Kanij Hasi

Impact of Blockchain Technology in Financial Services Sector

Metropolia University of Applied Sciences

Master of Engineering

Information Technology

Master's Thesis
26 November 2024

PREFACE

This thesis examines the transformative impact of blockchain technology within the financial services sector, focusing specifically on its adoption in the Finnish banking industry. As blockchain promises enhanced transparency, security, and operational efficiency, it also introduces complex challenges, such as regulatory uncertainties, integration issues, and the need for skilled personnel. Through a dual approach of primary data collected from structured questionnaires among Finnish bank employees and an extensive review of global secondary data, this study uncovers a nuanced landscape marked by both enthusiasm and skepticism.

The findings reveal that, while blockchain holds substantial potential to streamline operations and minimize intermediaries in banking, its full adoption is hindered by high implementation costs and regulatory barriers. Despite these obstacles, employees acknowledge blockchain’s promise for improved transparency and security. The research underscores a critical need for strategic recommendations aimed at facilitating blockchain adoption within Finnish banks, including partnerships with FinTech companies, investments in scalable infrastructure, and engagement with regulatory bodies to create supportive compliance frameworks.

By situating the Finnish banking sector within the global trend toward blockchain integration, this thesis offers actionable insights for financial institutions seeking to harness blockchain’s capabilities. It contributes to a growing body of literature by providing a focused, evidence-based analysis of blockchain's practical implications in a traditionally conservative sector, illustrating how Finnish banks might navigate and optimize blockchain to enhance customer experiences and remain competitive in an evolving financial landscape.

Espoo, 26 November 2024
Kanij Hasi

Abstract

Author:	Kanij Hasi
Title:	**Impact of Blockchain Technology in Financial Services Sector**
Number of Pages:	64 pages + 2 appendices
Date:	26 November 2024
Degree:	Master of Engineering
Degree Programme:	Information Technology
Professional Major:	Networking and Services
Supervisors:	Aarne Klemetti, Researching Lecturer Ville Jääskeläinen, Principal Lecturer

Blockchain technology has brought a disruptive potential to various industries, especially in finance, by promising increased transparency, security, and efficiency within transaction process. The study is focused on exploring what disruptive effect blockchain technology may have on the Finnish banking sector in terms of its adoption, benefits, challenges, and possible recommendations for successful implementation. This research investigates the impact of blockchain on operational efficiency, customer experience, and competitiveness in Finland's banking industry. The research is also a combination of both primary and secondary research. Primary data collection was conducted through structured questionnaires among employees working in Finnish banks, supported by a secondary data source on the application of blockchain in finance. The insights of primary data focused on employee perceptions about blockchain adoption, while simultaneously providing an overview of the global application of blockchain in financial institutions, hence identifying an industry trend.

The study showed mixed feelings of excitement and skepticism among employees with regard to the benefits accruing from blockchain. While most agree that it has the potential to enhance transparency, efficiency, and security, regulatory barriers, high implementation costs, and shortage of skilled personnel are some of the noticeable preventions. The results show that while blockchain bears the potential to disrupt traditional banking by streamlining their operations and reducing intermediaries, many things are yet to be done to ensure widespread adoption and acceptance. These findings stand in concert with the literature on the promise and pitfalls of blockchain in finance.

The paper concludes with strategic recommendations for Finnish banks on how to maximize the benefits accompanying blockchain by addressing the challenges in its adoption. This would include increasing collaboration with FinTechs for quicker integration of services, investing in scalable infrastructure, and close collaboration with regulators for the setup of clear compliance frameworks. The value of this contribution is that, for the first time, this paper addresses blockchain adoption at an industry level within Finnish banking. It provides hands-on, evidence-based recommendations for how banks can capitalize on blockchain to improve their operational.

Keywords: Blockchain technology, Finnish banking industry, operational efficiency, customer experience, competitive advantage

---

Table of Contents

1 Introduction

1.1 Problem Statement

The financial services sector is under huge pressure with leaps in technology, and among the more transformative forces is blockchain. Blockchain would hence provide the ability to disrupt this industry through increased transparency, security, and efficiency in the performance of financial transactions, but these promising advantages weigh against a host of obstacles to adoption that most of the financial institutions could face. But the key issue at the heart of it all is that blockchain is both complex and new in ways that create several kinds of barriers. There are regulatory uncertainties: financial institutions have to work their way through complex legal frameworks that do not yet fit with the decentralised and global nature of blockchain (Yermack, 2017). There are, however, substantial technical challenges associated with integrating blockchain into existing financial systems, which happen to be old and not aligned to accommodate such novel technologies. Besides, concerns on data security, privacy, and scalability issues of blockchain systems raise finance institutions' doubts about fully embracing the technology.

These are pressing challenges for banks in particular, because it feels compelled to remain competitive in a market changing literally day by day. In the event of poor implementation, blockchain might result in missed opportunities for innovation and efficiency gains due to the very reasons which would risk market share, transferring business to fintech competitors. It is, therefore, necessary to establish the specific areas within banks where blockchain technology will most suitably be inculcated, and further develop ways of surmounting the associated regulatory, operational, and technical challenges. These the study shall attempt to address through a wide analysis of the likely impact of the interest in blockchain on banks and strategic recommendations for its successful execution.

1.2 Research Aim

Primarily, this thesis aims at exploring the disruptive influence of blockchain technology on the financial services industry by focusing specifically on banking industry in Finland

1.3 Research Objectives

There are three objective-

- To investigate the state of art in blockchain technology and its application in the financial sector.
- To examine advantages and problems that come with adopting blockchain technology in Banking industry of Finland
- To proposes some strategic recommendations to help banks or financial institutions successfully implement block chain technology for better operational efficiency, increased customer experience and improved market competition level.

1.4 Research Questions

- What is the state the current developments in blockchain technology. How is it currently being applied across various areas of financial services?
- Which are the key benefits and challenges that bank faces in adopting and integrating blockchain into the existing operations of the bank are as follows.
- What are some strategic recommendations that might be made toward the successful implementation of blockchain technology in banks in operational efficiency, customer experience, and market competitiveness?

1.5 Research Rationale

Financial services are always at the leading edge of new technologies, but blockchain offers one of the greater sets of disruptions seen in a long time. Understanding and leveraging emerging technologies is key for financial institutions in their efforts to stay competitive within an increasingly digitalised global market (Glaser, 2017). The current research focuses on the consequences

of blockchain for the structure of financial services and fleshes out most of its concrete details within the frame of banking industry of Finland. The research is based on the need to bridge the gap in previous studies between the theoretical potentials of blockchain and its applied usage within the practical work of financial institutions.

If anything, blockchain technology offers a wealth of advantages: great transparency, security, and efficiency over transaction processing. These are essential attributes in the financial sector context since it is a place where trust, security, and efficiency mean a lot. While the advantages for blockchain are clear, though, its adoption into service has been relatively slow and unequal in many ways (Xu, Weber, & Staples, 2019). This kink, therefore, between the potential benefits and the current rate of adoption gives reason for some important questions that this research has been set out to address. To this end, it probes why financial institutions had been slow in adopting the blockchain technology; and what strategic actions can be taken to accelerate its adoption in order to maximise its full benefits.

This research has in turn been informed by the spiraling recognition that blockchain technology is indeed a disruptive force in the arena of financial services. The ability of the technology to eliminate intermediaries, reduce transaction costs, and enhance transparency in all processes threatens to shake the core of traditional banking models (Iansiti & Lakhani, 2017). Complexities associated with blockchain-from regulatory challenges and integration issues to concerns over data security and privacy-have contributed to this inhibition in its full deployment. It is, therefore, cardinal for banks to understand such challenges and find a way to go through them in order to keep the competitive advantage in the market.

Other crucial reasons include the strategic justification behind blockchain technology in banks and financial institutions due to the growing competition and regulatory environment. The financial services sector is still a front-runner in innovation, vastly driven by FinTech firms through the use of new technologies for the enhancement of efficiency and customer-centricity of their services (Kshetri, 2018). Innovation and adaptation have thus become crucial for traditional banks. Blockchain technology, having the ability to smoothen internal

processes and improve customer experiences, creates an opportunity for banks of Finland to attain differentiated positioning in the market.

Moreover, the research will be motivated by the organisational necessity to contribute to the vast body of knowledge concerning blockchain technology and its application within the financial sector. With the growing literature on blockchain, most of the research so far focuses on understanding the concept of the technology rather than its practical implications for financial institutions (Beck, Müller-Bloch, & King, 2018). Given that focus on a specific area such as banking industry of Finland, the current research tries to present concrete insights into the challenges and opportunities that accompany the adoption of blockchain in the financial services industry. Thus, the case results from this study might be a valuable source for other financial institutions, policymakers, and technology providers to understand the challenge of blockchain implementation. The justification for this research is manifold, touching on interest in investigating pragmatic challenges that blockchain diffusion faces, the strategic relevance of the technology to a financial institution and an intent to add to the increasing body of knowledge in finance on blockchain. The nature of this industry is in a constant state of change, and what is to be learned through this research will be instrumental in further allowing banks to act upon blockchain technology's capabilities to innovate, enhance operational efficiency, and stay competitive at the forefront of the market that's in flux.

1.6 Summary

It examines the influence of blockchain technology on the financial services industry, focusing on banking industry of Finland. It aspires to capture the current state of Blockchain adoption, possible benefits and challenges arising from its adoption, and how banks can use Blockchain strategically in its quest to enhance innovation and operational efficiencies for competitiveness. The research also aspires to provide strategic suggestions concerning how those obstacles can be overcome with respect to blockchain adoption and a better understanding of the role of blockchain in financial services.

2 Methods and Material

2.1 Research Philosophy

In the research of blockchain technology within the financial services sector, positivism is an appropriate philosophy because it depends on data that is empirical, observable, and measurable. In other words, it will give the researcher more independence to analyse objectively the impact of blockchain technology, since this approach sets a basis on quantifiable consequences in such arenas as efficiency in transactions, cutting costs, and fraud prevention-things that are at the core of financial services. By applying positivism, one could ensure that they were collecting hard data based on surveys, case studies, or financial performance metrics that would be necessary in establishing cause-and-effect relationships. In the study on blockchain adoption, positivism provides a framework where transparency and reduction in transaction costs are positioned as the outcome variables with improved validity and value of insights (Saunders, Lewis, and Thornhill, 2019). The paradigm of positivism is selected over other paradigms, such as interpretivism, for the reason that it prevents subjectivity and relies on facts that are replicable. While the technological and operational focus of this research makes selected the latter less appropriate, interpretivism could consider human and organisational factors.

2.2 Research Approach

The deductive approach has been appropriate in the context of blockchain technology research in the financial services industry because it allows researchers to evaluate existing theories against actual data. In other words, through established frameworks or hypotheses-for instance, how blockchain enhances elements such as transparency, cost reduction, or operational efficiency-researchers might draw empirical data with illustrations to validate or reject these kinds of theories (Robson and McCartan, 2016). This would be most efficient in the field of financial technology studies, where one would check clear

hypotheses, like "blockchain makes financial transactions more secure," with quantitative data which would guarantee objectivity and replicability of results. The use of a deductive method is also close to positivism, as the latter places the least emphasis on subjective experience, bringing quantifiable results to the fore. Alternative approaches inductive reasoning-building theories from observations-are less appropriate for this study. The influence of blockchain in finance is already well-theorised; hence, a deductive approach that tests and refines these theories is more applicable than to build new ones from scratch.

2.3 Research Strategy

This research follows survey and desk research strategies which are proven very effective in conducting research on the impact of blockchain technology in the financial services industry. In this regard, the former, survey research, enables the researcher to gather first-hand data from the main stakeholders in the industry-in this case, financial professionals-on the situation, challenges, and benefits concerning the adoption of blockchain. Such a method helps assess real-life applications and perceptions, hence offering sets of quantitative data that are useful in the deductive approach (Blaxter, Hughes, and Tight, 2010). Desk research, or secondary research, would complement surveys through the analysis of already existing studies, reports, and financial statements to derive a comprehensive overview of blockchain's broader impact on the sector. This approach is effective and efficient in tapping a wide range of already existing knowledge for ensuring a sound theoretical base. Other approaches, such as ethnography or experimental research, do not fit as well with the topic at hand. Ethnography, being centered on social interaction, would be too qualitative; experimental research, being too hard to consider given blockchain in financial systems is large-scale and real-world.

2.4 Research Methods

The quantitative method used in this research on blockchain technology in the financial services sector, as the focus would be on objective measurement and statistical analysis. In using a survey, as can be viewed from the research design, numerical data can be collected from a large sample of financial services employees and provides distinct responses about the adoption of blockchain and its consequences (Blaxter, Hughes, and Tight, 2010). Hypotheses on whether blockchain improves the operational efficiency or reduced the transaction cost for organisations may be tested. Quantitative methods will be appropriate since they produce data which, if statistically analysed, means that the results are reliable and replicable. This befits the deductive approach since existing theories of the benefits of blockchain are tested against the data collected. In this case, qualitative methodology would not be used, as would be the case with interviews or focus groups, since this would call for subjective experiences. Perhaps such subjective experiences would not provide a measurable, scalable diagnosis of how well blockchain works in the context of a financial institution.

2.5 Research Data Collection

The research on blockchain technology in the financial services sector has applied both primary and secondary methods of data collection to comprehend the impact caused by blockchain. The research design states that primary data is obtained through questionnaires administered on 30 financial sector employees. This is very important because it offers firsthand, contemporary information from direct participants in the implementation of blockchain technology. A survey of employees will enable the researcher to gather specific relevant data regarding impression and application about blockchain in the industry (Flick, 2018). Such data also enables an assessment of real-world adoptions, benefits, and challenges that blockchain brings forth in order to validate or refute the existing theories under test by the deductive approach.

Primary data would have the advantage of specifying insights concerning the research questions.

This involve analysing existing reports, statements of the financial position, and literature related to blockchain technology, which are considered secondary data. The rationale for this is that it would facilitate a good review of previous literature, hence giving the study a critical theoretical framework. Through the review of literature, the study will be able to identify knowledge gaps and put into context the overall trends and patterns of blockchain adoption within the financial services sector. Secondary data would put the experience of banks in perspective by comparing these with global trends of the implementation of blockchain, hence making the research comprehensive. The strength of collecting both primary and secondary data combines the validity of this study (Babbie, 2020). Primary data offers first-hand and current representation related to the studied organisation, while secondary data gives a broader and more established perspective. It ensures a balanced view so that the research is not based solely on theoretical but also on empirical and real-world evidence. Other methods of collecting data, such as relying solely on secondary data, would be able to present a historical context but would not present the relatively current organisation-specific insights that could come with the acquisition of primary data. On the other hand, basing one's research entirely on primary data lacks wide contextual understanding and theoretical framework necessary for comprehensive analysis. Therefore, the integration of both methods will provide a balanced way towards achieving the research objectives.

2.6 Population and Sampling

In this study, snowball sampling used to acquire respondents from the financial services industry, specifically those who have knowledge of or are familiar with blockchain technology. This is quite an effective method since it allows the researcher to get in touch with the population that may be very difficult to access (Walliman, 2017). Since blockchain technology is still quite new and specialised, finding experts in any particular organisation or industry can prove quite daunting. The snowball can start with initial participants referring others who are

knowledgeable; in this regard, a network of informed respondents is created. This helps in ensuring that the data collected is rich, relevant, and from people who have direct experiences.

2.7 Data Analysis

Quantitative data analysis in this research includes descriptions of data by graphs, charts, and descriptive statistics. It is appropriate because it will help in clear, visual presentation of numeric responses gathered through surveys. With the facilitation of tools such as Microsoft Excel, this research can present the trends in data about the percentage of blockchain adaption, perceived benefits, and challenges throughout the financial sector. Graphs and charts summarise large datasets into simple forms that may easily depict relationships of important variables. The descriptive statistics-mean, median, and standard deviation-indicate the summary of data patterns and provide an overview of the central tendency and dispersion of the responses. It enables an objective assessment of the impact of blockchain technology. Other approaches, such as qualitative analysis, would not be appropriate (Kumar, 2019). This is because they would focus on textual or narrative data from a type that cannot capture measurable, numerical results. In this way, developers may test hypotheses regarding blockchain's operational efficiency and safety in financial services.

2.8 Ethical Considerations

All these considerations within the study are ethical in nature, upon which much attention needs to be placed with regard to the protection of participants. The research study necessitates ethical guidelines in that sense; the information collected will be anonymised in such a way that the identity of the respondents will not be leaked. Also, prior to collecting the data, informed consent is sought to make sure that all participants have been fully informed about the purpose of this research and that their participation is voluntary (Creswell and Creswell, 2018). Moreover, data protection protocols are stringently honoured, storing and

managing all collected data in a safe way. This prevents unauthorised access and is in line with the laws on data protection. Ethical approval will be sought from the relevant institutional review boards to ensure that the current study meets all necessary ethical standards. Such measures protect the rights of participants while vouchsafing the credibility and ethical soundness of the findings of the study. Other ethical transgressions, such as lack of consent or violations of privacy, can render the research results void and even cause harm to the respondents.

2.9 Research Limitations

Despite the strengths, the followings are the limitations of this research. The sample size, 30 participants, may not fully represent the entire financial service sector and thus may limit the generalisability of the findings. The snowball-like process for sample selection has efficiently reached knowledgeable people, but might also introduce bias in the process; participants might only refer peers with similar experiences or views (Bryman, 2016). The second limitation is that this research is based on one area which is banking industry in Finland. This may limit the generalisability of findings to other banks, which could face very different challenges in the adoption of blockchain. Last but not least, considering the fast evolution of blockchain technology itself and changes in regulations, the results of this research may, within a very short period of time, be superseded by new developments. Consequently, these limitations would suggest that while the study indeed offers an insight into valuable understanding, further studies that are based on larger and more diverse samples are required for confirmation of its findings.

2.10 Summary

The methodology chapter covers issues such as the adoption of the deductive approach for the researching philosophy, and both primary and secondary data collection methods. Firsthand views from industry practitioners are derived from

surveys, while desk research provides a wider perspective. A quantitative analysis with use of graphs, charts, and descriptive statistics is done to objectively analyse the data. Snowball sampling can make research with knowledgeable participants possible, but the study does recognise ethical considerations and further limitations like sample size and the constantly changing nature of the technology. Overall, the methodology offers a framework through which an investigation is possible on how blockchain technology is shifting the paradigm in financial services.

3 Current State Analysis / Project Specifications

3.1 Blockchain Technology

According to Zheng et al. (2018) blockchain technology was first introduced with Bitcoin in 2008 in a whitepaper paper by Satoshi Nakamoto, described as a pseudonymous person or persons, it is now a paradigm-changing concept that extends well beyond cryptocurrency applications. Basically, blockchain is a decentralised system with distributed ledgers recording transactions across many computers in such a way that the registered transactions cannot be altered retroactively. Immutability is achieved through the use of cryptographic hashing and consensus mechanisms that all participants of the network have agreed are valid transactions. De Filippi & Hassan (2018), added that a blockchain consists of blocks, wherein each block contains a list of transactions. Once the block is complete, it gets added to the linear chain in chronological order. Because blockchain is decentralised, it means no one single entity controls the whole network; therefore, security becomes very high, with a reduced risk of fraud. Each vehicle in the network will get a copy of the whole blockchain, so data are publicly transparent and accessible for all participants.

Davidson, De Filippi, & Potts (2018), claimed that there are different kinds of blockchain, each with its own subtleties: public, private, and consortium blockchains. Public blockchains, like Bitcoin and Ethereum, are open to everybody and maintained by a very large network of nodes. Private blockchains are restricted and are oftentimes used within a particular organisation or among a group of organisations. Consortium blockchains are a hybrid form; in this kind of blockchain, a group of organisations collaboratively manages the blockchain. Andoni et al. (2019), argued that the blockchain depends on a number of its elements, which include consensus algorithms. These ensure that all nodes of the network are in consensus regarding the condition of the blockchain. Common types of consensus algorithms include proof of work PoW, used in Bitcoin, and Proof of Stake PoS, as in Ethereum 2.0. They play an indispensable role in maintenance for ensuring integrity through safety in the blockchain.

Peters & Panayi (2016) stated that another fundamental attribute of blockchain technology involves the use of cryptographic hashing in securing data in each

block. A hash function takes an input and produces a fixed-length string of characters that often appears random. A slight change to the input data will completely alter the hash that results, thus making it easy to detect tampering. Cong & He (2019), opined that another significant power of blockchain technology is smart contracts, which are self-executing contracts that have the terms of the agreement written directly into lines of code. These contracts can execute transactions automatically, without the need for intermediaries, when certain conditions are satisfied. Atzori (2017), opposed that the bottom line is, blockchain technology makes revolutionary strides in how data are stored, secured, and shared. Its decentralised nature, transparency, and security hold a huge potential to disrupt different industries-particularly finance, supply chain management, and healthcare-dependent on trust and intermediaries. As blockchain technology continues to evolve, its uses will expand, bringing new opportunities and challenges across several sectors.

3.2 Blockchain Code Overview

The Python code below provides a simplified implementation of blockchain fundamentals, specifically how blocks are created, validated, and linked sequentially. This code uses hashing and a proof-of-work mechanism to demonstrate how each block is mined and securely added to the chain.

Key Components of the Code

Block Class

The Block class represents an individual block within the blockchain. Each block is initialized with:

- **Data**: Stores the information in the block, such as transaction details.
- **Nonce**: A number used for mining to find a valid hash.
- **Previous Hash**: Links the block to the preceding block, creating the chain structure.
- **Timestamp**: Records when the block is created.

- **Hash Calculation**: Generates a unique hash using the nonce, data, previous hash, timestamp, and block number.

Python code:

```
import datetime
import hashliz

class Block:
    blockNo = 0
    data = None
    next = None
    hash = None
    nonce = 0
    previous_hash = 0x0
    timestamp = datetime.datetime.now()

    def __init__(self, data):
        self.data = data

    def hash(self):
        h = hashlib.sha256()
        h.update(
            str(self.nonce).encode('utf-8') +
            str(self.data).encode('utf-8') +
            str(self.previous_hash).encode('utf-8') +
            str(self.timestamp).encode('utf-8') +
            str(self.blockNo).encode('utf-8')
        )
        return h.hexdigest()
```

Blockchain Class and Mining Process

The Blockchain class manages the chain of blocks, starting with the "Genesis" block, the first block in the chain. Each new block is mined and linked to the previous one through its hash. The proof-of-work mechanism iterates through different nonce values until a valid hash that meets a difficulty target is found.

Python code:

```
class Blockchain:
    diff = 20
```

```
    maxNonce = 2**32
    target = 2 ** (256 - diff)
    block = Block("Genesis")
    dummy = head = block

    def add(self, block):
        block.previous_hash = self.block.hash()
        block.blockNo = self.block.blockNo + 1
        self.block.next = block
        self.block = self.block.next

    def mine(self, block):
        for n in range(self.maxNonce):
            if int(block.hash(), 16) <= self.target:
                self.add(block)
                print(block)
                break
            else:
                block.nonce += 1
```

Blockchain Creation and Display

The blockchain is initialized, and multiple blocks are added. Each block links to its predecessor via its previous hash, forming an immutable chain. The mining process adjusts the nonce to find a hash that meets the difficulty target, demonstrating proof-of-work in action.

Python code:

```
blockchain = Blockchain()

for n in range(10):
    blockchain.mine(Block("Block " + str(n+1)))

# Print the blockchain
current = blockchain.head
while current is not None:
    print(current)
    current = current.next
```

Result: Block creation

```
Block Hash: 98d2b7ddaa48246c12beb77e3d168d67fd3453e4e9dd4272d72d587ecfef94cc
BlockNo: 1
Block Data: Block 1
Hashes: 164416
--------------
Block Hash: 7662c4ef9fa95ccb2584369ff709397a4180b9e43565be2fa97b932df99cf78a
BlockNo: 2
Block Data: Block 2
Hashes: 163583
--------------
Block Hash: 45a20c03636660f08b64bb890859f533c747911f4c9ddff2f822c4787e5c977a
BlockNo: 3
Block Data: Block 3
Hashes: 69733
--------------
Block Hash: b7a3343cdf16e992da2c581e165080ecc3900581d4932684623a101b4af1631e
BlockNo: 4
Block Data: Block 4
Hashes: 975957
--------------
Block Hash: d612965496e63d705d4c24472a4435b814c2c8096d75415e6edb07aedf7de4f3
BlockNo: 5
Block Data: Block 5
Hashes: 1888262
--------------
Block Hash: d3df282ed63f83cccf8de2eb6e698688f39cbf9f72e6670db9d09042e55a3d88
BlockNo: 6
Block Data: Block 6
Hashes: 1160487
--------------
Block Hash: a7a8e63d366f7432820ed56dfcef9b6e726f3879616e803db19eb34ba2ce7f95
BlockNo: 7
Block Data: Block 7
Hashes: 90316
--------------
Block Hash: 2c2288e0eaeb0ed3b57fb1a834d3c89cc9babc2b36ee62f19acd6467dd50f6e4
BlockNo: 8
Block Data: Block 8
Hashes: 430636
--------------
Block Hash: 036ac80782db9655bbf14de36b880646f763c25b28a07b6d6bd3d625ff54e4ab
BlockNo: 9
Block Data: Block 9
Hashes: 368757
--------------
Block Hash: 6601860830d98df9b7284c075231d0626bdfaead54fb62a2b737a8edb686d8a5
BlockNo: 10
Block Data: Block 10
Hashes: 624104
--------------
Block Hash: 021206ae1b2054ca8ef227395b855ce3311eb781815d688be5a439a9708a58a9
BlockNo: 0
Block Data: Genesis
Hashes: 0
--------------
Block Hash: 98d2b7ddaa48246c12beb77e3d168d67fd3453e4e9dd4272d72d587ecfef94cc
BlockNo: 1
Block Data: Block 1
Hashes: 164416
--------------
Block Hash: 7662c4ef9fa95ccb2584369ff709397a4180b9e43565be2fa97b932df99cf78a
BlockNo: 2
Block Data: Block 2
Hashes: 163583
--------------
Block Hash: 45a20c03636660f08b64bb890859f533c747911f4c9ddff2f822c4787e5c977a
BlockNo: 3
Block Data: Block 3
Hashes: 69733
--------------
Block Hash: b7a3343cdf16e992da2c581e165080ecc3900581d4932684623a101b4af1631e
BlockNo: 4
Block Data: Block 4
```

```
Hashes: 975957
--------------
Block Hash: d612965496e63d705d4c24472a4435b814c2c8096d75415e6edb07aedf7de4f3
BlockNo: 5
Block Data: Block 5
Hashes: 1888262
--------------
Block Hash: d3df282ed63f83cccf8de2eb6e698688f39cbf9f72e6670db9d09042e55a3d88
BlockNo: 6
Block Data: Block 6
Hashes: 1160487
--------------
Block Hash: a7a8e63d366f7432820ed56dfcef9b6e726f3879616e803db19eb34ba2ce7f95
BlockNo: 7
Block Data: Block 7
Hashes: 90316
--------------
Block Hash: 2c2288e0eaeb0ed3b57fb1a834d3c89cc9babc2b36ee62f19acd6467dd50f6e4
BlockNo: 8
Block Data: Block 8
Hashes: 430636
--------------
Block Hash: 036ac80782db9655bbf14de36b880646f763c25b28a07b6d6bd3d625ff54e4ab
BlockNo: 9
Block Data: Block 9
Hashes: 368757
--------------
Block Hash: 6601860830d98df9b7284c075231d0626bdfaead54fb62a2b737a8edb686d8a5
BlockNo: 10
Block Data: Block 10
Hashes: 624104
--------------
```

This Python code illustrates how blockchain principles—such as immutability, decentralization, and cryptographic security—are achieved. Each block in the chain relies on the previous block's hash, ensuring that any attempt to modify a block would necessitate re-mining all subsequent blocks, thus safeguarding data integrity across the entire blockchain.

3.3 Importance and Drawbacks of Blockchain Technology

As per Risius & Spohrer (2017), blockchain technology over the last few years has gained wide attention, since it has unfolded a great transformation across industries. What makes blockchain technology important is the protection, transparency, and efficiency that it could provide in recording and validating transactions. This section discusses some of the key advantages and possible disadvantages presented by blockchain technology. Zetzsche, Buckley, & Arner (2018), said that decentralisation is considered one of the most salient features of blockchain technology. While the traditional system has a central authority controlling the data, blockchain enables a distributed network, with huge nodes managing the ledger. This makes manipulation of data or fraud less probable, as

no single entity can control an entire network. Such characteristics have wider appeal for industries related to finance and supply chain management, where lots of trust is needed.

Risius & Spohrer (2017), contradicted that probably the most overriding benefit of blockchain technology is its transparency and absolute immutability. All blockchain transactions can be ascertained by all participants in the network, and once added, they cannot be changed or deleted. Due to this transparency, participants are able to trust each other because they can themselves independently verify with ease the propriety of the data. This level of immutability is of particular value in industries which place a high demand on integrity, such as legal contracts, health records, and financial transactions. Yeoh (2017) claimed that because of blockchain's cryptographic security measures, data laid on the blockchain is secured against unauthorised access and tampering. Each block in the chain contains a cryptographic hash of the previous block, linking them together into what is called a chain. Thus, it is computationally impossible for an attacker to change the data without changing all the subsequent blocks-a task which requires consensus from the greater part of the network. With this level of security, blockchain technology becomes one of the most prospective solutions considering sensitive information and transactions.

According to Fan, Kuo, & Wang (2020), blockchain technology can greatly enhance process efficiency while reducing the cost of the entire activity due to the elimination of intermediaries. In more traditional systems, for instance, the middleware formed by banks, brokers, or clearinghouses is usually necessary in order to attain a valid settlement of a transaction. With blockchain, there is the ability to conduct transactions right between parties, reducing the need for intermediaries or related costs. This efficiency is really important for industries like finance, in which transaction costs and delays can be huge. Tasca & Tessone (2019), opposed that the most critical issues that blockchain technology faces at present are scalability. The number of transactions on the blockchain network determines how long it will take in time and resources to process and verify the transaction. This increases latency in the time it takes to execute a transaction and raises the cost of a transaction, especially in public blockchain networks like Bitcoin and Ethereum. As such, scalability issues act as one of the major reasons

why blockchain has not been taken up widely, while research into the development of methods like sharding and off-chain transactions is still an ongoing aspect.

Mik (2017), stated that most blockchains consume a high amount of energy, especially those which rely on Proof of Work for consensus. This is because mining requires complex computational mathematics which demand huge computational resources and subsequently more energy to validate transactions. With the continuous rise in the adoption of cryptocurrency, this has raised several questions regarding. Finck (2018), reviewed that blockchain technology's regulatory environment is still at a development stage, with much uncertainty regarding how and in what manner such technology will be governed, if at all, in many jurisdictions. This creates a very dicey situation for any organisation that would want to adopt the use of blockchain because of the legal environment that may be complex or even ambiguous at best. Ante (2020), contradicted that the decentralised nature of blockchain naturally raises questions about jurisdiction and liability in the case of dispute or security vulnerability. Integration with existing systems: Integration of blockchain technologies with existing systems poses complexities and is costly. Many organisations have legacy systems that are incompatible with blockchain, thus requiring huge investments in new infrastructure and training. There is also likely resistance from stakeholders who would feel unfamiliar or sceptical with the technology. While blockchain technology has a wide array of benefits, such as decentralisation, transparency, security, and efficiency, there is also significant challenges in scalability, energy consumption, regulatory uncertainty, and integration. It is within those growing pains that these challenges will be looked to with great importance for its wide adoption and the eventual long-term success of the technology.

3.4 Acceptance and Application of Blockchain Technology in Different Business Sectors

Schuetz & Venkatesh (2020) found that blockchain technology, originally developed as the backbone of cryptocurrencies, has gradually gained acceptance across various business sectors due to its potential to transform traditional processes. Its decentralised, transparent, and secure nature has made

it an attractive solution for a range of industries, from finance to supply chain management, healthcare, and beyond. This section shall venture into the adoption of blockchain technology through an analysis of different business sectors and how organisations leverage it for increased innovation and efficiency. Chen (2018), claimed that among a number of verticals, the financial services segment has been one of the earliest and most eager adopters of blockchain technology. Banks, payment processors, and other financial institutions make attempts to utilise blockchain in favor of enhancing the security, transparency, and efficiency of financial transactions. Rauchs et al. (2018), added that examples of such applications include cross-border payments, which involve trade finance, digital identity verification, and smart contracts. Various banks have entered into real-time cross-border payments using Ripple, a blockchain-based payment protocol, to arrange such transactions. This has extremely reduced transaction costs and settlement times. The technology is further being applied in anti-money laundering and know-your-customer processes for better compliance and fraud reduction.

Bharadwaj & Dolega (2021), opposed that supply chain management is another sector where the application of blockchain technology has been paramount. Its capability for tracking and tracing products through every stage in the supply chain-from raw materials to the end consumer-has made blockchain an indispensable instrument for ensuring transparency and accountability. IBM and Walmart are working with blockchain to improve the traceability of food, considering that food safety can be enhanced by knowing which farm your food came from and what transportation route it took. Equally, blockchains help combat fake goods in industries like pharmaceuticals and luxury goods, where authenticity can be a matter of life and death. Macrinici, Cartofeanu, & Gao (2018), stated that the concept of blockchain in healthcare could be considered for various reasons, including tightening data security, interoperability, and enhancing patient care. Because the technology creates an immutable and transparent record, it is ideal for storing sensitive health data. This means that it ensures patient information is secure and accessible only by those authorised. It is expected that blockchain technology will enable sharing medical records among various different service providers of healthcare with greater efficiency

and accuracy of patient care. Besides data integrity, blockchains are applied to minimise manipulations and fraud in clinical trials. For instance, the MedRec project applies blockchain in developing a decentralised record management system that places patients at the center of their medical information.

According to Biais et al. (2019), real estate is just beginning to scratch the surface in the field of applying blockchain for seamless, fraud-free, and transparent property transactions. With blockchain, the purchase and selling of property will be perpetually made easier by allowing the automation of the transaction through smart contracts that ensure security. These contracts will restrict the number of intermediaries involved, such as lawyers and brokers, hence reducing costs and accelerating the transactions. Arguably, blockchain will also be used to build decentralised land registries that guarantee property records are not only accurate but also tamperproof and can be accessed with ease. Schuetz & Venkatesh (2020), contradicted that blockchain technology adoption is also happening in the energy sector, both in energy trading and in grid management. Blockchain allows peer-to-peer energy trading, whereby consumers will directly buy and sell their excess energy among themselves rather than through traditional utility companies. This may lead to much more efficient and even sustainable energy markets.

Risius & Spohrer (2017), added that companies like Power Ledger, for instance, are using the blockchain to enable decentralised energy trading between various consumers, such as directly trading solar energy with their neighbors. Then, there is a blockchain-based integration of renewable sources that might give the grid more reliable and resilient energy. Governments all over the world have started exploring the uses of blockchain in areas such as digital identity, voting systems, and public records management. Fan, Kuo, & Wang (2020), opposed that blockchain's transparency and immutability make it ideally suited to ensure the integrity of public records and reduce corruption. For example, Estonia has integrated blockchain technology into all levels of government services, including digital identities, health records, and judicial records, making Estonia one of the most advanced digital societies in the world. In a nutshell, blockchain technology has attained wide acceptance in different business industries due to the ability it has to increase security, transparency, and efficiency. However, though still at

the beginning stages of adoption, blockchain applications extend fast and offer enormous opportunities for innovations and transformation across all industries.

3.5 Financial Service Sectors and Use of Technology

According to Cong & He (2019) little wonder the financial service industry has been in the forefront in adopting new technologies, considering the dire need to realise efficiency, security, and customer experience. The sector has, therefore, continued to adopt all sorts of technological innovations over time, ranging from ATMs and online banking to big data analytics and AI. The use of technology in financial services has transformed the operations of financial institutions in terms of new product and service offerings, improved customer experience, and added efficiency in risk management. Beck, Müller-Bloch, & King (2018), opined that technological advancement in financial services started several decades ago, with the introduction of mainframe computers in the 1950s that transformed data processing at banks. This was further enhanced in the 1960s and 1970s with the introduction of automated teller machines, allowing customers to easily access cash and account services outside of banking hours. The invention of the internet in the 1990s further hastened the technological shift in the financial industry, giving way to internet banking, where customers could maintain their accounts, transfer money, and pay bills while sitting in the comfort of their homes.

Xu, Weber, & Staples (2019), claimed that within this sector, the so-called fintech companies have been emerging in the last couple of years, using AI, blockchain, and big data technological innovations in order to make business propositions by disrupting traditional banking models. Yes, no doubt that such companies-cum-disruptors do come up with new financial products and purely innovative services of peer-to-peer lending, robo-advisors, and digital wallets, which are posing a challenge to conventionally established banks to change themselves according to this fast-changing landscape. Wonglimpiyarat (2019), disagreed that big data and analytics have become staple tool for financial institutions, which use them to gain valuable insights into customer behavior and preferences, assess risk, and make data-driven decisions. Backed by vast amounts of data analysis, financial institutions are in a position to spot patterns and trends that enable the tailoring of products and services to meet each customer's needs.

Halaburda, Gans, & Gandal (2020), argued that predictive analytics, for example, presents personalised financial recommendations to clients, as well as cross-selling products by banks, to the transaction history and spending in question. Big data on fraud detection, credit risk assessment, and regulatory compliances also benefit significantly. Catalini & Gans (2019), found that AI and ML are finding their place increasingly in the financial services sector for automating processes, enhancing decision-making, and smoothing customer interactions. AI-powered chatbots, for instance, have been implemented to deliver customer support, respond to queries, and conduct day-to-day customer transactions, thereby freeing human agents to attend to higher-value tasks.

Biais et al. (2019), said that these machine learning algorithms operate in credit scoring, fraud detection, and investment management. They allow financial institutions to provide far more accurate, timely decisions. AI is also causing a face change in the trading sector, where algorithmic trading of systems applies AI and ML on analysing market data to execute trades at a faster pace. These systems can identify trading opportunities in real-time, which may not catch the attention of human traders by processing large volumes of data. In addition, AI is helping in risk management efficiently by consciously looking at the past data and predicting future risks, therefore enabling financial institutions to proactively take actions in order to minimise their losses. Bharadwaj & Dolega (2021), opposed that blockchain/DLT has emerged as one of the transformative technologies in the domain of financial services, opening new vistas toward transaction management, security of data, and cost reduction. Blockchain, as discussed in earlier sections, is an enabling technology that provides for secure, transparent, tamper-evident transactions with no middlemen. This technology is being explored for various applications, including cross-border payments, trade finance, and digital identity verification. Financial institutions are also testing DLT for improving back-office procedures that, until today, have been slow and expensive, such as clearing and settlement.

Schuetz & Venkatesh (2020) reviewed that since the financial institutions are increasing their operations in digital technologies, cybersecurity becomes a top priority regarding concerns. The financial sector is one of the prime targets for cybercrimes because of its sensitivity in terms of data and financial activities.

Besides that, considerable investments are being made by financial institutions in state-of-the-art cybersecurity technologies such as encryption, multi-factor authentication, and threat intelligence systems. Such measures are crucial for the protection of customer data and the integrity of transactions with confidence in the digital financial ecosystem. Ante (2020), contradicted that in the age of smartphones, mobile banking and digital payments have thrived as an end-to-end change in customer interaction with financial institutions. The mobile banking applications enable customers to manage their accounts, transfer money, and undertake payments from anywhere in different geographies at any time. Digital payment systems like PayPal, Apple Pay, and Google Wallet have also become popular, letting customers make online and in-store purchases with convenience and safety. The move to mobile and digital banking is only pushing financial institutions to be more creative and develop new services that appeal to the demands of an increasingly tech-savvy customer base. Tasca & Tessone (2019), added that technology has been deeply ingrained into financial services, promoting innovation, efficiency, and improvement in customer experience. With new emerging technologies, the need for agility and adaptiveness is imperative for financial institutions to have a competitive advantage in the rapidly changing digital space. Further integration of technology into financial services will drive greater transformation, accompanied by new opportunities and challenges for the industry.

3.6 Impact of Blockchain Technology in Financial Services Sector

According to Fan, Kuo, & Wang (2020) blockchain technology has the potential to significantly transform the financial services sector in a number of long-standing challenges pertaining to transparency, security, efficiency, and trust. Its decentralised nature and ability to provide tamper-proof records of transactions offer a new paradigm on how financial institutions work, interact with customers, and adhere to regulatory requirements. This section explores the many impacts of blockchain technology on the financial services sector. Zetzsche, Buckley, & Arner (2018), stated that one of the most influencing aspects of blockchain technology seems to be the way it can really improve transparency and build trust in financial transactions. Most traditional systems for conducting finance involve

numerous middlemen, which introduce a lack of transparency and greater fraud exposure. Xu, Weber, & Staples (2019), opposed that blockchain allows all participants in a network to see and verify the various transactions occurring in real time, leaving little room for manipulation to build trust among them. Such level of transparency in nature is very important in areas such as auditing, where blockchain could provide a clear, visible, and irreversible source of every occurring financial transaction.

As per Phillip, Chan, & Peiris (2018), in-built cryptographic security attributes availed by blockchain ensure a sturdy barrier level against the threats of cyber harms and frauds. Each transaction on a blockchain is encrypted and linked to the previous transaction to create a chain of records that is practically impassable to alter. Therefore, fraud cannot be conducted using blockchains, since any kind of tampering with data would require changes in subsequent blocks in the chain- an action that surely will raise suspicion among the rest of participants of this system. Because of this, financial institutions are increasingly looking to blockchain for security implications, such as on sensitive information like customer data or transaction records, thereby reducing chances of data breaches and fraud. Halaburda, Gans, & Gandal (2020) contradicted that in this respect, blockchain technology can perform better, as it eliminates the need for intermediaries in the processing of the transactions and automates verification where required. Traditional financial transactions involve a lot of partiesicensed banks, clearinghouses, and payment processors-adding time and cost to the process. Since blockchain allows for the conducting and validation of transactions directly among the concerned transacting parties, it eliminates much of the intermediaries' need and drastically cuts transaction costs.

Gomber et al. (2018) argued that this, in turn, improves efficiency, particularly in cross-border payments where the time of settlement using blockchain is reduced from days to minutes. This also facilitates processes that were hitherto laborious, such as trade finance and securities trading. Among the top challenges faced by financial institutions, especially operating in a complex and increasingly globalised market environment, is regulatory compliance. Blockchain provides a very transparent and auditable record of transactions, easily accessible by regulators. Xu, Weber, & Staples (2019), claimed that in fact, this may ease the

burden of compliance with various regulations around AML, KYC, and others in terms of regulatory breaches. Automation of reporting processes offered by blockchain further enables the financial institutions to reduce the efforts in terms of time and cost to achieve compliance without compromising on accuracy and transparency.

Beck, Müller-Bloch, & King (2018), said that the blockchain technology holds the potential to impede traditional ways of doing business in the financial service industry by introducing novel modes of service delivery. For example, blockchain-driven platforms can allow for peer-to-peer lending, decentralised exchange, and automatic processing of insurance claims, among other roles traditionally played by banks, brokers, and insurers. This disruption is forcing these financial institutions to reconsider their business models and explore new avenues of innovation, such as offering blockchain-based services to customers or co-creating new products in cooperation with fintech. Tasca & Tessone (2019), opposed that though historically pleasing, wide-ranging benefits may arise from the adoption of blockchain technology by the financial services industry; its adoption nevertheless is fraught with several challenges. Issues of scalability, a host of regulatory uncertainties, and integration into existing systems are considered the main challenges. Besides this, there remains an added layer of concerns with respect to governance and accountability due to the decentralised nature of blockchain in the event of disputes or security breaches. Ante (2020), claimed that given the presence of these risks, it becomes very important on the part of financial institutions to accordingly consider them while implementing any solution on blockchains by closely working with regulators for staying compliant with legal and regulatory requirements. In the end, blockchain technology will have quite an effect on financial services industries through improved transparency, security, and efficiency while bringing a set of absolutely new challenges and risks. While the technology advances, it's projected that more and more adoptions will keep going, driving further innovation and transformation in the industry.

3.7 Summary

This literature review has discussed what blockchain technology encompasses, its importance, and the complexities that surround it, mostly in the provision of financial services. It has considered the wide usage of adoption in the manifold types of enterprises through which blockchain may inspire changes based not only on transparency but also on security and speed. While analysis has focused on business benefits in financial services, it also recognises blockchain as being disruptive to business models. Despite the tremendous potential of blockchain, several literature gaps have remained regarding empirical studies related to its real-world implementation, its regulatory challenges, and how much it can integrate with already existing systems. This review, therefore, signifies that future related research needs to be focused on practical applications, strategic implementation, and ways in which the related risks can be overcome.

4 Background

The financial industry is experiencing the fastest transformation ever through technological advancement, and among them, blockchain technology has proved to be one of the biggest disruptors. According to Catalini & Gans (2019), Blockchain is a decentralised digital ledger technology that holds potential for bringing more transparency, security, and efficiency into the operations of finance. However, despite such potential, it seems highly difficult to get a proper grasp on the concept and ways of implementation even by many financial institutions. This research hereby conducted focuses on how blockchain technology has caused a disruption in the financial services industry. Tapscott & Tapscott (2017) said that while blockchain technology was initially developed as the basis for virtual currencies, such as Bitcoin cryptocurrencies, applications have grown far beyond this use. Nowadays, blockchain is researched and put into practice in every imaginable direction of the financial industry, from payments to smart contracts, fraud inhibition, and regulatory compliance, among others. The most appealing characteristic of blockchain is the ability to provide a secure, immutable, and transparent record of transactions independently of intermediaries.

Halaburda, Gans, & Gandal (2020) claimed that Despite the hype with blockchain, several challenges have been realised in adopting blockchain in the financial sector. Such challenges include regulatory uncertainties, scalability, integration with existing systems, and issues of security and privacy. These put the institution to ensure that competition is at its height with the most stringent regulatory frameworks. As per Wonglimpiyarat (2019) all such issues have to be overcome successfully for a bank to leverage blockchain technology fully. The research is based on the irreplaceable state of blockchain technology and its application in the financial sector. The study shall try to find the state of the present adoption of block-chain, the benefits and challenges about its proposal to implement the technology in banks and also strategic recommendations on the way forward to optimise the use of the Blockchain technology at the bank. In this regard, the research will add to the fast-growing literature on the impact of blockchain on the financial services industry while equally providing actionable

insights into possible ways financial institutions could go ahead to implement the adoption of this technology.

Hence, Gomber et al. (2018) claimed that the current landscape of blockchain adoption in the financial sector will constitute a significant proportion of this research. It will involve a critical study of available reports, financial statements of the company studied, and scholarly articles on blockchain technology and its applications. The research will also be carried out with a focus on banking industry in Finland, where the technological infrastructure and strategies towards innovation shall be studied in order to find out the areas which may require blockchain integration. Phillip, Chan, & Peiris (2018) expressed that with this in mind, the key focus areas of interest for analysis will include: payments, smart contracts, fraud prevention, and regulatory compliance-individual benefits and challenges of blockchain utilisation in these areas. The findings of this study will be the necessary landmarks that banks would need in the effort toward improvement and further development of its blockchain solutions. The research could provide a benchmark to other financial institutions which will eventually adopt blockchain technology and provide strategic recommendations based on best practices. The wider implications of this research are that it contributes to the ongoing discussion regarding where blockchain technology might be of use in the financial services industry, helping to shape the future of financial innovation. This in itself would mean that the further the development of blockchain technology goes, the more radical the consequences on the financial services will be. In this respect, the research fades but provides banks and other financial institutions with a better insight regarding the opportunity provided by the blockchain for driving the operational innovation required to sustain their competitive advantages in an increasingly digital world.

Despite the rapidly expanding streams of research into blockchain technology and its application in the financial services sector, several gaps do remain. First, much of the academic literature to date has explored the theoretical possibility of blockchain, but there is a relative dearth of empirical work which considers exactly how this technology is being deployed in practice and its real-world impacts upon financial institutions. More importantly, there is a lack of comprehensive research

into the exact challenges and risk factors faced by the process of blockchain adoption to arrive at its current status with regard to regulatory compliance and interfacing with existing legacy systems. Additionally, though potential benefits of blockchain are well-documented, there remains the need for more in-depth analysis with regards to how financial institutions can strategically implement blockchain in a way that maximises these benefits. Among these constraints, the current study attempts to fill some of them by offering a critical case study of banks in Finland while reviewing the practical challenges and opportunities that may arise in blockchain adaption in the financial service sector, with strategic suggestions for its successful implementation.

5 Results and Analysis

5.1 Introduction

Chapter 4 discusses the findings and results obtained from both primary and secondary research conducted to achieve the understanding of the impact that blockchain technology has on the financial service sectors. Primary research was conducted in the form of a survey covering 30 employees of different banks. The secondary data collected through various renowned sources had been employed to study the current trend, benefits, and difficulties of blockchain in financial industry.

5.2 Primary Research

5.2.1 Demographic Questions

The background data gives good insight into the demographic information of the respondents based on gender, age, education, job function, years of experience, knowledge level of Blockchain, and whether their organization is currently using Blockchain. This sample is truly diverse and provides a well-rounded perspective, incorporating opinions from a number of sexes, ages, and levels of expertise in financial services. This also forms a sound basis for understanding any differences in perceptions related to the influence of Blockchain on the financial industry.

Table 1: Summary of Demographic Questions

Demographic Questions	**Summary of Responses**
1. Gender	Male-18 (60%), Female-10 (34%), Others-1 (3%), Prefer not to say-1 (3%)

2. Age	18-25 years-5 (17%), 26-35 years-10 (33%), 36-45 years-7 (23%), 46-55 years-5 (17%), 56+ years-3 (10%)
3. Highest Level of Education	High school diploma-2 (10%), Bachelor's degree-10 (30%), Master's degree-15 (50%), Doctoral degree-2 (7%), Other-1 (3%)
4. Role within Organisation	Manager-8 (27%), Analyst-9 (30%), IT Specialist-5 (17%), Operations Staff-5 (17%), Other-3 (10%)
5. Years of Experience	0-5 years-7 (23%), 6-10 years-10 (33%), 11-15 years-8 (27%), 16+ years-5 (17%)
6. Familiarity with Blockchain	Very familiar-8 (27%), Somewhat familiar-12 (40%), Not very familiar-7 (23%), Not at all familiar-3 (10%)
7. Blockchain Usage in Organisation	Yes-10 (33%), No-15 (50%), Not sure-5 (17%)

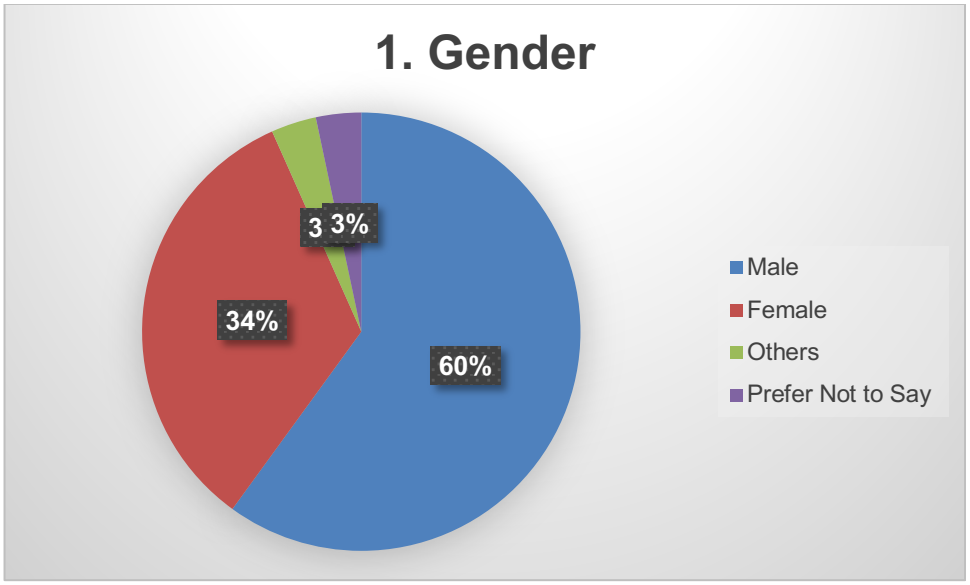


Figure 1: Gender of Respondents

The gender distribution indicates that the majority of respondents are male, 60% or 18 of the respondents. The next biggest group is the female respondents, with 34% or 10 of the respondents. Driving at the low end of this grouping is "Others" or "Prefer not to say," each at 3% or 1 respondent each. This sample is

predominantly male in nature and may reflect what it was in the financial services for the conduct of the study.

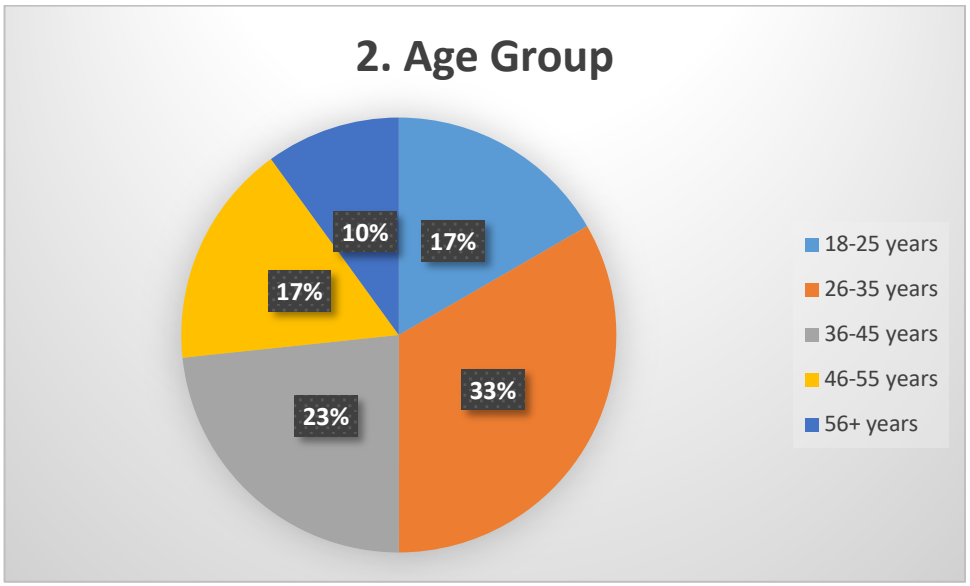


Figure 2: Age Group of Respondents

The most represented age groups are between 26-35 years of age at 33%, followed by those between 36-45 years at 23%, followed by those ranging from 18-25 years at 17%. These have fewer respondents in the categories of 46-55 and 56+ years at 17% and 10%, respectively. Thus, the distribution tends to lean young, signaling that the familiarity with blockchain and insight into its adoption may come most from the younger breed of professionals and probably a tech-savvy one.

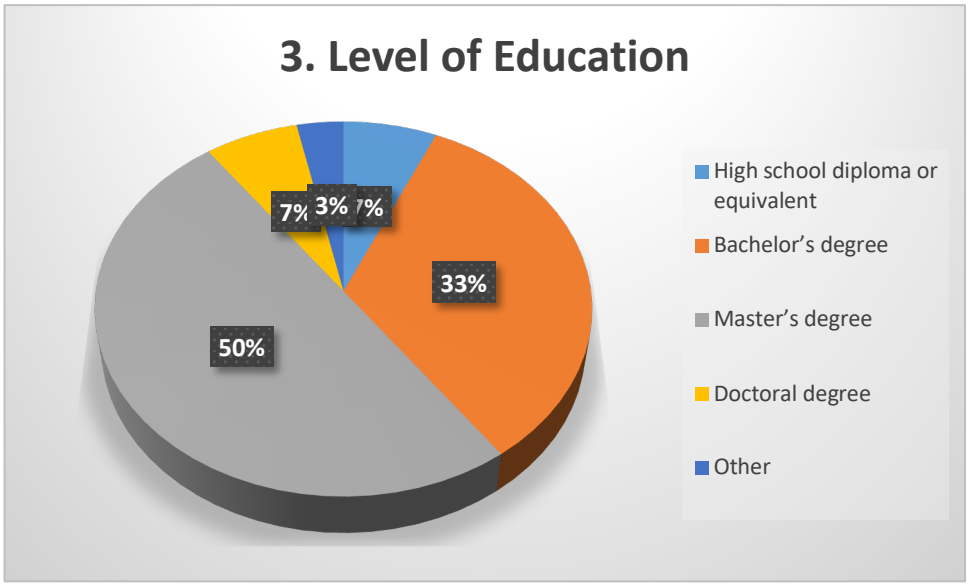


Figure 3: Level of Education of Respondents

Half of them answered that they had a master's degree, 33% have a bachelor's degree, while the rest have either high school, a doctoral degree, or something else. This would mean that an unusually high number of the respondents have a sufficient knowledge base to hold opinions on complex technologies such as blockchain.

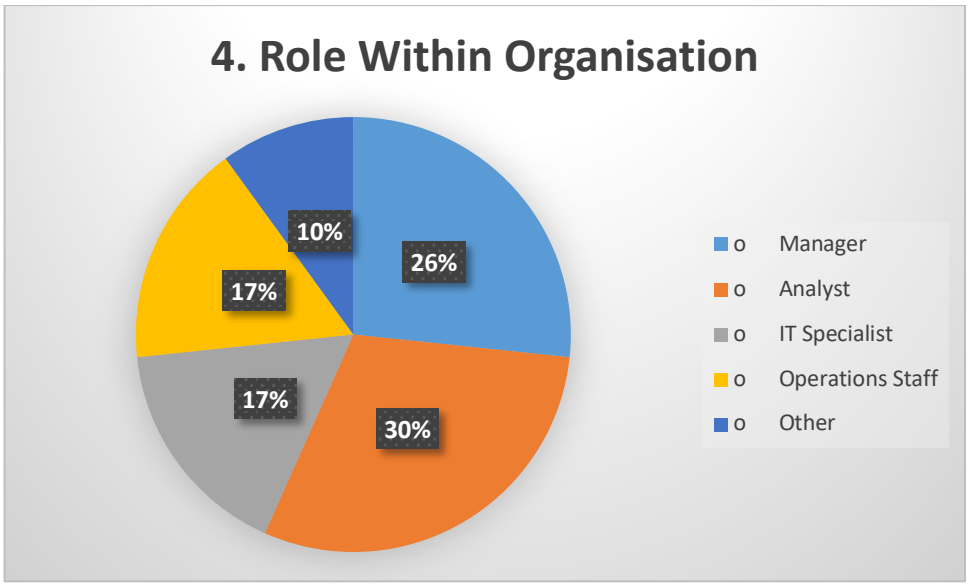


Figure 4: Role of Respondents within Organisation

The total number of analysts is 30%, while that of managers is 27%. IT specialists and operations staff are 17% each, and all others amount to 10%. The sample

spreads across organizational roles and covers, strategically and technically, both groups' perceptions of the impact of blockchain.

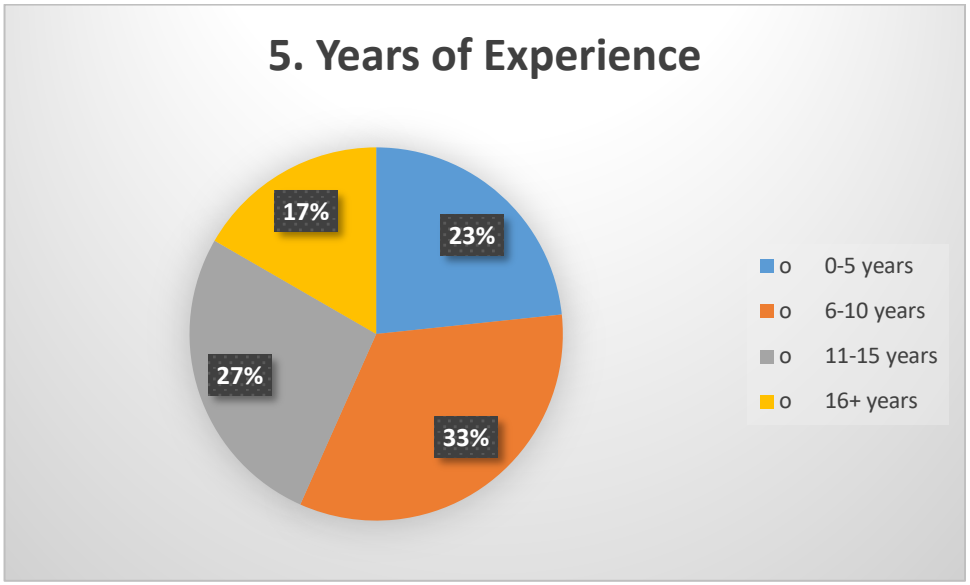


Figure 5: Years of Experience of Respondents

The respondents' experiences range from less than 5 years to more than 16 years, with the majority having 6-10 years in the industry. This variation in tenures would presumably provide insights into both senior practitioners and fresh entrants, which might offer a balanced perspective on both challenges and benefits blockchain could pose or present.

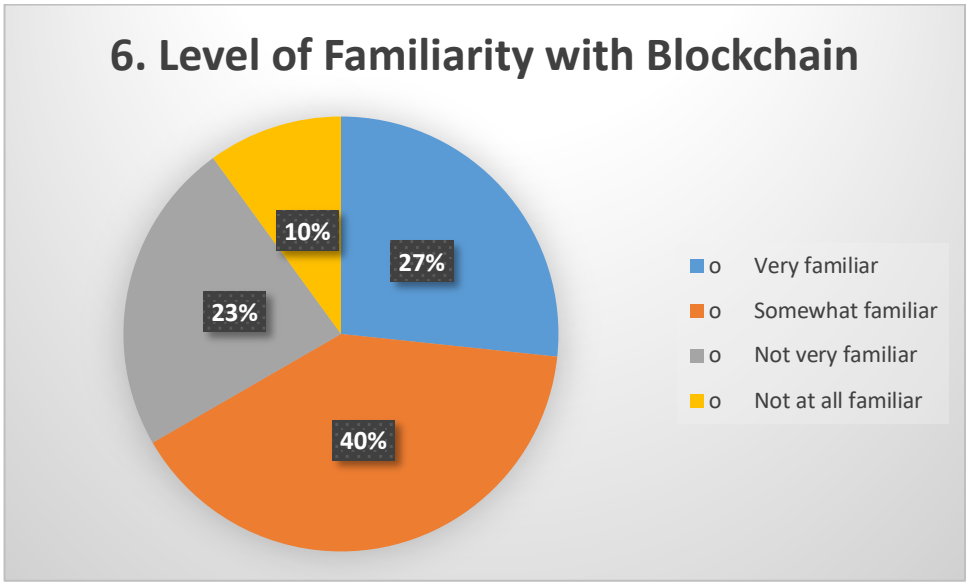


Figure 6: Level of Familiarity of Respondents with Blockchain

Of the total, a full 40% of respondents reported a general level of Blockchain familiarity, followed by a further 27% who are very familiar. Only 10% responded as unfamiliar with Blockchain. As compared to other emerging technologies, this high degree of Blockchain familiarity among the general public suggests that most respondents have at least a partial understanding of the basic tenets of Blockchain Technology. To that end, this becomes important for grounding reliability into such respondents' answers about blockchain.

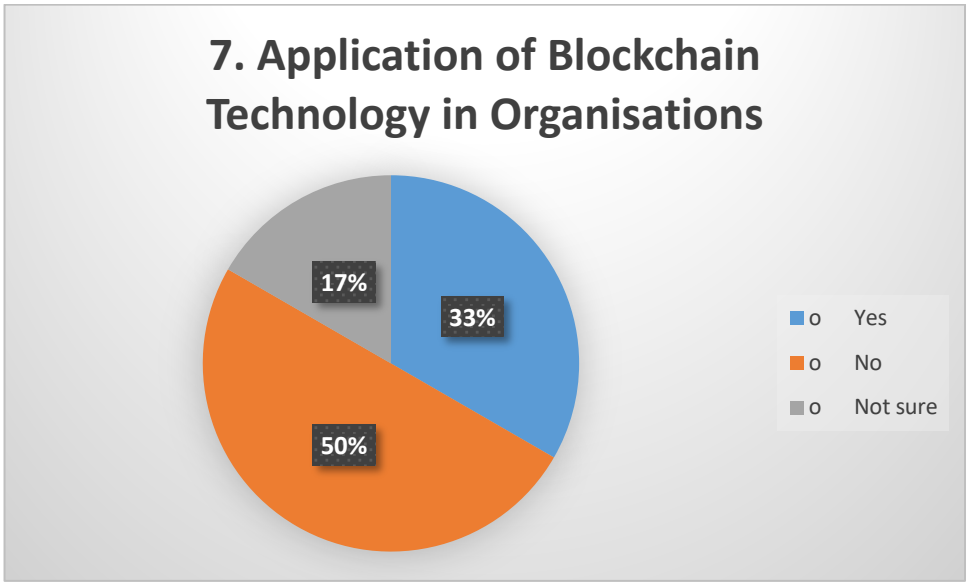


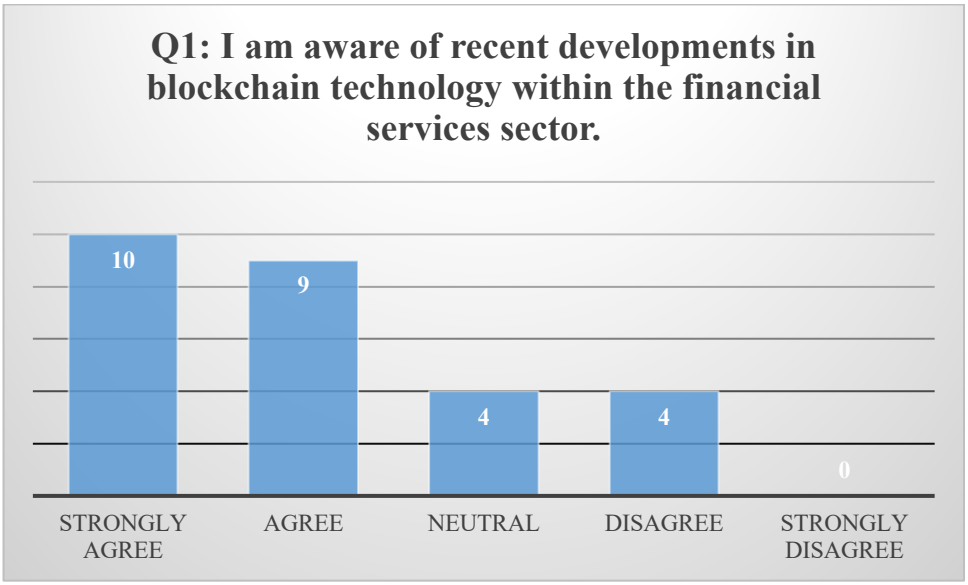
Figure 7: Application of Blockchain Technology within Respondent's Organisation

50% of the respondents claimed that their organization does not use blockchain technology, 33% reported that it was in use, and 17% were uncertain. The very low penetration would suggest that blockchain in this sector remains very much in its infancy; hence, there is more upside than downside, with a range of views on its eventual role in finance.

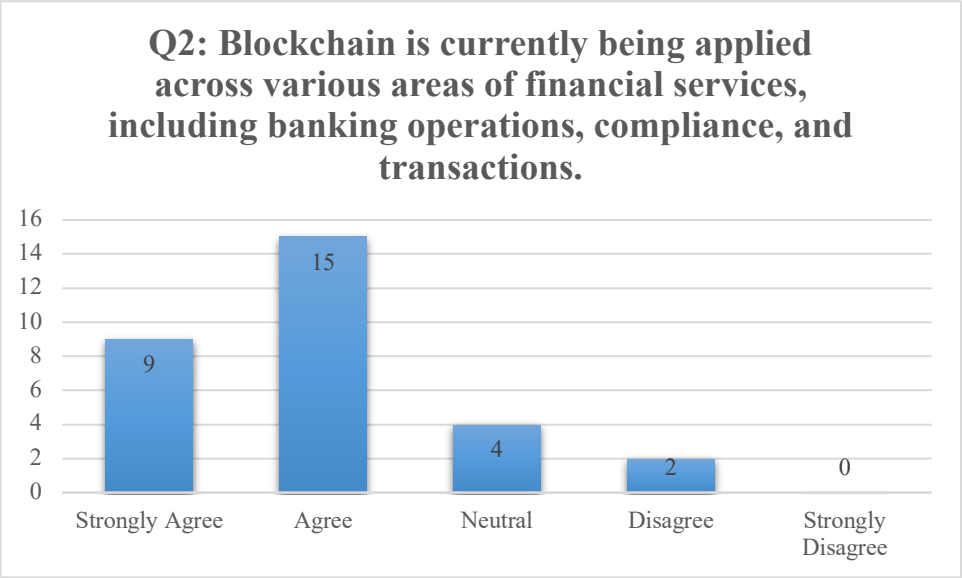
5.2.2 Research Information

The survey focuses on blockchain technology in the financial services sector, and certain questions point to important fields of interest, such as operational efficiency, customer experience, competitive advantage, and challenges

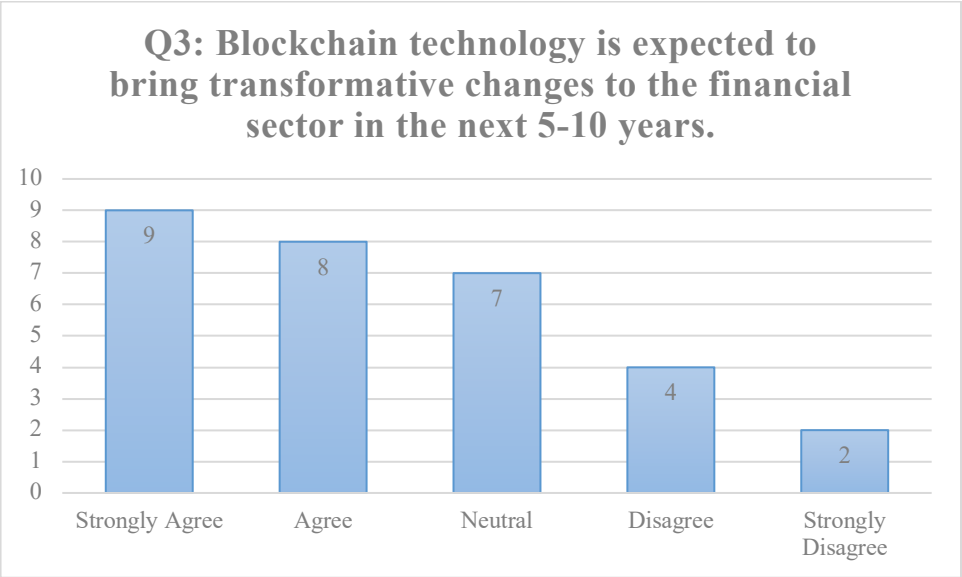
regarding how businesses will apply blockchain. The data shows enthusiasm for the potential benefits of blockchain, while at the same time any level of skepticism or uncertainty among respondents would suggest the call for further exploration and understanding of blockchain's role in enhancing banking operations and market positioning.



Results of the statement on the awareness of recent developments in blockchain technology within the financial services sector indicate that 33% strongly agree, 30% agree, 13% are neutral, while another 13% disagree. None of the respondents strongly disagree with this assertion. Most of them answered that they knew of the blockchain development in the financial sector, whereas the minority of 26% showed neutrality and disagreement, possibly demonstrating a lack of awareness by the group.

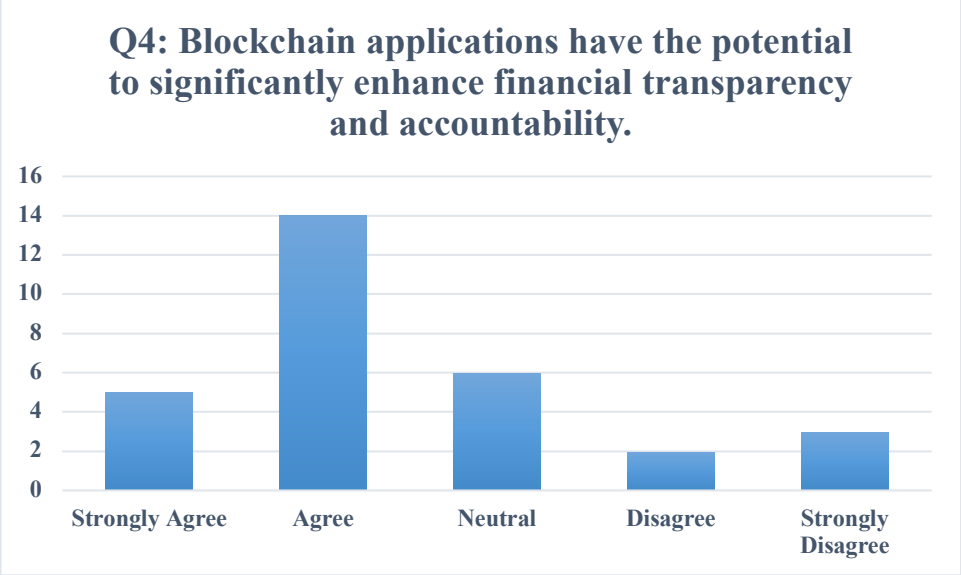


Responses to the statement that blockchain is currently being applied across many areas of financial services, including banking operations, compliance, and transactions, indicated that 30% strongly agree and 50% agree. A small minority, 13%, remain neutral, whereas 7% disagree. Overall, this would suggest that a sizeable majority-80%-believe blockchain is being applied in financial services. Whereas 20% were highly uncertain or did not see blockchain's influence in their specific areas; this may reflect the general lack of awareness or uneven implementation across organizations.

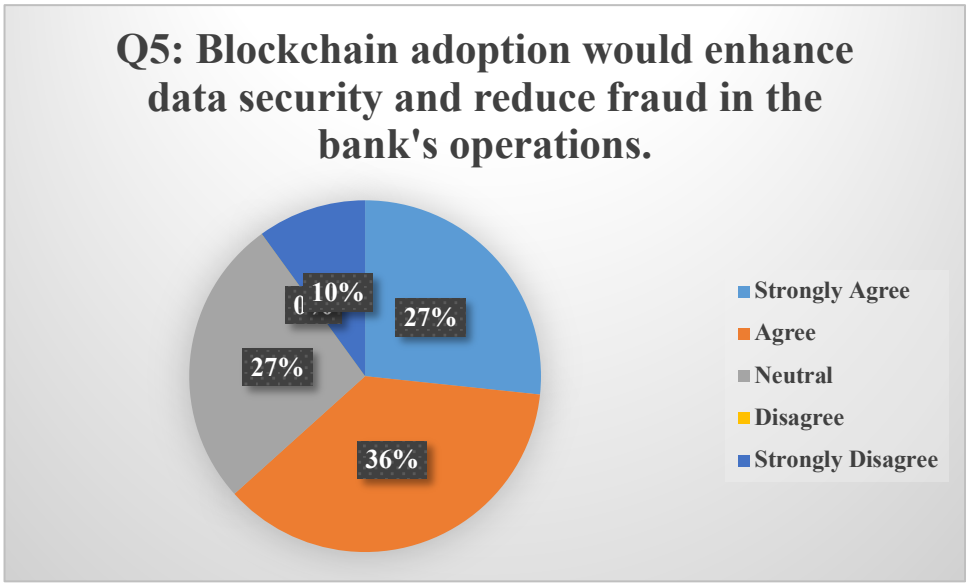


The response to the statement that blockchain technology is expected to bring transformative changes in finance within the next five to ten years shows 30% strongly agree, 27% agree, 23% are neutral, 13% disagree, and 7% strongly

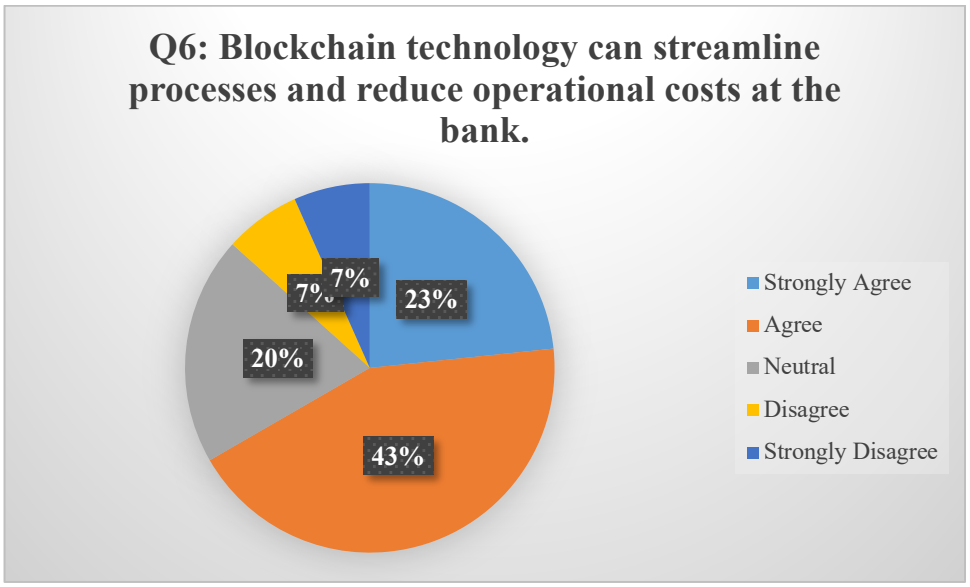
disagree. The results indicate that for more than half of the respondents, blockchain has a high probable impact on the financial sector in the short term, though a considerable number of the respondents are still in doubt or view this as 'hype'.



Results from the statement that blockchain applications have the potential to expand the level of financial transparency and accountability are 17% strongly agree and 47% agree. Six of the respondents, or 20%, remain neutral, while 7% disagree and 10% strongly disagree. These results show that a total of 64% of the respondents consider that blockchain has the potential to improve financial transparency and accountability. However, the fact that the responses hewed toward neutral and opposing views means that a greater proportion of the respondents still remain uncertain or unconvinced of its full potential in that respect.

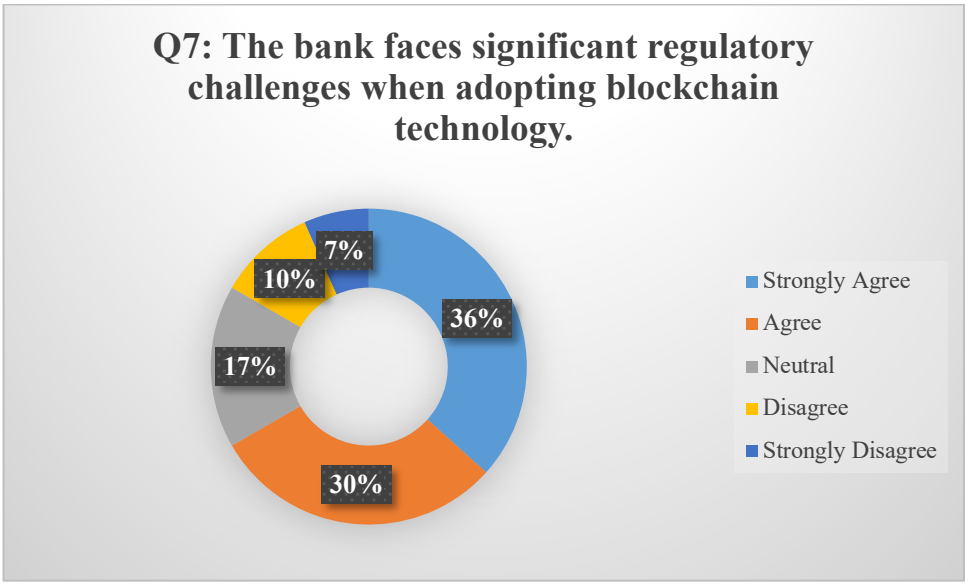


The results to the statement that blockchain adoption would improve data security and reduce fraud in the bank's operations show that 27% strongly agreed, while 37% agree. The remaining 27% are indifferent, while 10% strongly disagreed. None disagree outright. A majority, 64%, of the participants are of the view that blockchain will have a positive impact on improving data security and reducing fraud. However, since a few of the respondents showed strong disagreement with neutral responses, it would mean that a series of the surveyed people still remain somewhat uncertain or even skeptical as to the full effectiveness in blockchain providing those benefits.

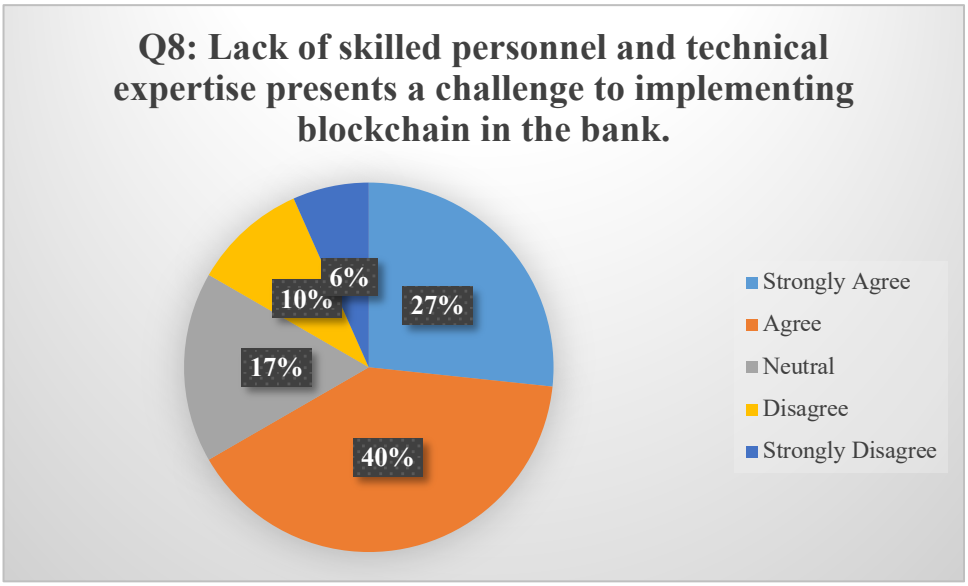


The result of the response to the statement that blockchain technology can make processes more efficient at and cut the operational cost of the bank is that 23

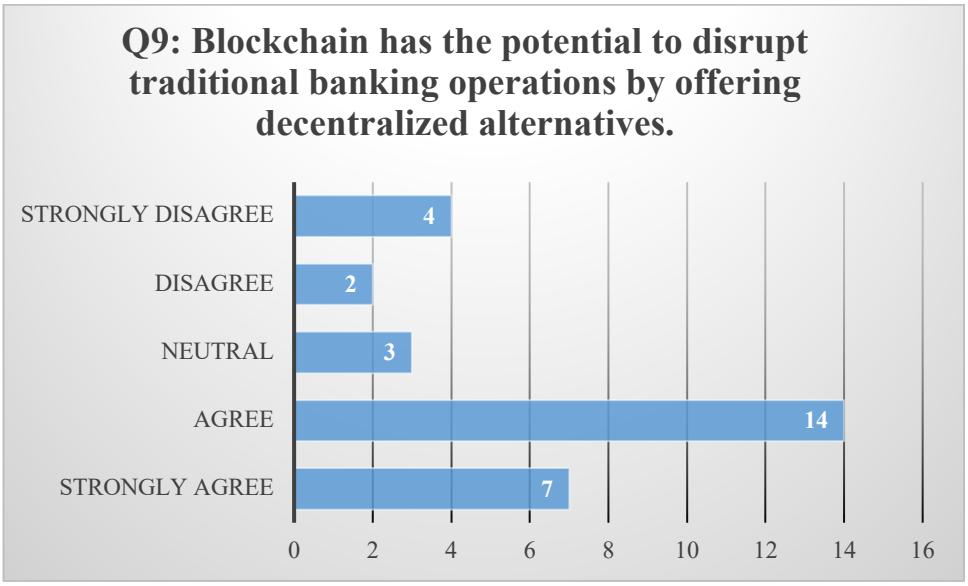
percent strongly agree, while 43 percent agree. Six, or 20 percent, remain neutral as 7 percent disagree and another 7 percent strongly disagree. The implication of these results is that 66 percent of the respondents knew blockchain could enhance efficiency and lower the bank's costs. On the other hand, neutral and disagreeing responses indicate that a large number indeed doubt or have reservations on whether blockchain can realize those benefits.



The responses to the statement that the bank faces significant regulatory challenges in adopting blockchain technology are as follows: 37 percent strongly agrees, 30 percent agrees, 17 percent neutral, 10 percent disagree, and 7 percent strongly disagree. From the result, it indicated that the majority of the respondents 67 percent acknowledged the presence of regulatory challenges when adopting blockchain technology. On the other hand, neutral and disagreeing responses show that some participants either do not view such challenges or believe that the regulatory issues are not serious, as others claim.

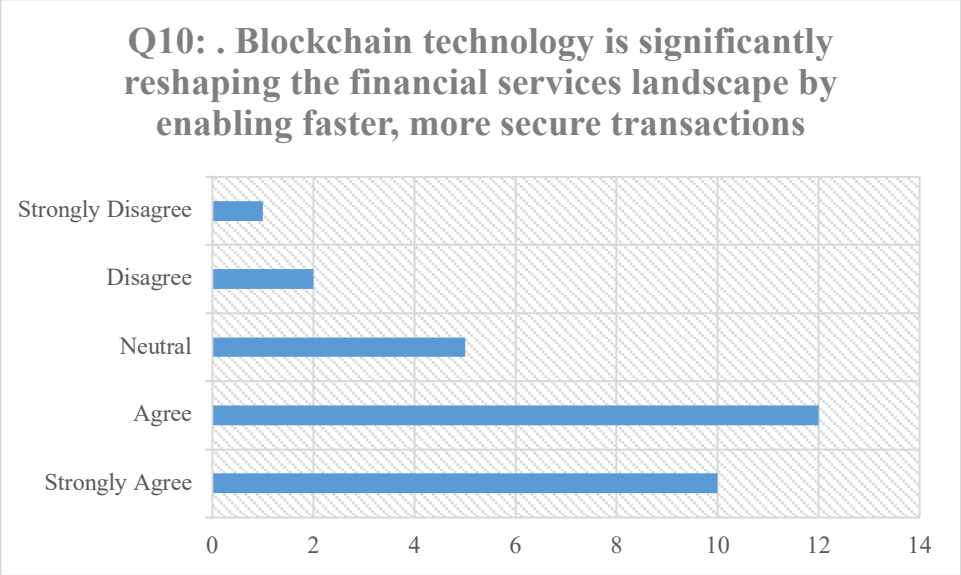


Results of the response to the statement that a shortage of skilled personnel and technical expertise has been a challenge in implementing blockchain in the bank are that 27 percent strongly agree and 40 percent agree. Meanwhile, 17 percent remain neutral, while 10 percent disagree and 7 percent strongly disagree. These results mean that the majority-67 percent-acknowledge the shortage of skills personnel and lack of technical expertise as a critical barrier to the implementation of blockchain. The neutral and opposing responses to this indicate that some participants either did not consider this a big issue or experienced the bank differently in terms of ability to implement blockchain.

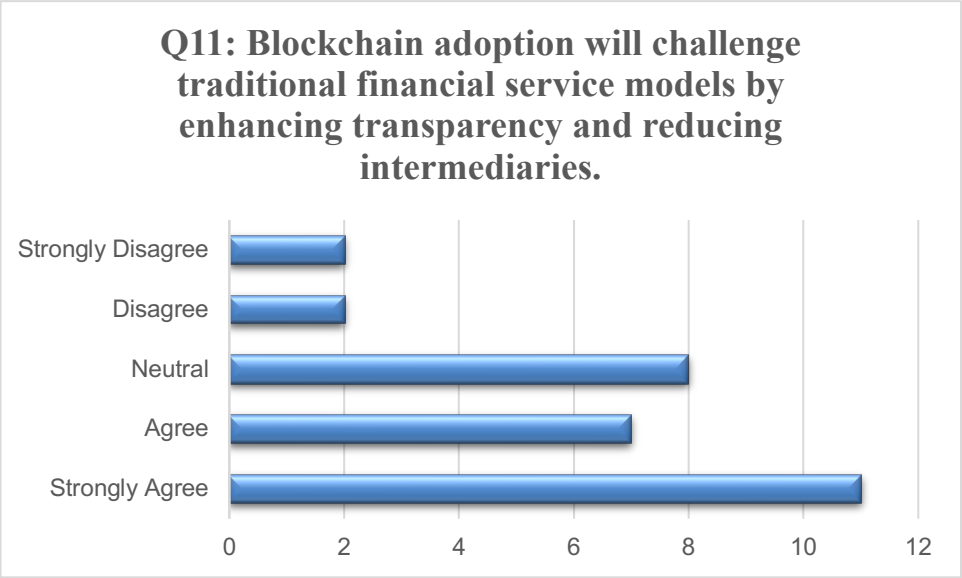


Responses to the statement that blockchain has the power to disrupt conventional banking operations by providing decentralized alternatives were as

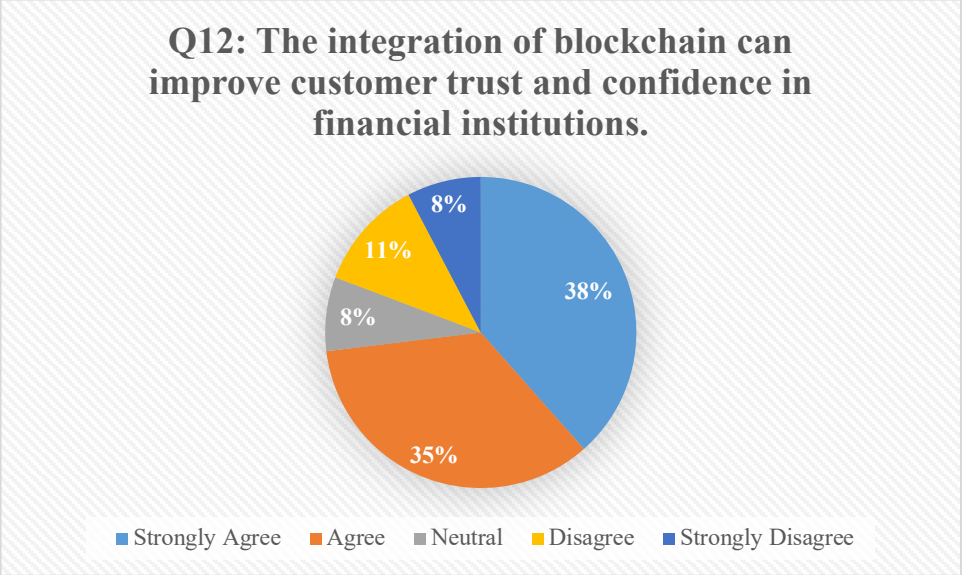
follows: 23 percent strongly agreed, 47 percent agreed, 10 percent were neutral, 7 percent disagreed, and 13 percent strongly disagreed. From these, it would appear that the majority at 70 percent think that blockchain has the potential to disrupt traditional banking operations. However, 20% of the respondents disagree or strongly disagree, meaning a large number of people are unwilling to be convinced that blockchain is going to disrupt the banking sector.



The responses to the statement that blockchain technology is drastically changing the face of financial services by greatly speeding up and securing transactions, are as follows: 33% strongly agree, 40% agree, 17% neutral, 7% disagree, and 3% strongly disagree. The results clearly bring forth that a full majority, amounting to 73%, are in agreement over blockchain technology transforming financial services through faster and more secure transactions. On the other hand, neutral and disagreeing responses hint at the fact that a small slice of participants might still doubt how far blockchain would affect this area.

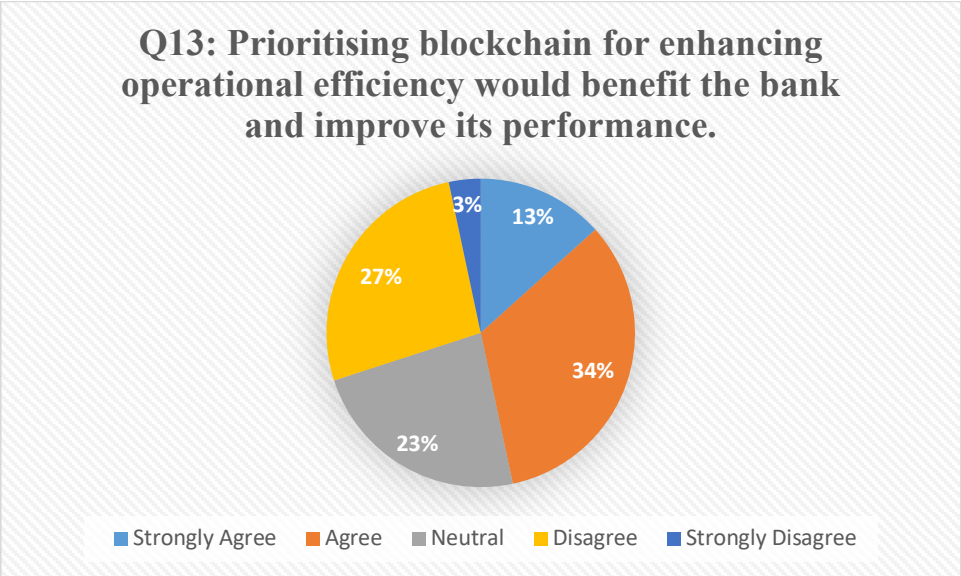


The fact that the blockchain adoption would be challenging to traditional financial service models for more transparency and fewer middlemen, 37% strongly agree, 23% agree, 27% are neutral, 7% disagree, and 7% strongly disagree. From these, 60 percent respondents believes that blockchain is going to disrupt conventional models of finance by making this area more transparent and with fewer middlemen. Whereas 27 percent are indifferent yet, 14 percent disagree, meaning they are not really convinced that blockchain can challenge conventional models.

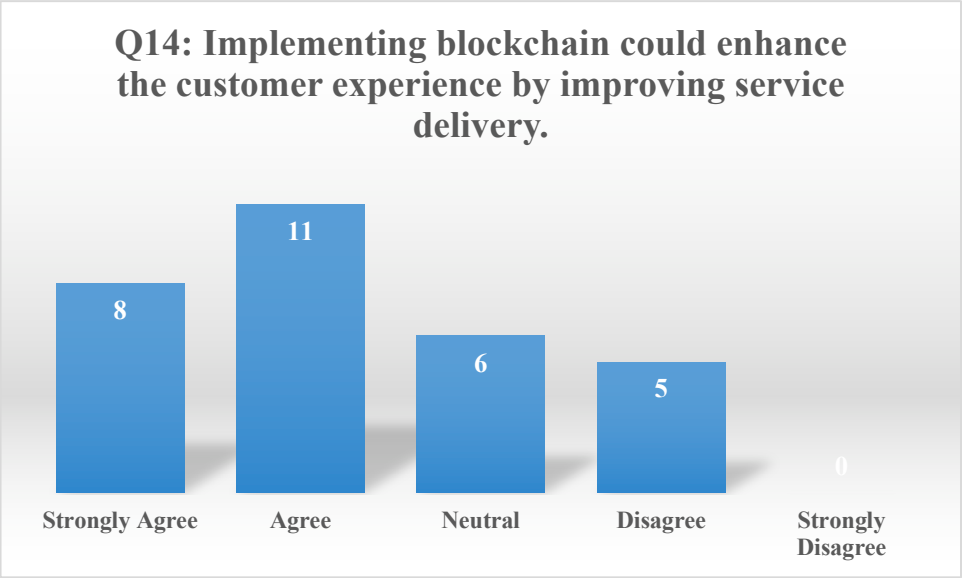


Responses to the statement that blockchain's integration improves customer trust in and confidence in the financial institution show that 33% strongly agree, 30% agree, while 7% are neutral and 10% disagree and 7% strongly disagree. The

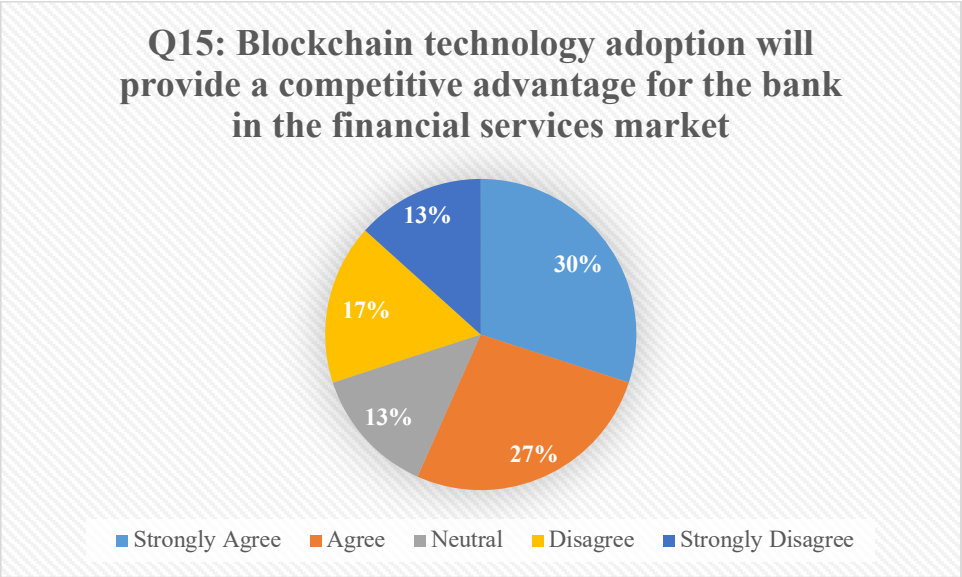
results reveal that a majority of 63% of the respondents view blockchain integration as being able to improve customer trust and confidence. However, 17 percent strongly disagree/disagree, which infers that some respondents are somewhat skeptical as to whether blockchain as such directly influences customers' perceptions of trust and confidence.



Collecting the responses from the statement that prioritizing blockchain to enhance operational efficiency would benefit the bank and improve its performance: 13% strongly agree, 33% agree, 23% neutral, 27% disagree, and 3% strongly disagree. These findings clearly indicate that a nearly equal number, 46%, perceived that a focus on blockchain to enhance operational efficiency would benefit the bank. However, the 50 percent in neutral and disagree responses shows that there is a great cloud of uncertainty or skepticism as to whether blockchain will enhance the bank's operational performance.



The responses to the statement that an implementation of blockchain would improve customers' experience in enhancing service delivery, are as follows: 27% strongly agreed, 37% agreed, 20% neutral, while 17% disagreed. No respondent strongly disagreed. This implies that 64% of the respondents believe blockchain can enhance customer experience through higher levels of service delivery. However, a neutral 20%, and 17 disagree, showing that though many are setting their eyes on benefits accruable from the chain; some are uncertain or skeptical of the blockchain implication for customer service.



Responses to the statement that blockchain technology adoption will provide a competitive advantage for the bank in the financial services market indicate that 30% strongly agree, 27% agree, 13% neutral, 17% disagree, and 13% strongly

disagree. Results thus depict that the majority of the responses, 57%, consider blockchain adoption as a way to gain a competitive advantage. A full 30% either disagree or strongly disagree, though, which suggests that a sizable minority of respondents are doubting blockchain as a source of competitive advantage in the financial services marketplace.

	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15
Mean	3.800000	4.033333	3.600000	3.533333	3.700000	3.633333	3.600000	3.700000	3.633333	3.966667	3.733333	3.733333	3.266667	3.533333	3.566667
Median	4.000000	4.000000	4.000000	4.000000	4.000000	4.000000	4.000000	4.000000	4.000000	4.000000	4.000000	4.000000	3.000000	4.000000	4.000000
Maximum	5.000000	5.000000	5.000000	5.000000	5.000000	5.000000	5.000000	5.000000	5.000000	5.000000	5.000000	5.000000	5.000000	5.000000	5.000000
Minimum	1.000000	2.000000	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000	2.000000	1.000000
Std. Dev.	1.297212	0.850287	1.248447	1.166585	1.178836	1.129032	1.191927	1.178836	1.129032	1.066200	1.284747	1.229896	1.112107	1.166585	1.278019
Skewness	-1.164526	-0.747247	-0.501790	-0.876963	-0.940298	-0.703247	-0.551758	-0.811842	-0.849464	-0.975229	-0.779615	-0.722746	-0.083184	-0.081688	-0.453345
Kurtosis	3.379334	3.180603	2.250999	3.060537	3.404202	2.992531	2.528325	2.872212	3.062782	3.430799	2.712246	2.591689	2.006150	1.581355	2.083346
Jarque-Bera	6.960468	2.832662	1.960221	3.849899	4.625023	2.472854	1.800284	3.315848	3.612871	4.987343	3.142497	2.820205	1.269271	2.549056	2.077929
Probability	0.030800	0.242602	0.375270	0.145883	0.099012	0.290420	0.406512	0.190534	0.164239	0.082606	0.207786	0.244118	0.530129	0.279563	0.353821
Sum	114.0000	121.0000	108.0000	106.0000	111.0000	109.0000	108.0000	111.0000	109.0000	119.0000	112.0000	112.0000	98.00000	106.0000	107.0000
Sum Sq. Dev.	48.80000	20.96667	45.20000	39.46667	40.30000	36.96667	41.20000	40.30000	36.96667	32.96667	47.86667	43.86667	35.86667	39.46667	47.36667
Observations	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30

Descriptive statistics across the 15 survey questions indicate that means range between 3.27 (Q13) and 4.73 (Q11), while for most of them, the median was at approximately 4. There is variability in standard deviation, higher for Q1 and Q9, at about 1.30, indicating that this population has mixed views regarding awareness in applying blockchain and its disruption to traditional banking. Skewness and kurtosis are showing slight asymmetry and moderate tailed distributions in the answers to the questions, especially Q1 with a skewness of -1.16 and Q9 with a skewness of -1.84, pinpointing that heavy one-sided responses either on the agreeing or disagreeing side are available. The Jarque-Bera test signifies non-normality of a considerable amount for certain questions, including Q11 with a probability of 0.207. In general, responses do carry a tendency to agree with most questions, reflecting a positive perception of possible impacts from blockchain on financial services. Clearly, there are areas of neutrality and/or more skeptical views, especially in the operational and competitive areas.

5.3 Secondary Research

5.3.1 Current State and Application of Blockchain Technology in the Financial Sector

Key Statistics	Theme	Source
80% of global financial institutions are exploring blockchain technology.	Blockchain in Financial Institutions	(Deloitte, 2023)
45% of financial institutions are already using blockchain in various operations.	Blockchain Adoption in Financial Institutions	(Al-Dmour et al., 2024)
Blockchain market in finance is expected to grow to $22.5 billion by 2025.	Growth of Blockchain Market in Finance	(Tsai et al., 2024)
SWIFT processes over $1.25 quadrillion annually and is integrating blockchain for faster transactions.	Blockchain in Cross-border Payments	(SWIFT, 2023)
72% of banks are developing blockchain-based digital identity systems.	Blockchain for Digital Identity Systems	(Accenture, 2017)
$4 trillion in assets expected to be tokenized by 2030.	Asset Tokenization	(World Bank, 2023)
Financial derivatives market valued at $4 trillion is exploring blockchain for transparency.	Blockchain in Financial Derivatives Market	(Dehni, 2024)
Securities settlement times reduced from T+2 to T+0 using blockchain.	Blockchain in Securities Settlement	(McKinsey & Company, 2020)

In the last few years, blockchain technology has seen tremendous advancement, most especially within the financial sector. As a matter of fact, by 2023, over 80% of global financial institutions will be studying and exploring blockchain technology as a means to derive more transparency and reduce costs. According to a study done by Deloitte (2023), 45% of financial institutions are already using blockchain in some form: payments, settlements, or record-keeping systems. The financial blockchain market will reach 22.5 billion dollars by 2025, a demonstration of its wild adoption and belief in its power to transform (Al-Dmour et al., 2024).

Another very innovative application of the blockchain is in cross-border payments. SWIFT has experimented with blockchain for proof-of-concept projects; in fact, it handles over 1.25 quadrillion dollars in yearly transaction volume (SWIFT, 2023). The transactions have become faster and more secure, as opposed to taking days, which would happen earlier. Furthermore, 72% of the banks are developing identity systems on the blockchain, expected to reduce fraud to a coroner's case and make KYC processes far easier (Accenture, 2017). Meanwhile, the concept of blockchain-based tokenization has gained increased attention in asset management, with estimates that by 2030 approximately $4 trillion in assets will be tokenized. Financial derivatives, currently over $12 trillion, are also testing blockchain to introduce greater transparency, reduce operational costs, and automate contracts.

In securities settlement, with the help of blockchain, the settlements that used to take T+2 have directly come down to T+0, showcasing its efficiency. In conclusion, blockchain technology is one of the fastest-improving areas in finance. Its applications are widely ranging and changing the game in areas as important as payments, identity management, asset tokenization, and even trade finance, which is indicative that not only is blockchain's integration to this sector current but also necessary for competitiveness in the future.

5.3.2 Advantages and Challenges of Blockchain Adoption in the Financial Sector

Key Statistics	Theme	Source
Banks could reduce operational costs by up to 30% using blockchain.	Cost Reduction through Blockchain	(PwC, 2023)
Cross-border payments currently cost the industry $25 billion annually, which blockchain can reduce.	Blockchain in Cross-border Payments	(Accenture, 2017)
Blockchain can improve transaction speeds by 40% in payments, trade finance, and securities.	Improved Transaction Speed with Blockchain	(Mishra et al., 2023)
Fraud and cyberattack risks in banking can be reduced by 50% through blockchain.	Blockchain for Enhanced Security in Banking	(Infosys BPM, 2023)
KYC verification time can be reduced by 45% using blockchain.	Blockchain for KYC Efficiency	(Infosys BPM, 2023)
Blockchain could unlock over $1 trillion in financial services efficiency gains by 2025.	Blockchain's Potential in Financial Services Efficiency	(IBM, 2023)
60% of banking executives identify regulatory uncertainty as a major barrier to blockchain.	Regulatory Challenges in Blockchain Adoption	(Deloitte, 2023)
Blockchain integration could cost major banks over $200 million annually.	High Implementation	(McKinsey & Company, 2020)

	Costs for Blockchain	
70% of banks face a shortage of blockchain experts, hindering adoption.	Shortage of Blockchain Experts in Banks	(Juniper Research, 2023)

Blockchain technology offers a set of beneficial factors to the banking industry. According to a report provided by PwC (2023), with the help of blockchain, there could be a saving of up to 30% of operational costs as it simplifies the processes and cuts down the middlemen involved. As an example, cross-border payments, estimated at a cost of $25 billion annually for the whole banking industry, can be highly minimized by blockchain technology working out the payments in a speedier and less cost-incurring manner. Further, Accenture estimates that blockchain shoots up transaction speeds in the fields of payment, trade finance, and securities settlement by 40%.

In addition to cost savings, blockchain enhances security by providing immutable and transparent transaction records. According to Infosys BPM (2023), the likelihood of fraud and cyberattacks in the banking sector can be reduced by 50% through blockchain's decentralized and encrypted structure. This capability is particularly valuable for KYC (Know Your Customer) processes, where blockchain can reduce the verification time by 45%, saving banks both time and resources. Moreover, the IBM (2023) estimates that blockchain could unlock over $1 trillion in financial services efficiency gains globally by 2025.

Apart from cost efficiencies, blockchain enhances security due to immutable and transparent transaction records. According to IBM (2023) mentions how blockchain can help reduce the possibility of fraud and cyberattacks in the banking industry by 50% thanks to its decentralized and encrypted structure. This makes it all the more useful for KYC processes where blockchain can reduce the verification time by 45%, thereby saving the banks both time and resources. According to the World Economic Forum (2023), blockchain could also unlock more than $1 trillion in financial services efficiency gains globally by 2025.

However, the adoption of blockchain is not without challenges. Among them, one can highlight the unclear regulatory environment. According to Deloitte's (2023)

research, 60% of banking respondents name unclear regulatory frameworks as a significant barrier to blockchain implementation. Moreover, blockchain adoption requires extensive upfront investments: according to McKinsey & Company (2020), the integration of blockchain might cost over $200 million on a yearly basis for large banks. Besides this, the absence of skilled professionals remains a pain, and Gartner estimates that 70% of banks go through suffering due to the shortage of blockchain experts, thus hindering wide adoption. Therefore, the conclusion would be that though blockchain offers many advantages in terms of cost-savings, enhanced security, and increased efficiency, for wide-scale adoption there are three major challenges: regulatory concerns, high costs in implementation, and a skills shortage that has to be addressed before wide-scale integration.

5.3.3 Strategic Recommendations for Successful Blockchain Implementation in Financial Institutions

Key Statistics	Theme	Source
Banks can improve operational efficiency by 20% through blockchain integration.	Operational Efficiency with Blockchain	(McKinsey & Company, 2020)
65% of banks implementing scalable blockchain infrastructure report significant efficiency improvements.	Scalable Blockchain Infrastructure for Efficiency	(Accenture, 2017)
70% of customers trust financial institutions more that utilize blockchain due to transparency.	Customer Trust with Blockchain Transparency	(Stockburger et al., 2021)
Blockchain-based services reduce transaction times from days to seconds.	Faster Transaction Times with Blockchain	(PwC, 2023)

Blockchain-based identity verification can reduce onboarding time by 50%.	Blockchain for Faster Identity Verification	(IBM, 2023)
80% of banks collaborating with fintech companies adopt blockchain innovations faster.	Bank-Fintech Collaboration for Blockchain Adoption	(Sedlmeir et al., 2022)
Smart contracts can reduce loan processing times by 30%.	Smart Contracts in Banking Operations	(Mishra et al., 2023)
55% of banking executives identify regulatory uncertainty as the biggest challenge in blockchain adoption.	Regulatory Challenges in Blockchain Implementation	(Sedlmeir et al., 2022)

Blockchain technology must be approached strategically in implementation so as to drive better operational efficiencies, greater customer experiences, and stronger market competitiveness. A report by McKinsey (2020) claimed that banks can achieve up to 20% higher operational efficiency due to the integration of blockchain into core processes such as payments and trade finance. The first key recommendation involves developing a scalable blockchain infrastructure. 65% of the large-scale deployments of blockchain infrastructure in banks have gone operational, and significant improvements in operating efficiency are reported.

Banks should be appropriately highlighting the potential of blockchain to smoothen transactions out while making them more transparent. An example is that, as shown in a PwC (2023) survey, 70% of customers have increased their readiness to trust financial institutions because of this immutable and transparent nature. In this direction, blockchain-based services, such as the settlement of real-time payment, shrink the time for transaction settlements from days down to mere seconds, hence improving customer experience. IBM (2023) estimates that use of blockchain for identity verification can alone help reduce onboarding time by 50%.

In other words, banks must collaborate with FinTech if they want to stay competitive. Tsai et al. (2024) that 80% of those banks already collaborating with FinTech firms would therefore be well-placed and quick to adopt blockchain innovations at a faster pace than others, thus offering them a market advantage. Also, the use of smart contracts for granting and settlement of loans would enhance precision and potentially reduce processing by 30%, according to Deloitte (2023). Implementation means regulatory challenges have also been overcome successfully. As per a study by PwC (2023), 55% of executives within banking think that regulatory ambiguity presents the biggest challenge in the way to blockchain adoption. Therefore, this calls for active engagement by banks with regulators with a view to arriving at a well-set-out prescription and compliance framework that will guarantee smoother integrations of blockchain into existing systems.

5.4 Summary

The outlook towards the adoption of blockchain in the financial setting is pretty positive, based on both primary and secondary research. Most of the respondents in the survey believed that it would save costs and thus enhance efficiency; at the same time, most of them identified some sort of problems relating to regulatory uncertainty and a shortfall of skilled personnel. Such above-mentioned views were complemented by secondary research showing first of all how blockchain is already contributing to enhancing the security, speed, and transparency of transactions. Generally speaking, blockchain does bring considerable opportunities for banks, but bearing in mind that successful accomplishment is to be attained after notable obstacles, mainly referring to regulatory frameworks and technological capabilities.

6 Discussions and Conclusions

6.1 Introduction

The chapter interprets the results of the study in terms of linking primary and secondary research to existing literature on blockchain's impact in the financial sector. Major themes that are discussed in this regard include operational efficiency, customer experience, and competitive advantage, among others. Identifying where the findings from the results support or differ from prior studies is also one of the prime focuses while writing this chapter context. This helps in the in-depth insight into the strategic implications for blockchain implementation within financial institutions.

6.2 Discussion

6.2.1 Objective 1: Current State and Application of Blockchain Technology in the Financial Sector

The findings from primary and secondary research indicate the status and application of blockchain in the context of the financial sector. The managerial implications of key findings of the primary research indicate that 63 percent of respondents were aware of the recent development in blockchain technology with regards to finance, while 26 percent remained neutral or disagreed, showing potential areas of unawareness. This is perpetuated by Zheng et al. (2018) and Schuetz & Venkatesh (2020), who indicate the fast development of blockchain but point to how its complexity hinders such understanding in financial services. Deloitte (2023) reports that while over 80 percent of global financial institutions

are exploring blockchain applications, knowledge limitations remain one of the obstacles.

Further, primary research insights reveal that 80 percent of the respondents acknowledged the application of blockchain across banking operations, compliance, and transactions, corroborating findings like Chen (2018) and Rauchs et al. (2018) in areas where the use of blockchain has been noted to be highly recognized. It is seen from SWIFT (2023) that blockchain applications across cross-border payments have been able to reduce transaction time from days to seconds. Yet, 20% doubt the influence of blockchain or find limited use in their specific areas, reflecting the Gartner (2023) finding on inconsistent adoptions due to organizational and technological barriers.

Considering the transformative power of blockchain, 57 percent of those polled think that over the next five to ten years, it is going to bring about irrevocable changes in finance. The observation has therefore been consistent with Xu, Weber, & Staples (2019) argument that, with each passing day, blockchain is increasingly liable to change aspects such as the transparency of transactions, their security, and the level of confidence especially on aspects such as compliance and identity verification. Further, secondary data from Accenture (2023) reveals that 72 percent of the banks are creating blockchain-based digital identity systems to improve Know Your Customer processes. On the other hand, skepticism on the part of 20 percent of the respondents echoes Finck (2018), who observed that scalability and regulatory challenges may hamper the full transformative capability of blockchain.

Towards greater transparency and accountability, 64 percent are in support that blockchain can retain that achievement. This finding is supported by Zetzsche, Buckley, & Arner (2018), who emphasize that blockchain can build tamper-proof ledgers. However, a full 20 percent of the respondents disagree or remain neutral, supporting Ante (2020) says technical and regulatory limitations dampen the gain in transparency. The World Economic Forum (2023) estimates that blockchain might unlock more than $1 trillion in financial services efficiency gains globally by 2025. Yet, it provides the clarity of regulations as central to reaping those benefits.

In addition, primary research suggests that 66 percent of respondents believe blockchain can streamline processes and reduce operational costs. This will facilitate seamless and cheap processes for cross-border payments among other similar activities, suggested earlier by Fan, Kuo, & Wang (2020). According to a secondary research by PwC (2023), it shows that blockchain adoption can reduce up to 30 percent of the operational cost for banks, while Tasca & Tessone (2019) note scalability issues that prevent full operational integration.

6.2.2 Objective 2: Advantages and Challenges of Blockchain Adoption in the Financial Sector

The results of the benefits and hurdles of adopting blockchain technology in the financial sector reflect both the considerable advantages and residual barriers identified through primary and secondary research. A powerful advantage of blockchain, as noted by 66 percent of the respondents, is its potential for reducing operating costs and improving efficiency. This is in line with what Fan, Kuo, & Wang (2020) discuss regarding the ability of blockchain to cut down on intermediaries in transactions and therefore result in much lower costs. A secondary study by PwC (2023) suggested that banks could save up to 30 percent in costs by adopting blockchain processes, especially in cross-border transactions where the processes have been simplified by blockchain.

Also, 64 percent of the individual responses believe that, blockchain could make bank operations data security better and fraud impossible as it will be impossible to doctor the transaction records, a precept earlier echoed by Zetzsche, Buckley, & Arner (2018) as one of major security advantages. In addition, an IBM (2023) reports that blockchain use in banking could cut fraud and cyber attack risks by 50 percent, hence the optimism in the responses. On the other hand, some primary data reflect skepticism because 27 percent remained neutral, and 10 percent strongly disagreed with this suggestion, implying that doubts on blockchain's effectiveness in security purposes are persistent. Tasca & Tessone (2019) also echo this tension as, taking into consideration that scalability issues

would hamper the security and speed benefits of blockchain when considering wider and more realistic applications.

Despite such advantages, the challenges from a regulatory point of view are considered a major issue-a view expressed by 67 percent of the respondents, who denote it as a serious barrier to its adoption. In support of such a view is Deloitte's (2023) report that up to 60 percent of banking executives regard uncertainty in regulation as the main obstacle in the implementation of blockchain. These regulatory challenges are further exacerbated by high initial implementation costs since huge investments are needed for the integration of blockchain. McKinsey (2023) further estimates that for major banks, the cost of implementing blockchain could run over $200 million annually. This challenge is further confirmed by 33 percent of the survey respondents remaining neutral or skeptical concerning immediate benefits accruable from blockchain, thus hinting at cost-effectiveness and timelines for implementation.

Adding to the complication of technical expertise, there was a belief that an absence of skilled personnel acts as a further obstacle to blockchain adoption, to which 67 percent agreed. This logically follows the statement of Gartner (2023), as it said that 70 percent of all banks have skill shortages, and that acts as a deterrent in holding them back from blockchain pursuits. This underlines the need not only for technical training but also of the need for expertise per se, necessary for bridging the knowledge gap inside organizations, especially in emerging technologies such as Blockchain.

6.2.3 Objective 3: Strategic Recommendations for Successful Blockchain Implementation in Financial Institutions

Strategic measures would facilitate blockchain implementation in the financial industry to achieve operational efficiency, enhanced customer experience, and thereby competitive advantage. Findings from the primary research, it can be assumed that the opinions of the respondents regarding blockchain's efficiency are positive. As much as 66 percent of the participants responded that blockchain can be effective in streamlining operations and cost reduction. In support, PwC

(2023) tend to indicate that through blockchain, operational expenditure can be trimmed as high as 30 percent, while Accenture (2023) reports that 65 percent of the banks that have moved to scalable blockchain infrastructure also witnessed a gain in efficiency. A percentage of the respondents have maintained neutrality or skepticism, reflecting previous concerns raised about blockchain scalability and integration in legacy systems.

Moreover, 64 percent of the surveyed agreed that blockchain could be used to enhance service delivery, implying that banks should use blockchain to speed up and make transparent transactions. PwC (2023) also finds that 70 percent of customers would go for financial institutions that have a tendency to use blockchain because it is transparent and may improve customer trust. IBM (2023) supports this with evidence that blockchain-based verification could reduce the onboarding time by half, therefore even optimizing customer-facing processes. However, a number of respondents further expressed some skepticism over this, and this can be supported from the assertion of Schuetz & Venkatesh (2020), who argued that any new technological introduction within an existing model must be carefully planned and complemented with extensive training of the staff for smooth continuity of customer experience.

Blockchain is also a source of competitive advantage in the financial industry, as 57 percent of the respondents perceive that it could raise the market status of their institutions. This perception is supported by the observation of the World Economic Forum (2023) that when traditional banks collaborate with fintech blockchain solution firms, it enables them to reap the benefits of blockchain much quicker, hence sustaining their competitiveness. Deloitte (2023) adds that blockchain-driven smart contracts have the potential to reduce loan processing by up to 30 percent and could therefore appeal to customers who desire efficiency. However, skepticism among the 30 percent reflects a hesitation linked to poor regulatory challenges, and high initial costs of innovative blockchain technology, also documented by McKinsey (2023), citing implementation costs over $200 million for major banks.

Banks should work in conjunction with regulators so that compliance frameworks lead the way through legal obscurities associated with the adoption of blockchains. To this effect, PwC (2023) indicated that 55% of executives identify

regulatory uncertainty as the main factor impeding blockchains, for which more clarity is needed in legal directives. This observation was seconded by Xu, Weber, & Staples (2019), who maintained that due to its transparency and features of maintaining a record, effective integration has the potential tomakes blockchain facilitate regulatory compliance.

6.3 Conclusion

In the recent years, blockchain technology has been considered a revolutionary force to the traditional mode of operations, especially in financial services. This research aims to explore blockchain disruptive power in changing the traditional way of conducting financial processes through the case of Finland-a country that adopts new technologies rapidly. The Finnish banking sector provides a distinctive context in which to research the real-world consequence and expected changes since the implementation of blockchain for increased transparency, security, and efficiency of financial services.

This paper aimed to explore the disruptiveness of blockchain technology in the Finnish banking sector, mapping its potential to enable efficiency, transparency, and competitive advantage. The paper analyzed actual and perceived benefits of Blockchain as well as challenges of implementing Blockchain in the Banking Sector through a survey based on responses from Finnish banking professionals and using recent literature and reports as secondary data.

Primary research findings suggest that the view of the blockchain potential in the industry is pretty varied but largely optimistic. A majority of the respondents are of the view that blockchain is able to reduce operational costs while enhancing data security and increasing transaction speed. Sixty-four percent believe that blockchain has the potential to enhance data security and reduce fraud. It is also believed by 66% that blockchain has the potential to make operations simpler and reduce costs, while for 70%, it is a potential game changer which might disrupt traditional banking models. On the other hand, regulatory uncertainty and a deficit in skill were reported as major problems. 67% of the responding companies reported the regulatory issue to be a significant barrier, which also has been asserted to be the case from findings from secondary research. This view is supported by secondary data since authors like PwC and IBM state that blockchain indeed has the capability to improve security, hence reduce costs, but it is tough to implement because of high initial investments and ambiguity in regulations.

Ultimately, the study fulfills its aim by investigating the impact of blockchain in the Finnish banking industry. The combination of primary and secondary results

identifies the transformative power of blockchain, but at the same time makes banks accept regulatory environments and invest in qualified personnel. The treatise is holistic in capturing the effects of blockchain; thus, it provides key insights in line with the research aim-that blockchain may disrupt the banking industry once these challenges are conventionally taken care of and its privileges are fully utilized. Like aim, this research has also addressed the questions as well. These are detailed below-

Question 1: The first research question concerns the state of the art on blockade technology and its applications in the financial industries, which has been satisfactorily answered through both primary and secondary research. Primary findings indicate that 63% of the respondents are aware of blockchain developments; 80% of these note its usage in various banking operations. This is further supported by the fact that secondary research overviews highlight the role of blockchain in cross-border payments, digital identity, and trade finance. Putting all the findings together has shown that the adoption has grown but remains uneven, reinforcing the details explored in this question.

Question 2: The second research question, referring to the opportunities and challenges of blockchain adoption within the Finnish banking industry, has been wholly answered by both primary and secondary findings. The primary research shows that 66% of respondents believe that blockchain can further streamline a lot of processes in order to cut costs related to operations, though 67% are usually aware that there are many regulatory challenges. Key themes revealed from secondary research include cost reduction, improved security, and regulatory challenges. These findings put together ensure that the research has fully covered the benefits and challenges of adopting blockchain.

Question 3: With the use of both primary and secondary findings, this paper provided strategic recommendations for blockchain implementation that would enhance efficiency, customer experience, and competitiveness in the markets for banks. In primary research, strong predispositions toward blockchain were expressed, with 63% stating that blockchain would improve customer trust, while secondary sources of information identified scalable infrastructure, collaboration with fintech, and regulatory compliance as some of the key strategies. Put together, these revelations care well for one another and confirm that indeed

some strategic recommendations concerning blockchain adoption were well founded in this study.

6.4 Recommendations

The following recommendations are targeted to support the effective blockchain adoption into operation by the Finnish banking industry, ensuring enhanced operational efficiency, improved customer experience, and competitive positioning. These will be informed by the findings from both primary and secondary research through actionable steps toward addressing important challenges and maximizing the full potential of blockchain. These recommendations are-

1. Banks should invest in highly scalable blockchain infrastructure to make operational processes more efficient and handle high transaction volumes.
2. Cross-border blockchain payment solutions will help reduce transaction time and cost, enhancing the efforts toward better customer service and competitive positioning.
3. Emphasis on the training of staff in blockchain technology will help narrow the gap in skills and ensure a superior level of adoption and implementation within the ambit of banking processes.
4. Banks should work with the regulatory bodies to come up with a blockchain framework that is within the law to reduce the legal risks while still allowing room for innovation.
5. Emphasizing blockchain ensures safety and security in data handling and prevents frauds, thereby building trust in the customers and keeping cyber threats at control.
6. Partnerships with Fintech will quicken blockchain innovation so that banks can compete by offering advanced and customer-centric services.

7 Summary

Summary concludes that there is a high possibility of blockchain improving efficiency, customer satisfaction, and competitive positioning in finance. Though these findings also support the advantages of blockchain, such as smooth operations and increased trust, the challenges of regulatory uncertainty and high costs have been highlighted. The findings, therefore, match the literature in terms of suggesting that strategic planning and regulatory engagement must go hand in glove if banks are to realize blockchain's full benefit.

References

1. Accenture (2017). *Blockchain technology could reduce investment banks' infrastructure costs by 30 percent, according to Accenture report*. Available at: https://newsroom.accenture.com/news/2017/blockchain-technology-could-reduce-investment-banks-infrastructure-costs-by-30-percent-according-to-accenture-report#:~:text=17%2C%202017%E2%80%93Blockchain%20technology%20could,is%20part%20of%20Aon%20Hewitt (Accessed: 25 October 2024).

2. Al-Dmour, A. *et al.* (2024) 'Blockchain applications and Commercial Bank Performance: The mediating role of AIS quality', *Journal of Open Innovation: Technology, Market, and Complexity*, 10(2), p. 100302. doi:10.1016/j.joitmc.2024.100302.
3. Andoni, M., Robu, V., Flynn, D., Abram, S., Geach, D., Jenkins, D., ... & Peake, R. (2019). Blockchain technology in the energy sector: A systematic review of challenges and opportunities. *Renewable and Sustainable Energy Reviews*, 100, 143-174. https://doi.org/10.1016/j.rser.2018.10.014
4. Ante, L. (2020). Smart contracts on the blockchain – A bibliometric analysis and review. *Telematics and Informatics*, 57, 101519. https://doi.org/10.1016/j.tele.2020.101519
5. Atzori, M. (2017). Blockchain technology and decentralized governance: Is the state still necessary? *Journal of Governance and Regulation*, 6(1), 45-62. https://doi.org/10.22495/jgr_v6_i1_p5
6. Babbie, E. (2020). *The Practice of Social Research.* 15th ed. Boston: Cengage Learning.
7. Beck, R., Müller-Bloch, C., & King, J. L. (2018). Governance in the Blockchain Economy: A Framework and Research Agenda. *Journal of the Association for Information Systems*, 19(10), 1020-1034. https://doi.org/10.17705/1jais.00518

8. Bell, J. and Waters, S. (2018). *Doing Your Research Project: A Guide for First-Time Researchers.* 7th ed. Maidenhead: Open University Press.
9. Bharadwaj, N., & Dolega, P. (2021). Regulatory challenges of cryptocurrencies in the EU: The role of fundamental rights. *Computer Law & Security Review*, 41, 105535. https://doi.org/10.1016/j.clsr.2021.105535
10. Biais, B., Bisière, C., Bouvard, M., & Casamatta, C. (2019). The blockchain folk theorem. *The Review of Financial Studies*, 32(5), 1662-1715. https://doi.org/10.1093/rfs/hhz005
11. Blaxter, L., Hughes, C., and Tight, M. (2010). *How to Research.* 4th ed. Maidenhead: Open University Press.
12. Bryman, A. (2016). *Social Research Methods.* 5th ed. Oxford: Oxford University Press.
13. Catalini, C., & Gans, J. S. (2019). Some Simple Economics of the Blockchain. *Communications of the ACM*, 63(7), 97-105. https://doi.org/10.1145/3359552
14. Chen, Y. (2018). Blockchain tokens and the potential democratization of entrepreneurship and innovation. *Business Horizons*, 61(4), 567-575. https://doi.org/10.1016/j.bushor.2018.03.006
15. Cong, L. W., & He, Z. (2019). Blockchain Disruption and Smart Contracts. *The Review of Financial Studies*, 32(5), 1754-1797. https://doi.org/10.1093/rfs/hhz007
16. Creswell, J.W. and Creswell, J.D. (2018). *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches.* 5th ed. Los Angeles: SAGE Publications.
17. Davidson, S., De Filippi, P., & Potts, J. (2018). Blockchains and the economic institutions of capitalism. *Journal of Institutional Economics*, 14(4), 639-658. https://doi.org/10.1017/S1744137417000200
18. De Filippi, P., & Hassan, S. (2018). Blockchain technology as a regulatory technology: From code is law to law is code. *First Monday*, 23(12). https://doi.org/10.5210/fm.v23i12.9557
19. Dehni, J. (2024). *Asset tokenization could awaken a coming of age for investors*. Forbes. Available at: https://www.forbes.com/sites/jasondehni/2024/09/08/asset-tokenization-

could-awaken-a-coming-of-age-for-investors/ (Accessed: 25 October 2024).

20. Deloitte (2023). *2023 Global Blockchain Survey: Blockchain reaches beyond Bitcoin*. Deloitte Insights. Available at: https://www2.deloitte.com/content/dam/insights/articles/US144337_Blockchain-survey/DI_Blockchain-survey.pdf (Accessed: 25 October 2024).
21. Deloitte. (2023). *The journey toward dynamic settlement*. Available at: https://www2.deloitte.com/content/dam/Deloitte/us/Documents/financial-services/us-the-journey-toward-dynamic-settlement.pdf (Accessed: 25 October 2024).
22. Fan, K., Kuo, T. T., & Wang, S. (2020). Beyond financial innovation: The impact of blockchain on society. *Technological Forecasting and Social Change*, 154, 119993. https://doi.org/10.1016/j.techfore.2020.119993
23. Finck, M. (2018). Blockchains and data protection in the European Union. *European Data Protection Law Review*, 4(1), 17-35. https://doi.org/10.21552/edpl/2018/1/6
24. Flick, U. (2018). *An Introduction to Qualitative Research.* 6th ed. Los Angeles: SAGE Publications.
25. Glaser, F. (2017). Pervasive Decentralisation of Digital Infrastructures: A Framework for Blockchain Enabled System and Use Case Analysis. *Hawaii International Conference on System Sciences*. https://doi.org/10.24251/HICSS.2017.186
26. Gomber, P., Kauffman, R. J., Parker, C., & Weber, B. W. (2018). On the Fintech Revolution: Interpreting the Forces of Innovation, Disruption, and Transformation in Financial Services. *Journal of Management Information Systems*, 35(1), 220-265. https://doi.org/10.1080/07421222.2018.1440766
27. Halaburda, H., Gans, J. S., & Gandal, N. (2020). The Impact of Blockchain Technology on Financial Services: A Review. *Journal of Strategic Information Systems*, 29(2), 101575. https://doi.org/10.1016/j.jsis.2020.101575

28. Iansiti, M., & Lakhani, K. R. (2017). The Truth About Blockchain. *Harvard Business Review*, 95(1), 118-127. https://doi.org/10.4135/9781526430102.n7
29. IBM. (2023). *IBM Blockchain solutions*. Available at: https://www.ibm.com/blockchain (Accessed: 25 October 2024).
30. Infosys BPM. (2023). *Securing the future of banking: Exploring the synergy of blockchain and cybersecurity*. Available at: https://www.infosysbpm.com/blogs/financial-services/securing-the-future-of-banking-exploring-the-synergy-of-blockchain-and-cybersecurity.html (Accessed: 25 October 2024).
31. Juniper Research. (2023). *Blockchain deployments to save banks $27 billion by 2030*. Available at: https://www.juniperresearch.com/press/blockchain-deployments-save-banks-27bn-by-2030 (Accessed: 25 October 2024).
32. Kshetri, N. (2018). Blockchain's roles in strengthening cybersecurity and protecting privacy. *Telecommunications Policy*, 42(4), 385-396. https://doi.org/10.1016/j.telpol.2017.11.011
33. Kumar, R. (2019). *Research Methodology: A Step-by-Step Guide for Beginners.* 5th ed. Los Angeles: SAGE Publications.
34. Macrinici, D., Cartofeanu, C., & Gao, S. (2018). Smart contract applications within blockchain technology: A systematic mapping study. *Telematics and Informatics*, 35(8), 2337-2354. https://doi.org/10.1016/j.tele.2018.10.004
35. McKinsey & Company. (2020). *Building the AI bank of the future*. Available at: https://www.mckinsey.com/~/media/mckinsey/industries/financial%20services/our%20insights/building%20the%20ai%20bank%20of%20the%20future/building-the-ai-bank-of-the-future.pdf (Accessed: 25 October 2024).
36. Mik, E. (2017). Smart contracts: Terminology, technical limitations and real world complexity. *Law, Innovation and Technology*, 9(2), 269-300. https://doi.org/10.1080/17579961.2017.1378468
37. Mishra, R. *et al.* (2023) 'Critical success factors of Blockchain technology adoption for sustainable and resilient operations in the banking industry

during an uncertain business environment', *Electronic Commerce Research* [Preprint]. doi:10.1007/s10660-023-09707-3.

38. Peters, G. W., & Panayi, E. (2016). Understanding Modern Banking Ledgers through Blockchain Technologies: Future of Transaction Processing and Smart Contracts on the Internet of Money. *Banking Beyond Banks and Money*, 239-278. https://doi.org/10.1007/978-3-319-42448-4_13
39. Phillip, A., Chan, J., & Peiris, S. (2018). A new look at cryptocurrencies. *Economics Letters*, 163, 6-9. https://doi.org/10.1016/j.econlet.2017.11.020
40. PwC. (2023). *Fintech partnerships: A new paradigm for financial services*. Available at: https://www.pwc.com/bb/en/press-releases/fintech-partnerships.html (Accessed: 25 October 2024).
41. Rauchs, M., Glidden, A., Gordon, B., Pieters, G., Recanatini, M., & Vagneur, K. (2018). Distributed ledger technology systems: A conceptual framework. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.3230013
42. Risius, M., & Spohrer, K. (2017). A blockchain research framework: What we (don't) know, where we go from here, and how we will get there. *Business & Information Systems Engineering*, 59(6), 385-409. https://doi.org/10.1007/s12599-017-0506-0
43. Robson, C. and McCartan, K. (2016). *Real World Research.* 4th ed. Hoboken: Wiley.
44. Saunders, M., Lewis, P., and Thornhill, A. (2019). *Research Methods for Business Students.* 8th ed. Harlow: Pearson Education.
45. Schuetz, S., & Venkatesh, V. (2020). Blockchain, adoption, and financial inclusion in India: Research opportunities. *International Journal of Information Management*, 52, 101936. https://doi.org/10.1016/j.ijinfomgt.2019.04.009
46. Sedlmeir, J. *et al.* (2022) 'The Transparency Challenge of blockchain in organizations', *Electronic Markets*, 32(3), pp. 1779–1794. doi:10.1007/s12525-022-00536-0.

47. Stockburger, L. *et al.* (2021) ‘Blockchain-enabled decentralized identity management: The case of self-sovereign identity in public transportation’, *Blockchain: Research and Applications*, 2(2), p. 100014. doi:10.1016/j.bcra.2021.100014.
48. SWIFT (2023). *SWIFT unlocks potential of tokenisation with successful blockchain experiments*. Available at: https://www.swift.com/news-events/press-releases/swift-unlocks-potential-tokenisation-successful-blockchain-experiments (Accessed: 25 October 2024).
49. Tapscott, D., & Tapscott, A. (2017). How Blockchain is Changing Finance. *Harvard Business Review*, 1-9. https://doi.org/10.4324/9781315746747-2
50. Tasca, P., & Tessone, C. J. (2019). A taxonomy of blockchain technologies: Principles of identification and classification. *Ledger*, 4, 1-39. https://doi.org/10.5195/ledger.2019.140
51. Tsai, C.-H., Liou, D.-K. and Lee, H.-L. (2024) ‘Blockchain-supported online banking scheme’, *Egyptian Informatics Journal*, 27, p. 100516. doi:10.1016/j.eij.2024.100516.
52. Walliman, N. (2017). *Research Methods: The Basics.* 2nd ed. London: Routledge.
53. Wonglimpiyarat, J. (2019). FinTech banking industry: a systemic approach. *Foresight*, 21(5), 523-530. https://doi.org/10.1108/FS-06-2018-0056
54. World Bank (2023). *Blockchain technology and financial services: Exploring blockchain potential in the banking sector*. Available at: https://documents1.worldbank.org/curated/en/099200503082329768/pdf/P17425408f3aa00580a2620810813ed0370.pdf (Accessed: 25 October 2024).
55. Xu, X., Weber, I., & Staples, M. (2019). Architecture for Blockchain Applications. *Springer*. https://doi.org/10.1007/978-3-030-03047-7
56. Yeoh, P. (2017). Regulatory issues in blockchain technology. *Journal of Financial Regulation and Compliance*, 25(2), 196-208. https://doi.org/10.1108/JFRC-08-2016-0068
57. Yermack, D. (2017). Corporate Governance and Blockchains. *Review of Finance*, 21(1), 7-31. https://doi.org/10.1093/rof/rfw074

58. Zetzsche, D. A., Buckley, R. P., & Arner, D. W. (2018). The distributed liability of distributed ledgers: Legal risks of blockchain. *University of Illinois Law Review*, 2018(4), 1361-1406. https://doi.org/10.2139/ssrn.3018214
59. Zheng, Z., Xie, S., Dai, H. N., Chen, X., & Wang, H. (2018). Blockchain challenges and opportunities: A survey. *International Journal of Web and Grid Services*, 14(4), 352-375. https://doi.org/10.1504/IJWGS.2018.095647

8 Appendix

8.1 Appendix 1

Questionnaire: Impact of Blockchain Technology in Financial Services

Demographic Information

1. Gender

- Male
- Female
- Others
- Prefer not to say

2. Age

- 18-25 years
- 26-35 years
- 36-45 years
- 46-55 years
- 56+ years

3. What is the highest level of education you have completed?

- High school diploma or equivalent
- Bachelor's degree
- Master's degree
- Doctoral degree
- Other

4. What is your role within your organization?

- Manager
- Analyst
- IT Specialist
- Operations Staff
- Other

5. How many years of experience do you have in the financial services industry?

- 0-5 years
- 6-10 years
- 11-15 years
- 16+ years

6. What is your level of familiarity with blockchain technology?

- Very familiar
- Somewhat familiar
- Not very familiar
- Not at all familiar

7. Does your organization currently apply blockchain technology in any capacity?

- Yes
- No
- Not sure

Research Information

Section A: Investigating the State of Blockchain Technology in the Financial Sector

Question	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1. I am aware of recent developments in blockchain technology within the financial services sector.					
2. Blockchain is currently being applied across various areas of financial services, including banking					

operations, compliance, and transactions.					
3. Blockchain technology is expected to bring transformative changes to the financial sector in the next 5-10 years.					
4. Blockchain applications have the potential to significantly enhance financial transparency and accountability.					

Section B: Advantages and Challenges of Blockchain at the Bank					
Question	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5. Blockchain adoption would enhance data security and reduce fraud in the bank's operations.					
6. Blockchain technology can streamline processes and reduce operational costs at the bank.					
7. The bank faces significant regulatory challenges when adopting blockchain technology.					
8. Lack of skilled personnel and technical expertise presents a challenge to					

implementing blockchain in the bank.					

Section C: Blockchain's Disruptive Influence on Financial Services Industry					
9. Blockchain has the potential to disrupt traditional banking operations by offering decentralized alternatives.					
10. Blockchain technology is significantly reshaping the financial services landscape by enabling faster, more secure transactions.					
11. Blockchain adoption will challenge traditional financial service models by enhancing transparency and reducing intermediaries.					
12. The integration of blockchain can improve customer trust and confidence in financial institutions.					

Section D: Strategic Recommendations for Blockchain Implementation					
13. Prioritising blockchain for enhancing operational efficiency would benefit the bank and improve its performance.					
14. Implementing blockchain could enhance the customer experience by improving service delivery.					
15. Blockchain technology adoption will provide a competitive advantage					

for the bank in the financial services market					

8.2 Appendix 2: Code

```
import datetime
import hashlib

class Block:
    blockNo = 0
    data = None
    next = None
    hash = None
    nonce = 0
    previous_hash = 0x0
    timestamp = datetime.datetime.now()

    def __init__(self, data):
        self.data = data

    def hash(self):
        h = hashlib.sha256()
        h.update(
            str(self.nonce).encode('utf-8') +
            str(self.data).encode('utf-8') +
            str(self.previous_hash).encode('utf-8') +
            str(self.timestamp).encode('utf-8') +
            str(self.blockNo).encode('utf-8')
        )
        return h.hexdigest()

    def __str__(self):
        return "Block Hash: " + str(self.hash()) + "\nBlockNo: " + str(self.blockNo) +
"\nBlock Data: " + str(self.data) + "\nHashes: " + str(self.nonce) + "\n--------------"

class Blockchain:
```

```
    diff = 20
    maxNonce = 2**32
    target = 2 ** (256 - diff)
    block = Block("Genesis")
    dummy = head = block

    def add(self, block):
        block.previous_hash = self.block.hash()
        block.blockNo = self.block.blockNo + 1
        self.block.next = block
        self.block = self.block.next

    def mine(self, block):
        for n in range(self.maxNonce):
            if int(block.hash(), 16) <= self.target:
                self.add(block)
                print(block)
                break
            else:
                block.nonce += 1

blockchain = Blockchain()

for n in range(10):
    blockchain.mine(Block("Block " + str(n+1)))

# Print the blockchain
current = blockchain.head
while current is not None:
    print(current)
    current = current.next
```