UNIVERSITY OF LJUBLJANA
SCHOOL OF ECONOMICS AND BUSINESS

MASTER'S THESIS

THE IMPACT OF DISRUPTIVE TECHNOLOGY ON INTERNATIONAL BUSINESS MANAGEMENT: THE CASE OF BLOCKCHAIN TECHNOLOGY

Ljubljana, June 2024 KATERINA ILIEVSKA

AUTHORSHIP STATEMENT

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LIST OF ABBREVIATIONS

AI - Artificial Intelligence
AML - Anti-Money Laundering
APAC - Asia-Pacific
AWS - Amazon Web Services
BBVA - Banco Bilbao Vizcaya Argentaria

BEV - Battery Electric Vehicles
CAGR – Compound Annual Growth Rate
CBDCs - Central Bank Digital Currencies
CEO – Chief Executive Officer
CFTC - U.S. Commodity Futures Trading Commission
CODA - Cryptographic Operations Distributed Algorithm
COVID-19 - Coronavirus Disease 2019
CSR - Corporate Social Responsibility
DAOs - Decentralized Autonomous Organizations
DeFi – Decentralized Finance
DEXs - Decentralized Exchanges
DLT/ DL - Distributed Ledger Technology
EBL - Electronic Bill of Lading
EDI - Electronic Data Interchange
EHR - Electronic Health Record
EPS - Earnings Per Share
ERP - Enterprise Resource Planning
ESG - Environmental, Social, and Governance
EU – European Union
GDP - Gross Domestic Product
GDPR - General Data Protection Regulation
GPS - Global Positioning System
HIPAA - Health Insurance Portability and Accountability Act
HITECH Act - Health Information Technology for Economic and Clinical Health Act
IEEE - Institute of Electrical and Electronics Engineers
IoT – Internet of Things
IT - Information Technology
KYC - Know Your Customer
MiCA - Markets in Cryptoassets
MNEs - Multinational Enterprises
NFTs - Non-Fungible Tokens
PBFT - Practical Byzantine Fault Tolerance
PHI - Protected Health Information
PoA - Proof of Authority
PoS - Proof of Stake
PoW - Proof of Work
Q1 - Quarter 1
RFID - Radio-Frequency Identification
ROI - Return on Investment)
RPCA - Ripple Protocol Consensus Algorithm
UAE - United Arab Emirates
XRP – Ripple

1 INTRODUCTION

Blockchain technology has emerged as a transformative force across various industries, revolutionizing the way transactions are recorded and verified. Initially introduced in 2008 to track transactions in the decentralized digital currency Bitcoin, blockchain has since evolved to encompass a wide range of applications beyond finance. While early research predominantly focused on Bitcoin, recent years have witnessed a shift towards exploring its implications in diverse sectors such as education, healthcare, IoT, and government applications (Sunny et al, 2022). Despite the growing interest in blockchain technology, there remains a research gap in understanding its impact on international business management.

A thorough literature review was conducted to explore the current state of research on blockchain technology, drawing from sources such as ResearchGate, IEEE Xplore, ScienceDirect, Harvard Business Review, Plos One journals, Google Books, and Cobiss database. This review revealed a wealth of literature focused on the applications of blockchain in specific industries, particularly healthcare, supply chains, smart contracts, taxonomy, insurance, and capital markets. However, upon narrowing the focus to blockchain in international business management, the literature proved to be comparatively scarce.

I have derived the main research question "What are the implications on the individual MNE for implementing blockchain technology?" from gaps in existing literature and from suggested future directions for research by authors in similar papers. Torres de Oliveira (2020) in his paper on Blockchain and the MNE, explores the implications of blockchain on international business, business processes and models. I found that this author focuses on processes and models related to online transactions, micropayments, and cryptocurrencies – leading to the gap that he leaves out research on how the individual MNE is affected (management's perspective) as well as how does each industry differentiate in that aspect. Sunny (2022) provides an overview of blockchain application themes in diverse sectors, by placing the technology itself in the center and excluding research on the management in each sector. Slatvinska (2022) examines the impact of blockchain in the financial sector and international trade – the existing gap being that these are only two industries, thus, overlooking the application of the technology in more sectors. Levis (2021) provides a deep understanding on how the adoption of blockchain could lead to changes in Europe, impacting society, policy, economy, and technology. This paper will be instrumental in developing the future forecast for the impact in industries in Europe, however, does not explore how should the managers adapt on an international level once the technology becomes more and more implemented in their industry. Apart from the explained gaps in existing literature, some of the same authors suggest future directions of research, which further influenced me in deriving my research question. Torres de Oliveira (2020) indicates the necessity to explore whether blockchain enables a new organizational form, or new business models for MNEs. Levis (2021) suggests for future researchers to do more extensive research on differences between industries and whether corresponding core activities should be changed. Slatvinska (2022) indicates the opportunity to build models of effective management for industries that

use blockchain. By taking into consideration these existing gaps and directions for future research by the authors, I have derived the main research question which will contribute to the existing literature by evaluating the impact that blockchain technology has on the management of international companies in diverse sectors and thus international business. This differs from the existing literature in the way that it focuses on the management perspective of the MNEs using blockchain technology.

The primary purpose of this thesis is to assess the present and future impact of blockchain technology on international companies and the broader landscape of international business. To achieve this, the following goals have been outlined:

1 Summarize the financial and non-financial impact of blockchain on individual MNEs across different industries.
2 Derive potential benchmarks for new entrants in each industry where blockchain is prevalent.
3 Forecast the future impact of blockchain technology on various industries and its implications for international business.

These goals will be pursued through a series of research questions (the citations are research where gaps were identified, leading to the research question), including:

1. What are the implications for individual MNEs upon implementing blockchain technology? (Torres de Oliveira et al, 2020; Sunny et al, 2022; Slatvinska et al, 2022; Levis et al, 2021)
2. How do surrounding stakeholders of MNEs, including suppliers, logistic companies, and customers, perceive and adapt to blockchain technology? (Baraniuk, 2020; Mahmood, 2021)
3. What are the implementation rates of blockchain in different industries, and what are the main challenges faced by MNEs? (Ahi et al, 2022; Tyagi, 2021)
4. Are there potential new benchmarks or business models emerging in industries where blockchain is prevalent? (Iansiti & Lakhani, 2017; White, 2017)
5. In which other industries could blockchain be beneficial, and how should management prepare for its adoption? (Tucker & Catalini, 2018)

The research questions outlined above guide the investigation into how blockchain technology impacts MNEs and their stakeholders. Through a qualitative approach, specifically semi-structured in-depth interviews with key stakeholders from nine companies in supply chains, healthcare, and capital markets, the research captures the multifaceted effects of blockchain technology. This thesis aims to offer actionable insights for MNEs considering blockchain adoption, helping them navigate these complexities and leverage the technology for strategic advantage. By examining these factors, the study seeks to contribute valuable knowledge to the growing field of blockchain research and provide practical recommendations for businesses aiming to implement this transformative technology.

This structure of the thesis ensures a comprehensive examination of blockchain technology's impact on international business management. The Introduction provides an overview of blockchain technology, outlines the research questions and objectives, and identifies gaps in existing literature. . Following the introduction, the “Literature Review” section delves into the current state of blockchain research. It reviews existing literature on the applications of blockchain in specific industries, such as healthcare, supply chains, smart contracts, insurance, and capital markets. This comprehensive review identifies what has already been studied and highlights the gap which justifies the research and sets the groundwork for the thesis's contributions. The "Management and Disruptive Technologies" section introduces the fundamental concepts of blockchain, including decentralization, immutability, and consensus mechanisms. Following this, the "Blockchain Application in Different Industries" section explores the specific applications and impacts of blockchain in supply chains, healthcare, and capital markets. This section details transformations in these sectors, their impacts on the company itself and surrounding stakeholders (Porter’s five forces analysis). The "Research Methodology" section explains the qualitative approach used in the practical part of the thesis, setting the ground for the interview findings. The "Findings" section presents the key findings from the interviews ,summarizing benefits, challenges, and future trends specific to each industry. The "Research Recommendations" section provides strategic recommendations for managers, discusses theoretical implications, and outlines research limitations and future research directions. Finally, the "Conclusion" summarizes the main findings and highlights the thesis's contributions to existing literature. The thesis concludes with a comprehensive bibliography, listing all references used throughout the research.

2 MANAGEMENT AND DISRUPTIVE TECHNOLOGIES

The evolution of management strategies in response to disruptive technologies has been driven by the recognition of their transformative potential and the challenges they pose to organizations. Disruptive technologies such as artificial intelligence, blockchain, the Internet of Things, and cloud computing have reshaped industries and markets, demanding strategic management to navigate complexities and seize opportunities. Challenges in innovation and technology adoption include the need for creativity, technical expertise, and risk-taking, as well as the evaluation of benefits versus risks, coping with fear of failure, and determining relevant technologies amidst rapid advancements. Additionally, organizational change is imperative, involving fostering an innovative culture, investing in infrastructure, promoting communication and leadership, and creating change management frameworks to facilitate transitions. Strategic management of disruptive technologies necessitates agility, innovation, and a proactive approach to embrace change and sustain long-term success in dynamic markets (Magaña Durán, 2023).

Blockchain technology has emerged as a disruptive innovation, revolutionizing the way data and digital transactions are stored and verified in the digital era. Blockchain is a decentralized and distributed ledger that securely records transactions across numerous computers or nodes

(Nakamoto, 2008). The first successful application of blockchain technology dates back to the creation of Bitcoin. Bitcoin's success not only pioneered the concept of cryptocurrencies but also popularized the underlying technology of blockchain, leading to its widespread exploration and adoption in various industries.

2.1 Introduction to Blockchain

Blockchain operates on core concepts that are essential to its functionality and advantages. The first is decentralization, which eliminates the necessity for a central authority or intermediary. To ensure distributed consensus, transactions are instead verified and recorded by numerous users, or nodes, throughout the network (Swan, 2015). Another crucial blockchain principle is immutability. Once a transaction is included in a block, it can no longer be altered or tampered with. One characteristic that sets blockchain technology apart is transparency. Participants in the network can see every transaction that has been recorded on the blockchain. This transparency contributes to the integrity and trustworthiness of the system, as it allows for verification and auditing by all stakeholders (Antonopoulos, 2015).

A blockchain consists of three key components: blocks, cryptographic hash functions, and linking mechanisms. Each block contains a bundle of transactions and a reference to the previous block, forming a chain-like structure. Cryptographic hash functions play a crucial role in blockchain security. Based on the input data, these functions produce a hash, which is a fixed-size unique output. The block's and its contents' integrity are checked using the hash. It is computationally impossible to alter the content of the block without being noticed because even a tiny change in the input data will produce a completely different hash value (Swan, 2015). Each block is sequentially linked to the one before it through linking mechanisms such cryptographic pointers or hashes, forming a chain of blocks. The integrity and chronological order of the transactions maintained on the blockchain are guaranteed by this linking. It is extremely difficult and impractical to modify a block because doing so would involve changing all subsequent blocks as well (Antonopoulos, 2015).

2.1.1 Consensus Mechanism

Blockchain networks rely on consensus mechanisms to allow users to reach consensus on a single version of truth without the need for a centralized authority. These mechanisms ensure the integrity and security of the blockchain by establishing consensus among the distributed nodes. Each mechanism has its own advantages, drawbacks, and suitability for specific use cases, and their selection depends on the desired characteristics of the blockchain network.

Proof of Work (PoW) is one of the most well-known and commonly utilized consensus mechanisms, first proposed by Bitcoin (Nakamoto, 2008). In PoW, users compete to solve challenging mathematical puzzles in order to validate and add new blocks to the blockchain. This process requires substantial computational power and energy consumption. Once a

miner solves the puzzle, they broadcast the answer to the network, where other users can confirm it before accepting the block. PoW ensures security through the computational work performed and makes it challenging to alter previous transactions. Due to its resource-intensive nature, PoW is associated with high energy consumption and scalability issues (Antonopoulos, 2015).

Proof of Stake (PoS) is an alternative consensus mechanism that addresses some of the shortcomings of PoW. In PoS, the creator of the next block is chosen based on the stake they hold in the network (Buterin, 2014). The stake represents the participants' ownership of the native cryptocurrency. Validators are chosen to add new blocks and validate transactions based on the amount of cryptocurrency they are prepared to "stake" as collateral, as opposed to competing through computational power. PoS is thought to be more energy efficient than PoW and may provide scaling advantages. However, it introduces new challenges such as the "nothing at stake" problem and potential centralization risks if a small number of participants hold a considerable share of the coin supply (Antonopoulos, 2015).

Other consensus mechanisms are PBFT and PoA. Practical Byzantine Fault Tolerance (PBFT) is a consensus mechanism designed for permissioned blockchain networks. It focuses on reaching consensus among nodes even when there are faulty actors present. PBFT requires a predefined group of validators who agree on the order and validity of transactions. Proof of Authority (PoA) is another consensus mechanism commonly used in private or consortium blockchains. It relies on a fixed set of recognized and trusted validators who take turns producing blocks. The integrity of the network is maintained via the authentication of validators based on their reputation or authority (Dziembowski et al., 2018).

2.1.2 Distributed Ledger Technology

Blockchain is based on distributed ledger technology (DLT), which provides the framework for its decentralized and transparent nature. DLT makes it possible to store, distribute, and synchronize data among numerous users or network nodes. Unlike traditional centralized systems in which a single entity controls the ledger, DLT distributes and replicates the ledger among participants, ensuring transparency and trust (Swan, 2015). This dispersed nature eliminates the need for intermediaries, improves security, and lowers the possibility of a single point of failure (Nakamoto, 2008). DLT can be implemented through different types of distributed ledgers. Public ledgers, such as the Bitcoin blockchain, are available to anyone, and anyone can participate in transaction validation. On the other side, private ledgers limit participation and access to a certain group or organization. Consortium or permissioned ledgers are shared by a group of members who cooperatively maintain and control the network. These ledgers provide more privacy and control while still enjoying the advantages of decentralization (Swan, 2015). Another significant feature of DLT is smart contracts. They are autonomous contracts that follow predetermined guidelines and conditions that are encoded in the blockchain network. Smart contracts automate and enforce agreements,

enabling secure execution of transactions without relying on intermediaries (Buterin, 2014). DLT and blockchain technology are being more widely used in numerous industries. Blockchain is being explored in the financial sector for asset tokenization, trade finance, and safe and effective cross-border payments (Tapscott & Tapscott, 2016). Supply chain management can benefit from increased transparency and traceability, reducing fraud and ensuring the authenticity of goods (Huckle et al, 2016). In healthcare, blockchain has the potential to improve data interoperability, patient privacy, and supply chain integrity (Ekblaw et al, 2016). These examples highlight blockchain's potential to transform industries and offer more effective solutions.

2.2 Key findings from main research papers

The landscape of blockchain research has undergone a significant evolution, transitioning from early Bitcoin-centric inquiries to a broader exploration of its applications across industries and regions. While the period from 2015 to 2021 focused largely on financial management and security, attention in 2021 expanded to encompass education, healthcare, IoT, and government applications. Below, I have provided a summary of 9 scientific papers from recent years – 2020 to 2023. The papers are categorized in the following columns: Authors and year of publishing, Title, Industry and Region, Context of study, Type of paper and research methodology, Main findings, and Future research directions. There are 3 conceptual, 4 review, and 2 empirical papers. The first 4 papers focus on blockchain's application in various industries, and provide managerial implications, thus are closest to my thesis, which is why it is important to include them on the list. The next 5 papers each present one of the most cited papers for their corresponding industry: Financial sector, Human Resource Management, Supply Chain Management, Healthcare and Digital Currencies.

Table 1: Summary of key findings from main research papers

Authors and year of publishing	Title	Industry and Region	Context of study	Type of paper and research methodology	Main findings	Future research directions
Torres de Oliveira, R., Indulska, M. & Zalan, T. (2020)	Blockchain and the multinational enterprise: Progress, challenges, and future research avenues	Various industries; Global perspective	The study focuses on the implications of blockchain for various sectors including micropayments, online transactions, trust, business models, cryptocurrencies, in the context of international business.	A conceptual approach based on the authors' expertise and reflection on the intersection between blockchain and international business. The authors draw upon existing literature, industry insights, and own analysis.	The findings indicate blockchain's potential to transform global payments with stablecoins and CBDCs, emphasizing decentralized networks' ability to provide global-scale digital services. It also discusses blockchain's role in addressing sustainability goals.	Indicates the necessity to explore whether blockchain enables a new organizational form, or new business models for MNEs
Sunny, F. A., et al. (2022)	A Systematic Review of Blockchain Applications.	Various industries; Global perspective	The study aims to provide a comprehensive overview of blockchain application themes and emerging areas across different industries. It seeks to identify key themes in each domain.	It is a systematic literature review paper. The researchers developed a Python code to search various online databases. The study analyzed 750 articles between 2015 and 2021.	The paper observed a shift in research focus over time, with increased attention towards blockchain applications in education, IoT, and government. Also identifies challenges such as scalability and security and the need for robust policies.	Indicates the need to develop frameworks for blockchain adoption across sectors and suggests particular areas to focus on in each industry.
Levis, D., Fontana, F., & Ughetto, E. (2021)	A look into the future of blockchain technology.	Various industries; Europe	Aims to investigate the potential future scenarios of blockchain adoption in Europe by 2030. It seeks to understand how blockchain could disrupt various industries, reshape business models, influence societal and paradigms.	This is an empirical paper that employs the Delphi method. The Delphi method involves gathering insights from a panel of experts through multiple rounds of surveys and iterations to reach a consensus on future scenarios.	The study outlines four scenarios for the adoption of blockchain in Europe by 2030. It suggests that blockchain will have a deep impact on multiple dimensions, including business, culture, society, regulation, economy, and technology. It also stresses the need for cooperation between industry actors and regulators.	Further research is needed on the impacts of blockchain on different industries and geographies. It also encourages new possible paradigms arising from blockchain adoption.

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Table 1: Summary of key findings from main research papers

Authors and year of publishing	Title	Industry and Region	Context of study	Type of paper and research methodology	Main findings	Future research directions
Pal, A., Tiwari, C. K., & Haldar, N. (2021)	Blockchain for business management: Applications, challenges and potentials.	Various industries (marketing, supply chain, HR, finance); Global perspective	Aims to understand and explore the applications, challenges, and potential of blockchain in managing processes. It conducts a systematic literature review to analyze the current state of blockchain adoption in different key functions of management.	A review paper that employs a systematic literature review methodology. The authors use academic databases like Google Scholar and Scopus to extract and select peer-reviewed articles on blockchain use in business management.	The main findings highlight the potential of blockchain to revolutionize business operations across diverse sectors by enhancing transparency and efficiency in operations. However, challenges such as data privacy concerns, security issues, scalability constraints, regulatory hurdles hinder adoption.	Future research should quantitatively assess blockchain's costs and benefits across sectors and explore its impact on key business metrics. Also, more research is needed in HRM area.
Slatvinska, V., Demchenko, V., Tretiak, K., Hnatyuk, R., & Yarema, O. (2022).	The Impact of Blockchain Technology on International Trade and Financial Business	Financial sector and international trade; Global perspective	The study examines how blockchain technology is changing the landscape of international trade and financial business, aiming to measure its effects and potential contributions to these sectors.	A conceptual paper that utilizes methods of analysis and synthesis of information from researched academic articles, reports, and statistical data. It employs averages, regression analysis, and graphs.	The main findings emphasize blockchain’s potential for enhancing international trade and financial business by improving settlement processes, applying smart contracts, enhancing logistics chains, reducing costs for merchants, and combating corruption in the public sector.	Further exploring the impact across various sectors and at a global level, with the aim of developing effective management models for different economies.
Kim, T.-H., Kumar, G., Saha, R., Rai, M. K., Buchanan, W. J., Thomas, R., & Alazab, M. (2020)	A Privacy Preserving Distributed Ledger Framework for Global HRM: Blockchain Aspect	Human Resource Management; Global perspective	The study aims to address the challenges in HRM related to data integrity, by proposing a blockchain solution. It introduces a distributed ledger framework for managing HR records.	A conceptual paper. The methodology involves designing a privacy-preserving framework, implementing smart contracts, and evaluating the performance of the proposed system.	The technology can help in maintaining data privacy under HRM. The analysis of the results of the proposed model confirms the efficiency in terms of time, memory consumption, failure point identification, and read-write latencies.	Future researchers could focus on how to make the system more efficient. They could also look into using special encryption for data security.

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Table 1: Summary of key findings from main research papers

Authors and year of publishing	Title	Industry and Region	Context of study	Type of paper and research methodology	Main findings	Future research directions
Moosavi, J., Naeni, L.M., Fathollahi-Fard, A.M., & Garrigues, P. (2021)	Blockchain in supply chain management: a review, bibliometric, and network analysis	Supply chain management; Global perspective	The paper conducts a systematic review to identify how blockchain can contribute to supply chain management. It analyzes significant studies, collaboration patterns, and emerging technologies in the field.	The paper is a systematic review utilizing bibliometric and network analysis. It is primarily a conceptual paper, although it also employs empirical data analysis through bibliometric methods.	The analysis identifies key supply chain areas where blockchain could contribute. The study reveals that IoT, and smart contracts are leading emerging technologies in the field. Blockchain is shown to enhance transparency and security in supply chain management.	Further research on blockchain's adaptability in supply chains, investigate its integration with other technologies, and assess its real-world impact.
Taherdoost, H. (2023)	Blockchain and Healthcare: A Critical Analysis of Progress and Challenges in the Last Five Years.	Healthcare; Global perspective	The study assesses the progress and challenges encountered in incorporating blockchain into healthcare. It examines the potential uses, such as safe data exchange, interoperability, and privacy protection.	This is a review paper that utilizes a mixed-methods methodology. The researchers reviewed 124 articles published by MDPI between 2018 and the current date, focusing on blockchain technology in healthcare.	The study highlights the potential of blockchain to improve data management, privacy, and security in healthcare. It identifies challenges such as privacy protection, integration with systems, interoperability, regulations, data diversity, and energy consumption.	The authors suggest exploring how blockchain intersects with emerging disciplines. Further research needed to fully understand adaptability across various domains.
Kumari, V., Bala, P. K., & Chakraborty, S. (2023)	An Empirical Study of User Adoption of Cryptocurrency Analyzing Role of Success Factors	Digital Currencies; Study is conducted in India	The study investigates the factors influencing individuals' intention to use cryptocurrencies, with a particular focus on personal innovativeness, technology awareness, and financial literacy.	This is an empirical and conceptual paper. The research methodology involves analyzing 312 responses using Covariance-Based Structural Equation Modelling (CB-SEM).	The study suggests that improving technology awareness and financial literacy encourages adoption. Also, it showed that believing in the benefits can help explain why some people are more willing to try it.	Future research should explore regions beyond India. Research could also focus on the hedonic motivations and demographic factors.

Source: Own work

3 BLOCKCHAIN APPLICATION IN DIFFERENT INDUSTRIES

Blockchain is transforming various industries with innovative applications. Industries benefiting from blockchain include real estate, where it streamlines property transactions; the energy sector, where it supports peer-to-peer energy trading and improves grid management; the entertainment industry, where it helps protect intellectual property; the government sector, where it enhances the transparency and security of voting systems; and the automotive industry, where it aids in vehicle history tracking and autonomous vehicle data sharing (Sunny et al, 2022). These examples highlight the diverse potential of blockchain to revolutionize traditional processes across different sectors. In the following section, I will focus on blockchain's application in three industries: supply chain, healthcare, and capital markets. The sub-chapter "Blockchain in Supply Chains" delves into how blockchain is transforming supply chain management. It begins by explaining the industry's transformation and then analyzes the impact on companies and stakeholders using Porter's Five Forces analysis. The sub-chapters "Blockchain in Healthcare" and "Blockchain in Capital Markets" are structured similarly. Additionally, in healthcare, ethical concerns are addressed, while in capital markets, digital currencies are defined.

3.1 Blockchain in Supply Chains

Digital supply chains use technology to digitize and streamline different parts of supply chain operations. They include the application of digital technologies to improve visibility, efficiency, and collaboration throughout the supply chain ecosystem, including the Internet of Things (IoT), cloud computing, big data analytics, artificial intelligence (AI), and blockchain (Yerpude et al, 2022). Real-time tracking and monitoring of goods, simplified data sharing among supply chain partners, and data-driven decision-making for better operational and strategic outcomes are all made possible by digital supply chains. They aim to build an interconnected, flexible supply chain ecosystem that can react to market changes and customer demands quickly.

The development of supply chain networks has been significantly shaped by the advancement of technology. Supply chains have historically relied on labor-intensive manual procedures, paper-based records, and limited visibility into inventory and transportation. Technological improvements have, however, completely changed how supply chains operate. An important step towards automating supply chain procedures and enhancing data sharing between business partners was made possible by the development of barcode scanning and electronic data interchange (EDI) in the 1970s and 1980s (Monczka et al., 2021). Various functional areas of supply chain management were further linked in the 1990s with the implementation of enterprise resource planning (ERP) systems, allowing for greater collaboration and information sharing (Monczka et al., 2021). The 2000s witnessed the emergence of technologies such as RFID (radio-frequency identification) and GPS (global positioning system), enabling real-time tracking and tracing of goods in the supply chain

(Monczka et al., 2021). In addition, advancements in big data analytics and cloud computing made it easier to collect and analyze large amounts of supply chain data for better decision-making. In recent years, blockchain technology has gained prominence in the context of digital supply chains. The traceability of goods, verifying products, and safe information sharing across supply chain partners are just a few areas where it has the potential to alter things (Yerpude, Sood, & Grima, 2022).

3.1.1 Transformation with blockchain

The emergence of blockchain technology has significantly changed supply chains, which are the foundation of international trade and commerce. Some of the main benefits that have improved the strategy and processes of companies include enhanced transparency and traceability, improved security and authenticity, streamlined supply chain processes, enhanced trust and transparency between supply chain partners, and more efficient financial transactions.

Blockchain's decentralized ledger ensures transparency and traceability in supply chain transactions. For example, Walmart implemented a blockchain-based system to track food product origins, reducing traceability time from weeks to seconds (Vitasek et al, 2022). This addressed operational challenges in moving commodities across borders, time zones, and climates, requiring over 200 data points per invoice. To streamline this process, Walmart Canada partnered with DLT Labs to create the DL Freight system, resulting in real-time data collection and fewer invoice discrepancies, ensuring timely payments to carriers and operational efficiency (Vitasek et al, 2022).

Blockchain's cryptographic algorithms ensure enhanced security and data authenticity in the supply chain. For instance, Everledger, a technology solutions provider, employs blockchain to track diamond provenance, mitigating the risk of counterfeit diamonds (Hulstijn & Smits, 2020). Everledger's blockchain system allows stakeholders to verify diamond authenticity and ethical sourcing at each supply chain stage, reducing fraud through transparency. Every diamond transaction is publicly recorded on a shared ledger accessible to authorized parties, minimizing the likelihood of fraudulent activities such as diamond swapping and double financing (Hulstijn & Smits, 2020).

Blockchain's smart contracts automate and streamline supply chain processes, reducing administrative burdens. Maersk and IBM collaborated on TradeLens, a blockchain platform that digitizes and automates global trade processes (Hedman et al, 2019). Managing and processing this extensive paperwork involved in global trade is time-consuming, prone to errors, and often requires physical handling and mailing. By digitizing trade processes and leveraging smart contracts, TradeLens streamlined the entire process, making it more efficient, accurate, and secure. Although Tradelens was discontinued in Q1 2023, the industry could build on their use cases where the benefits of blockchain were showcased.

Blockchain makes it possible for supply chain participants to collaborate and share data in a safe way, promoting efficiency and building trust. One example is IBM Food Trust, where companies like Nestlé and Walmart collaborate to enhance food safety through shared blockchain-based information (Browne, 2017). Traditionally, supply chains in the food industry involve many parties, including farmers, manufacturers, distributors, retailers, and regulators. These parties' inability to coordinate might result in delays, inefficiencies, and higher risks for food safety. All participants now have access to real-time and standardized data due to the IBM Food Trust platform, which improves collaboration and fastens decision-making (Browne, 2017).

Blockchain facilitates secure and efficient payment processes in supply chains. Platforms like TradeShift demonstrate how blockchain streamlines invoicing and payment workflows, reducing processing times and costs. The use of blockchain-based digital currencies further enables faster cross-border transactions, improving financial inclusivity and accessibility for participants in supply chains (McKinsey & Company, 2022).

3.1.2 The impact of blockchain on the company in supply chains

The implementation of blockchain technology in supply chains has significant implications for MNEs at the individual company level. These implications encompass various aspects, including financial performance, internal corporate policies, and corporate culture.

Blockchain adoption can enhance supply chain performance, as demonstrated by Penfolds, a wine producer that partnered with DNV GL to develop VeChain, a blockchain-based platform for supply chain transparency and traceability (Boddy, 2019; Treasury Wine Estates, 2023). Prior to VeChain implementation in 2019, Penfolds faced counterfeit wine challenges, damaging its reputation and finances. With VeChain, each wine bottle receives a unique blockchain identity containing detailed information about its journey, including vineyard location and storage conditions, accessible to consumers via QR code scanning. This transparency boosted consumer trust, safeguarded the brand, and increased sales. VeChain also streamlined supply chain operations, automating quality control and tracking, leading to cost reductions in manual labor and inventory management. Through blockchain, Penfolds achieved improved visibility, consumer trust, and financial success (Treasury Wine Estates, 2023).

Companies frequently need to adjust their internal rules and procedures to conform to the transparency and traceability characteristics of blockchain before implementing the technology. For instance, in the collaboration between Nestlé, Unilever, and IBM Food Trust, which enhanced food safety through standardized protocols for data sharing and verification (IBM, 2018), the updated policies sought to accurately record data on the place of origin, quality assurance, certifications, and supply chain movements, fostering trust and enabling simple access to vital information. Additionally, to guarantee the reliability and integrity of the blockchain system, strict data verification methods were put in place. The companies

sought to improve transparency, accountability, and compliance inside the blockchain-enabled system by implementing these policy adjustments, which helped to advance food safety procedures and consumer confidence.

Finally, integrating blockchain fosters a culture of transparency, collaboration, and trust within a company. For instance, Provenance – a company that helps other companies to reduce greenwashing risks, gives customers the ability to follow a product's route, encouraging transparency and sustainability. To satisfy consumer needs for traceability, when businesses adopt Provenance, it requires them to embrace transparency, accountability, and ethical standards (Provenance, n.d.). This calls for putting in place reliable record-keeping, data sharing, and collaboration with stakeholders. Companies can boost consumer trust, strengthen relationships, and improve their reputation by fostering such a culture. The emphasis on transparency and responsible sourcing aligns with the features of blockchain technology, driving positive change in supply chains and meeting consumer expectations.

3.1.3 The impact of blockchain on the stakeholders

In a supply chain industry, implementing blockchain technology can have various effects on different stakeholders. The following section analyzes how it impacts suppliers, customers, new entrants, substitutes, employees and society.

With blockchain, suppliers may benefit from increased transparency and trust in the procurement process. For example, the international mining company BHP collaborated with MineHub Technologies to integrate blockchain into their supply chain (IBM Newsroom, 2019) . By tracking and documenting the transit of goods, BHP was able to ensure secure and transparent transactions between suppliers and customers. Blockchain enabled suppliers to track the progress of their shipments, lowering uncertainty and enhancing planning and inventory management. Since the data could not be changed or tampered with, the immutable nature of blockchain records increased supplier trust while lowering the likelihood of fraud and disputes. Stronger relationships between suppliers and the supply chain company were developed by enhanced transparency and trust, which resulted in more cooperation and benefits.

Customers benefit by experiencing improved service, access to more authentic products, and enhanced transparency. Everledger, a blockchain-based platform that enables buyers to confirm the authenticity and ethical source of diamonds, is a noteworthy example (Hulstijn & Smits, 2020). Customers can have trust in the validity of their purchases since they know that the data stored on the blockchain is reliable and tamper-proof. Stronger connections between customers and enterprises are fostered by this degree of transparency and trust, which raises customer satisfaction. Blockchain's capacity to verify a product's origin enables consumers to make informed decisions and promotes ethical sourcing practices.

For new entrants, the use of blockchain in the supply chain sector may provide challenges. Due to increased effectiveness, increased trust, and established network collaboration, established players who have already incorporated blockchain may have a competitive advantage. However, newcomers also have the chance to learn from technologically advanced companies and design their supply chain processes from the ground up with transparency and traceability. Newcomers can show they are committed to innovation and gain an advantage in the market by using blockchain. The potential new benchmarks in the industry are explored later in more detail.

If a supply chain company uses blockchain, substitutes and competitors in the sector can feel more pressure to catch up. Blockchain technology offers transparency, security, and efficiency, which makes it a superior value proposition than alternatives. At the same time, adopting blockchain can be an opportunity for substitutes. An example of blockchain disrupting substitutes can be seen in the energy sector. Power Ledger, a blockchain-based energy trading platform, facilitates peer-to-peer energy transactions and empowers individuals and companies to purchase and sell renewable energy directly (Power Ledger, n.d.). Power Ledger offers users an acceptable alternative to traditional energy suppliers, minimizing reliance on centralized energy systems. This blockchain-based solution allows substitutes to emerge as potential competitors, challenging the dominance of established energy companies.

The introduction of blockchain in a supply chain company may result in changes to job titles, skill requirements, and overall work processes. Employees may need to learn new skills in cybersecurity, data analysis, or IT, to operate and use the blockchain system successfully (PWC, 2017). Blockchain can also automate manual procedures and eliminate the need for middlemen, improving efficiency. Employees could therefore shift their attention to tasks like data analysis, problem-solving, and strategic decision-making. However, the adoption of blockchain might also cause some skepticism and opposition among employees who may be wary of technical changes or worry about losing their jobs (PWC, 2017). For a seamless transition, effective change management strategies, clear communication, and employee involvement in the adoption process are essential.

The implementation of blockchain in the supply chain industry can have a positive impact on overall society. The pillars of blockchain include transparency, security and efficiency, which support ethical behavior throughout the supply chain, trust, and responsible sourcing. Additionally, the ability of blockchain to reduce counterfeiting, fraud, and unethical behavior might help create a supply chain ecosystem that is more socially responsible.

3.2 Blockchain in Healthcare

Digital health, the amalgamation of technology and healthcare, has witnessed significant evolution since its conceptualization in the late 20th century, with rapid advancements and market growth in recent years. Government initiatives such as the U.S. Affordable Care Act

and regulatory changes like the HITECH Act have spurred the integration of digital solutions like electronic health records and telehealth into healthcare systems, particularly notable in the early 21st century. The emergence of advanced technologies like AI, big data analytics, blockchain and robotics has further propelled innovation in digital healthcare, with developments such as AI-based patient monitoring tools and digital twins gaining prominence in the late 2010s and early 2020s. The COVID-19 pandemic has accelerated the adoption of digital health technologies, particularly telehealth, highlighting its importance in healthcare delivery during the early to mid-2020s (Bernstein, n.d.).

3.2.1 Transformation with blockchain

Blockchain technology has emerged as a transformative force in healthcare, aiming to revolutionize patient care, data management, and system transparency. Fueled by demands for enhanced security, interoperability, and transparency, blockchain has made significant strides in reshaping traditional healthcare practices.

Its implementation has streamlined data sharing and storage, leveraging encryption methods and decentralized storage to bolster data integrity and privacy (Azaria et al., 2016; Praveen, 2021). By providing a standardized framework for information interchange, blockchain promotes interoperability, potentially improving patient outcomes and care coordination (Praveen, 2021; Mettler, 2016). This technology has broad applications across crucial healthcare procedures, including electronic health record (EHR) management, supply chain tracking, clinical trials, and medical record management. Blockchain-enabled EHRs empower patients to control their health data securely while facilitating seamless care coordination across providers (Mettler, 2016). In supply chain management, blockchain tracks and authenticates pharmaceuticals, medical devices, and supplies, ensuring product quality and authenticity (Ekblaw et al., 2016). Its role in clinical trials enhances transparency, data integrity, and patient consent management, utilizing smart contracts to automate protocol execution and ensure data accuracy (Benchoufi & Ravaud, 2017). Furthermore, blockchain is applied in telemedicine, patient identity management, and healthcare payment systems, offering a secure platform for managing patient IDs and facilitating financial transactions (Ahmad et al., 2021). As blockchain technology continues to evolve, its impact on healthcare is poised to deepen, promising further innovations in patient care delivery, data management, and system efficiency.

3.2.2 Ethical issues

Blockchain technology offers numerous advantages in healthcare, but its implementation raises ethical concerns. Privacy and security are major issues due to the immutability of blockchain, which could lead to long-lasting effects of data breaches and undermine patient trust (Kiania et al, 2023). Informed consent becomes challenging with blockchain's decentralized nature, potentially compromising patient autonomy and transparency in data

usage (Velmovitsky et al., 2020). To mitigate the risk of data breach, healthcare blockchain applications often use encryption and cryptographic hashing techniques to anonymize patient data, separating it from identifiable information. Data ownership is another concern, as the immutability of blockchain may limit patients' control over their health information, hindering their ability to manage sensitive data and correct errors (Velmovitsky et al., 2020). Unlike traditional databases, blockchain makes it difficult to delete or modify data once recorded, making compliance with regulations like GDPR challenging. Consequently, blockchain is primarily used for governance and auditability in healthcare, rather than as a direct repository for patient data. These ethical issues highlight the need for careful consideration and regulation in the integration of blockchain technology into healthcare systems.

3.2.3 Development of legislation

Due to the ethical issues that can arise from implementing blockchain in the healthcare industry, clear legislation has to be in place. Lawmakers and regulators have recognized the potential of blockchain technology to transform healthcare data management, prompting discussions and consultations for tailored legislation in various regions (Estonian e-Health Foundation, 2018; Sharma, 2020). Notably, Estonia and Dubai have initiated blockchain-driven healthcare initiatives as examples of forward-thinking regulation and adoption. However, significant regional and national differences exist in legislation governing blockchain in healthcare, with many jurisdictions lacking specific laws, leading to reliance on broader data protection and privacy regulations. In the United States, the Health Insurance Portability and Accountability Act (HIPAA) addresses privacy and security of protected health information but may not fully encompass blockchain's decentralized nature and potential to enhance data integrity (U.S. Department of Health, n.d.). Similarly, the General Data Protection Regulation (GDPR) established by the European Union offers a comprehensive framework for data protection, yet its applicability to blockchain remains unclear due to challenges related to data rectification, erasure, and enforcement within decentralized systems (European Union, n.d.). Prospective legislative developments aim to address blockchain complexities, promote data interoperability, ensure patient data privacy and ownership, and enhance cybersecurity to safeguard medical data from cyber threats. These efforts seek to provide stakeholders with assurance, facilitate seamless data exchange, empower patients, and bolster the security of blockchain networks in healthcare.

3.2.4 The impact of blockchain on the healthcare institution

Decentralized, unchangeable, and transparent, blockchain technology has many benefits that have an impact on different areas of healthcare companies. The next section looks at how implementing blockchain has affected healthcare institutions' financial performance, internal corporate policies, internal culture, and global expansion.

The implementation of blockchain in the healthcare industry has the potential to have a substantial impact on institutions' financial performance. Healthcare providers can save money and operate more efficiently by streamlining transactions, getting rid of intermediaries, and cutting administrative expenses. For instance, the healthcare startup Hashed Health, which focuses on blockchain technology, has created a platform that streamlines the claims administration and payment procedures. Because of the enhanced revenue cycles and decreased revenue leakage brought about by using this blockchain system, healthcare institutions can improve their financial performance (Kushch et al, 2019).

Internal policies and procedures inside medical institutions may undergo radical transformation as a result of integrating blockchain technology. The auditable and tamper-resistant characteristics of blockchain can increase trust and transparency within organizations. An example is MedRec, a decentralized electronic health record (EHR) system built on blockchain. MedRec gives patients more control over their medical information and gives healthcare professionals secure access to accurate and current patient data. Since patient permission and data privacy are now more important than ever, medical facilities that have adopted MedRec have revised their data-sharing policies (Azaria et al, 2016).

The implementation of blockchain in healthcare creates a shift in the internal culture of institutions, emphasizing collaboration and data-driven decision-making. Teams are encouraged to collaborate openly and effectively when using a shared, immutable ledger. Gem, a blockchain-based platform, has introduced blockchain solutions for the pharmaceutical supply chain, which improves traceability and combats counterfeit drugs. By encouraging confidence and cooperation among stakeholders, its adoption has improved patient safety and healthcare outcomes (Dmitry, 2023).

Blockchain technology has the potential to help healthcare organizations expand internationally by resolving issues with cross-border data interchange and compliance. As an example of how using blockchain can facilitate seamless patient data exchange across European borders, take the European blockchain-based eHealth initiative EHR Data. Healthcare institutions can expand their services and work with foreign partners using blockchain-powered interoperability, thereby improving patient care on a global scale (European Commission, 2022).

3.2.5 The impact of blockchain on the stakeholders

Blockchain technology has been making waves across various industries due to its potential to transform traditional processes. In the following section I will show how blockchain has impacted each of the stakeholders of the healthcare institution: patients, employees, substitutes, competitors, suppliers, new entrants, and society. The impact is supported by real-life examples.

The integration of blockchain technology in healthcare has revolutionized patient-centered care, ensuring secure storage and sharing of medical data. With its decentralized structure and cryptographic encryption, blockchain enables real-time access to accurate medical information while preserving patient privacy (Rahmani et al., 2020). For instance, Estonia's e-Health system leverages blockchain to empower patients with control over their electronic health records, fostering trust and collaboration between patients and healthcare providers. This innovative approach not only enhances patient decision-making but also facilitates seamless data exchange, highlighting the transformative impact of blockchain in healthcare.

Blockchain integration in healthcare has positively impacted healthcare practitioners by streamlining administrative tasks and reducing paperwork, allowing them to focus more on patient care and research (Azaria et al., 2016). For instance, MedRec, a secure decentralized electronic health record (EHR) system, exemplifies this improvement by optimizing administrative procedures and enhancing collaboration among healthcare providers. This blockchain-based system not only facilitates seamless data sharing and access to patient records but also creates opportunities for healthcare professionals to specialize in blockchain-related roles, thus advancing their careers in the evolving healthcare landscape.

Substitutes, such as telemedicine and remote health monitoring solutions, have benefitted from blockchain adoption in healthcare. Blockchain's safe and transparent data management has improved interoperability between different healthcare platforms, allowing for easy integration with telemedicine services. This interconnection enables substitutes to efficiently communicate with healthcare organizations and obtain patient records (Ahmad et al., 2021). These developments enable better healthcare delivery and outcomes by fostering a more patient-centric and interconnected healthcare ecosystem.

Healthcare providers are motivated to use this technology as they become more aware of its transformative potential in order to stay relevant and offer cutting-edge services to their patients. This innovation competition benefits patients by resulting in better healthcare services and more personalized care. Additionally, this push for blockchain adoption has effects across the sector, encouraging a culture of continuous improvement and pushing the limits of what healthcare can accomplish through collaboration and technology. As a result, a more effective, secure, and patient-centric healthcare ecosystem benefits patients and the healthcare sector as a whole.

Blockchain implementation in the healthcare sector has influenced suppliers as well. Supply chain management in healthcare is critical, as any error or delay could lead to life-threatening consequences. Counterfeit medications are a big concern in the healthcare supply chain. The Health Research Funding Organization revealed that about 10–30% of pharmaceuticals in underdeveloped nations are counterfeit (Ozawa et al., 2018). Blockchain's transparency and traceability improve supply chain efficiency, reduce counterfeit drug incidents, and ensure the delivery of genuine and safe products (Jadhav & Deshmukh, 2022).

Blockchain enables startups and innovative organizations to develop decentralized applications and services that integrate seamlessly with existing healthcare systems. As a result, innovation is encouraged, and a broad ecosystem of healthcare solutions is fostered. The adoption of blockchain in healthcare also benefits society at large. Patients are first and foremost protected from data breaches and medical identity theft thanks to blockchain's improved data security and privacy. In turn, this fosters trust in the healthcare system. Additionally, better patient outcomes and fewer medical errors result from increased accuracy and efficiency (OECD, 2020).

The use of blockchain technology in the healthcare industry has had a big impact on many stakeholders. While employees benefit from reduced administrative duties and improved teamwork, patients gain better data protection and greater control over their medical information. Increased interoperability and transparency benefit suppliers and substitutes, resulting in better services and safer goods. Most significantly, society benefits from better patient outcomes and increased trust in the healthcare system.

3.3 Blockchain in Capital Markets

The digitization of capital markets has evolved through stages, initially acknowledging its significance for efficiency and cost reduction, albeit trailing other financial sectors. Challenges encompassed complex IT systems, reliance on legacy methods, and inadequate prioritization of transformation outcomes. However, the industry is now in a pivotal phase where digital transformation is vital for innovation, regulatory compliance, and adapting to emerging trends. Key drivers include globalization, regulatory shifts, and the blending of traditional and alternative business models. Stakeholders increasingly favor investment in cloud, analytics, and robotic process automation, with blockchain maturing beyond conceptual stages. Digital transformation is deemed essential across all processes, with platform-based models set to drive growth. Technologies like cloud computing, distributed ledgers, and mobile platforms promise increased leverage and automated decision-making. Success hinges on leaders embracing agile methods, prioritizing design-centric approaches, and transitioning to outcome-focused product/platform models (Das, n.d).

3.3.1 Transformation with blockchain

Blockchain technology has become a game-changing force in the financial industry, providing a secure and decentralized platform for handling transactions and data. It was initially launched in the capital markets as a ground-breaking approach to challenges with efficiency, security, and transparency. Blockchain technology initially appeared in the financial sector with the 2009 launch of Bitcoin, the first cryptocurrency, by an unknown party operating under the pseudonym Satoshi Nakamoto (Nakamoto, 2008). Blockchain, the technology that underpins bitcoin, offered a decentralized and tamper-resistant ledger system that served as the basis for numerous financial applications. Beyond Bitcoin, other

blockchain-based platforms have emerged, resulting in the development of increasingly sophisticated and customizable blockchain networks. Vitalik Buterin introduced smart contracts with the launch of Ethereum in 2015, allowing for the execution of self-executing contracts with predefined rules without the need for intermediaries (Buterin, 2013). This development greatly increased interest in blockchain's potential application in capital markets because smart contracts have the ability to simplify complex financial processes. The potential of blockchain in the capital markets has caught the interest of many financial organizations and authorities. Its safe and unchangeable nature promised to improve the accuracy of financial data and speed up settlement procedures. As a result, pilot initiatives and consortiums emerged with the goal of exploring and implementing blockchain solutions in the capital markets.

The ability of blockchain technology to revolutionize traditional financial processes fueled its adoption in the banking and finance sector. Cross-border payments were one of the first areas of blockchain technology being used in finance. The usage of numerous intermediaries and clearinghouses made traditional international remittances time-consuming and expensive. Blockchain-based solutions provide a quicker and more affordable option for international money transfers. A significant player in this market has emerged: Ripple, a well-known blockchain-based payment network (Khalil, 2019). Additionally, the distributed ledger technology (DLT) of blockchain presented opportunities to boost the general effectiveness of financial activities, such as trade finance, supply chain finance, and securities settlement. Blockchain-based systems that automate trade and supply chain financing reduced paperwork and improved the traceability of goods and funds (Xu et al, 2019). The integration of blockchain with traditional financial systems also enabled the creation of digital assets and the tokenization of real-world assets. Security tokens backed by real-world assets such as real estate or commodities enabled fractional ownership and liquidity in traditionally illiquid markets (World Economic Forum, 2019). In the following sub-sections I will analyze what are the implications of adopting blockchain for multiple stakeholders in the finance industry, as well as present the concept of digital currencies and bitcoin.

3.3.2 The impact of blockchain on the stakeholders

The financial sector has been completely transformed by blockchain technology, which provides a decentralized, secure, and transparent platform for handling transactions and data. The following section examines the varied impact of blockchain adoption in finance, including its implications on the financial industry, customers, international business, new entrants, competitors, and society.

Blockchain adoption in finance has a huge impact on the industry. One key advantage is its ability to expedite transactions by eliminating the need for intermediaries like banks, thereby enhancing efficiency. Moreover, blockchain technology, exemplified by platforms like

JPMorgan's Liink (formerly Interbank Information Network), has notably reduced settlement times for cross-border payments, from days to minutes or even seconds, bolstering operational efficiency and liquidity management (Finextra, 2020). This innovation also brings cost savings by automating smart contracts and streamlining processes, resulting in greater affordability. Additionally, blockchain's nature ensures data integrity, mitigating fraud and enhancing security.

The adoption of blockchain has empowered customers by enabling faster, transparent, and secure transactions. Decentralized Finance (DeFi) platforms, a key blockchain innovation, have reshaped lending and borrowing services by eliminating traditional financial intermediaries. Platforms like Aave exemplify this shift, offering users the ability to earn interest on deposited assets and lend cryptocurrency holdings, while enabling borrowers to access loans by collateralizing their cryptocurrencies (Aave, n.d.). By circumventing fees and delays associated with traditional banking, DeFi platforms like Aave democratize financial services, granting access to individuals previously excluded from the traditional banking system.

Blockchain has transformed internal company policies and culture within international finance firms by promoting decentralization, which fosters creativity and teamwork by challenging hierarchical structures. Utilizing blockchain's smart contracts streamlines internal and compliance processes, reducing administrative costs. For instance, Santander, a global bank, leveraged blockchain to streamline shareholder voting processes, enhancing corporate governance transparency and efficiency (Santander, 2018). By immutably recording shareholder voting records on the blockchain, Santander enables instant verification and auditing of voting outcomes, bolstering shareholder engagement, trust, and confidence.

Blockchain has facilitated financial companies' expansion into new markets by streamlining international transactions and overcoming regulatory hurdles. Leading the way is Ripple, a prominent blockchain-based payment network that enables instant, low-cost international transfers through its native cryptocurrency XRP (Lacapra, n.d.). By eliminating intermediaries, Ripple has significantly reduced the cost and time associated with cross-border payments, enabling finance firms to explore untapped markets and pursue global business opportunities. Additionally, blockchain adoption has spurred the emergence of decentralized exchanges (DEXs) like Uniswap, where users can trade cryptocurrencies directly from their wallets, promoting financial inclusion and enhancing security (Uniswap, n.d.). Firms not embracing blockchain face increasing pressure to adapt or risk losing market share, as blockchain-enabled solutions gain momentum, satisfying client demands and efficiency criteria more effectively.

Blockchain implementation in finance brings profound societal benefits. Platforms like BanQu utilize blockchain to extend financial inclusion, granting unbanked individuals digital identities and access to previously inaccessible services (Larsen, 2018). This fosters

economic stability, amplifies marginalized voices, and reduces poverty. Blockchain's transparency cultivates trust between customers and financial institutions, promoting accountability and responsibility. Moreover, in the fair-trade industry, blockchain ensures ethical sourcing and sustainability.

3.3.3 Digital currencies

Digital currencies are a type of alternative currency that operates on a decentralized network, typically based on blockchain. They are not governed or controlled by any central authority, in contrast to traditional fiat currencies that are issued by governments and central banks. To protect transactions and verify the creation of new units, they instead rely on cryptographic techniques. Digital wallets, which are accessible through computers or mobile devices, are frequently used to store and manage digital currencies.

Blockchain is the underlying technology that makes it possible for digital currencies to exist and function. A blockchain is a collection of interconnected blocks, each of which includes a list of transactions. Using cryptographic hashes, these blocks are connected to one another to form a continuous information chain. The integrity and transparency of the whole transaction history are guaranteed once a block is put to the blockchain because it cannot be changed or removed at that point. Through a consensus process, a network of nodes (computers) verifies and confirms transactions (Swan, 2015).

Bitcoin remains the most prominent cryptocurrency, but a plethora of alternatives, known as "altcoins," are gaining traction. Ethereum, introduced by Vitalik Buterin in 2015 (Buterin, 2013), pioneered smart contracts, enabling various applications like decentralized finance (DeFi), non-fungible tokens (NFTs), and decentralized autonomous organizations (DAOs) (Antonopoulos, 2015). Litecoin (Lee, 2011), often dubbed "silver" to Bitcoin's "gold," boasts faster transaction confirmations and a unique hashing algorithm, making it suitable for everyday transactions. Ripple's XRP (Lagarde, 2018) specializes in facilitating quick and cost-effective cross-border transactions through its Ripple Protocol Consensus Algorithm (RPCA) technology (Ripple, n.d.). These altcoins address flaws in traditional financial systems, offering alternatives with improved transaction speed, cost-effectiveness, and functionality. As the cryptomarket evolves, new digital assets continue to emerge, expanding blockchain technology's potential applications.

3.3.4 Bitcoin and impact on traditional currencies

Founded in 2009 by an individual or group going by the pseudonym Satoshi Nakamoto, Bitcoin is the original decentralized digital currency that has taken the financial world by storm. Bitcoin's distinctive qualities are what make it so appealing: it runs on a peer-to-peer network that eliminates the need for intermediaries like banks and allows for safe, transparent transactions. In addition to enabling smooth transactions, this ground-breaking

technology—has caused a radical change in the world of finance. This section explores the factors that led to Bitcoin's growth, how it has affected traditional currencies, its outlook and limitations.

Bitcoin's disruptive potential in challenging established banking structures has propelled its popularity. Originating as a hedge against governmental control over monetary policy during economic instability (Nakamoto, 2008), its limited supply of 21 million coins has positioned it as a hedge against inflation and currency devaluation. This scarcity has driven heightened investment interest, leading to record-high market values. Bitcoin's impact on traditional currencies is profound. It has sparked debates on the future nature of money, prompting central banks to explore central bank digital currencies (CBDCs) (Mersch, 2018). CBDCs aim to combine fiat currency stability with crypto benefits, such as swift cross-border transactions, fostering innovation in the financial industry (Bank for International Settlements, 2020).

Bitcoin's future remains uncertain amid ongoing debate. Advocates liken it to gold, citing its decentralized structure and scarcity as factors contributing to its potential as a reliable store of value (Popper, 2016). Conversely, critics highlight its price volatility and regulatory challenges, casting doubt on its widespread adoption as a medium of exchange (Roubini, 2018). Environmental concerns arise from the energy-intensive mining process associated with Bitcoin's Proof of Work consensus mechanism (Nakamoto, 2008). Efforts to address this include exploring eco-friendly alternatives like Proof of Stake, which reduces energy consumption while maintaining blockchain security (Buterin, 2013). Scalability concerns also loom, with potential network congestion as transaction volumes increase (Tschorsch & Scheuermann, 2016). Solutions such as the Lightning Network aim to mitigate these challenges by facilitating off-chain transactions. In summary, while Bitcoin spurs financial innovation and holds promise as a store of value, overcoming obstacles like price volatility, regulatory ambiguity, environmental impact, and scalability limitations will be crucial for its widespread adoption.

The rise of bitcoin has sparked debates about the nature of money in the future, encouraged central banks to investigate issuing virtual currencies, and exposed the world to the revolutionary possibilities of blockchain technology. Even though Bitcoin's future is still unknown, it has had a significant impact on the financial industry. The rise of alternative cryptocurrencies also highlights how dynamic the digital asset market is, as each coin aims to creatively solve a particular need.

4 RESEARCH METHODOLOGY

The primary research methodology employed for this thesis involves semi-structured, in-depth interviews. I believe this to be the best method for my research as the research questions themselves are qualitative and require greater description as well as insight into

the selected company's practices. A semi-structure interview consists of a checklist of topics followed up by questions such as "why" and "how" which allows for the discussion to generate more information (Adams, 2015). Questions such as how the selected company/its strategy and policies were affected by blockchain, how did company culture change, and how much they had to transform their business model, are questions that can be most accurately understood if explained by an insider. Other advantages include that the findings are quicker to identify due to the high quality of answers and there are no peer pressures – the interviewees feel more comfortable to share information that they might not in focus groups (Adams, 2015). The disadvantages are that a lot of time is spent on the interviews – as they need to be transcribed, organized, and analyzed (Boyce, 2006), as well as a lot of time was spent to find an adequate person to agree to participate. Further, interviews are prone to bias – if I want to "prove" a theory that I had before, I might lead the interviewee to confirm it, and they are not generalizable – due to small samples and not using random sampling methods (Boyce, 2006).

A total of nine interviews were conducted across three industries: Supply Chains, Healthcare, and Capital Markets. I was conducting the interview process from October 8th, 2023, to January 9th, 2024. First, I did research on which companies within the 3 chosen industries use blockchain technology. The selection of companies was based on findings from online databases, including BlockData, which lists top companies using blockchain technology in 2021 and 2022 (Schweiger, 2021; Team Blockdata, 2022). Second, I checked which companies are active on LinkedIn. Third, I created a list of companies and started searching employees of those companies on LinkedIn which would be suitable for the interview topic – Managers, HR, Marketing, Directors, CEOs, Product Leads, Head of Blockchain Divisions, IT specialists, Sales department. Before sending a message to reach out to the employees, I had to send a request to connect with them (LinkedIn does not allow to send a message to anyone, unless you pay a Premium subscription). Fourth, I sent the request to connect to a total of 309 employees within 25 companies. Fifth, only a third of the connection requests were accepted so I subscribed to LinkedIn premium for 3 months, and finally led to messages sent to a total of 164 people (within 25 companies). Each message was personalized to reflect the industry they work in, how it relates to my thesis and how their experience and knowledge according to their job title could be helpful to my thesis. Sixth, out of the total 164 messages sent, I received a reply from only 27 people, of which 9 agreed to an interview. The process lasted for 3 months with repeating 5 stages multiple times – find blockchain companies, find the appropriate employees to contact according to their job title, send connection requests, wait, and send messages to the people that accepted the connection. The process was repeated until 9 interviews (3 per industry) were achieved.

The main challenge in accessing people stemmed from the relatively small number of companies that use blockchain technology, necessitating contact with strangers rather than individuals within companies I had existing contacts with. Additionally, the contacted individuals were from different countries – USA, Russia, Abu Dhabi, Spain, UK, Slovenia, etc. – so cultural differences and varying time zones affected response rates. Each interview

was meticulously prepared in advance, involving general research of the company and preliminary questions related to the research questions of my thesis. The aim during each interview, which lasted 20-30 minutes, was to guide the interviewees in answering the research questions while avoiding confirmation bias. The main limitation is that instead of factual data, the interview answers represent the personal opinions of the interviewees.

Table 2: Summary of Interviewees details

Category / **Company**	*Interview date*	*Gender*	*Age*	*Position*	*Years in the job*	*Company Revenue*
Walmart	04-01-24	Female	30 - 35	Associate - Distribution Operations	2.5 years	$611,289 million
Circulor	18-12-23	Male	50 - 55	High (management) position in Sales	3 years	$3.2 million
Tradelens	06-12-23	Male	35 - 40	High (management) position in onboarding	3.5 years	$2,343 million (Managed by Maersk)
Hashed Health	25-10-23	Female	40 - 45	Operations – High position	1.5 years	<$5 million
Digipharm	26-12-23	Male	35 - 40	High management position	6 years	< $5 million
Avaneer Health	26-12-23	Male	50 - 55	Business Development – High pos.	Approx. 3 years	$10 – 25 million
Mastercard	12-12-23	Female	40 - 45	Risk management- high position	1.5 years	$25.1 billion
Visa	21-12-23	Male	25 - 30	Global Crypto Analyst	Almost 2 years	$32.7 billion

Source: Own work.

5 FINDINGS

In the following section, I present the findings derived from practical research, the methodology for which was explained in the preceding chapter. Detailed insights emerge from interviews conducted with professionals in the respective sectors. Key findings from these interviews are presented for each of the three industries, summarising the benefits, challenges, and future trends unique to each. Subsequently, the thesis transitions to a "Generalization and Analysis" section, conducting a cross-industry examination to discern commonalities and distinctive challenges across supply chains, healthcare, and capital markets. This comparative analysis draws broader conclusions about blockchain adoption.

5.1 Supply Chains: Key Findings from the Interviews

In the following section, I have summarized the key findings from the conducted interviews of the companies: Walmart, Circulor and Tradelens. The main points are summarized in a table for each company, according to the following categories: Gender, Age, Position, Company, Years in the Company, Revenue, Industry, Role of blockchain, Year of founding/ adopting blockchain, Reason for Adopting Blockchain, Benefits, Challenges or drawbacks for the company, Impact on Customers, Impact on Company Culture, Impact on External Parties, Interviewee's Perspective on Industry Impact, Interviewee's Perspective on Blockchain Growth, Biggest Challenges with Stakeholders, Main Challenges in International Business and New Potential Benchmarks for Industry. Afterwards, the key findings are presented in more detail, which correspond to the main research questions mentioned in the Introduction section. The detailed analysis is followed by short performance indicators where public data was available. Note that the interviews were conducted confidentially, thus the main limitation of the findings below is that the information is based on personal opinions and experience of the interviewees, rather than factual data (see Research Methodology for further details on the interview process). The section is finalized with a generalization analysis for the three interviews, in order to determine general findings for the effect of blockchain in supply chains.

Table 3: Summary of Key Interview Findings from Supply Chain Industry

Category **Company**	**Walmart**	**Circulor**	**Tradelens**
Gender	Female	Male	Male
Age	30 - 35	50 - 55	35 - 40
Position	Associate - Distribution Operations	High (management) position in Sales	High (management) position on the onboarding team
Company	Walmart (Canada)	Circulor (Global)	Tradelens - A.P. Moller - Maersk
Years in the Company	2.5 years	3 years	3.5 years
Revenue	$611,289 million	$3.2 million	$2,343 million (Managed by Maersk segment)
Industry	Retail	Supply chain management	Supply chain management
Role of blockchain	Food-tracing; freight invoice and payment reconciliation solution.	Traceability and supply chain solutions for manufacturers.	Industry platform that provides supply chain visibility, workflow automation and collaboration.
Year of founding/ adopting blockchain	- October 2016 (Walmart ltd.) - February 2020 (Walmart Canada)	Founded in October 2017	Founded in 2018
Reason for Adopting Blockchain	Enhanced transparency, traceability, and efficiency in the supply chain, aiming to improve product tracking from supplier to store shelf.	Ensuring responsible sourcing in supply chains, creating transparency and visibility into complex supply chains.	Digitizing the entire supply chain, closing the gap in information exchange, providing better visibility. The focus is on long-term efficiency.
Benefits	Improved traceability, enhanced inventory management, reduced errors, and increased overall efficiency. Transparency for customers through the app.	Traceability of commodities and materials, preservation of the immutability of transactions, utilization of various data points for ESG and CSR.	Better visibility and information exchange. After the platform was shut down, the industry became more open to EBL solutions as the benefits were already showcased.

table continues

continued

Table 3: Summary of Key Interview Findings from Supply Chain Industry

Category **Company**	**Walmart**	**Circulor**	**Tradelens**
Challenges or drawbacks for the company	Implementation costs, technological complexity, and the need for industry-wide compatibility standards pose challenges. Perceived as a worthwhile investment despite these hurdles.	Limitations in handling vast quantities of data with blockchain, need for additional databases alongside blockchain, education of the market on traceability, urgency to address challenges due to impending regulations.	Delays in entering markets like China and Russia highlighted the resistance and lack of flexibility in adapting to new technologies.
Impact on Customers	Walmart-Canada seen as more trustworthy and committed to providing transparent and responsibly sourced products. Positively impacted customer perception.	Customers can focus on specific supply chains for due diligence. Expectation of transparency in sourcing and supply chain practices.	The platform's impact on customers was positive in terms of better visibility and information exchange. Customers were open to providing feedback, and the platform aimed to address their pain points.
Impact on Company Culture	Emphasizing innovation, technology adaptation, and a commitment to improving business processes.	Shifting towards a culture of responsibility and transparency, addressing challenges with education and urgency in implementing traceability.	There was a discussion about the sustainability aspect, however, the interviewee emphasized the need for a critical filter regarding the actual sustainability and eco-friendliness.
Impact on External Parties	Improved transparency positively influenced relationships with stakeholders, fostering enhanced trust and collaboration.	Influence on external parties like suppliers to behave in a more sustainable manner, expectation of transparency in global supply chains.	The platform faced challenges due to the industry's lack of readiness. Dealing with government authorities and regulatory bodies in various countries presented many hurdles.

table continues

continued

Table 3: Summary of Key Interview Findings from Supply Chain Industry

Category **Company**	**Walmart**	**Circulor**	**Tradelens**
Interviewee's Perspective on Industry Impact	Anticipates increased blockchain adoption in supply chains, revolutionizing transparency, security, and efficiency.	Increasing awareness and demand for traceability in supply chains, regulation and legislation driving the adoption of traceability platforms.	The interviewee believed that success in the future would come when the industry is more ready for blockchain applications.
Interviewee's Perspective on Blockchain Growth	Foresees blockchain usage expanding beyond supply chain to various sectors like finance and healthcare. Attractive due to its secure, transparent data storage.	Foresees blockchain becoming more niche specific. Certain industries require high levels of trust and immutability. Mentions blockchain's limitations in large supply chains.	The hope was that the industry would become more prepared for blockchain applications, with a smaller gap between the current state and the readiness for such innovations.
Biggest Challenges with Stakeholders	Stakeholder challenges include implementation costs, technological complexities, and the need for industry-wide compatibility standards. Positive view despite this.	Educating stakeholders on traceability, urgency in addressing challenges before regulations come into effect, need for detail on materials to meet new regulations.	Overpromises made by different teams due to the complexity of the platform created challenges. Thus, managing expectations and explaining delays to customers was an issue.
Main Challenges in International Business	The need for industry-wide compatibility standards.	Varying government controls in different countries, adaptation to different legislative environments.	Delays in entering markets like China and Russia due to regulatory hurdles and resistance to new technologies.
New Potential Benchmarks for Industry	High transparency and traceability as the most important characteristics in choosing a supply chain provider.	Digital product passports as new benchmarks for proving the makeup, provenance, and carbon footprint of products. Legislation setting new benchmarks for transparency.	The interviewee emphasized the need for a modern management style in startups. The suggestion was that disruptive solutions required a more agile approach to succeed.

Source: Own work

5.1.1 Walmart

Walmart is one of the world's largest multinational retail corporations, operating a chain of hypermarkets, discount department stores, and grocery stores. It was founded by Sam Walton in 1962 and is headquartered in Bentonville, Arkansas, USA. Walmart operates under various names in different countries, including Walmart in the United States and Canada, Asda in the United Kingdom, and Seiyu in Japan, among others (Walmart, n.d.). The company is known for its wide range of products at competitive prices, including groceries, clothing, electronics, home goods, and more. Walmart has been exploring the use of blockchain technology in its operations, particularly in its supply chain management. I explored two of Walmart's blockchain initiatives. The first initiative started in October 2016, when Walmart in collaboration with the technology-giant IBM, announced a food tracing system. The initial time to track the origin of mangos in US stores was 7 days, which reduced to 2.2 seconds (Hyperledger, 2018). The second initiative is from Walmart Canada, which was initiated in February 2020, when Walmart and DLT Labs launched a blockchain-based freight invoice and payment reconciliation solution (Bitvalex, 2019).

5.1.1.1 Interview Findings

The adoption of blockchain technology by Walmart-Canada was driven by a strategic initiative to enhance the transparency, traceability, and overall efficiency of its supply chain. The primary goal was to revolutionize product tracking from the supplier to the store shelf, ensuring data integrity and providing real-time visibility into the movement of goods.

In terms of benefits, the interviewee mentions improvements in traceability, enhanced inventory management, a reduction in errors, and an overall increase in supply chain efficiency. Notably, the transparency facilitated by blockchain extended to customers, empowering them with additional product information on the Walmart online app.

Regarding drawbacks of the technology, the interviewee mentioned the implementation costs, technological complexity, and the necessity for industry-wide compatibility standards. Despite challenges, she maintains a positive outlook - "*Initial installation and ongoing maintenance costs can be substantial, but the potential benefits in transparency and operational efficiency can outweigh these costs in the long run. As a supply chain graduate, I would like to think blockchain is a good investment hence the hurdles.*"

Regarding whether blockchain had any effect on Walmart's sustainability image, the interviewee thinks that "*Customers who value sustainability and authenticity may view Walmart-Canada as more trustworthy and committed to providing authentic and responsibly sourced products.*" She also thought that internally, blockchain could spark a cultural shift within the company. It fostered an environment emphasizing innovation – *"Initiatives like these often lead to a cultural change within the company, emphasizing innovation, technology adaptation, and a commitment to improving business processes. This can*

encourage a more data- and technology-driven culture within the organization. Paperwork still exists but given the large number of vendors involved it quite eases the process."

Externally, the impact extended to stakeholders such as investors, suppliers, and partners. The improved transparency and efficiency in the supply chain positively influenced the relationships with these external entities, fostering enhanced trust and collaboration.

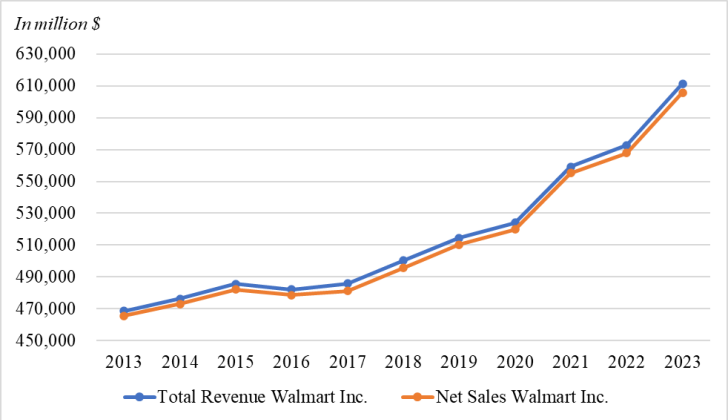
Looking at the broader industry perspective, the interviewee envisaged a significant shift. Blockchain adoption in supply chains was expected to grow, offering unparalleled advantages in transparency, security, and efficiency. Furthermore, the interviewee predicted a trend where more companies would emulate Walmart-Canada's approach, adopting similar initiatives as blockchain technology continued to mature and standardize.

The attractiveness of blockchain lies in its ability to provide secure, transparent data storage, making it a compelling technology for industries seeking heightened security and reliability.

5.1.1.2 Performance indicators

On the Financial Statements (2013 to 2023) can be seen that both total revenue and net sales have increased throughout time except from 2015 to 2016 where both decreased. Note that the first blockchain initiative of Walmart, that started in October 2016, could be driven by the negative financial impact from 2015 to 2016. Total Revenue and Net Sales depend on multiple factors, and even though a positive correlation with blockchain can be drawn, it cannot be established as a significant factor for overall growth.

Figure 1: Total revenue and Net sales of Walmart Inc. from 2013 to 2023

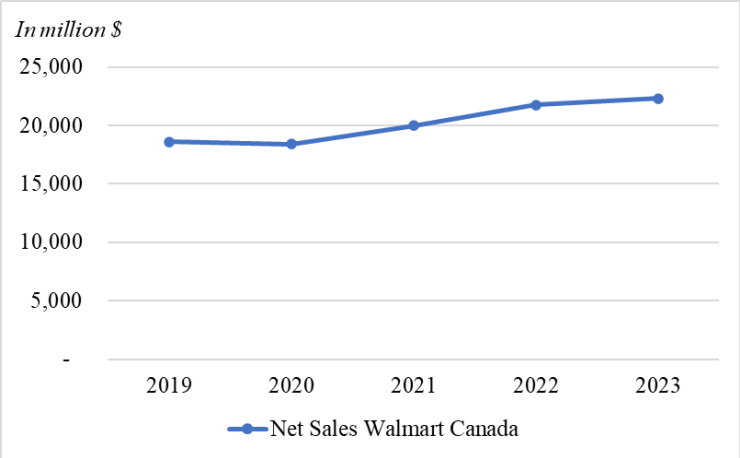


Source: Own work based on Financials of Walmart (2013 to 2023) (see Appendix 2)

Regarding the second initiative, taken by Walmart-Canada in February 2020, below is shown the growth of Net Sales from 2019 to 2023. Note that there is no information on Net Sales for previous years specifically for Walmart – Canada. There was a decrease in sales from 2019 to 2020, whereas the blockchain initiative was launched in February 2020. Similarly to

the previous graph, blockchain could be a response to decreasing sales, but even though a positive correlation can be drawn, it cannot be established as a significant factor for growth.

Figure 2: Graph summary for Net sales of Walmart Canada from 2019 to 2023



Source: Own work from the Financials of Walmart (2019 to 2023) (see Appendix 3)

The interviewee, on blockchain's financial impact mentions *"While it is difficult to detach the financial impact due to blockchain adoption alone, improved supply chain efficiency can positively influence financial performance through reduced costs, minimizing waste and optimized inventory management.*"

5.1.2 Circulor

Circulor, a startup incorporated in October 2017, is a developer of a supply chain traceability platform designed to help businesses to demonstrate responsible sourcing, improve their ESG performance and reduce their environmental impact. Their platform enables real-time tracking of raw materials and production processes, facilitating responsible sourcing and emissions monitoring. Notable collaborations include ensuring fully traceable, zero-carbon lithium production with Vulcan Energy and establishing full chain of custody tracking for cobalt in Volvo Cars' electric vehicles. Their sustainability products aid clients in setting ESG KPIs and driving improvements across supply chains, while risk management solutions identify anomalies and deviations, allowing for corrective action with a transparent audit trail on the blockchain.

5.1.2.1 Interview Findings

Circulor employs blockchain to ensure the immutability of transactions within their supply chain platform. The interviewee explains that the primary motivation for embracing blockchain lies in preserving the immutability of transactions related to the physical movement of materials and responsible sourcing - "*With conflict and critical materials, there*

are issues with modern slavery, child labor, and materials of unknown origin. They (clients) wanted to figure out where their materials were coming from. Most manufacturers don't know what is in their supply chain." Circulor's traceability platform focuses on identifying the origin of materials to address these challenges. Thus, customers can focus on specific supply chains, ensuring due diligence, and meeting ESG and CSR goals.

Regarding blockchain's drawbacks, the interviewee highlights challenges in scaling blockchain for large datasets, emphasizing the need for other databases. Circulor uses a private permission blockchain for specific purposes, "*Blockchain is not designed to hold and manage large quantities of data. We use private permission blockchain, Hyperledger Fabric, and the reason we use that is there's some degree of trust between the parties already. So therefore it's not costly because we're not using public blockchain and therefore not having to create a massive carbon footprint doing it. That's the one big disadvantage of blockchain is that it can't cope with vast quantities today.*"

Customers benefit from the traceability platform by gaining visibility into supply chains, enabling them to make informed decisions regarding responsible sourcing. The platform contributes to sustainability and aligns with rising consumer expectations for ethical practices.

Regarding the impact on external parties, the interviewee thinks that enhanced traceability positively influences external parties, aligning with market expectations. Investors may be more inclined to engage with companies demonstrating transparency in their supply chains.

The interviewee foresees blockchain evolving into a niche play, finding applications in industries requiring high levels of trust and immutability, such as gemstones and luxury goods - *"I think in certain use would be applied, for instance gemstones. It's obviously a good use case, particularly, there's a lot of problems with gemstones coming out of Africa to end up in in a shopping mall in Dubai, people saying well, it's from Tanzania, but it's not so, there are cases there for that. I think also luxury goods. You know Louis Vuitton and LVMH are looking at blockchain for diamonds. So I think there's certain use cases out there."*

Educating the market and overcoming the lack of understanding about traceability were identified as significant challenges. The urgency to address these challenges has increased with upcoming regulations, prompting parties to recognize the importance of supply chain solutions. This also brings new industry expectations -*"a company turns around and gives us what they think is their supply chain map. We start doing the traceability map, and we find more often than not, that's not actually the supply chain. So it's now becoming expected that you know the idea of transparency which traceability is part of and is now expected if you're going to be supplying a company, even geographies whereby they didn't really share data like, China, Southeast Asia, they now realize that to apply to the Western world, they're expected to give visibility to what they do, specifically how they actually source, manage and output products. So that is changing the world in terms of the expectations."*

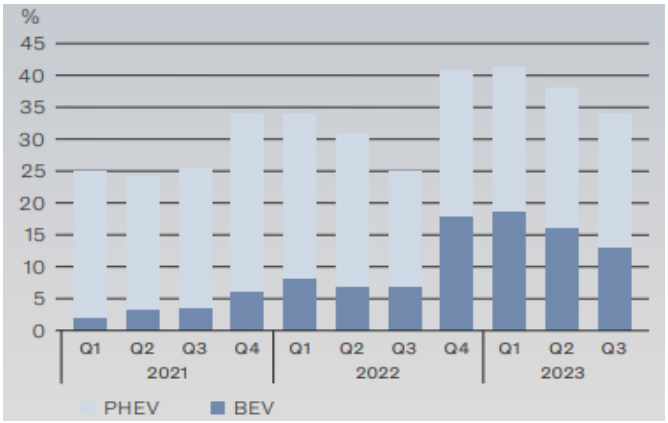
Globally, challenges include navigating diverse regulations, geopolitical considerations, and varying levels of government control. Verification of sourcing information emerges as a significant challenge - "*some countries are very much government controlled, and so China, for example, they have very stringent laws around data export, and they have the Critical Infrastructure Act. Obviously, we have a lot of geopolitical and a lot of wars going on globally, so there's a lot of places where like companies don't want, to be seen buying from. Russia for instance, has massive natural resources around nickel that you know a lot of the Western economies don't want to seem to be purchasing from.*"

The emerging trend towards digital product passports is recognized as a potential benchmark for the industry. These passports, focusing on verification and accuracy, could reshape how industries approach provenance, carbon footprint, and material composition documentation.

5.1.2.2 Performance indicators

Circulor was incorporated in October 2017, and is still being funded. The latest funding stage was Series B (by this stage, startups are expected to have demonstrated market traction, a solid business model, and revenue growth), with total capital raised of $39.14 million (Pomanda, 2021). There are no publicly available financial statements online for Circulor, however there are financial summaries from third parties, such as Pomanda (2021) demonstrating revenue growth of $582.46k in April 2019 to $4.03m in December 2021. One of their customers is Volvo Cars. Circulor is helping Volvo Cars in tracing the cobalt used in the batteries of its electric cars (Volvo Cars, 2020). Below is shown the growth of sales of battery electric vehicles (BEV) which was 13% of total share of sales in Q3 2023. Note that increase in share of sales of electric vehicles cannot be attributed to a single cause such as implementation of blockchain, however having in mind that Volvo's mission is to become a fully electric car company by 2030 (Volvo Car Group, 2023), it is a feasible decision to invest in traceability solutions.

Figure 3: Growth of sales of battery electric vehicles (BEV) from Q1 2021 to Q3 2023



Source: Volvo Car Group (2023)

5.1.3 Tradelens

TradeLens was a joint initiative launched in 2016 by A.P. Moller - Maersk and IBM, aiming to revolutionize global supply chains through blockchain technology. It was the only successful deployment of enterprise blockchain in a public supply chain network until its discontinuation. The platform sought to improve collaboration and visibility among ocean shipping companies but faced challenges in achieving full global industry collaboration. Despite its closure, TradeLens demonstrated the potential of blockchain in enhancing supply chain effectiveness and transparency (Cecere, 2022).

5.1.3.1 Interview Findings

The initial purpose of TradeLens was to digitize the entire supply chain, providing better visibility and information exchange. The goal was to close the gap in the industry, especially in highly regulated countries like Russia, and apply blockchain for long-term benefits.

The platform aimed to offer benefits to customers by providing better visibility and information exchange. Blockchain application, particularly in handling digital assets like electronic bills of lading (EBL), demonstrated benefits – *"Movement of that digital asset (EBL) was exactly underpinned by the blockchain, so every single transaction and transfer of that asset from 1 entity to another was recorded in our ledger. And so, in EBL we've seen the beauty of blockchain application."*

Despite the benefits, the interviewee does not think that blockchain is the most important for visibility purposes – "*Probably, my comment won't be popular among my former colleagues, but you don't need a blockchain for visibility purposes. You can throw a fancy word as blockchain, but probably will be more of marketing step. But, to collect the data from various sources to ensure that this information passes through a set of requirements to match the data quality criteria and to provide some of the milestones which are currently missing for the cargo owners, you don't need the blockchain, you just need a database with a set of rules which will be governed according to general terms. So, it's easier to develop something with less popular, less modern solution, but to get all these stakeholders on the same page*."

Regarding the impact on customers, the interviewee said that customers were open to providing feedback, and the platform aimed to address their pain points. The platform's impact on customers was positive in terms of better visibility and information exchange.

The interviewee expressed optimism about the industry being ready for blockchain in the future. He believes that the success of blockchain might be built on the Tradelens' lessons.

The platform faced challenges in getting stakeholders on board, especially ocean carriers who were key to the platform's success. Regulatory issues and resistance from external parties were significant hurdles. The main challenge was the industry's lack of readiness.

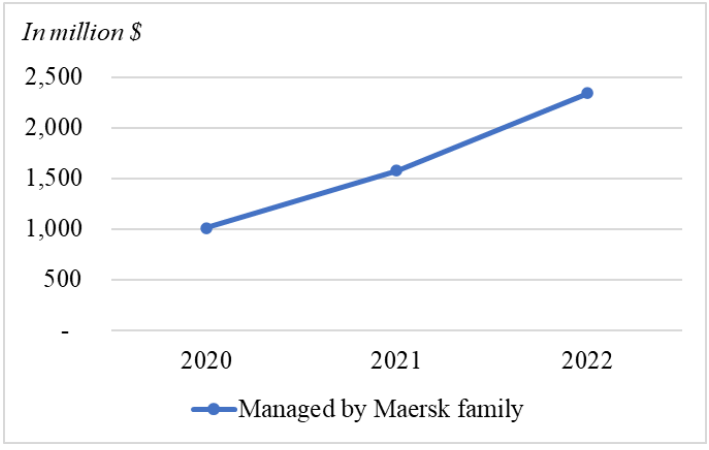
Some of the main challenges when dealing in the international environment, were overpromising by sales teams due to complexity in selling TradeLens as a product alongside core solutions, and the difficulty of managing customer expectations, especially in an international context. Another big challenge was different country regulations – *"when it comes to the government authorities, it took us, like almost maybe two or three years, to enter China as a market. Still, it was quite a tough exercise to meet all the legal requirements from this country. And with Russia that also was quite a hustle, with all possible check-ins with regulatory bodies…That's kind of an example of how tough some of the counterparts were when it comes to being flexible to try something else and we were not even trying to put it on stone, even to just have one proof of concept, one pilot it was taking years."*

As a new benchmark, he emphasized a modern management style in startups. The suggestion was that disruptive solutions required a more agile approach to succeed – "*I believe that startups as TradeLens backed up by huge companies can only survive and actually deliver the value with an absolutely modern management style or being stacked up as separate entity from day one. Perhaps that's not TradeLens opinion, that's my opinion. But we had enough time to deliver, and we didn't deliver simply because of the old-fashioned way of managing things. We came into the government 60 times before shaking hands. So with such disrupting solutions, you don't have that much time, you need to move faster, so perhaps for whatever company built on the ashes of TradeLens that's going to be the key to success."*

5.1.3.2 Performance indicators

The revenue from Tradelens is included in the "Managed by Maersk" segment in the Financials 2022 and 2021 (this segment is not present on previous financials). Below is shown the revenue growth of the "Managed by Maersk" segment from Q4 2020 to Q4 2022. Note that since multiple services are included in this segment, its growth cannot be only attributed to Tradelens.

Figure 4: Revenue growth of "Managed by Maersk" Segment from Q4 2020 to Q4 2022



Source: Own work based on Maersk Financial Statements (2021, 2022) (see Appendix 4)

Apart from the growing revenue, Maersk reported each year from 2019 to 2022 growing network members (ports and terminals, custom authorities, ocean carriers), reaching 360+ in Q3 2022 (A.P. Moller – Maersk, 2022b). Despite the growing numbers, Tradelens was discontinued in Q4 2022. Rotem Hershko, Head of Business Platforms at A.P. Moller-Maersk, stated "*Unfortunately, while we successfully developed a viable platform, the need for full industry collaboration has not been achieved. As a result, TradeLens has not reached the level of commercial viability necessary to continue work and meet the financial expectations as an independent business."* (Cecere, 2022).

5.1.4 Industry conclusions based on interview findings

The interviews with representatives from Walmart, Circulor, and Tradelens reveal several common themes and trends in the adoption of blockchain within the supply chain industry.

All three companies emphasize the primary goal of enhancing transparency and traceability in their supply chains. Blockchain adoption is driven by the need to improve product tracking, ensure responsible sourcing, and create visibility into complex supply chains.

Improved traceability, enhanced inventory management, and reduced errors are recurring benefits across the companies. Positive impacts on customer perception, increased trust, and commitment to transparent and responsibly sourced products are common outcomes.

Common challenges include implementation costs, technological complexities, and the need for industry-wide compatibility standards. Each company faces specific challenges, such as market education for Circulor, and the need for industry-wide compatibility standards for Walmart.

There is a shared acknowledgment of a cultural shift towards responsibility and transparency, aligning with the demand for sustainable and traceable supply chains.

There is a collective anticipation of increased blockchain adoption in the supply chain industry, expecting revolutionary changes in transparency, security, and efficiency. Forecasts include blockchain becoming more niche specific and expanding beyond supply chain to various sectors.

Success of blockchain is hindered by the industry's varying readiness, requiring collaborative efforts to establish standards, and overcome resistance. Emphasis on the need for innovation, faster adaptation to new technologies, and a modern management style, particularly in startups.

High transparency and traceability are highlighted as crucial characteristics for choosing a supply chain provider. New benchmarks include digital product passports for provenance and carbon footprint, legislation setting standards for transparency and responsibility, and a more agile approach to supply chains.

Overall, the supply chain industry is navigating the challenges of blockchain adoption while recognizing the transformative potential of this technology in enhancing accountability, efficiency, and sustainability across global supply chains.

5.1.5 What to expect for the industry

Recent legislative efforts in both the US, around June 2021, and Europe, particularly with the German Supply Chain Act effective from January 1, 2023, are reshaping the legal framework for blockchain technology in supply chain management. In the US, states like Arizona and Tennessee have recognized blockchain signatures and records, while others are adapting commercial laws to accommodate blockchain. Legal considerations include modifications to contract terms and data privacy compliance, with ongoing developments in smart contract enforceability and antitrust risks (Foley & Lardner LLP, 2021). Meanwhile, in Europe, the German Supply Chain Act mandates transparency and preventive measures against human rights abuses and environmental violations, with blockchain technology offering solutions for enhanced transparency, security, and communication, potentially aiding compliance efforts (Fazzone & McNew 2021).

The future outlook for the blockchain supply chain market indicates significant growth potential, driven by several factors such as increased demand for supply chain transparency, heightened security requirements, and the adoption of blockchain technology across various industries. The market size is expected to grow from USD 0.84 billion in 2024 to USD 6.31 billion by 2029, with a remarkable CAGR of 49.87% during the forecast period (2024-2029) (Mordor Intelligence, 2024b). The Asia Pacific region is projected to be the fastest-growing market, while North America remains the largest market due to its advanced technology adoption and infrastructure. Retail and consumer goods are anticipated to dominate the market, fueled by the need for quality assurance, product safety, and authenticity. The industry is expected to witness technological innovations and increased adoption across sectors, particularly in North America, where major industry players like IBM, Microsoft, Oracle, and AWS are driving market dynamics (Mordor Intelligence, 2024b).

The blockchain supply chain industry faces several challenges amidst its promising growth trajectory. Key obstacles include a lack of awareness and education among businesses regarding blockchain's capabilities, complexity in integrating blockchain with existing supply chain systems, evolving regulatory and legal concerns, scalability and performance limitations of traditional blockchain platforms, interoperability issues between disparate networks, and ongoing security and privacy considerations. Overcoming these challenges will require collaborative efforts from industry stakeholders to educate, innovate, and implement robust solutions that enhance transparency, efficiency, and trust within global supply chains (IMARC Group. 2024).

Overall, the blockchain supply chain market is poised for significant expansion, with advancements in technology and increasing adoption driving future growth.

5.2 Healthcare: Key Findings from the interviews

In the following section, I have summarized the key findings from the conducted interviews of the companies: Hashed Health, Digipharm and Avaneer Health. The main points are summarized in a table according to the following categories: Gender, Age, Position, Company, Years in the Company, Revenue, Industry, Role of blockchain, Year of being founded, Reason for Adopting Blockchain, Benefits, Challenges or drawbacks, Impact on Customers, Impact on Company Culture, Impact on External Parties, Interviewee's Perspective on Industry Impact, Interviewee's Perspective on Blockchain Growth, Biggest Challenges with Stakeholders, Main Challenges in International Business and New Potential Benchmarks for Industry. Afterwards, the key findings are presented in more detail, which correspond to the main research questions mentioned in the Introduction section. The detailed analysis is followed by short performance indicators where public data was available. Note that the interviews were conducted confidentially, thus the main limitation of the findings below is that the information is based on opinions and experience of the interviewees, rather than factual data (see Research Methodology for further details on the interview process). The section is finalized by a generalization analysis for the three interviews, to determine general findings for the healthcare industry.

Table 4: Summary of Key Interview Findings from Healthcare Industry

Category **Company**	**Hashed Health**	**Digipharm**	**Avaneer Health**
Gender	Female	Male	Male
Age	40-45	35-40	50-55
Position	Operations – High position	High position in Management	Business Development – High pos.
Company	Hashed Health (USA)	Digipharm (UK Headquarters)	Avaneer Health (USA)
Years in the Company	1.5 years	6 years	Approx. 3 years
Revenue	<$5 million (Zoom Info, n.d.-a)	< $5 million (Rocket Reach, n.d.)	$10 – 25 million (Cience, n.d.), (Zoom Info, n.d.-b)
Industry	Venture studio for building healthcare related companies	Digital healthcare	Digital healthcare
Role of blockchain	Used in the venture studios as part of different end-applications such as for credentialing.	Enables a platform for interaction and data exchange between multiple stakeholders in healthcare.	Enables a platform for interaction and data exchange between multiple stakeholders in healthcare.
Year of being founded	Founded in 2016	Founded in 2017	Founded in 2020
Reason for Adopting Blockchain	Blockchain was adopted for its practical aspects, as providing infrastructure for tracking, traceability, encryption, and transparency.	The reason for entering the market was the global need for a system that enables healthcare entities to pay for high-cost drugs based on their effectiveness rather than consumption (value-based model)	Leveraged blockchain for decentralized and secure data exchange, addressing privacy concerns and ensuring individual data control. The ultimate goal is to serve only as network administrators.
Benefits	Primary benefits include trust, transparency, tracking, traceability, and real-time access in healthcare.	Benefits include efficiency and transparency, security and confidentiality, and a patient reporting ecosystem.	Reduced claim denials, substantial cost savings, global applicability, enhanced patient experience, heightened data security.

table continues

continued

Table 4: Summary of Key Interview Findings from Healthcare Industry

Category **Company**	**Hashed Health**	**Digipharm**	**Avaneer Health**
Challenges or drawbacks for the company	Drawbacks are not explicitly mentioned. Implied challenges include practical considerations, not all ventures needing blockchain, and potential high costs.	While not explicitly stated, the interviewee implies that blockchain might not be cost-effective, suggesting practical considerations in the decision to adopt blockchain.	Limitation on putting Protected Health Information (PHI) on the blockchain due to privacy risks. A challenge is limited data points, which will diminish with more data.
Impact on Customers	Enhances experience by providing secure and efficient solutions. Also addresses patient challenges in accessing medical information. However, customers prioritize effectiveness and ROI.	Blockchain improves the overall customer experience by providing secure and efficient solutions. Patients benefit from secure and flexible access to information, ensuring security of sensitive data.	Faster and accurate data processing, reduced claim denials, increased data security, and a seamless experience during medical visits for patients.
Impact on Company Culture	Blockchain's infrastructure allows scalability, avoiding continuous rebuilding during business growth. In this sense, it encourages sustainability	Digipharm addresses concerns of sustainability by opting for private permission blockchains, avoiding the energy-intensive mining process of public blockchains.	Implicit alignment with a modern, technology-driven approach, emphasizing efficiency and a reduction in paper usage without explicit focus on a green agenda.
Impact on External Parties	The attractiveness of the ventures within Hashed Health to external parties is not determined by the presence of blockchain. Key factors include understanding ROI, effective utilization, and addressing customer needs for speed and reliability.	Digipharm's impact on external parties involves an innovative approach to value-based healthcare. Investors benefit from transparency, while suppliers and partners engage in transactions based on performance, ensuring transparency.	The challenge of convincing large healthcare entities to adopt a new approach underscores the disruptive nature of their solution in the traditional healthcare data exchange landscape.

table continues

continued

Table 4: Summary of Key Interview Findings from Healthcare Industry

Category **Company**	**Hashed Health**	**Digipharm**	**Avaneer Health**
Interviewee's Perspective on Industry Impact	Blockchain is an infrastructure, thus its impact on the industry will be visible in end-applications rather than solely from the technology.	Opportunities in the industry reflect collaboration and innovation in using blockchain to address healthcare challenges.	Suggests blockchain applications in securing medical records, improving transparency, facilitating anonymized data exchange in clinical trials.
Interviewee's Perspective on Blockchain Growth	The interviewee predicts blockchain's potential will be recognized when robust applications demonstrate their capabilities	The interviewee anticipates increased blockchain utilization. The global nature of healthcare issues and suggest a positive trajectory.	Strong confidence in blockchain and decentralized finance, predicting significant disruptions in various industries, comparable to AI.
Biggest Challenges with Stakeholders	The main challenge in getting stakeholders on board with Hashed Health is their unfamiliarity with blockchain, needing explanations of its healthcare applications.	A major challenge is establishing trust in a risk-averse industry. Innovators within organizations are essential, considering the complexity of multiparty agreements.	Challenges in reaching key decision-makers, overcoming the complexity of blockchain understanding, and leveraging the advantage of being founded by prominent entities.
Main Challenges in International Business	Existing data-handling legislation is seen as sufficient. There is, however, anticipation of future regulations on specific usage points.	Challenges arise when dealing with local companies globally, such as in the Middle East. Different cultural variations to be navigated.	Bureaucratic and regulatory challenges in expanding globally, with potential resistance to an American company's involvement.
New Potential Benchmarks for Industry	Emphasis on collaborative and innovative aspects. Ventures within Hashed Health offer practical use cases of blockchain that could serve as benchmarks showing its benefits.	Digipharm introduces a patient reporting ecosystem, including its cryptocurrency, Digi Health. This could set a benchmark for patient integration into value-based models.	Benchmarks include real-time data exchange, blockchain governance for data integrity, reduction in claim denials, data monetization, global interoperability, and data control.

Source: Own work

5.2.1 Hashed Health

Hashed Health is a venture studio that partners with top founders, enterprises, & VCs to build startups that represent the future of healthcare. Hashed focuses on accelerating innovation and development in the healthcare industry through blockchain and distributed ledger technologies. Founded in 2016 and based in Nashville, Tennessee, Hashed Health works with various stakeholders in healthcare, including providers, payers, and technology companies, to implement blockchain solutions that address industry challenges such as interoperability, data security, and administrative inefficiencies.

5.2.1.1 Interview Findings

The reason for adopting blockchain in some of their studios is due to it being able to address issues in healthcare systems, such as the tedious process of professional credentialing and the need for real-time access to patient information.

The interviewee lists the benefits – *"I would say the five pillars of blockchain are that it's decentralized, it's distributed, encrypted, immutable and there's a tokenization piece. So, while you don't have to use all five of those pieces, those are the pieces that we look to when we're looking at how do we not only sustain the business and utilize the technology for today, but how do we also move it into the future. Blockchain has that flexibility as an infrastructure and a foundational platform to kind of build through. And you can leverage all of those things at different points in time throughout the scaling of the business."*

Blockchain enables secure access to medical information, enhancing patient-physician interactions and participation in clinical trials – *"Most patients don't understand that they have a legal right to their information, they don't know how to get it, and more importantly, they don't know what to do if they even had it. Because what are you going to do, store all your medical information on your telephone? Probably not. So blockchain gives you the ability to have the flexibility of access going to a physician and saying, hey, I need this information. Also for participating in clinical trials, all of those things are available to you, and you can feel secure because of how the data is being managed and maintained."*

The interviewee does not explicitly mention disadvantages of blockchain, however, it's implied that the choice to adopt blockchain is driven by practical considerations, and not all startups or ventures may necessarily need blockchain. The interviewee notes that blockchain's presence in startups doesn't notably affect their financial performance. Success hinges on assessing the ROI and the technology's ability to meet customer needs. Financial performance is contingent on proper labeling, utilization, and whether the technology offers speed and reliability – *"So, I can't say that the usage will impact it a great deal, just like any other new technology. Where is the ROI and how does that actually impact your customer? Is there something in that build process that you're doing quicker or much more reliable that gives your client the ability to say, yeah, this is great, and it does actually address the issue*

that I'm having, and I'm willing to pay you a recurring fee. So, I think it really depends how it is labeled and utilized. That will really impact the actual price point of the end product."

Related to sustainability and culture, the interview states that the five pillars of blockchain—decentralization, distribution, encryption, immutability, and tokenization—guide decision-making to utilize the technology effectively. Blockchain's flexibility as an infrastructure allows businesses to adapt over time, avoiding the need for continuous rebuilding. This supports scalability throughout the business's growth, and sustainability as part of the culture.

Regarding impact on the healthcare industry, the interviewee emphasizes that blockchain is seen as an infrastructure, *"I don't think your customer knows how your clothes are made, the customer is looking if you address their problem in a way that is financially responsible for them to use. So, I think most of the customers never know what the back-end systems are. Only in the sense of our investors, even they most of the time aren't really interested in how the magic works."*. There is also an emphasis on the collaborative and innovative aspects of blockchain in building startups that address healthcare challenges.

Related to the growth of blockchain, the interviewee states that users interact with applications utilizing blockchain as the backend, so it should be considered as an infrastructure, *"We have to really do some due diligence with regard to understanding that the word itself, you're not going to use a blockchain, what you're going to do is go to an application and it's going to have that as its back end. And the adoption will really only come when they see these things such as these applications that are robust."*

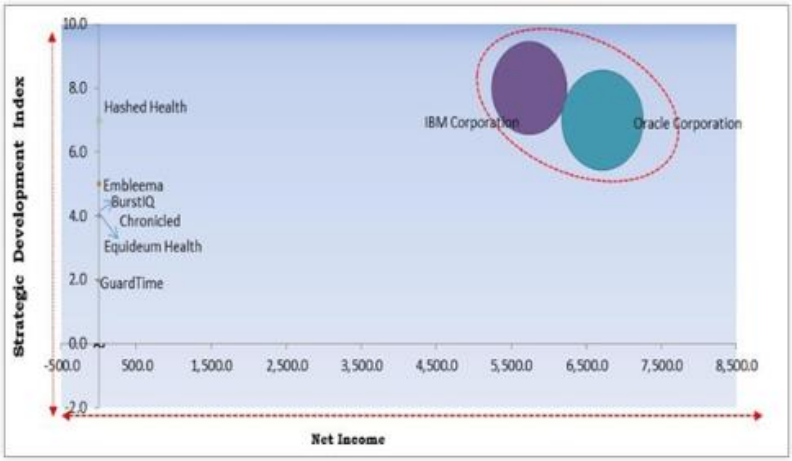
The main challenge in getting stakeholders on board with Hashed Health is their unfamiliarity with blockchain, needing explanations of its healthcare applications. International challenges are not addressed. The interviewee considers existing data-handling legislation adequate and anticipates future regulation to focus on security, encryption methods, and data retention periods.

The interviewee highlights the collaborative and innovative aspects of using blockchain. Ventures within Hashed Health, such as those involving professional credentialing, offer practical use cases of blockchain in healthcare serving as benchmarks showing its benefits.

5.2.1.2 Performance indicators

The current revenue of Hashed Health is less than $5 million (Zoom Info, n.d.-a), the exact number cannot be confirmed as it is not freely accessible. According to the Global Blockchain Technology in Healthcare Market Report 2022 to 2028, Hashed Health is one of the key innovators in blockchain in the healthcare market with the highest Strategic Development Index, despite having a low net income compared to big players such as IBM and Oracle (Research and Markets, 2022). The report's base year is 2021, and the net income is in $ million.

Figure 5: Cardinal Matrix - Blockchain in Healthcare Market Competition Analysis



Source: Research and Markets (2022)

5.2.2 Digipharm

Digipharm, founded in 2017, is a company specializing in healthcare and pharmaceutical industries, aiming to revolutionize them through blockchain technology and smart contracts. By integrating blockchain, Digipharm creates transparent and secure systems for managing healthcare data and transactions, while smart contracts automate processes like payments and supply chain management, reducing intermediaries. Emphasizing value-based healthcare, Digipharm incentivizes positive outcomes over service volume, and may employ its own token for transactions within its ecosystem. Its applications span areas like clinical trials and patient data management, aiming to enhance efficiency, transparency, and patient-centricity in healthcare and pharmaceuticals (Digipharm, n.d.).

5.2.2.1 Interview Findings

The primary reason for entering the market was the need for a system that enables healthcare organizations to pay for high-cost drugs based on their effectiveness rather than consumption – *"Anybody who's buying healthcare or buying drugs or healthcare technologies, we make sure that pay is based on performance. So, when it doesn't work, they pay reduced prices or get paid their reduced price."* Blockchain, specifically through smart contracts, automates and secures this value-based model.

With blockchain, Digipharm allows stakeholders to witness data processing and understand its origin. Security, particularly in sensitive areas like drug pricing, is ensured through blockchain's encryption, preventing unauthorized access. Moreover, Digipharm adopts a *"patient reporting ecosystem where we can reward patients to implement some of these or inform these agreements by answering surveys on how well a treatment works for them. You know, if a patient has a pain drug it's only the patient that tells you, if it works or not."*

When asked about potential disadvantages of adopting blockchain, the interviewee implies that blockchain might not be universally cost-effective. The decision to adopt blockchain is driven by practical considerations, and cost-effectiveness varies based on specific use cases.

Related to the impact on customers, it can be derived that blockchain improves the overall customer experience by providing secure and efficient solutions to longstanding problems in the healthcare industry. Patients benefit from secure and flexible access to information, facilitating activities like sharing medical data with physicians and participating in clinical trials. The management of data ensures security and trust in handling sensitive information.

Digipharm addresses sustainability concerns by opting for private permission blockchain systems like Hashgraph. These systems avoid the energy-intensive mining process associated with public blockchains – *"We don't use a blockchain that requires mining. We use a private permission blockchain system. We initially started in Hyperledger, then we moved to CODA and now we use Hashgraph. So, none of these actually use mining, they just use different consensus mechanisms. So, there isn't high cost in terms of energy, and even the cost of transactions is cheap. So, I think for us it works absolutely fine."*

Digipharm's impact on external parties revolves around its innovative value-based healthcare. Acting as a third party, they automate processes via smart contracts, ensuring transparency. Investors are attracted to the system's transparency, which enhances trust. Suppliers and partners engage in a payment system based on performance, facilitated by blockchain for transparency.

Digipharm's model, including its patient ecosystem and cryptocurrency (Digi Health), sets it apart in the industry. Competitors are beginning to emerge, validating the concept. The global nature of healthcare issues offers plenty of opportunities for growth, reflecting the collaborative and innovative aspects of using blockchain in healthcare solutions.

The interviewee is optimistic about blockchain, suggesting that the industry will witness further adoption. The global nature of healthcare issues, coupled with the growing awareness and implementation of blockchain solutions, suggests a positive trajectory.

The major challenge in getting stakeholders on board is establishing trust in a risk-averse healthcare industry. Healthcare professionals often resist change, making it essential to find innovators within organizations to champion projects. The multiparty agreement structure, involving hospitals, drug companies, and insurance companies, adds complexity.

The interviewee notes challenges internationally, especially with local companies in regions like the Middle East, due to diverse communication preferences and cultural norms. Establishing local entities is vital to address these challenges, alongside adhering to existing regulations like GDPR. Although anticipating more regulations, the interviewee believes they may not significantly impact their operations – *"I think there's existing legislation. I think we just need to stick to GDPR and data privacy, so we have to build ours solution*

around it. We just have to make sure our system doesn't put patient data on the blockchain, make sure our smart contracts are private and can't be seen by other people and things. I think that's what's more important."

Digipharm introduces a patient reporting ecosystem, including its cryptocurrency, Digi Health. This innovative approach could set a benchmark for integrating patient perspectives into value-based models, distinguishing Digipharm from competitors. It also serves to assess the impact on patient engagement, data accuracy, and overall success in value-based models.

5.2.2.2 Performance indicators

The current revenue of Digipharm is < $5 million (Rocket Reach, n.d.), the exact number cannot be confirmed as it is not freely accessible. There are no financial statements available publicly for Digipharm, however they have a token called DigiHealth (DHG) that demonstrated peaks at the end of January 2023, beginning of May 2023 and beginning of November 2023. These movements are all related to the expansion activities taken by the team (see Appendix 5).

Figure 6: DigiHealth Token price overview since inception

Source: CoinGecko crypto exchange (n.d)

5.2.3 Avaneer Health

Avaneer Health is a pioneering digital platform in healthcare, established in 2020 by a consortium of industry leaders including Aetna, Elevance Health, Cleveland Clinic, HCSC, Merative, PNC Financial Services Group, and Sentara Healthcare. This secure network facilitates real-time data connectivity, collaboration, and transparent access within healthcare, simplifying administrative processes. Avaneer Health utilizes blockchain for its decentralized nature and governance protocol, ensuring secure and auditable data exchange.

Its unique model fosters collaboration among stakeholders and technology vendors, driving solutions to streamline administrative tasks and enhance the overall healthcare experience (PR Newswire, 2023).

5.2.3.1 Interview Findings

According to the interviewee, Avaneer aims to facilitate data exchange between public-private payers and providers, with the ultimate goal being solely network administrators.

Benefits include enhanced healthcare data sharing, reduced claim denials and improved accuracy, thereby streamlined processes. The interviewee highlights substantial cost savings, envisioning industry-wide savings in the hundreds of billions of dollars. Avaneer's adaptable technology caters to diverse healthcare systems, offering real-time information access and universal applicability.

Blockchain's limitation in storing Protected Health Information (PHI) due to privacy concerns reflects a cautious adoption – *"You can't put PHI on a blockchain, and the reason why you can't put it on the blockchain is because you can't delete it. So, there's enormous privacy risk. And so, you can't have a blockchain based network. The way we leverage blockchain is, every participant on the network has their own private environment where they store their data. When that data is exchanged, it's via an encrypted API that we have no idea what data they exchange, but as the network administrator we know that they exchange something. And that's how we use blockchain. We record it to the blockchain as a governance protocol. So that at any time in the future if that data needs to be audited or comes under dispute we can point to the respective environments and say this is exactly what you're talking about."* Avaneer has been live for a year, and the main challenge has been limited data points, however, the interviewee anticipates this to fade as more data accumulates.

Patients benefit from improved health insurance coverage processing – *"Let's say, I'll use myself an example, a hospital on the network has permission to receive information about me, then they can get my coverage information directly from my health insurance company. So that information is just automatically pushed now from that time forward, for the very first time. From that point forward, they never have to actively ask about me again with respect to coverage, because any updates, changes or modifications happen as soon as the network learns about it, it's pushed to them and into their systems, whether they need it at that time or not. So, the next time I go to see the doctor, they will have the most current and up to date information. And so that kind of efficiency then is applicable in any healthcare environment.",* leading to reduced delays in accessing services and fewer claim denials. Enhanced data security increase trust in healthcare data exchange, while instant access to health information ensures seamless patient experience.

The interviewee indirectly touches on company culture, emphasizing efficiency and modernization aligning with a technology-driven approach. Regarding sustainability, while

not prioritizing green initiatives, Avaneer's solution reduces paper usage by addressing healthcare inefficiencies, which indirectly implies environmental benefits through modernization.

The interview offers limited insights into the external impact of Avaneer, but he expresses confidence in blockchain revolutionizing healthcare. Convincing large healthcare entities to adopt this approach highlights the disruptive nature of Avaneer's solution.

Regarding industry impact, the interviewee foresees a future where individuals monetize their genetic data, emphasizing the necessity for personal control and compensation. He outlines blockchain's potential, such as securing medical records, enhancing transparency, and enabling anonymized data exchange in clinical trials, for instance *"If you were to get cancer today and you could go to any hospital, all the hospitals, for the most part are going to be on the exact same drug protocol for that cancer, the exception being if it's something rare, or if that drug protocol is ineffective for you as an individual. And the reason why they do that is to track the efficacy of the protocol over time and also to track the damage that drug protocol may do to you over time, like destroy your liver or create another condition. So, all that could be, you know, a blockchain-related application."*

The interviewee is highly optimistic about the growth of blockchain and decentralized finance, stressing the capacity to eliminate intermediaries and enhance data security. He predicts that blockchain's immutability will lead to substantial disruption, with industries like banking and real estate introducing asset tokenization for secure ownership tracking.

The main challenge in engaging stakeholders lies in reaching the key decision-makers – *"The challenge is always getting to talk to the right people. And the right people are the senior executives, the C-Suite. And the reason why that's the challenge is there's only a handful of them. Let's say I want to focus on Ohio, there's maybe 18 hospitals big enough for initial value, so that means you have 18 CFOs or CEOs to talk to. So now they're like 36 people right in the entire state that you need to talk to. And guess what? There are thousands of other people that want to talk to them too."* Being founded by renowned health insurance companies and globally recognized providers has enabled them to launch at scale, covering over 115 million lives, a feat challenging for random startups to achieve.

Expanding globally may pose bureaucratic and regulatory challenges. The interviewee recognizes potential resistance to an American company operating in other countries' healthcare systems, stating the need for strategic planning to navigate cultural differences.

Potential benchmarks include real-time data exchange and innovative blockchain governance protocols. Avaneer's focus on instant information sharing and transparent data management could set standards for data integrity in healthcare. Their commitment to reducing claim denials may establish lower denial rates as a key performance indicator, while their technology's global replicability introduces benchmarks for seamless data exchange.

5.2.3.2 Performance indicators

The current revenue of Avaneer Health is $10 – 25 million (Cience, n.d.; Zoom Info, n.d.-b), the exact number cannot be confirmed as it is not freely accessible, whereas the accessible sites state different numbers – so above is taken the average. The latest news on performance available, is that Avaneer announced on January 13, 2022, that it has secured $50 million in seed funding from prominent organizations (Newswire, 2022). The network aims to address challenges in achieving real data interoperability within the U.S. healthcare system. The network's first participants include major organizations like Aetna, Anthem, Cleveland Clinic, and others, representing a significant coverage of 80 million lives and 14 million annual patient visits. Avaneer Health plans to use the funding to launch its nationwide network, solutions, and marketplace, with a focus on improving data flow efficiency in healthcare (Newswire, 2022). Thus, overall performance is yet to be seen.

5.2.4 Industry conclusions based on interview findings

All three companies adopted blockchain to address specific challenges in the healthcare industry. These challenges include tedious processes like professional credentialing, ensuring real-time access to patient information, and implementing value-based payment models. Blockchain is seen as a solution to expedite services and provide secure platforms for data management. The benefits include trust, transparency, tracking, traceability, and real-time access to information.

While not explicitly mentioned, the implied drawbacks of blockchain include potentially high costs and the practical consideration that not all ventures or startups may necessarily need blockchain.

Blockchain positively impacts customer experience by providing secure and efficient solutions, empowering patients with control over their data, and streamlining processes in medical visits. However, blockchain is considered only as an infrastructure, so its presence does not determine whether customers will choose a particular healthcare provider.

The interviewees indirectly touch on the impact on company culture, emphasizing efficiency, modernization, and a technology-driven approach. Even though not prioritizing green initiatives, blockchain indirectly promotes sustainability by reducing paper usage and streamlining processes.

Blockchain impacts external parties like investors and suppliers by enhancing transparency and trust, attracting investment, and ensuring fairness. Interviewees foresee blockchain revolutionizing healthcare, however, they imply the need for more use cases to showcase industry benefits.

The interviewees are highly optimistic about the growth of blockchain technology, stressing its potential to eliminate intermediaries, enhance data security, and lead to substantial disruption across various industries, including healthcare, banking, and real estate.

Challenges in getting stakeholders on board include unfamiliarity with blockchain, resistance to change, and the need to convince large healthcare entities to adopt new approaches. Expanding globally may pose bureaucratic and regulatory challenges. Main challenges include navigating diverse communication preferences, cultural norms, and global regulatory differences.

Potential benchmarks for the industry include real-time data exchange, innovative blockchain governance protocols, and commitment to reducing claim denials. These benchmarks could set standards for data integrity, transparency, and efficiency in healthcare.

5.2.5 What to expect for the industry

The blockchain in healthcare market is projected to experience significant growth, with an expected increase from USD 3.61 billion in 2024 to USD 29.76 billion by 2029, at a remarkable CAGR of 52.48% during the forecast period of 2024-2029. North America emerges as the fastest growing and largest market for blockchain in healthcare, driven by regulatory implementations, the need to address healthcare fraud, rising costs, and the imperative to secure patient data. Major trends shaping the market include a focus on counterfeit-proofing and data protection, driven by rising incidents of counterfeit medicines and the complexity of pharmaceutical supply chains. Additionally, the market is characterized by key players such as IBM Corporation, Microsoft Corporation, Patientory Inc., Guardtime Federal, and Hashed Health, who are developing innovative solutions. Technological advancements, regulatory frameworks, and strategic partnerships are expected to further fuel market growth, making blockchain a critical component in revolutionizing healthcare systems globally (Mordor Intelligence, 2024a).

The implementation of blockchain in healthcare faces several challenges. Data protection laws, such as the UK GDPR, present complexities regarding the immutability of blockchain entries and the right to erase or correct personal data. Finding solutions that balance blockchain's inherent immutability with data protection requirements is crucial. Additionally, the high implementation costs of blockchain, especially for large-scale projects, pose financial challenges for healthcare organizations (Ryan & Valu, 2023).

Despite challenges, blockchain technology holds significant potential for transforming various aspects of healthcare, including supply chain management, health records, credential verification, and IoT security. Furthermore, emerging technologies like non-fungible tokens (NFTs) present new opportunities for patients to control and monetize their health data, facilitating collaborations with research organizations and clinical trials (Ryan & Valu, 2023).

5.3 Capital Markets: Key Findings from the interviews

In the following section, I have summarized the key findings from the conducted interviews of the companies: Mastercard, Visa, and BBVA. The main points are summarized in a table according to the following categories: Gender, Age, Position, Company, Years in the Company, Revenue (annual), Industry, Role of blockchain, Year of adopting blockchain/ Year of being founded, Reason for Adopting Blockchain, Benefits/ Impact on Customers, Disadvantages/ drawbacks of adopting blockchain, Impact on Company Culture, Impact on External Parties/ Interviewee's Perspective on Industry Impact, Interviewee's Perspective on Blockchain Growth, Biggest Challenges with Stakeholders/ Main Challenges in International Business, New Potential Benchmarks for the Industry. Note that in comparison to the other 2 industries, some categories are merged according to the information received from the interviewees. Afterwards, the key findings are presented in more detail, which correspond to the main research questions mentioned in the Introduction section. The detailed analysis is followed by short performance indicators. Note that the interviews were conducted confidentially, thus the main limitation of the findings below is that the information is based on opinions and experience of the interviewees, rather than factual data (see Research Methodology for further details on the interview process). The section is finalized by a generalization analysis for the three interviews, to determine general findings for the financial industry.

Table 5: Summary of Key Interview Findings from Capital Markets Industry

Category **Company**	**Mastercard**	**Visa**	**BBVA**
Gender	Female	Male	Male
Age	40 - 45	25 - 30	40 - 45
Position	Risk management-high position	Global Crypto Analyst	Blockchain and Digital Assets
Company	MasterCard Incorporated	Visa Incorporated	Banco Bilbao Vizcaya Argentaria
Years in the Company	1.5 years	Almost 2 years	13 years
Revenue (annual)	$25.1 billion	$32.7 billion	$29.38 billion
Industry	Banking	Banking	Banking
Role of blockchain	Crypto cards, development of the Multi-Token Network (MTN) for interoperable payments, customers' crypto risk exposure, CBDC projects.	Crypto cards, tokenization. Visa leads initiatives like USDC settlement capabilities, offers crypto consulting, and combats crypto-related fraud.	Blockchain-based Payments, Crypto Asset Management, Digital Wallets, Blockchain Research and Development, DeFi Integration, Smart Contracts.
Year of adopting blockchain/ Year of being founded	Started investing in blockchain technology since 2015 (Mastercard, n.d.)	Started investing in blockchain technology since 2015/2016 (Bajpai, 2020)	Started testing in the blockchain space around 2017 (according to interviewee)
Reason for Adopting Blockchain	MasterCard entered the blockchain space driven by the increasing demand for mainstream adoption. The move addresses the rising use of exchanges for crypto transactions, aiming to mitigate disintermediation risks.	Visa entered the blockchain space due to perceiving crypto as an existential threat. The primary motivation was to address the potential shift of users towards crypto solutions.	BBVA recognized the potential of blockchain to disrupt traditional banking practices and enable decentralized services. The interviewee anticipated a shift towards a more decentralized financial system.

table continues

continued

Table 5: Summary of Key Interview Findings from Capital Markets Industry

Category **Company**	**Mastercard**	**Visa**	**BBVA**
Benefits/ Impact on Customers	Key benefits include making the blockchain ecosystem safe, secure, and compliant, faster transactions, and the ability to pay with crypto through a Mastercard.	Key benefits include reduced transaction fees (particularly through use of stablecoins), more efficient and cost-effective cross-border transactions and financial inclusion.	Key benefits include operational efficiencies, cost reduction in financial asset exchange, and providing security to consumers that want to invest in this new market.
Disadvantages/ drawbacks of adopting blockchain	Potentially higher cost of blockchain, attributed to its early adoption stage, regulatory challenges, awareness, replacing existing products.	Regulatory challenges, market uncertainty, replacing existing products, potential energy consumption concerns.	The shift from centralized to decentralized operations requires cultural change and IT training, infrastructure development for traditional assets, time and cost.
Impact on Company Culture	MasterCard expresses a commitment to responsible practices, challenging claims about the environmental impact of blockchain and emphasizing ongoing advancements toward energy-efficient alternatives.	Concerns about energy usage are more pronounced outside the crypto community. Awareness is growing within the crypto space, evident in the industry's shift towards more energy-efficient protocols as PoS.	Shift involves a different way of thinking and a cultural change. Sustainability is ingrained in BBVA's strategy, thus proof-of-stake tokens are considered as a greener alternative.
Impact on External Parties / Interviewee's Perspective on Industry Impact	The interviewee outlines their distinctive blockchain strategy with 5 pillars, emphasizing safety, security, and disruption of traditional paradigms. Their goal is widespread blockchain adoption.	Companies, including fintech players and traditional finance institutions, are entering the crypto space, but specific products and visions differ. Visa's blockchain initiatives can drive further innovation, collaboration and competition in the industry.	Anticipation of more banks entering blockchain space with evolving regulations. Banks building capabilities, including custody and trading solutions.

table continues

continued

Table 5: Summary of Key Interview Findings from Capital Markets Industry

Category **Company**	**Mastercard**	**Visa**	**BBVA**
Interviewee's Perspective on Blockchain Growth	The interviewee maintains an optimistic outlook on the growth of blockchain and crypto, highlighting active involvement in conferences and emphasizing a positive trajectory in the industry.	Predicts significant growth in blockchain, particularly in the finance sector, with the expectation that all payments will eventually move to public or private blockchains.	Optimistic about blockchain growth. Sees potential in industries requiring data sharing or quick value exchange between untrusting entities. Sees potential in sectors as supply chains, government, healthcare.
Biggest Challenges with Stakeholders/ Main Challenges in International Business	Challenges in getting stakeholders on board revolve around navigating diverse regulatory landscapes and raising awareness among traditional institutions unfamiliar with cryptocurrencies.	The primary challenge faced by Visa is regulatory uncertainty. Especially in the US, banks, being highly regulated, are hesitant to enter the crypto space due to unclear regulations, posing a significant obstacle for stakeholders and clients.	Regulatory challenges -emphasizing the need for frameworks. Significant variations when dealing with different regulators and strict supervision in the financial industry. Complexity of DeFi and direct crypto for average users, as well as lack of awareness.
New Potential Benchmarks for the Industry	The introduction of a multi-token network highlights a new era, enabling banks to tokenize funds, fostering interoperability, and expanding use cases. Another new benchmark is to encourage banks to embrace innovation and directly offer crypto-related services to customers.	The interviewee emphasizes ongoing development of crypto solutions for payments, cross-border transactions, and increased use of crypto in developing nations with volatile currencies.	Emphasizes the importance of the public sector adopting blockchain for transparency and efficiency. A potential benchmark is the change in mindset from centralized to decentralized processes. Other benchmarks are building capabilities such as custody and crypto solutions.

Source: Own work

5.3.1 Mastercard

Since 2015, Mastercard has been investing in blockchain initiatives to advance digital payments and financial services. Their efforts include the Multi-Token Network (MTN) and Mastercard Crypto Credential, which enhance security and compliance in digital asset transactions. Additionally, Mastercard assists financial institutions in offering white-label cryptocurrency trading and custody services to meet rising demand. Through partnerships and pilot programs, Mastercard explores innovative ways to integrate blockchain and cryptocurrencies into payment systems, catering to evolving consumer needs. Moreover, Mastercard offers crypto cards, allowing users to spend cryptocurrencies at merchants accepting Mastercard payments, facilitating seamless transactions between fiat currencies and digital assets (Mastercard, n.d.).

5.3.1.1 Interview findings

Driven by the growing demand for blockchain, MasterCard entered the blockchain space with the aim to mitigate the risk of future disintermediation. Their blockchain strategy revolves around 5 pillars: customer ease in using crypto, ensure ecosystem safety, interoperability among digital assets, introduce the multi-token network, emphasize the safety of traditional banking. The goal is to provide choices, enable banks to offer crypto and use crypto as a payment method.

The key benefits identified include making the blockchain ecosystem safe, secure, and compliant. The development of products focuses on these principles, whether related to traditional card payments or innovations in the blockchain and crypto space. Further benefits include faster transactions, and the ability to pay for daily needs through a crypto Mastercard.

The interviewee acknowledges that blockchain may be more expensive than other technologies, "*Is blockchain more expensive than other technologies? Probably yes, because it is at an earlier stage of adoption, and it really depends on what is the network that you are trying to build, how many participants, is it permissionless or no, is it public or private, etcetera. So, if you go for a public existing blockchain and you want to implement use cases on top of that, then of course there is no cost of infrastructure, but if you are for example a network of banks and you want to work together and build your proper private blockchain, then it's a little bit more expensive.*"

When asked about blockchain's environmental impact, the interviewee acknowledges historical validity to concerns, particularly related to mining and proof of work protocols, but stresses the evolution towards more energy-efficient alternatives like proof of stake. She expresses optimism about ongoing developments reducing the environmental footprint.

MasterCard's initiatives impact the industry by providing banks with possibilities to expand their services. For instance, the multi-token network facilitates new customer services and

fund tokenization, enabling banks to diversify offerings. Also, application developers can integrate with the network. This initiative has broader implications for capital markets, enabling fractional ownership and increased accessibility. The interviewee expects mainstream acceptance.

The interviewee optimistically shares her perspective on the growth of blockchain and crypto, highlighting their active involvement in the crypto environment. Contrary to the notion of stagnation, the interviewee sees a positive trajectory in the industry. She points out that established entities, including central banks, are actively exploring blockchain-based alternatives for payments, aiming to leverage the benefits while addressing associated risks.

The main challenges in the international landscape revolve around navigating diverse regulatory environments, fostering collaboration with regulators, and raising awareness among traditional institutions. Legislation hurdles differ globally, ranging from absent regulations to outright bans – "*So, we see for example, in countries in Africa, for example in Nigeria, you have a ban from the central bank and despite that you have one of the highest crypto adoption rates in the world and when the central bank started to monitor and asking for banks to prohibit any purchase from crypto exchanges, what happened is that people started transacting peer-to-peer, so there is another offer that emerged which is more difficult to trace and to see for the central bank. So, it's very difficult to ban crypto altogether. And in some other countries you have advanced regulations, for example UAE is probably one of the most advanced countries in terms of crypto regulation. What we see is that there are more and more companies coming to Dubai and Abu Dhabi to experiment. There are the banks that are starting to also explore crypto custody and at the same time it's much safer, because when you regulate, you can also set rules, right? And then you can enforce.*"

The interviewee highlights a new era with the multi-token network. This innovation enables banks to tokenize money in customer accounts, fostering interoperability and expanding the scope of use cases. The concept facilitates complex transactions, including real estate transactions, and multiple parties. A new industry benchmark would be expectations of all banks to be directly offering crypto-related services to customers, increasing choice.

5.3.1.2 Performance indicators

Mastercard exceeded industry expectations in Q4 2023, with earnings per share (EPS) at $3.18 and revenue hitting $6.5 billion (CoinMarketCap, 2024). This strong performance is attributed to increased consumer spending, market expansion, and digital payment growth. The company's focus on digital transformation and strategic initiatives has bolstered its adaptability in the market (CoinMarketCap, 2024). One of the reasons for blockchain initiatives, as confirmed by the interviewee, is the perceived threat to traditional banking systems. The Q4 2022 Financials, state that "While this (rise of digital currencies) presents opportunities, it also poses a potential threat to existing products and services" (Mastercard, 2022, pg.21). Their Q4 2022 Financials indicate growth in the broader category of "Value-

added services," which includes blockchain-related products. As this segment is broad, its growth cannot be only attributed to blockchain.

Figure 7: Components of Net Revenue for 2020, 2021 and 2022

	For the Years Ended December 31,			Increase (Decrease)	
	2022	2021	2020	2022	2021
			($ in millions)		
Payment network	$ 14,358	$ 11,943	$ 9,897	20%	21%
Value-added services and solutions	7,879	6,941	5,404	14%	28%
Net revenue	$ 22,237	$ 18,884	$ 15,301	18%	23%

Source: MasterCard (2022)

5.3.2 Visa

Visa started investing in blockchain initiatives since 2015, and still actively explores blockchain and cryptocurrency initiatives, partnering with exchanges and fintech firms for cryptocurrency payments via Visa cards. It offers APIs for integrating crypto services, explores CBDCs and stablecoins, and conducts blockchain R&D for applications like supply chain management. Additionally, Visa facilitates crypto card development, allowing users to spend cryptocurrencies at Visa-accepting merchants, bridging digital assets and traditional payments (Bajpai, 2020).

5.3.2.1 Interview Findings

The primary reason Visa entered blockchain is due to seeing crypto as an existential threat to its revenue and market share. Visa anticipated the potential shift towards crypto solutions, especially for merchant transactions where the fees are significantly lower than traditional card networks.

The interviewee mentions 3 key benefits: reduced fees, global cross-border payments, and financial inclusion – *"Right now you can see maybe 1% fees being pretty common across all blockchains, but that's again cheaper than Visa. So that's a big threat there. But another big reason for fintech firms, and for all payments players to get involved is cross-border payments. So, our world is more and more global every single day and through products like stable coins, USDC, USDT, people are able to send money to their families everywhere in the world or buy products ever in the world in an instant without having to deal with swift, right, and wiring money across the world. And it's done way cheaper than swift, right? You can move theoretically $100 million for the price of two cents or less on Solana, or maybe 10 bucks on Ethereum, whereas a wire would cost $25, or you have to break that up into multiple wires, depending on your bank. And then other examples which come from like Nigeria or Argentina, is that their currencies by their central banks are, inflating at obscene levels so that people are getting paid in their local currency and then they don't have enough*

money by the end of the week to really pay off what they need to pay off. So, we have, the newly elected Prime Minister of Argentina now accepting Bitcoin for business transactions. The really key part is these developing nations with inflating money. They need a solution other than what their current world provides."

While not explicitly mentioned, some of the drawbacks that Visa can face with the adoption of blockchain in the industry are regulatory challenges, market uncertainty, and compliance concerns.

In response to sustainability, the interviewee acknowledges concerns about energy usage especially among those outside the crypto community. Within the crypto space, there is a growing awareness, evident in the industry's shift toward more energy-efficient protocols, such as proof-of-stake systems. While Visa is described as a green company, he emphasizes their focus on the crypto side and is not aware if Visa has committed to carbon-neutral goals.

Visa's blockchain initiative impacts the industry and external parties in several ways. It intensifies competition among financial players, expands market offerings, and influences regulatory discussions. The entry of major players like Visa, PayPal, and MasterCard into the crypto space signals a shift and may drive further innovation in the industry. By integrating blockchain, Visa's move drives both competition and collaboration in the blockchain ecosystem.

The interviewee predicts significant growth in blockchain – *"I think all the payments will be on public or private blockchains in the future. When it comes to healthcare, I think the data part of that will grow, but there's a lot of compliance issues in healthcare that makes it way trickier. And for supply chain, there are some companies that are pushing a lot of their supply chain on ledgers because it's a very easy way to track everything and it allows for everyone in that specific supply chain to see the data at the same time as others whenever it's published or updated."*

Regarding the main challenges, the interviewee states that regulatory challenges persist globally – *"When trying to talk to others who are not in crypto that want to be in crypto, their biggest concern is regulation. So, we are headquartered in the US and the US has strict unclear regulations. In Dubai, there's an economic free zone, in London there may be an economic free zone upcoming. And that would make it a lot easier to test our products with certain clients. But right now, that's our biggest rejection point and what stops people from really entering into crypto confidentially, especially the banks because banks are highly regulated in the United States."* He predicts 5 to 10 more years before significant regulatory clarity is achieved in the US. He cites examples such as New York's BitLicense as a regulatory framework in place but emphasizes the lack of comprehensive federal regulations.

The interviewee does not explicitly mention new industry benchmarks, but he emphasizes the ongoing development of crypto solutions for payments, cross-border transactions, increases use of crypto particularly in developing nations with volatile currencies.

5.3.2.2 Performance Indicators

Visa reported that customers spent $2.5 billion using its crypto-linked cards in the first quarter of fiscal 2022, accounting for 70% of its crypto volume in the previous fiscal year (Holland, 2022). This indicates growing utility and value in having a Visa card linked to a crypto platform. Visa's CEO emphasized the company's commitment to the crypto space, aiming to provide connectivity, scale, and reliability for crypto offerings to expand. The company's network of crypto wallet partners has grown to over 65, including Coinbase and BlockFi, with nearly 100 million merchants accepting crypto as payment. Despite crypto market volatility, Visa observed continued growth in payment volume, particularly driven by crypto rewards programs. The chart below compares Visa's network with selected competitors for year 2022 (Visa Inc., 2023).

Figure 8: Comparison of Visa with network competitors for 2022

	Visa	American Express	Diners Club / Discover	JCB	Mastercard
Payments Volume ($B)	11,668	1,540	243	312	6,568
Total Volume ($B)[2]	14,108	1,553	258	320	8,177
Total Transactions (B)	260	10	4	6	150
Cards (M)	4,160	133	80	153	2,713

Source: Visa Inc. (2023)

Same as Mastercard, Visa recognizes the potential risk of disintermediation, especially as several jurisdictions are considering the development of central bank digital currencies (CBDCs) for retail payments. If successful, CBDCs and evolving digital currencies could potentially impact Visa's domestic and cross-border payments (Visa Inc., 2023).

5.3.3 BBVA

Entering the blockchain space since 2017, BBVA has taken significant strides to meet the demands of its private banking clientele by integrating digital assets into its banking services. In 2021, BBVA's Swiss subsidiary broadened its offerings beyond traditional assets by introducing trading and custody services for cryptocurrencies like bitcoin and ether, alongside the launch of New Gen, an entirely digital investment account. In 2023 they launched "Blockchain to go," an educational program aimed at providing accessible knowledge about cryptocurrencies and blockchain technology to individuals and businesses. This initiative includes weekly "learning pills" published on their website to demystify concepts like decentralized finance (BBVA, 2023b).

5.3.3.1 Interview Findings

BBVA initiated blockchain testing as an alternative for value exchange in the Internet economy. Recognizing its potential to disrupt traditional banking practices and enable

decentralized services, the bank invested in understanding and building capabilities for blockchain. This involved anticipating a shift towards a more decentralized system, reducing intermediaries.

Regarding blockchain benefits, the interviewee states *"The main benefits could come on onto directions and one direction would be efficiencies - operational efficiencies or reducing costs in the exchange of assets, like bonds or securities. So that could be a new area of efficiency. That could be the new rails. So, you see this new technology for doing the same things as we do now, but in a different way that could be more efficient. And that yet has to be proven. So, we see it with cryptocurrencies that it is proven that it works. And it is much more efficient, it works 24/7/365 unlike in the traditional financial industry. But we still need to build all this infrastructure for the traditional assets to be working on top of it."*

The interviewee highlights two main potential cons of blockchain: infrastructure development and cost. Transitioning traditional assets to blockchain requires significant infrastructure development, which takes time. Adopting blockchain also involves a costly paradigm shift from centralized to decentralized operations. This shift requires investment in cultural change, IT practices, cybersecurity, and training personnel, making the process complex and expensive.

In response to the impact on company culture, the interviewee emphasizes a significant shift in mindset regarding asset and data security from centralized control to decentralized networks. This requires adaptation across the industry, including regulators and service providers. Additionally, sustainability plays a vital role in BBVA's strategy – *"When we started offering Bitcoin to our clients, we were challenged by the reputation and sustainability team, saying that Bitcoin was proof of work and proof of work was energy intensive and that was not very green. So, we needed to justify why the miners now are trying to use sustainable energy to mine and how the industry is trying to be better. So yes, it impacts, and you need to justify, and for us will be easier to offer proof of stake tokens instead of proof of work tokens for example. So, yes, sustainability is in our DNA now."*

Regarding the impact of blockchain initiatives on external parties and the industry, the interviewee highlights a growing trend among banks to enter the blockchain space in response to evolving regulations like the pilot regime in Europe and the MiCA regulation. He notes the emergence of capabilities such as custody and trading solutions as banks adapt to regulatory changes. Furthermore, he anticipates increased participation from banks as regulations progress globally.

The interviewee is optimistic about blockchain's growth, particularly in industries requiring secure data sharing and fast value exchange between untrusted entities like supply chain, healthcare, and government administration. He also stresses the significance of public sector adoption – *"I think it makes a lot of sense also in the administration of the government and the public sector should be the first one to use blockchain because it provides transparency,*

it enables everyone to see what's going on and understand what's going on. So that should be the first use cases in the public sector and if this was the case, adoption in the private sector will be faster because once the public sector starts using it, the private sector will connect to interact with the public sector and in the end they will all embrace it."

The interviewee highlights regulatory uncertainties and the challenge of educating clients on digital assets as major barriers to global blockchain adoption. He mentions varying regulatory landscapes – "*The central banks are on top of the industry from the banks of the countries, and we cannot do things that are not regulated. So, the first one of the countries regulated was Switzerland and this is why we launched the service in Switzerland because there was a clear regulation that allowed us to operate in the space, knowing what we had to do to comply. In Europe for example, we have not been able to operate in the space until now because there was no regulation. Now we have MICA – market in crypto assets, that has just been approved. With that, we could step into the space. For example, in the US, there is no regulation yet, so it's difficult for banks to operate with crypto. And South America, the same, still countries without regulation or even in some countries, like for example, Argentina or Mexico, the central bank doesn't allow banks to step into crypto. If we cannot touch crypto, it's difficult for us to operate with public blockchains, if we want to develop smart contracts and build things, we need to manage crypto. So, yes, regulation matters a lot and it's stopping the financial industry from using more public blockchain technology, in certain regions and in certain countries."* Emphasizing the need for comprehensive regulatory frameworks, he advocates for clearer regulations to facilitate broader blockchain adoption, support scalable applications, and reduce operational costs.

A new benchmark for the industry could be the change in mindset in shifting from centralized to decentralized processes, which impacts not only internally but also involves regulators, central banks, and industry providers. As regulatory frameworks evolve, more banks are entering the blockchain space, building capabilities such as custody and trading solutions, which could be another new benchmark for banks.

5.3.3.2 Performance indicators

BBVA ranks 27th in the 2022 Financial System Benchmark, placing 12th among 155 banks assessed, indicating superior performance compared to industry peers. It ranks third among financial institutions headquartered in Southern Europe and excels in governance and strategy, ranking among the top 10. The interviewee noted that the bank entered the digital assets space as it recognized its potential to disrupt traditional banking practices (World Benchmarking Alliance, n.d.). Thus, it can be expected for more investing into the digital assets space as part of their strategy (BBVA, 2022). One of the latest developments in the crypto market is The Markets in Cryptoassets (MiCA) Regulation, adopted by the EU Parliament in April 2023, which is the world's pioneering legislation governing cryptoassets and stablecoins. Scheduled to take effect between mid-2024 and early 2025, MiCA aims to

protect consumers, investors, and ensure financial stability while fostering innovation in the crypto market. It classifies cryptoassets, mandates transparency, and excludes DeFi and NFTs. MiCA's significance lies in providing regulatory clarity, consumer protection, and fostering innovation (BBVA, 2023a).

5.3.4 Industry conclusions based on interview findings

The main reason banks are entering the blockchain space is due to recognizing blockchain as a threat to traditional banking. They see blockchain as a means to create more secure, efficient, and cost-effective systems for value exchange. The aim is to expand financial services through blockchain. Whether it's enabling banks to offer crypto services, reducing transaction fees for merchants, or enhancing operational efficiencies, there's a shared goal of leveraging blockchain to provide more choices and accessibility in financial services.

Sustainability and energy efficiency are recognized as important considerations within the blockchain space. Interviewees acknowledge concerns about the environmental impact of certain blockchain protocols, such as proof of work, and express optimism about the industry's transition towards more energy-efficient alternatives like proof of stake.

There's a common theme of transitioning from centralized to decentralized operations. This shift requires significant investment in infrastructure development, cultural change, IT practices, cybersecurity, and personnel training. However, it's seen as essential for realizing the benefits of blockchain technology and adapting to the evolving regulatory landscape.

The entry of major players like Mastercard, Visa, and BBVA into the blockchain space is driving both competition and collaboration within the industry. Their initiatives influence market offerings, regulatory discussions, and the overall direction of blockchain innovation.

There is overall optimism about the growth of blockchain technology, particularly in the finance sector. All three interviewees foresee significant growth in blockchain adoption, albeit with different timelines and challenges in various sectors.

Regulatory challenges are a common concern. Each interviewee emphasizes the importance of navigating diverse regulatory environments and fostering collaboration with regulators. Interviewees also emphasize the importance of educating clients, regulators, and stakeholders about the benefits and potential risks. They mention the need for clearer regulations to facilitate broader blockchain adoption, support scalable applications, and reduce operational costs.

A notable trend is the shift in industry standards towards decentralized processes and capabilities. Companies are adapting their operations and investing in new technologies to meet evolving customer demands and regulatory requirements. This shift represents a new benchmark for the industry, signaling a broader transition towards decentralized systems.

5.3.5 What to expect for the industry

The global cryptocurrency banking market size has surged from $4.61 billion in 2023 to an estimated $7.12 billion in 2024, with a projected compound annual growth rate (CAGR) of 54.6%. This growth is driven by increasing demand for fast fund transfers, digital banking services, and government initiatives. Moreover, the market is expected to reach $27.69 billion by 2028, with a CAGR of 40.4%, propelled by blockchain adoption in banking, cryptocurrency usage, and fraud reduction efforts. Major trends include blockchain integration into insurance and asset servicing, strategic mergers and acquisitions, and the rise of digital currencies. Cryptocurrency adoption, reduction in fraud through blockchain, and mergers and acquisitions are key factors driving market growth. Major players include SAP SE, IBM, Accenture PLC, and Amazon Web Services. The North American region leads the market, with Asia-Pacific expected to witness the fastest growth (The Business Research Company, 2024).

Blockchain adoption faces multiple challenges. Interoperability issues hinder integration with existing systems (Deloitte, 2021), scalability challenges arise with expanding networks (Habib et al., 2022), and privacy concerns persist despite security features (Shah et al., 2019). Regulatory uncertainty also inhibits adoption, with undefined criteria hindering widespread use (Shah et al., 2019). Challenges include global coordination, KYC and AML compliance, and legal frameworks for smart contracts (IMF, 2020; Boar & Wehrli, 2021).

In 2023, the United States emerged as a leading enforcer of legal actions against major players in the crypto industry, with regulators like the SEC and CFTC taking significant enforcement actions against companies like Binance and Coinbase (Sigalos & Browne, 2024). However, the absence of a comprehensive regulatory framework tailored for the crypto industry led to a regulation-by-enforcement approach, highlighting the need for clearer guidelines. In Europe, the approval of the Markets in Crypto-Assets regulation (MiCA) aimed to regulate the crypto industry and address fraud and illicit financing, with countries like France and Germany adjusting their regulatory frameworks accordingly. Meanwhile, in Asia, Singapore and Hong Kong finalized rules and registration regimes for stablecoins and digital asset businesses, signaling a growing acceptance of crypto assets despite challenges posed by China's anti-crypto stance. Globally, jurisdictions are enhancing their regulatory frameworks to provide clarity and legitimacy to the crypto market (Sigalos & Browne, 2024).

Challenges such as regulatory uncertainties and security concerns persist, but emerging trends like Central Bank Digital Currencies (CBDCs) and DeFi expansion suggest a future where cryptocurrencies and blockchain technology play a significant role in banking operations. Looking ahead, increased adoption of cryptocurrency by banks, integration of blockchain, and expansion of DeFi use cases are expected to shape the future of digital assets in banking, driving innovation and creating more efficient, secure, and inclusive financial services (Boykov, 2023).

6 RESEARCH RECOMMENDATIONS

In the following section are presented the practical and theoretical implications as well as the research limitations and future research directions. I have also created a figure which presents a novel framework for blockchain implementation, following my main findings.

6.1 Practical implications

The findings from the 1st and 2nd research question highlight the necessity for multinational enterprises (MNEs) across various industries, including supply chain, healthcare, and finance, to strategically invest in infrastructure, personnel training, and regulatory compliance to effectively navigate the adoption of blockchain technology. Companies need to recognize and address industry-specific challenges such as interoperability issues in supply chains, data privacy regulations in healthcare, and regulatory uncertainties in finance. Additionally, the shift towards technology-driven solutions underscores the importance of prioritizing transparency and traceability to meet evolving stakeholder expectations. Moreover, the insights suggest that while blockchain may not have a significant financial impact on individual MNEs in healthcare and supply chains, it poses a substantial threat to traditional banks and financial institutions due to the widespread adoption of digital currencies.

The findings from the 3rd research question suggest that MNEs face several practical challenges when implementing blockchain technology across different industries. These challenges include relatively high implementation costs, regulatory complexities, technological hurdles, interoperability issues, and resistance to change. To address these challenges, MNEs need to allocate sufficient resources and expertise to navigate the complexities of blockchain implementation effectively. Moreover, collaborative efforts between industry stakeholders and regulatory bodies are crucial to overcoming regulatory barriers and fostering broader adoption. Furthermore, the promising growth potential in supply chains, healthcare, and cryptocurrency banking highlights the importance for MNEs to prioritize investment in blockchain technology to capitalize on the demand for transparency, data security, and digital banking services.

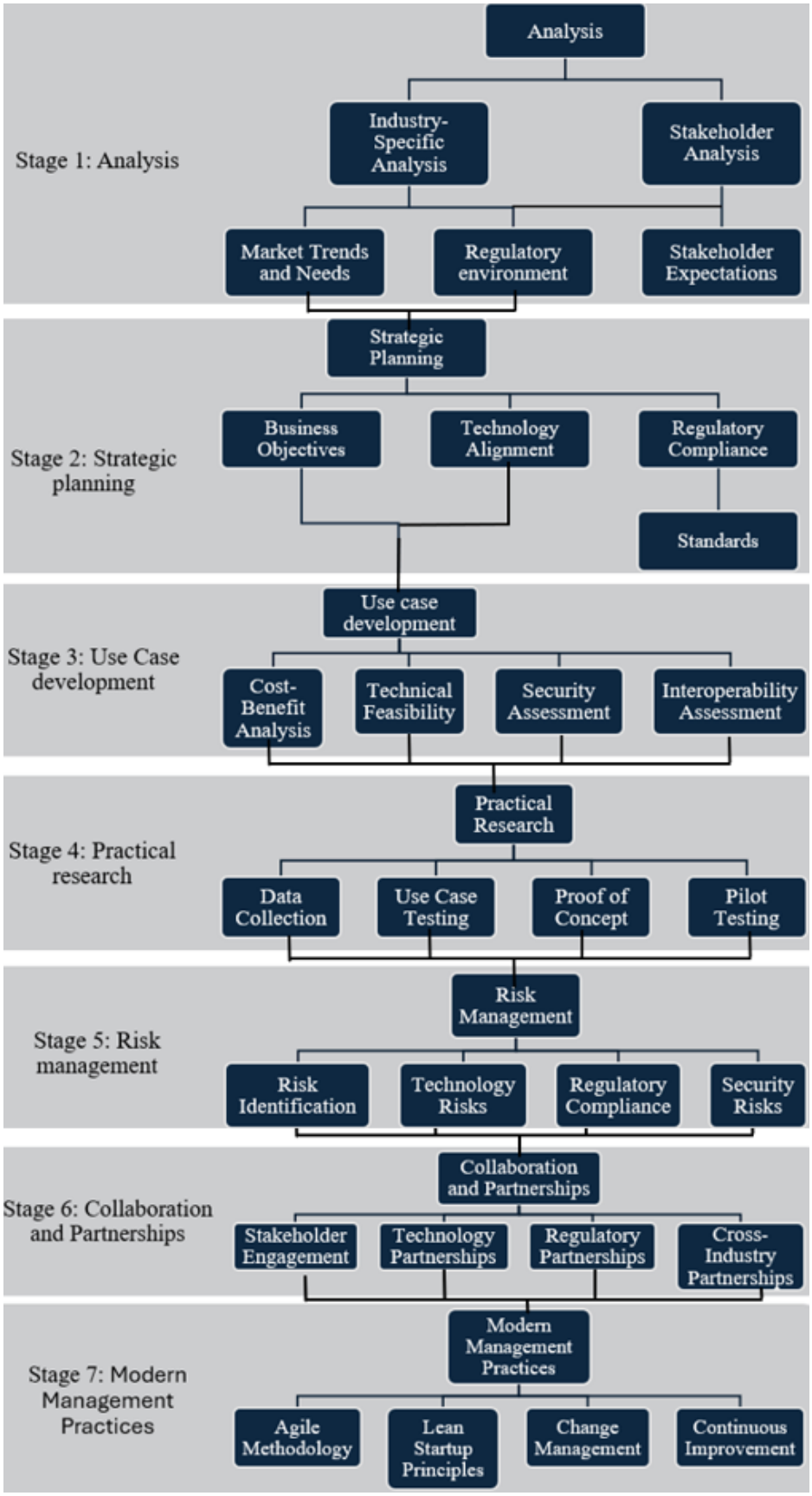
The emergence of new benchmarks and business models in industries where blockchain is prevalent signifies a significant shift in operational paradigms as explored by the 4th research question. Supply chain benchmarks such as digital product passports and agile approaches present practical solutions to enhance transparency and traceability, addressing longstanding challenges in the industry. In healthcare, the focus on real-time data exchange and innovative governance protocols highlights the potential for improved data integrity and efficiency in healthcare systems. Moreover, the adoption of decentralized processes in capital markets, including the use of CBDCs and expansion of DeFi, signals a transformative move towards transparency and efficiency in banking operations. These practical implications underscore

the need for organizations to adapt to evolving industry standards and embrace innovative technologies to remain competitive in the rapidly changing business landscape.

Regarding the 5th research question, which identifies potential industries for blockchain integration, several practical implications arise for managers navigating the evolving landscape of blockchain technology. Firstly, strategic planning becomes paramount as managers must assess feasibility, evaluate implementation costs, address regulatory requirements, and foster an innovative culture to effectively leverage blockchain's potential. Secondly, effective risk management is crucial due to inherent risks such as technological complexities, regulatory uncertainties, and cybersecurity threats associated with blockchain adoption. Prioritizing robust risk management strategies is necessary to ensure successful implementation. Thirdly, collaboration and partnerships are pivotal for driving blockchain adoption across industries. Managers must actively engage with stakeholders, regulatory bodies, and technology partners to establish interoperability standards, address regulatory concerns, and foster innovation. Finally, embracing a modern management style, particularly in startups, is imperative for implementing disruptive solutions, emphasizing agility and efficiency in navigating blockchain adoption complexities.

According to the practical implications from my main findings, I have developed a novel framework for blockchain adoption. The structure chart shown below outlines a comprehensive framework for implementing blockchain technology across industries. The process begins with a thorough analysis phase, where industry-specific factors, market trends, regulatory environments, and stakeholder expectations are evaluated. Next, this analysis informs strategic planning, which involves aligning business objectives with technology capabilities and regulatory compliance requirements. After, use cases are developed to identify practical applications of blockchain within the industry context. This involves assessing the cost-benefit analysis, technical feasibility, security considerations, interoperability requirements, and privacy concerns associated with each use case. Practical research is then conducted to validate these use cases through data collection, testing, proof of concept development, and pilot testing. Risk management is a critical component throughout the implementation process, encompassing the identification and mitigation of technology, regulatory, security, and privacy risks. Collaboration and partnerships play a vital role in driving blockchain adoption, involving engagement with stakeholders, technology partners, regulatory bodies, and industry alliances to establish standards, address concerns, and foster innovation. Modern management practices, such as Agile methodology, Lean Startup principles, Design Thinking, Change Management, and Continuous Improvement, are employed to ensure agility, efficiency, and adaptability in implementing blockchain solutions. By following this structured approach, organizations can effectively navigate the complexities of blockchain implementation and realize its transformative potential in driving sustainable growth and creating value. Note that this framework is to facilitate blockchain adoption, however blockchain should be considered as a tool or infrastructure to conduct customer value, rather than the complete purpose of the product.

Figure 9: Novel framework for blockchain adoption



Source: Own work

6.2 Theoretical implications

Theoretical implications from the 1st and 2nd research question suggest that the adoption of blockchain technology by multinational enterprises (MNEs) reflects a broader cultural shift towards embracing technology-driven solutions across various industries. The findings highlight the importance of considering industry-specific nuances and challenges in the adoption of blockchain, emphasizing the need for a tailored approach to implementation. Furthermore, the research underscores the evolving role of blockchain in reshaping traditional financial institutions, indicating a significant financial impact in capital markets. This highlights the relevance of exploring the theoretical frameworks surrounding blockchain adoption and its implications for individual MNEs and the broader financial ecosystem. Additionally, the research raises questions about the evolving perception of blockchain from being a buzzword to a strategic tool for enhancing operational efficiency and meeting stakeholder demands for transparency and data integrity.

The 3rd research question sheds light on the theoretical underpinnings of blockchain implementation in multinational enterprises (MNEs) and its impact across various industries. The varying implementation rates of blockchain highlight the significance of industry-specific factors in shaping adoption patterns. Moreover, the identification of key challenges such as high implementation costs and regulatory complexities contributes to the theoretical understanding of the barriers to blockchain adoption in MNEs. The role of legislative efforts, such as the German Supply Chain Act, underscores the importance of regulatory frameworks in shaping the legal landscape for blockchain technology. Additionally, the emphasis on collaborative efforts and regulatory advancements suggests that theoretical frameworks need to consider the dynamic interplay between industry stakeholders, regulatory bodies, and technological innovations in facilitating broader blockchain adoption.

Relating to the 4th research question, the emergence of new benchmarks and business models in industries where blockchain is prevalent has theoretical implications for understanding organizational change and technological innovation. Supply chain benchmarks and agile approaches represent manifestations of organizational adaptation to technological disruptions, highlighting the dynamic nature of industry structures and practices. Similarly, the focus on real-time data exchange and governance protocols in healthcare underscores the role of institutional arrangements in shaping information flows and operational efficiencies within complex systems. Furthermore, the shift towards decentralized processes in capital markets reflects broader trends in governance and economic organization, signalling a transition towards more transparent and efficient financial systems. These theoretical implications contribute to our understanding of how technological advancements, such as blockchain, intersect with organizational dynamics and industry evolution.

The exploration of industries ripe for blockchain integration, as posed by the 5th research question, offers theoretical insights into the intersection of technology, organizational

dynamics, and industry evolution. It underscores the importance of strategic planning and risk management in leveraging blockchain's transformative potential across diverse sectors. Moreover, the emphasis on collaboration and partnerships highlights the role of interorganizational relationships in facilitating technology adoption and innovation diffusion. Additionally, the necessity for a modern management style signals an ongoing shift towards technology-driven cultures within organizations, prioritizing agility and efficiency in implementation strategies. These theoretical implications contribute to our understanding of the broader implications of blockchain adoption for organizational theory and practice, elucidating the challenges and opportunities inherent in technological innovation across various industries.

6.3 Research limitations and future research directions

There are several future research directions that can be derived from this thesis. Regional differences in blockchain adoption and regulatory environments pose significant implications for future research. Investigating variations in blockchain implementation strategies and challenges across different regions could provide valuable insights into the contextual factors shaping adoption dynamics. Additionally, comparative studies examining the regulatory frameworks governing blockchain technology in various jurisdictions could shed light on the regulatory barriers and facilitators influencing adoption rates and organizational strategies. Another avenue for future research involves conducting a deeper financial analysis, potentially utilizing non-public data, to establish a time-varying correlation between blockchain adoption and financial performance or macroeconomic events. Exploring the causal relationships between blockchain adoption and firm profitability, market valuation, or response to macroeconomic shocks could provide a more nuanced understanding of the economic implications of blockchain technology. Moreover, given the evolving nature of blockchain technology and its impact on business practices, longitudinal studies tracking the changes in organizational strategies, performance metrics, and market dynamics over time would offer valuable insights into the long-term implications of blockchain adoption. Longitudinal research designs could capture the dynamic interplay between technological advancements, regulatory developments, and industry transformations, providing a more comprehensive understanding of the multifaceted effects of blockchain on international business management.

Despite these limitations, this study contributes to the existing literature by evaluating the impact of blockchain technology on the management of international companies across diverse sectors, offering insights crucial for international business management. Unlike previous research, this study focuses on the managerial perspective of multinational enterprises (MNEs) implementing blockchain, providing a framework for managers to adapt strategies amid growing blockchain adoption. The managerial implications derived from this research are not only applicable to blockchain but also hold relevance for navigating future disruptive technologies.

7 CONCLUSION

In this Master Thesis, I have first presented an overview of blockchain technology and its impact on traditional practices. I have done practical research on 3 industries where blockchain is present, and have discussed the impact on the company, surrounding stakeholders, and international business in each of the industries. I have derived general findings for each industry, and I have identified the trends, challenges, and future outlook of blockchain in each of the industries. Finally, I have assessed the impact of blockchain in each industry based on practical and theoretical research as well as provided managerial implications.

The findings of this research illuminate the dynamic landscape shaped by blockchain's disruptive influence, showcasing its capacity to reshape operations, enhance transparency, and catalyze innovation across industries. Despite formidable obstacles, including high implementation costs, regulatory intricacies, and technological barriers, the remarkable growth potential of blockchain underscores its pivotal role in defining the future trajectory of global business. The emergence of novel benchmarks and innovative business models further accentuates the industry's evolution towards decentralized, efficient, and transparent frameworks. Furthermore, the identification of additional industries poised to benefit from blockchain underscores the technology's remarkable versatility and transformative potential beyond traditional sectors. The managerial implications distilled from this research underscore the imperative of strategic foresight, robust risk management, collaborative partnerships, and adoption of modern management paradigms in navigating the intricate terrain of blockchain integration. In summary, blockchain technology stands as a beacon of promise, poised to revolutionize industries, elevate transparency, and propel innovation to unprecedented heights. However, unlocking its full potential necessitates concerted efforts from industry stakeholders, regulatory bodies, and visionary innovators to surmount challenges, foster collaboration, and harness blockchain's transformative power effectively. By embracing a culture of innovation, fostering collaborative ecosystems, and cultivating adaptability, organizations can position themselves at the vanguard of the blockchain revolution, driving sustainable growth, and generating value in an increasingly interconnected digital landscape.

In conclusion, this Master Thesis enriches the existing literature by offering profound insights into the transformative potential of blockchain technology and its profound implications for international business practices in the digital age. Through meticulous analysis and strategic foresight, this research contributes knowledge by empowering stakeholders to navigate the complexities of blockchain integration and seize the opportunities it presents for organizational growth and advancement.

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APPENDICES

Appendix 1: Povzetek (Summary in Slovene language)

Tehnologija veriženja blokov (blockchain) je postala prelomna sila s transformativnimi posledicami za različne panoge, vključno z upravljanjem dobavne verige, zdravstvom in financami. Namen tega diplomskega dela je oceniti sedanji in prihodnji vpliv veriženja blokov na mednarodna podjetja in širši prostor mednarodnega poslovanja. Glavni cilji vključujejo povzetek finančnega in nefinančnega vpliva veriženja blokov na mednarodna podjetja v različnih sektorjih, določitev potencialnih meril za nove udeležence v panogah, ki jih poganja veriženje blokov, ter napoved prihodnjih posledic veriženja blokov na različne sektorje in mednarodno poslovanje.

Za dosego teh ciljev je zastavljenih več raziskovalnih vprašanj, ki raziskujejo posledice uvedbe veriženja blokov za posamezna multinacionalna podjetja, dojemanje in prilagajanje okoliških deležnikov, stopnje uvedbe in izzive, s katerimi se soočajo multinacionalna podjetja v različnih panogah, potencialna merila uspešnosti in nove poslovne modele ter opredelitev panog, v katerih bi bila uvedba veriženja blokov lahko koristna.

Z intervjuji s predstavniki ključnih industrijskih akterjev v dobavni verigi, zdravstvu in finančnem sektorju so bile ugotovljene skupne teme in trendi pri uvajanju veriženja blokov. Ti vključujejo poudarek na preglednosti, sledljivosti in učinkovitosti ter izzive, kot so stroški izvajanja, tehnološka zapletenost in regulativna negotovost. Kljub izzivom vlada optimizem glede transformativnega potenciala tehnologije veriženja blokov, pri čemer se pričakuje povečano sprejetje in revolucionarne spremembe v vseh panogah. Tržne napovedi kažejo na znaten potencial rasti, ki ga poganja vse večje povpraševanje po preglednosti, varnosti in učinkovitosti v dobavnih verigah, zdravstvenih sistemih in finančnih storitvah.

Disertacija se zaključi s posledicami za menedžerje, pri čemer je poudarjen pomen sodobnega pristopa k upravljanju za uspešno vključevanje tehnologije veriženja blokov v poslovne dejavnosti. Sodobni menedžerji morajo sprejeti inovativnost, sodelovanje in prilagodljivost, da bi učinkovito izkoristili transformativni potencial blockchaina. Da bi zagotovili uspešno sprejetje in integracijo tehnologije veriženja blokov, morajo dati prednost dodeljevanju virov, obvladovanju tveganj in vključevanju deležnikov. Poleg tega morajo menedžerji sodelovati z industrijskimi deležniki, regulativnimi organi in tehnološkimi partnerji, da bi vzpostavili standarde interoperabilnosti, obravnavali regulativna vprašanja in spodbujali inovacije v ekosistemu.

S sprejetjem inovacij, sodelovanja in prilagodljivosti lahko organizacije izkoristijo preobrazbeno moč veriženja blokov in spodbujajo trajnostno rast v prihodnosti mednarodnega poslovanja. Prihodnost tehnologije veriženja blokov je izjemno obetavna za revolucijo v panogah, povečanje preglednosti in spodbujanje inovacij. Vendar bodo za uresničitev njenega polnega potenciala potrebna usklajena prizadevanja zainteresiranih strani v panogi, regulativnih organov in tehnoloških inovatorjev za reševanje izzivov in spodbujanje sodelovanja.

Appendix 2: Total revenue and Net sales of Walmart Inc. from 2013 to 2023 (Sources: Walmart Inc.,2023; Walmart Inc., 2020; Walmart Inc., 2017)

Results of Operations

Consolidated Results of Operations

(Amounts in millions, except unit counts)	Fiscal Years Ended January 31, 2023	2022	2021
Total revenues	$ 611,289	$ 572,754	$ 559,151
Percentage change from comparable period	6.7 %	2.4 %	6.7 %
Net sales	$ 605,881	$ 567,762	$ 555,233

Five-Year Financial Summary

Walmart Inc.

(Amounts in millions, except per share and unit count data)	As of and for the Fiscal Years Ended January 31, 2020	2019	2018	2017	2016
Operating results					
Total revenues	$ 523,964	$ 514,405	$ 500,343	$ 485,873	$ 482,130
Percentage change in total revenues from previous fiscal year	1.9%	2.8%	3.0%	0.8%	(0.7)%
Net sales	$ 519,926	$ 510,329	$ 495,761	$ 481,317	$ 478,614

(Amounts in millions, except per share and unit count data)	As of and for the Fiscal Years Ended January 31, 2017	2016	2015	2014	2013
Operating results					
Total revenues	**$485,873**	$482,130	$485,651	$476,294	$468,651
Percentage change in total revenues from previous fiscal year	**0.8%**	(0.7)%	2.0%	1.6%	5.0%
Net sales	**$481,317**	$478,614	$482,229	$473,076	$465,604

Appendix 3: Net sales of Walmart Canada from 2019 to 2023 (Sources: Walmart Inc.,2023; Walmart Inc., 2021; Walmart Inc., 2020)

(Amounts in millions)	Fiscal Years Ended January 31,		
Walmart International net sales by market	**2023**	**2022**	**2021**
Mexico and Central America	$ 40,496	$ 35,964	$ 32,642
Canada	22,300	21,773	19,991
China	14,711	13,852	11,430
United Kingdom	—	3,811	29,234
Other	23,476	25,559	28,063
Total	$ 100,983	$ 100,959	$ 121,360

Of Walmart International's total net sales, approximately $20.3 billion, $18.5 billion and $16.6 billion related to eCommerce for fiscal 2023, 2022 and 2021, respectively.

(Amounts in millions)	Fiscal Years Ended January 31,	
Walmart International net sales by market	**2021**	**2020**
Mexico and Central America	$ 32,642	$ 33,350
United Kingdom	29,234	29,243
Canada	19,991	18,420
China	11,430	10,671
Other	28,063	28,446
Total	$ 121,360	$ 120,130

Of Walmart International's total net sales, approximately $16.6 billion and $11.8 billion related to eCommerce for fiscal 2021 and fiscal 2020, respectively.

(Amounts in millions)	Fiscal Years Ended January 31,	
Walmart International net sales by market	**2020**	**2019**
Mexico and Central America	$ 33,350	$ 31,790
United Kingdom	29,243	30,547
Canada	18,420	18,613
China	10,671	10,702
Other	28,446	29,172
Total	$ 120,130	$ 120,824

Of International's total net sales, approximately $11.8 billion and $6.7 billion related to eCommerce for fiscal 2020 and fiscal 2019, respectively.

Appendix 4: Revenue of "Managed by Maersk" family 2020, 2021 and 2022 (Sources: A.P. Moller – Maersk, 2021; A.P. Moller – Maersk, 2022)

Logistics & Services highlights — USD million

	2021	2020
Revenue	**9,830**	**6,963**
Direct costs (third party cost)	7,396	5,328
Gross profit	**2,434**	**1,635**
Direct operating expenses	967	704
Selling, General & Administration (SG&A)	560	477
Profit before depreciation, amortisation and impairment losses, etc. (EBITDA)	**907**	**454**
EBITDA margin	9.2%	6.5%
Profit after depreciation and impairment losses, before amortisations (EBITA)	**678**	**289**
EBITA margin	6.9%	4.2%
Profit before financial items (EBIT)	**623**	**264**
EBIT margin	6.3%	3.8%
Invested capital	3,130	1,773
Gross capital expenditure, excl. acquisitions and divestments (CAPEX)	460	153
Operational and financial metrics		
EBIT conversion (EBIT/gross profit - %)	25.6%	16.1%
Revenue from Managed by Maersk	1,578	1,014
Revenue from Fulfilled by Maersk	2,320	1,457
Revenue from Transported by Maersk	5,932	4,492
Supply chain management volumes (kcbm)	98,394	77,023
Intermodal volumes (kFFE)	4,491	3,640
Sea freight volumes (TEU)	133,452	401,369
Air freight volumes (tonne)	173,648	138,086

Logistics & Services highlights — USD million

	2022	2021
Revenue	**14,423**	**9,830**
Direct costs (third party cost)	10,717	7,396
Gross profit	**3,706**	**2,434**
Direct operating expenses	1,482	967
Selling, General & Administration (SG&A) costs	846	560
Profit before depreciation, amortisation and impairment losses, etc. (EBITDA)	**1,378**	**907**
EBITDA margin	9.6%	9.2%
Profit after depreciation and impairment losses, before amortisations (EBITA)	**944**	**678**
EBITA margin	6.5%	6.9%
Profit before financial items (EBIT)	**814**	**623**
EBIT margin	5.6%	6.3%
Invested capital	9,858	3,130
Gross capital expenditure, excl. acquisitions and divestments (CAPEX)	657	460
Operational and financial metrics		
EBIT conversion (EBIT/gross profit - %)	22.0%	25.6%
Managed by Maersk revenue	2,343	1,578
Fulfilled by Maersk revenue	3,898	2,320
Transported by Maersk revenue	8,182	5,932
Supply chain management volumes (kcbm)	110,264	98,394
Intermodal volumes (kFFE)	4,526	4,491
Air freight volumes (tonne)	211,484	163,838[1]

1 2021 Air freight volumes have been restated to exclude pure terminal handling.

Appendix 5: DGH Token Roadmap (Source: Digipharm, n.d)