Winter 2022 CS 687 Capstone Project
Progress Report
Information Security in Banking and the Blockchain Connection

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Abstract

More consumers are using technology based applications for digital payments and their banking needs. Blockchain has emerged as a key technology that may greatly impact the future of financial services. Banks have an opportunity to use blockchain as a solution that can keep data secure and their customers satisfied. Blockchain characteristics align with key aspects of information security. There are many potential benefits of using blockchain for financial services, as well as barriers for adoption. The purpose of this study is to demonstrate how a blockchain works and if and how it can be useful for organizational purposes. A survey recently conducted on financial executives was reviewed to examine views on blockchain. Example case studies were also reviewed to look at potential case uses for blockchain in banking based on what other organizations have done. The findings suggest that a permission based blockchain is the best option for banks that want to use the technology. The main areas of banking that can benefit from blockchain are data security, digital identity verification and operation costs. Further research should be done to determine how blockchain can expand on digital identity verification, improve on gathering information for compliance, and use along with other technologies such as Artificial Intelligence and Internet of Things.

Keywords: Banking, Blockchain, Financial Services, Information Security, Technology

1. INTRODUCTION

Banking services have changed rapidly due to emerging technologies and the frequency in which customers interact with their personal devices on a day-to-day basis. Financial Technology (FinTech) has driven the use of technology-based applications that offer various banking solutions. E-commerce and E-finance have led to a global financial movement from a physical to a virtual world (Trivedi et al., 2021). In response to the trend, an array of banking products and services are now available online. These changes create more competition for maintaining customers and attracting new customers. With the rise of Bitcoin and cryptocurrency in general, blockchain has emerged as a key technology that can have a major impact on the financial services industry. This study will discuss and demonstrate how blockchain applications can be a viable solution for a variety of banking services and needs. Blockchain technology can revolutionize banking and be beneficial for both banks and their customers.

Problem Statement

How can banks improve data security and the customer banking experience with blockchain technology?

Motivation

Over the years, banks have suffered from massive data breaches that have threatened their security and reputation. Security vulnerabilities have exposed the traditional banking system. Blockchain has the potential to be a solution to this problem and make the banking process more secure, efficient and completely transparent

(Chowdhury et al., 2021). All transactions are recorded as part of chain using cryptography. This transaction system can be appealing to banks that are interested in managing their banking records in a secure and efficient way (Smith & Dhillon, 2020). In addition, blockchain has the potential to improve the banking experience for customers. Customers expect financial institutions to keep up with emerging technologies and offer user-friendly banking solutions to meet their needs. Customers also expect good service, personalization, and data security which banks can improve with the use of technologies such as machine learning, Artificial Intelligence, and blockchain ("From Chatbots to Blockchain," 2020). Blockchain makes it more seamless to conduct transactions all around the world and keep track of those transactions.

Approach

The paper will discuss how banks can adapt to the emerging technology of blockchain and how these types of applications can improve data security and the customer experience. An analysis will be done on the benefits and risks of blockchain and how banks can best apply this technology for banking purposes.

Conclusions

This paper looks at current approaches organizations are taking in relation to the adoption of blockchain technology and identifies what opportunities exist. The goal is to highlight how this potential solution can greatly impact the future of financial services and improve banking.

2. BACKGROUND

Blockchain is a relatively new emerging technology that is in the early stages of adoption. It is the technology responsible for the functionality of Bitcoin, a digital currency that has grown popular in recent years (Smith & Dhillon, 2020). A blockchain houses transactions in a single block and all those blocks create a chain, as shown in Figure 1.

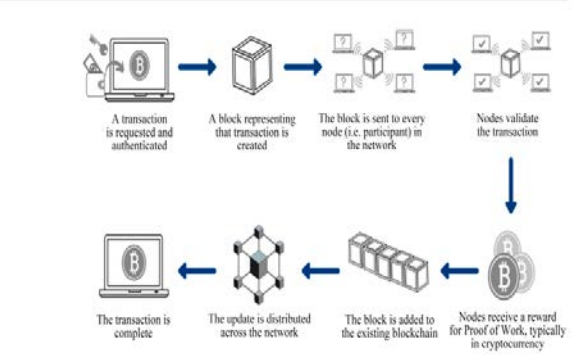

Figure 1: How blockchain works (Chowdhury et al., 2021).

According to (Rajnak & Puschmann, 2020), five characteristics make up a blockchain:

- Distributed database
- Transparency
- Peer-to-Peer transactions
- Unchangeable records
- Computational

A blockchain is a decentralized distributed ledger, which means there are multiple parties participating in the building of these blocks by the transactions they make (Smith & Dhillon, 2020). It encourages a shared value system because anyone can contribute. It was created to solve problems related to efficiency and transparency.

Blockchains support peer-to-peer based transactions. Peers communicate directly with each other and then each node keeps and forwards the data to all other nodes on the network (Rajnak & Puschmann, 2020). Another key trait of blockchain is that transactions cannot be altered, which makes it ideal for keeping records of things like bank balances, cash, and transactions (Chowdhury et al., 2021).

Blockchains are governed by rules and algorithms used to trigger transactions, such as smart contracts (Kawasmi et al., 2020). As firms continue to build relationships with other companies, these smart contracts are key. They are digital and can be automated to help simplify business processes that are repetitive and ongoing.

Information Security and Blockchain

Blockchain technology has key features that fall in line with the CIA Triad Model for information security, a framework which stands for Confidentiality, Integrity, and Availability, as shown in Figure 2 (Gupta, 2018). The purpose of this model is to provide a standard framework for creating and implementing security controls to protect data.

Confidentiality is keeping sensitive information secure and out of the hands of unauthorized individuals. Cyber criminals are motivated to break into banking systems for their financial benefit. Banks and other organizations spend millions of dollars a year on cryptography and other methods of control to protect data both data at rest and data in motion (Gupta, 2018).

Blockchain confidentiality seeks to conceal transaction information from those participants in the network who should not see it. Permission based blockchain is the best option for organizations because it allows you to customize which participants on the distributed ledger network have access to certain data (Gupta, 2018). Banks can keep detailed customer data such as account numbers private. Participants will only be able to see enough information to confirm a transaction has been completed.

How is this achieved?

Access controls tie users to an identity with particular access. A certificate authority is setup to validate attributes (Gupta, 2018). Cryptography also plays an important role. Authentication is achieved through the use of cryptographic keys which verify every exchange and those involved in the exchange (Chowdhury et al., 2021). Authorization occurs when the two parties agree on the blockchain exchange (Chowdhury et al., 2021).

Integrity is making sure information is not tampered with. It aims to maintain the accuracy, trustworthiness, and consistency of data throughout the entire life cycle (Gupta, 2018). User access controls can help create permissions so unauthorized access in not allowed. Banks are required to meet compliance measures related to information they gather and keep on their customers.

Blockchain protects the integrity of data by using a method called hashing. This hashing uses cryptography to keep the ledger free from tampering (Gupta, 2018). Once the hashing is done, it cannot be altered in any way. The message pattern is very specific and difficult to analyze (Gupta, 2018). Blockchains are designed to prevent any disruptions or changes to any blocks in the ledger. Peers will periodically validate their blockchain to ensure the chain is not broken (Gupta, 2018). Banks can keep their business applications secure.

Availability is providing reliable and readily available access to data. If data is not available when needed it loses its value and becomes illegitimate (Gupta, 2018). This can have major ramifications. Common forms of cyber-attacks that threaten availability are ransomware attacks and distributed denial of service (DDoS) attacks. They keep valuable information away from individuals who have an authorized and legitimate need to access it (Gupta, 2018). Banks try to prevent these harmful attacks by using firewalls, DDoS and ransomware protections, and having a plan for disaster recovery.

Blockchains run on a decentralized system, in order to keep data available at all times. The nature of decentralization makes it more difficult to disrupt applications. All nodes have a copy of the ledger so there is no single point of failure (Gupta, 2018). It's important for banks to have a good record of all their transactions for record keeping and reporting purposes. Blockchain availability is ensuring the validity and success of transactions.

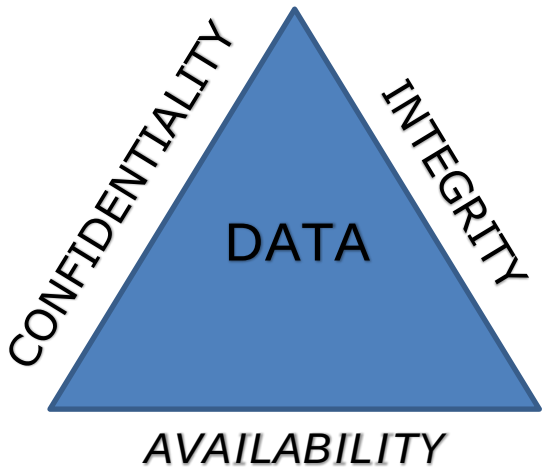

Figure 2: The CIA Security Triad Model for Information Security (Gupta, 2018).

Types of blockchain

A public blockchain is decentralized and can be used by anyone. The open blockchain eliminates the need for third parties to participate in exchanges on a distributed network (Chowdhury et al., 2021). Some good examples of a public blockchain are Bitcoin for cryptocurrency exchanges and Ethereum a major blockchain in use today. This type of blockchain can be costly, but records transactions well.

A private blockchain is a permission based type that needs to provide members with consent before they carry out transactions and actions. Due to the constraint, it is not completely decentralized. Every transaction is confirmed and then recorded. This type of blockchain is generally less costly and quicker in comparison to the public blockchain (Chowdhury et al., 2021). It works well for business models and needs.

A hybrid blockchain has the characteristics of both public and private blockchain. It offers decentralization in a private organization. It is highly adaptable. XinFin is an example of an organization that works with both Ethereum (Public) and Quorum (Private) for worldwide exchanges (Chowdhury et al., 2021).

3. RELATED WORK

This literature review will discuss how blockchain technology can revolutionize and improve the financial services industry. It will also give an analysis of the advantages and disadvantages of using blockchain and the challenges of user adoption.

	Traditional Banking	**Blockchain Banking**
Efficiency	Many intermediaries, low efficiency, complex clearing process. Capable of processing many transactions per second.	High efficiency. Peer to peer transmission. Decentralized.
Cost	High operational and administrative costs. Much paperwork and duplicate tasks and records.	Low costs, complete automation.
Security	Low level of security. Centralized systems easy to hack or disrupt. Leak of sensitive information possible.	Distributed storage database. More difficult to hack due to complex encryption and more security.
Overall Customer Experience	Limited customer experience, limited geographically.	Good customer experience. Real time. New products and services. Not geographically limited.

Figure 3: Comparison of Traditional Banking and Blockchain Banking (Sims, 2021).

Blockchain technology is driving innovation in banking and offering solutions for an improved banking structure and customer experience. Several large banks have already begun investing in emerging technologies such as blockchain, artificial intelligence, and machine learning because they are an important part of improving the customer experience ("From Blockchain to Chatbots," 2020). Banks have an opportunity to learn about blockchain and update their current business models to address the needs of their customers and the blockchain market.

There are many benefits to using blockchain technology for financial services, as highlighted below and shown in Figure 3:

1. Lower costs – Blockchain can improve overall banking operations (Rajnak & Puschmann, 2020). The current banking system involves much paperwork, duplication of records, and high operational costs (Sims, 2021). Blockchain banking streamlines the process through automation, therefore, driving down costs. According to Accenture, banks can save on costs related to finance reporting, business operations, compliance, and centralized operations, as shown in Figure 4 (Chowdhury et al., 2021). In addition, banks can save on transactions that typically involve bank-to-bank exchanges.

Figure 4: Potential Cost Savings from using Blockchain in Banking (Chowdhury et al., 2021).

2. Greater security – Banks have faced data breaches in increased numbers over the years due to the vulnerabilities of the current banking system. Blockchain uses a complex system of cryptographic encryption on a distributed storage system, which makes it difficult to hack (Pal et al., 2021). Banks use intermediaries for processing, which makes it easier to intercept transactions. Blockchain does not use third parties. According to Marie Tatibouet, chief marketing officer at Gate Technology, a cryptocurrency exchange based in China, since the blockchain network is distributed, there is no single point of failure (Likos, 2021). Therefore, blockchains are viewed as reliable.

3. Increased transaction speed –
Blockchain transactions occur securely over a mobile network, which eliminates the need to visit banks in person, wait in line, use real cash, and incur payment transaction fees ("From Blockchain to Chatbots," 2020). Banks can stand to benefit from increased productivity and the prevention of fraud. Other areas of banking that can benefit from the digital aspects of blockchain are trade finance and loans and credits (Gupta, 2021). The trade process would flow better by saving time and eliminating paper bills and invoices. The loan and credit process would be faster, more accurate, and more secure. This helps lower the credit risk of banks overall.

5. Improved compliance – Blockchain can assist in meeting regulatory compliance through improved transaction accuracy. Blockchain can also assist during the customer onboarding process by creating and managing a Know Your Customer (KYC) repository to ensure customer data and identity information is kept up to date (Kawasmi et al., 2020). This process is required and expected of all financial institutions by banking regulators. Failure to meet compliance measures can lead to financial losses through fines and reputational damages. Accenture estimates organizations can save between 30-50% on compliance by using blockchain (Kawasmi et al., 2020).

6. Better reconciliation – It would be easier for banks to keep track of their transactions because they can settle the transactions themselves (Gupta, 2021). Mistakes can be found and fixed quickly. In contrast, the traditional SWIFT method can cause a standard bank transfer to take days to settle. A basic bank transfer must go through a set of intermediaries before it reaches its final destination.

7. Greater transparency – Increased transparency leads to greater trust. Once transactions are cleared, they can be traced. The distributed ledgers have a time stamp and are immune to any tampering. Auditing has the potential to occur continuously in real time with the capability of analyzing all transactions instead of just a random sample size (Kawasmi et al., 2020). As a result, this ongoing financial reporting will lead to better communication between the banks and regulators when there is a violation that needs to be addressed.

8. Automated contracts – In addition, blockchain uses smart contracts to develop transaction terms that can be reviewed and agreed upon by all parties involved in the transaction (Chen et al., 2021). Certain events will trigger these smart contracts leading to a more automated process.

9. Greater financial reach – Blockchains provide banks the opportunity to reach the unbanked, who traditionally struggle by not having access to banks. It can make activities like payment services, saving and investing and having access to credit easier (Chapiro, 2021). This can drastically improve the quality of life for many people in underdeveloped countries, especially in times of emergency or crisis. There is an overall improvement in customer service because there are no geographic limitations and they are conducting real-time transactions (Sims, 2021).

Despite the advantages of blockchain, there are still challenges and barriers that exist and are preventing banks from fully adopting the technology. Blockchain technology has capacity constraints, which is a cause of concern given the rapidly increasing number of transactions taking place (Pal et al., 2021). The increased data sharing and data storing can cause issues with scalability. The larger a blockchain is, the more storage it will need to process millions of

transactions in time (Kawasmi et al., 2020). The blockchain process uses complex algorithms to determine user permissions and therefore, takes more computing power and energy consumption (Kawasmi et al., 2020). Of course, smaller organizations will use less energy than larger organizations, but this is still a factor to consider and compare to current energy consumption levels on traditional banking systems. The need for more energy can mean increased costs. Also, with too many users on the network, transaction processing time can slow down as more time is needed to complete transactions (Liang et al., 2021).

Blockchain has been associated with forms of bitcoin fraud and scams, which hinders its growth and acceptance. Blockchain transactions on the public database are accessible to the public and therefore, privacy cannot be guaranteed. Certain parts of blockchain are still vulnerable to fraud through the compromise of many network members (Pal et al., 2021). If there is a compromise in the blockchain, it may prove difficult to trace back transactions which are related to criminal activities.

There are many regulatory aspects and implications to consider with blockchain. Regulations have not quite caught up with addressing blockchain technology as it is in the early stages of adoption (Pal et al., 2021). A lack of regulatory oversight and industry standards have led to a very volatile environment (Kawasmi et al., 2020). Regulators need to create a framework of standards that can be used across all banks. Until then, it will be difficult for banks to adopt a technology with so many regulatory questions and concerns.

Studies on blockchain technology and its role in the financial services industry suggest the blockchain market will continue to grow and banks must adapt to it. There are still challenges in adopting blockchain technology and room for improvement. However, banks must also understand the potential benefits and advantages blockchain provides for banking and the overall customer experience.

Managed blockchain networks offer many financial services capabilities. It can take some time to setup the network, but once it is up and running, it can provide functionality that is relevant and useful for financial services.

4. APPROACH

The approach for this paper will be to create a demo blockchain network. Blockchain has the potential to impact banking greatly in the foreseeable future. This approach is to highlight some of the features and how banks can use the technology as a solution.

Technologies Used

The blockchain network will be created on the IBM Cloud Blockchain Platform console. This is run through Linux and made to be compatible with Hyperledger fabric.

Design

The IBM Blockchain Platform was created and launched. A Kubernetes cluster was created and then linked to the blockchain platform.

User Requirement

The development process requires an IBM Cloud account to access the IMB Cloud infrastructure. The project also requires the latest version of Visual Studio Code, Docker, and Node.js code. In addition, within VS Code, the extension for IBM Blockchain was added. The free account IMB Lite Plan was used for this project. IBM Watson is compatible with a PC or Mac computer. This project will be utilizing a Desktop Mac Computer.

Implementation

The first step in setting up an entry point for the blockchain was to create an MSP organization. For purposes of the demo blockchain, generic names will be used when naming the different categories within the system. A certificate authority (CA) was added with the name “Org1CA.” The CA administrator was named “admin” and the enroll secret was named “adminpw.” The Associate identity process was setup to confirm the CA Admin identity will be associated with the CA node. A user was registered and then an admin was registered for the organization. The first user created will be the admin. This identity acts as an organization admin and allows for the operation of nodes on the console. The attributes will not be customized for this project but note they can be added for role-based access control over resources.

Next, the MSP (also known as the peer’s organization) must be defined. The details include the MSP display name and MSP ID. The root certificate authority was chosen according to the root CA for the organization that was created and an identity name was created. The admin certificate was created for the organization as an admin identity. A confirmation of identity name and enroll secret

is required. The identity was generated as the admin for the organization and added to the wallet. Export option was chosen so that the public and private keys would not be lost. It was confirmed the MSP definition was created with these options.

After the CA has been created, the next step was to create a peer node. Peers are an important part of the blockchain network process because they host ledgers and smart contracts. A peer was created and named "Peer Org1." Advanced deploy options were left at the default options for this project. The peer identity is linked to the certificate authority, and then the organization MSP and latest fabric version are selected. The organization admin was chosen as the associated identity to be the admin of the peer.

Next, an orderer was created. Users were registered with admin and orderer identities. The orderer MSP definition was created and the Orderer CA was selected for the root Certificate Authority. The created organization was added under Consortium members. Finally, a channel was created, the ordering service was selected under channel details, and the organization was added as a channel member. This makes up the basic setup of the blockchain.

A smart contract was created using VS Code and adding the extension for IBM Blockchain. The smart contract project is created and written in Go/Node.js. The smart contract is then packaged and installed. To finalize the smart contract, it is instantiated and the endorsement policy is setup. The final step is to download the connection profile and start writing client applications for use with blockchain.

5. DATA COLLECTION

The data utilized in this project was obtained by a Global Blockchain survey conducted in 2021 by Deloitte, a multinational consulting firm specializing in business advisory services. Since the data has already been collected, the focus will be on comparing the results to the implementation and design of the research approach to gain a better understanding of blockchain and case for its use in banking.

The Deloitte survey was conducted between March 24 – April 10th and those polled represent a sample of over 1,200 senior executives in 10 locations including Brazil, China, Germany, Hong Kong, Japan, Singapore, South Africa, the United Arab Emirates, the United Kingdom, and the United States, as shown in Figure 5 ("Deloitte's 2021 Global Blockchain Survey," n.d.).

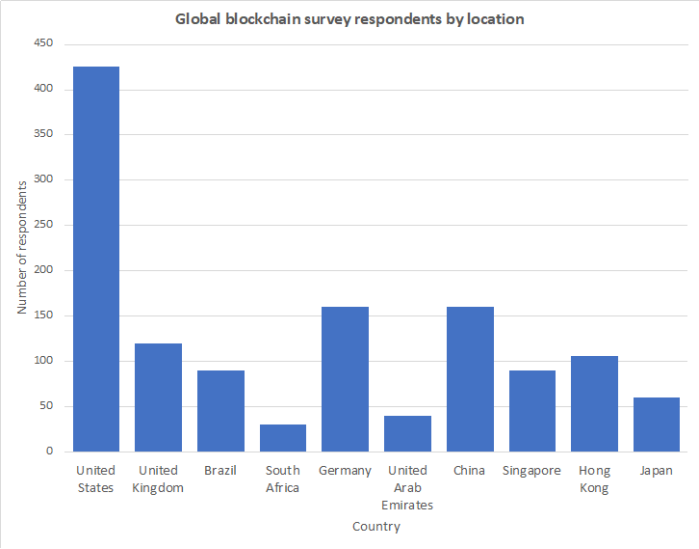

Figure 5: Global blockchain survey respondents by location. ("Deloitte's 2021 Global Blockchain Survey. A new age of digital assets," n.d.).

The purpose of the survey was to gain insights into overall attitudes about blockchain and how it relates to financial services. The respondent categories are defined as the Financial Services Industry (FSI) overall, Financial Services Industry Pioneers (FSI Pioneers), and the respondents polled overall. While FSI represents global financial services industry leaders, FSI pioneers makeup a subset of FSI leaders who are great supporters of emerging technologies like blockchain and whose organizations have already begun using blockchain applications and solutions.

Survey Highlights:

- Attitudes on blockchain and digital assets
- Top case uses for blockchain in financial services
- Barriers for blockchain adoption and acceptance
- Digital identity opportunities in blockchain
- Areas of regulation that need to change for blockchain

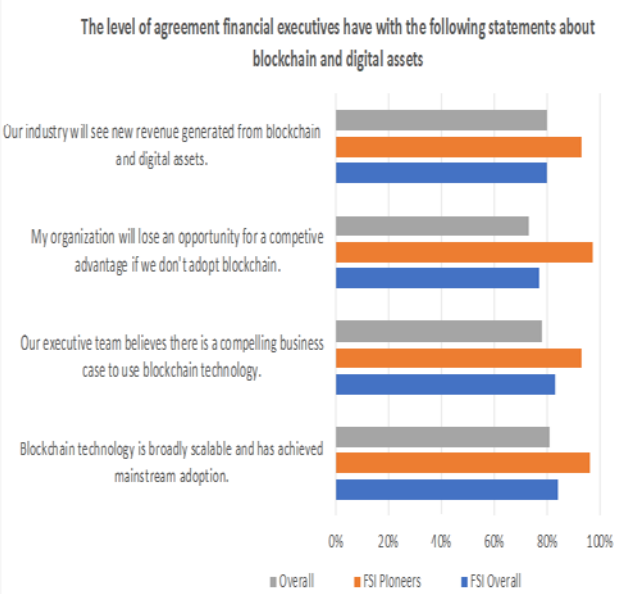

Figure 6: Attitudes on blockchain and digital assets ("Deloitte's 2021 Global Blockchain Survey. A new age of digital assets," n.d.).

Many FSI pioneers strongly believe blockchain has reached mainstream adoption and are making blockchain and digital assets a top five strategic priority, as shown in Figure 6.

Meanwhile, a majority of respondents agree that there is a relevant case to be made for blockchain and their organization will lose a competitive advantage if they choose not to adopt blockchain technology.

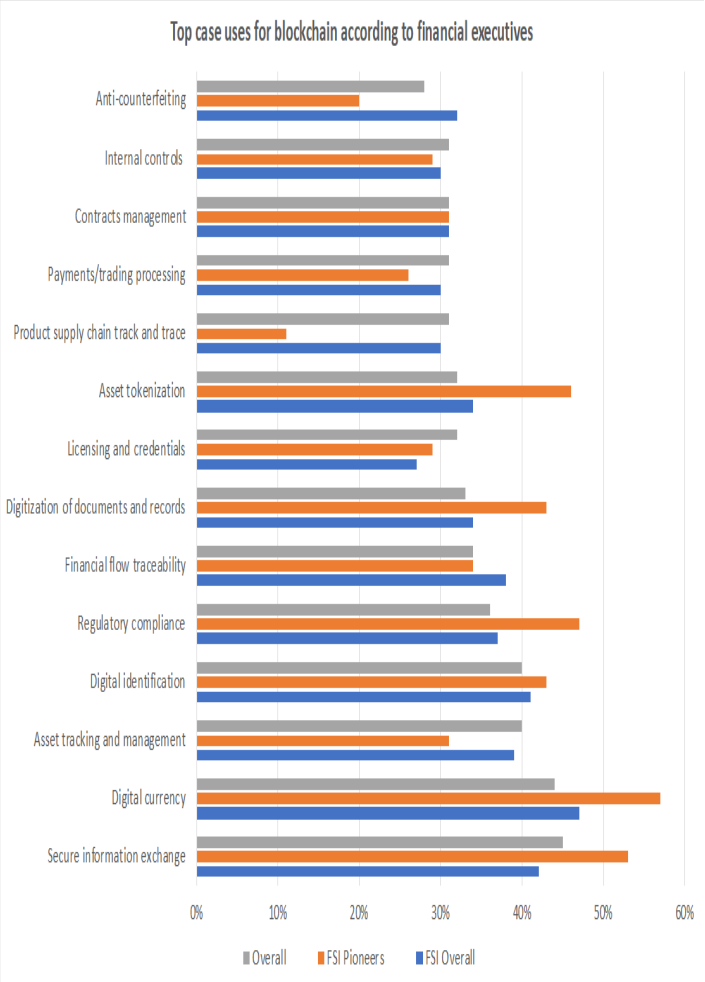

Figure 7: Blockchain use cases ("Deloitte's 2021 Global Blockchain Survey. A new age of digital assets," n.d.).

The majority of FSI respondents agree that the best blockchain use cases for banking are digital currency, digital identification and secure information exchange, as shown in Figure 7. FSI pioneers see other potential areas of growth for blockchain use cases in regulatory compliance, digitization of records and asset tokenization.

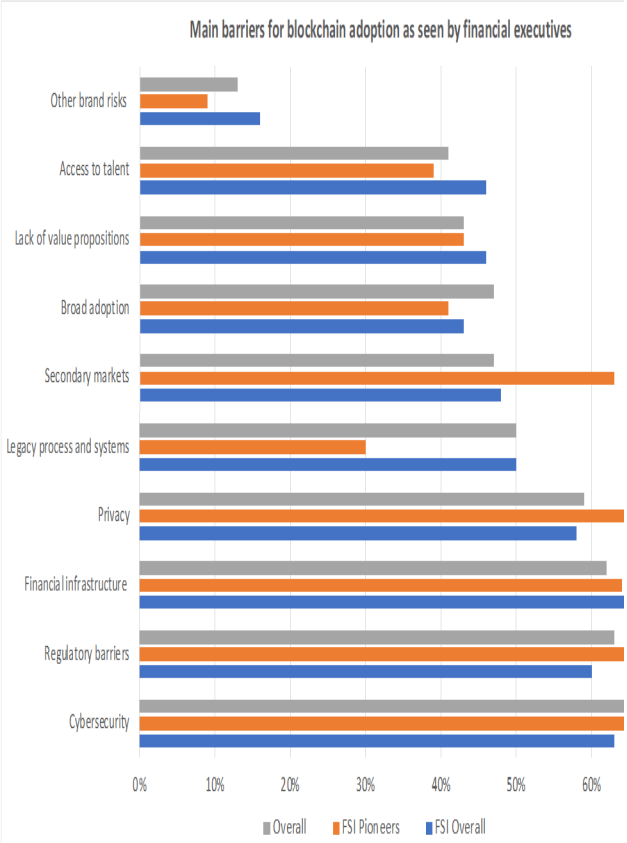

Figure 8: Adoption and acceptance factors ("Deloitte's 2021 Global Blockchain Survey. A new age of digital assets," n.d.).

Blockchain technology has yet to reach mainstream adoption and acceptance due to areas of concern related to cybersecurity, privacy, regulations and financial infrastructure, as shown in Figure 8.

Some banks are reluctant to abandon their legacy systems and processes. Banks and their leaders also don't see enough value in blockchain or are unclear about the benefits. Cybersecurity remains a primary concern as banks have dealt with many data breaches over the years. In addition, a lack of clear regulation on blockchain makes it difficult to understand when and how it is appropriate to transact with blockchain applications.

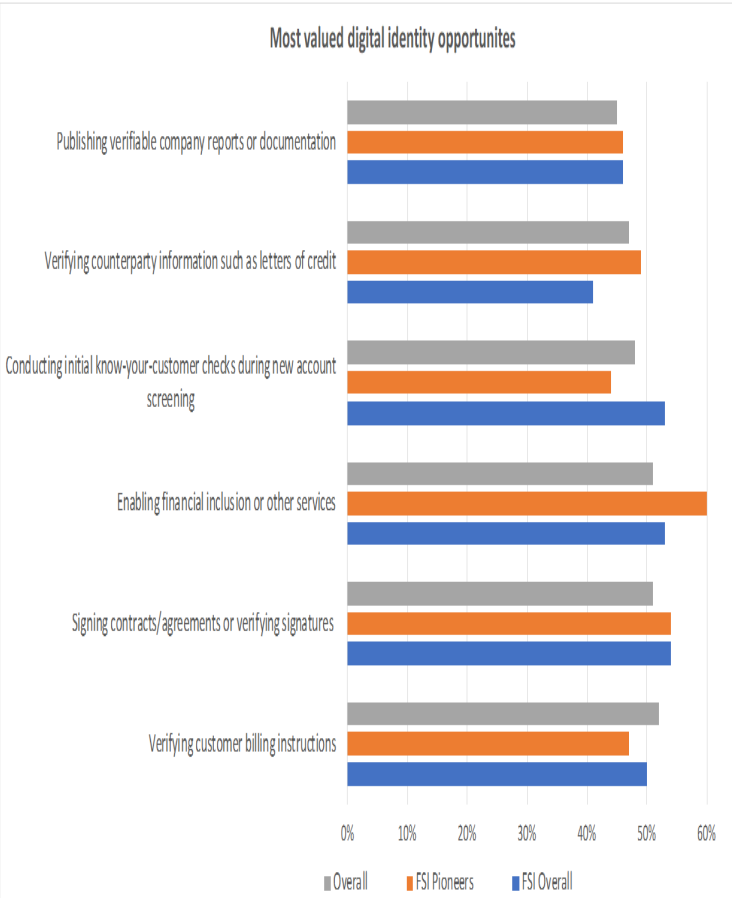

Figure 9: Most valued digital identity opportunities ("Deloitte's 2021 Global Blockchain Survey. A new age of digital assets," n.d.).

Most FSI respondents value digital identity applications for verification purposes, as shown in Figure 9, which is an important part of transaction processing. Particular areas of interest are streamlining the initial know-your-customer new account screening process, contract signing and signature verification and verifying billing instructions.

FSI pioneers see digital identity applications as extremely important for supporting financial inclusion. Financial growth comes from reaching more customers across various regions even the unbanked.

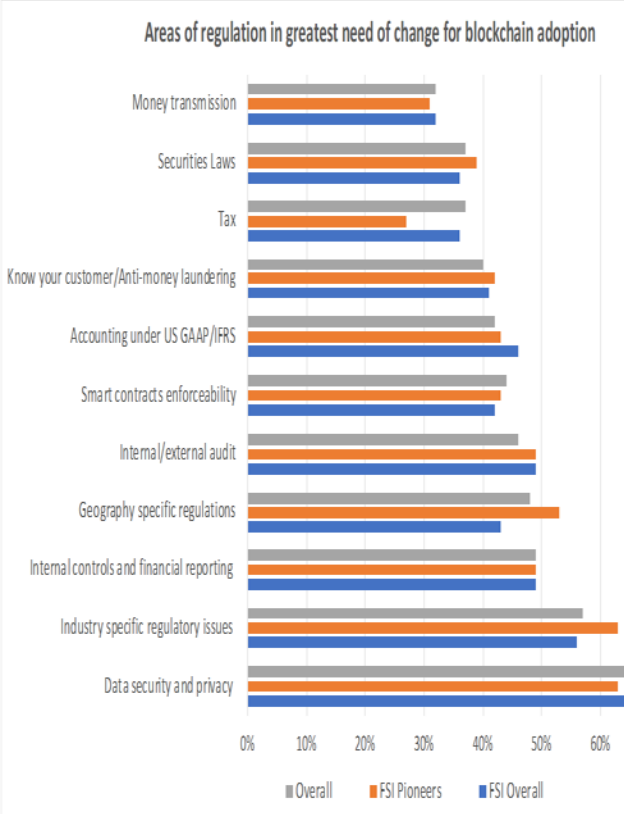

Figure 10: Areas of legislation in need of change for blockchain ("Deloitte's 2021 Global Blockchain Survey. A new age of digital assets," n.d.).

As previously stated, regulation is lacking and insufficient for blockchain technology at the moment. There are some key areas of regulation that are in need of change in order for blockchain to reach mass adoption and acceptance, as shown in Figure 10. The top areas of concern are data security and privacy, industry specific regulatory issues, geographically specific regulations, and internal controls and financial reporting.

6. DATA ANALYSIS

My data analysis was focused on evaluating how blockchain is impacting the financial services industry. The following hypotheses were assessed:

1. The use of blockchain in banking can increase data security.
2. The use of blockchain in banking can improve the overall customer experience.

To perform this analysis, the strategy is based on:

- Review cases of financial institutions and other organizations using blockchain and how it impacted security.
- Identify case examples where blockchain improved the overall customer experience.

Case Study 1: MIT and Blockchain based credentials

In 2007, an art school graduate saw an opportunity to improve a process. The concept grew from a common problem he noticed: art students had when trying to share their art portfolio online. The process was difficult and time consuming. This led to the development of a company called SlideRoom, which has made it possible for potential students to upload their art portfolios so that schools can easily have access and review them (Hargraves & Karnoupakis, 2020).

After the success of SlideRoom, an additional opportunity was seen by the creators to improve the overall process of students applying for college. Sending applications and documentation by paper seemed like an outdated process. MIT partnered with the company to create a Blockchain-based credentials system for verification. The concept was simple. Like Bitcoin, people would be able to share something of value but instead of money, it would be degrees, certifications, examinations, photo IDs, and badges. An application was created to manage the user credentials. The credentials are decentralized and therefore, the users own them. After a successful run with MIT, the company was hired by other universities and colleges for its services.

Banks have a similar verification responsibility in meeting their Know Your Customer (KYC) and Anti Money Laundering (AML) compliance standards.

Know Your Customer Due Diligence is a set of standards used within the investment and financial services industry to verify customers, their risk profiles, and financial profile ("Information on Complying with the Customer Due Diligence (CDD) Final Rule," n.d.).

Anti-Money Laundering is the process of deterring criminals and preventing them from hiding money obtained through illegal purposes ("The Anti-Money Laundering Act of 2020," n.d.).

Blockchain has the potential to streamline and simplify the KYC process for banks. It offers the capability to create a repository of customer information that can shared among different organizations (Devanesen, 2021). Many companies gather customer information for verification purposes but the process is repetitive for the customer as they must do so for each group. With blockchain, records cannot be altered and duplication of records is avoided. The customer experience can be improved in this way.

An important part of the relationship between customers and their banks is trust. Blockchain decentralizes personal data so customers have can verify their identity and have more control over their information to maintain privacy. Currently banks use a centralized system to store data, which is more prone to privacy risks and being intercepted by third parties.

Case Study 2: Blockchain and AI for Banking

According to tech expert Francesco Correa in his 2017 article, "The convergence of AI and Blockchain: What's the deal?" there are many ways AI can change blockchain for the better (Boobier, 2020).

- Blockchain consumes much energy but the effective use of AI can help manage the burden since AI is known for its energy efficiency.
- The major problem of scalability can be solved by having AI prune the data to make sure only necessary data is saved.
- Blockchain applications are not entirely immune to security issues but thanks to machine learning, AI can ensure there is a successful application deployment decreasing the chances of issues.
- People have more control of their data and regulations will continue to be created and applicable for blockchain purposes.
- AI can work to provide network optimization, which can improve efficiency.
- While blockchain uses a distributed ledger, it is often seen as a manual process. But with technology advancements in AI, the process can one day be automated.

Banks stand to benefit from machine learning and AI applications that can help customize products and cater to the various needs of their customers. For example, chatbots can assist with general customer service questions and basic account transactions such as transfers between accounts. In addition, Correa mentions that blockchain can also be beneficial for the adoption of AI by improving trust in technology and data systems, improving AI effectiveness which leads to more data security, and making AI more accessible.

Case Study 3: IBM's Blockchain World Wire for Banking

A main feature of blockchain is that it provides banks with the ability to make payments across different geographic locations and foreign exchanges. IBM's Blockchain World Wire allows banks to speed up foreign transactions and exchanges using 'Stellar Protocol' (Boobier, 2020). The financial platform is made in an open form and accessible to anyone. The Stellar Development Foundation is non-corporate, non-profit and funded by charitable donations and the purchase of Lumens, which is a type of bitcoin (Boobier, 2020). Money transfers remain a common transaction type and digital assets and blockchain make the process smoother and faster without a need for intermediaries. IBM World Wire offers a private permissioned solution that can be appealing to customers for many reasons including security, privacy, and efficiency.

This can be highly beneficial for business customers who conduct business internationally and want a more streamlined process for making transactions. Blockchain can offer more options for these business customers. For example, they can create smart contracts to establish

relationships and trust with business partners and clients.

7. FINDING

This study finds that blockchain is changing the financial services infrastructure and financial executives are aware and bracing for a future with blockchain and digital assets. The FSI pioneers have led the way and have been highly impactful on the use and growth of blockchain.

The key areas of banking that can benefit from the use of blockchain: security, verification, and operations.

Security

- Secure information exchange
- Privacy via private permission based blockchain
- No intermediaries involved in transaction process

Verification

- Digital identity applications can improve banking processes such as signing contracts, verifying signatures, conducting KYC checks for compliance and verifying customer billing instructions.
- With greater verification methods comes greater trust.

Operation Costs

- There is a potential to save on banking operation costs associated with centralized systems, business operations, financial reporting and compliance.

The main barriers that have kept blockchain from reaching mainstream adoption are concerns of disrupting the current financial infrastructure, lack of regulations, cybersecurity risks, and privacy (for public blockchains).

Based on a review of organizations who implemented blockchain, it was successful in areas of digital identity verification, using alongside AI for improved customer experiences, and assisting with international exchanges.

8. CONCLUSION

Financial institutions continue to face data security issues as transactions are increasingly moving digitally through the centralized banking system. Blockchain technology has the potential of being a valuable solution that can improve data security and the customer experience. Benefits include lower costs, improved data security, faster transactions, improved compliance, greater transparency, better reconciliation, automated contracts, and a greater financial reach. The most appropriate form of blockchain for organizations is a private permission based blockchain platform. This type of blockchain adheres to the pillars of the information security CIA Triad Model which focuses on confidentiality, integrity, and availability.

This study was bound by limitations of time and a lack of access to financial leaders and experts that would make an interview of my own possible. The survey of financial executives reviewed in this paper is limited to a sample size of only certain countries and the United States makes up the majority of respondents. However, the survey does provide a sense of how many financial executives view blockchain technology and digital assets and how they see it impacting financial services of the future.

9. FUTURE WORK

There is still much to learn about the capabilities of blockchain technology. Once considered a threat to traditional legacy banking systems, more and more financial institutions are exploring ways to use blockchain applications as solutions.

While it does offer benefits, barriers remain and are hindering the adoption and acceptance of blockchain. These barriers need to be examined and addressed in order for financial institutions to truly see the value of using blockchain.

One area that would be interesting to look into further would be how financial institutions can capitalize on digital identity applications and partner with other businesses to change the way individuals are verified in the future. Imagine being verified by your bank when you open an account and then the bank is able to share that identity verification with others so you can also get registered to vote, get a driver's license,

renew a vehicle registration, etc. True to the nature of the blockchain, they would only share the verification and no sensitive data, which would be kept secure. Today, we must constantly verify our identity time and time again with various organizations for various purposes. I think it's possible for this to work if enough organizations participate in the blockchain to the point where it becomes verified and trusted. It could become a new standard for identity verification.

Another area that has great potential for the future is using blockchain to improve the KYC and AML procedures that banks must complete to meet compliance. Currently, many of these processes are manual or require periodic account and customer verification. A blockchain repository of customer information could be updated by the customer so they are in more control of their information but also provide the financial institutions with the information they need. By streamlining the process in this way, it would lead to more efficiency, accurate data, and a better customer experience.

Finally, it seems the value of blockchain can be complemented when used alongside other technologies. I think it would be interesting to do more research on how Artificial Intelligence (AI) and Internet of Things (IoT) can improve blockchain as it relates to smart retail services, predictive learning, and digital intellectual property. These technologies all have one thing in common, they build trust. For financial institutions, trust is important for maintaining relationships with their partners and customers.

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