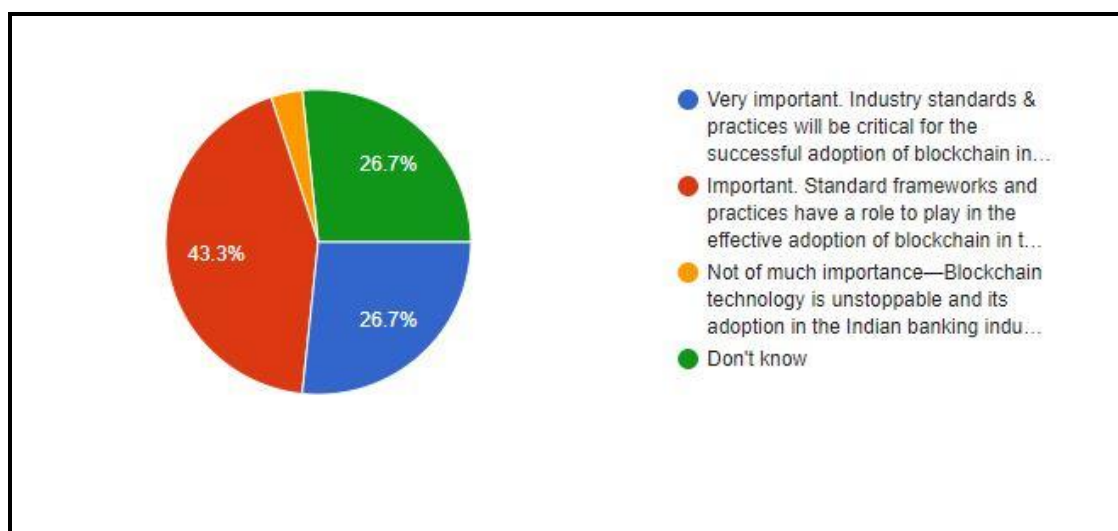

Figure 15. Importance of Industry standards in the proliferation of Blockchain Technology

Chapter 6: Findings & Conclusions

6.1. Findings of the study

Overall, the respondents of the interview and questionnaire were positive about Blockchain technology's potential in transforming the Indian banking industry. Most participants in our report believed in the ability of Blockchain technology to reach scale and mainstream adoption. Respondents from Information technology background were more informed and knowledgeable about the potential of Blockchain technology than people from Banking and Finance backgrounds. Most participants in the study saw regulatory constraints and lack of industry standards as the biggest adoption challenge faced by Blockchain being adopted by the Indian banking industry. One of our respondents who is a marketing research entrepreneur had this to say:

"Large scale adoption of blockchain technology will be met with resistance from the various regulatory bodies of the Indian government since it is going to cause an extreme change."

-   Sandeep Panazhi, *Oceanof Panels* (2019)

The first research question was the following:

RQ1: What is the main advantage of Blockchain technology over existing systems used by Indian banks?

The advantages of Blockchain technology over existing systems used by Indian banks are decentralization, immutability, more security, and more transparency. From our study it can

be concluded that the main advantage of Blockchain technology over existing systems used by Indian banks is that it can create trust without the need for a centralized authority. But, at this moment in the context of Indian banking system it is hard to conclude that decentralized trust has the potential to replace centralized trust in the Indian banking sector.

H1: Decentralized trust has the potential to replace centralized trust in the Indian banking sector

Most respondents who participated in the interview and survey were unsure about the possibility of Indian banks adopting Blockchain technology which is totally decentralized. So, this hypothesis can be considered to be disproven.

H2: Cost-effectiveness created by the adoption of Blockchain technology is the main attraction of Blockchain technology for Indian banks over existing systems.

Though cost-effectiveness created by Blockchain technology is very appealing to the Indian banking industry, the information gathered from interviews and surveys suggest that decentralized consensus and enhanced security features of Blockchain technology are more attractive to the Indian banking sector rather than cost-effectiveness. So, this hypothesis can be considered to be disproven.

The second research question was the following:

RQ2: Are Indian banks ready to adopt such a disruptive technology like Blockchain?

Since the benefits of adopting Blockchain technology by the Indian banking industry significantly outweighs the costs, it is safe to conclude that Indian banks are very much ready to adopt the technology.

H3: Indian banks will adopt Blockchain technology in their business operations in the near future.

This hypothesis is proven right. Many banks in India have already adopted Blockchain based solutions for services like consortium banking. There are no reasons to doubt the likelihood of Blockchain based solutions appearing in different areas of Indian banking.

H4: Indian regulators will not hinder the adoption of Blockchain technology by Indian banks.

The results from this study shows that in order for the successful adoption of blockchain technology by the Indian banking industry, questions around the legal and regulatory framework needs to be resolved by the Indian government. Indian regulators will have a big role in determining how well blockchain technology will be utilized by the banks in the country. Engagement with Indian regulators in all aspects of the technology adoption lifecycle is a must for Indian banks to successfully unlock all the potential benefits that is offered by blockchain technology. Engaging with Indian regulators by educating them about the technology, figuring out ways to determine the risks and coming up with tailor-made solutions for their specific problems is the way ahead for Indian banks with respect to blockchain technology.

6.2. Limitations of the study

The literature review and methodology have certain limitations. The literature that was selected for this study was very dependent on few key words like "Blockchain", "Indian Banking" etc. From the beginning of the study, it was difficult to define keywords correctly to choose relevant literature. As Blockchain technology is quite young, most of the articles and literature found on the subject matter were conceptual in nature. Though few empirical studies were found, but they were not very relevant for this study. It was also difficult to find respondents for interview and survey who are knowledgeable about both Blockchain technology and the banking industry in India.

6.3. Conclusion

Blockchain technology has enormous potential to shakeup the Indian banking industry. Many advocates of blockchain technology usage see it as at par with the Internet. Internet made the sharing of information possible on large-scale, whereas blockchain technology is seen to possess the ability to store and share value on a large-scale. Indian banking firms have to comprehend the main feature of this technology and figure out how they can solve many of their current business and operational problems by adopting blockchain technology-based solutions. Indian banks need to identify opportunities, conduct feasibility studies and assess proof of concepts.

In this independent final report, we have analyzed the potential disrupting effect of blockchain technology on the Indian banking industry. Blockchain technology was originally developed to evade intermediation. But, if Indian banks are going to make use of

blockchain technology, there is a high probability that it will be directed toward centralized control by a consortium of banks or by the government. In the Indian context, blockchain technology has the potential to streamline banking services and also offer financial inclusion to unbanked citizens of the country. Blockchain can bring transparency to payment rains and ownership titles. Since, blockchain technology is still in the emergent phase, there are many unknowns with respect to how it will be adopted by the Indian banking industry. We believe that this independent final report was able to contemplate and highlight at least some of the potential implications of blockchain technology adoption by the Indian banking industry.

6.4. Future Research

Blockchain technology is expected to cause disruption in many industries, and most enthusiasts of the potentials of this technology see the financial industry as the field that will be most affected. Our research focused on the potentials of blockchain technology adoption by the Indian banking industry. There are many unexplored questions and areas of blockchain technology adoption by the Indian banking industry. Our research dealt with only five use cases of the blockchain technology: Consortium Banking, Payments, Smart Contracts, Know Your Customer (KYC) and Trade Finances. There are plenty other use case scenarios of blockchain technology that can be conceptualized for the banking industry and financial industry at large. The adoption of blockchain technology demands an exhaustive technological and regulatory assessment. In order to have widespread adoption of blockchain, increased societal awareness and sound technical expertise are indispensable.

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Appendix

Appendix A

Blockchain Adoption by the Indian Banking Industry
* Required

1. **Name of your employer [You can skip this question if you want to]**

   _____

2. **Please state your designation**

   _____

3. **The organization you work for is a** *
   Mark only one oval.

   ◯ Bank

   ◯ IT Company

   ◯ Consulting company

   ◯ Financial and Insurance Services

   ◯ Other

4. **1. What's your level of familiarity with 'Blockchain' technology?** *
   Mark only one oval.

   ◯ I'm very familiar with it

   ◯ I'm somewhat familiar with it

   ◯ I've heard the term

   ◯ Generally unfamiliar

   ◯ No idea

5. **2. Is the Bank you work for currently implementing Blockchain technology? [Answer only if you work for a bank, otherwise please select "I do not work for a bank"]** *
   Mark only one oval.

   ◯ Yes. My bank is currently implementing blockchain technology.

   ◯ No. But they are exploring the likelihood of adopting blockchain technology in the foreseeable future

   ◯ No. My bank has no plans in the foreseeable future for adopting blockchain.

   ◯ I do not work for a bank

   ◯ Don't know

6. **3. What benefits (specific to the banking industry) do you expect from Blockchain technology being adopted by Indian Banks? [Please select all that is applicable]** *

Check all that apply.

☐ Improved transaction visibility and integrity

☐ Better data protection

☐ Time savings (Less time required for settling disputes, verifying transactions, finding information etc. leading to fast settlement & deliveries.)

☐ Stronger working relationship with partners (via better collaboration, etc.)

☐ Lower transaction cost

☐ Don't know

7. **4. Which is the principal attribute/characteristic of Blockchain technology that makes it attractive to Indian banking industry?** *

Mark only one oval.

◯ Cannot be corrupted – Immutable records

◯ Decentralized consensus – Distributed Ledgers

◯ Enhanced security (Cryptographic Signature)

◯ Faster settlement – Data efficiency

◯ Transparency across the network

◯ Lower transaction cost

◯ Don't Know

8. **5. Will Blockchain technology dramatically disrupt the Indian Banking industry?** *

Mark only one oval.

◯ Yes

◯ Maybe

◯ No

◯ Too early to tell

◯ Don't know

9. **6. Which Blockchain use scenario do you see as the most likely to be adopted by Indian Banks?** *

Mark only one oval.

◯ Consortium banking/Loan Syndication

◯ Payment Settlement

◯ Smart Contracts

◯ Know Your Customer

◯ Trade Finances

◯ Don't Know

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10. **7. What do you think are the biggest adoption challenges to Indian bank's efforts to use Blockchain? [Please Select All That is Applicable] ***

Check all that apply.

☐ Blockchains are still an emerging technology. Lack of understanding about the potential usage and benefits blockchain

☐ Detecting valid use cases that are relevant, cost-effective, and practical to implement for the Indian banking industry

☐ Absence of industry standards

☐ Regulatory constraints

☐ Security & Privacy concerns

☐ Don't Know

11. **8. Is your bank developing/planning to develop & implement its blockchain solutions in house? Or are they going to use external specialists/consulting firms who specialize in the application of blockchain? [Answer only if you work for a bank, otherwise please select "I do not work for a bank"] ***

Mark only one oval.

○ Currently developing or planning to develop within the company.

○ Will use outside specialists/consultants

○ I do not work for a bank

○ Don't Know

12. **9. What level of importance do you attach to the development of industry standards and practices for supporting Blockchain platforms, applications, and commercial products? ***

Mark only one oval.

○ Very important. Industry standards & practices will be critical for the successful adoption of blockchain in the Indian banking industry.

○ Important. Standard frameworks and practices have a role to play in the effective adoption of blockchain in the Indian banking industry.

○ Not of much importance—Blockchain technology is unstoppable and its adoption in the Indian banking industry will be widespread.

○ Don't know

13. **10. Thank you for the response. If you have anything more to add about the likely adoption of Blockchain technology by the Indian banking industry, kindly write down your response.**

_____

_____

_____

_____

_____

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Appendix B

List of Interviewees

#	Name	Title	Industry/Sector	Company	Country	Interview Date
1	Deepak Faridabad	Manager	Banking	Federal Bank	India	5/11/2019
2	Nived Vasukuttan	Insurance Executive	Financial Services	DAMAC Properties	United Arab Emirates	5/12/2019
3	Ram Mohan	Senior Software Engineer	Technology	Toshiba Software India Private Limited	India	5/15/2019
4	Renjit Jose	Assistant Officer In charge	Banking	South Indian Bank	India	5/16/2019
5	Sachin Dinesh	Business Analyst	Technology Consulting	Deloitte India	India	5/16/2019
6	Sandeep Panazhi	Entrepreneur	Marketing Research	Oceanof Panels	India	5/10/2019
7	Shakeb Nazmi	Forex Officer	Banking	Indian overseas Bank	India	5/15/2019

Appendix C

Interview Questions

1. How familiar are you with blockchain technology?

2. Why do you think banks in India are going to use or not going to use Blockchain technology?

3. What are the different challenges and opportunities offered by Blockchain to the Indian Banking Industry?

4. Are you familiar with any use cases in your bank or the in the Indian Banking Industry as a whole?

5. What do you see as a really good use case for Blockchain in the Indian Banking sector?

6. Are you familiar with smart contracts? Can smart contracts be applied for long-term and complex contracts?

7. Do you think Indian Regulators are going to support the adoption of Blockchain technology by the Indian Banking Industry?

8. What are the characteristics of Indian Market that you think will either propel it forward in regards to blockchain adoption or stifle its path?

9. Does Indian government view digital assets favorably? Do you think the government will create legal framework which will allow innovation to happen and various use cases/trials to go ahead?