



Vaasan yliopisto
UNIVERSITY OF VAASA

Nataliya Borodacheva

**Blockchain for Supply Chain Resilience,
Transparency, and Trust: A Multi-Case Study
Analysis**

School of Technology and Innovations
Master's Thesis in Industrial Management
Programme

Vaasa 2025

UNIVERSITY OF VAASA**School of Technology and Innovations**

Author: Nataliya Borodacheva
Title of the Thesis: Blockchain for Supply Chain Resilience, Transparency, and Trust:
A Multi-Case Study Analysis
Degree: Master of Science in Economics and Business Administration
Programme: Industrial Management
Supervisor: Khuram Shahzad
Year: 2025 **Pages:** 74

ABSTRACT:

Due to increasing complexity and vulnerability of supply chains to disruptions, many companies explore the potential of blockchain technology to improve transparency, resilience and trust. This study explores how blockchain supports these goals through qualitative approach with multi-case studies from agri-food, shipping and logistics, retail, and automobile industries – Terra Delyssa, Maersk, Walmart and Volvo. Based on SCRM (Supply Chain Risk Management) Theory and Trust Theory, the research combines secondary data with insights from two expert interviews to provide a comprehensive overview of blockchain value and its adoption challenges. Thematic analysis was used to analyze the data, and guided by four key themes: enhancing traceability and transparency, risk reduction and supply chain resilience, building consumer and stakeholder trust, and challenges in blockchain adoption. The findings illustrate that blockchain can strengthen resilience, enhance transparency, and mitigate risks. However, its successful implementation more likely depends on stakeholder alignment, governance models, digital maturity, and integration with existing systems. In some contexts, the dominance of centralized systems limits blockchain’s transformative potential. From a managerial perspective, the study emphasizes the importance of aligning blockchain efforts with real business needs and stakeholder readiness, investing in digital skills, and ensuring strong data governance. This thesis contributes to the existing literature by providing a cross case-study analysis on blockchain’s role in supply chain management and highlights the key limitations and barriers to its successful and sustainable implementation.

KEYWORDS: Blockchain, trust, transparency, resilience, supply chain management, SCRM, traceability

Contents

1	Introduction	5
1.1	Research Background and Significance	5
1.2	Research Goal and Objectives	6
1.3	Research Questions and Scope	6
1.4	Research Approach and Theoretical Framework	7
1.5	Research Methods	7
1.6	Structure of the Thesis	8
2	Literature Review	10
2.1	Introduction	10
2.2	Theoretical Background	11
2.3	Supply Chain Risk Management (SCRM) Theory	11
2.4	Trust Theory	18
2.5	Constraints and Barriers to Blockchain Adoption	25
2.6	Conceptual Framework	26
3	Methodology	30
3.1	Introduction	30
3.2	Research Design	31
3.3	Data Collection Methods	34
3.4	Data Analysis Methods	36
3.5	Ethical Considerations	37
3.6	Validity and Reliability of the Data	38
3.7	Summary	39
4	Empirical Findings	40
4.1	Introduction	40
4.2	Case Study Overview – Terra Delyssa	41
4.2.1	Thematic Findings	41
4.3	Case Study Overview – Maersk and TradeLens	43
4.3.1	Thematic Findings	44

4.4	Case Study Overview – Walmart and Blockchain Adoption	45
4.4.1	Thematic Findings	46
4.5	Case Study Overview – Volvo and Blockchain for Ethical Sourcing	47
4.5.1	Thematic Findings	47
4.6	Expert Interview Findings	48
4.6.1	Summary of Interview Findings and Cross-Case Comparison	52
5	Discussion of Findings and Conclusion	53
5.1	Introduction	53
5.2	Synthesis of Findings	53
5.3	Cross-Case Comparison and Literature Integration	59
5.4	Theoretical Implications	60
5.5	Practical Implications	63
5.6	Limitations of the Study	63
5.7	Recommendations for the Future Research	64
5.8	Summary	64
	References	68
	Appendices	73
	Appendix 1. Interview Questionnaire	73
	Diagrams	
	Diagram 1. Contribution of the Conceptual Framework	28
	Tables	
	Table 1. Qualitative Research vs. Quantative Research	33
	Table 2. Overview of Expert Interview Participants	34
	Table 3. Interview Findings and Cross-Case Comparison	52

1 Introduction

1.1 Research Background and Significance

The rapid digitalization of global supply chains has transformed how goods, data, and decisions flow across borders and stakeholders. As supply chains become increasingly international, complex, and interdependent, issues related to transparency, risk, and trust have become more pressing. (Zhao, Bal, and Ma, 2021)

The traditional supply chain network is vulnerable and weak due to the many interruptions in the modern world, including pandemics, wars, environmental disasters, and geopolitical conflicts. (Nagariya et al., 2024)

The blockchain is one of the emerging technologies with significant potential to address such challenges as reducing fraud, improving traceability, enhancing resilience, and minimizing losses and risks by applying decentralized, immutable, and transparent data exchange. (Kamath, 2018a; Kshetri, 2018)

On top of that, blockchain technology enables to promote interorganizational trust among various stakeholders among entire supply chain. (Shahzad et al., 2024) There are numerous industries that already applied pilot blockchain technology including food sector, logistics, retail, luxury, pharmaceuticals, and automotive. (Centobelli et al., 2022; Galvez, Mejuto, and Simal-Gandara, 2018)

However, despite global blockchain interest, there is still a lack of practical hands-on experience in complex real-world supply chains. Since technical blockchain adoption is a common challenge, very few researches examine and assess how blockchain affects organizational trust among stakeholders and government institutions particularly with limited digital maturity. (Batwa and Norrman, 2021)

This study aims to research the role of blockchain adoption to enhance transparency, foster resilience, and build trust but also to explore potential limitations and barriers in scalability adoption across industries.

1.2 Research Goal and Objectives

The purpose of this study to evaluate how blockchain technology supports transparency, robustness, and trust in the entire supply chains network across different industries and governance models, and to identify the potential constrains of its successful adoption.

This research based on the following objectives:

- (1) To evaluate the effectiveness of blockchain in improving supply chain transparency and security
- (2) To analyze current gaps in transparency, security, and trust
- (3) To explore technical, financial, and organizational barriers to blockchain adoption
- (4) To assess and explore implementation challenges
- (5) To provide recommendations for successful blockchain integration with a focus on scalability, integration, and sustainability

1.3 Research Questions and Scope

Based on these objectives, this paper addresses the following research questions:

1. How does blockchain technology effect on supply chain transparency and traceability?
2. What are the primary constraints and barriers for blockchain adoption in various industries?

In order to explore blockchain across different sectors, this study, particularly, based on four case studies: Terra Delyssa (agri-food), Maersk (shipping/logistics), Walmart (retail), and Volvo (automotive). The scope of the study includes both secondary data analysis and primary data from expert interviews with consultants from Kept and K3 Business Solutions. One of the key objectives of this research – to highlight challenges and main features of blockchain adoption for practitioners and scholars.

1.4 Research Approach and Theoretical Framework

This study represents a qualitative, descriptive approach based on a multiple case study design and supplemented by two theoretical frameworks:

Supply Chain Risk Management (SCRM) Theory that investigates and analyzes how blockchain affects and mitigates operational and financial risks across entire supply chain network. (Jüttner, Peck, and Christopher, 2003; Wieland and Wallenburg, 2012)

Trust Theory explores how blockchain reduces bias and mistrust in interpersonal relationships among stakeholders and builds trust by applying a technology driven approach. (Batwa and Norrman, 2021; Yavaprabhas, Pournader, and Seuring, 2023)

Both frameworks allow us to study blockchain from an interpersonal trust, transparency, and resilience perspective rather than as a technical tool across supply chain. Also, these frameworks enable to provide holistic analysis by applying both SCRM and Trust Theories to assess blockchain influence on traceability, and relationships between stakeholders. To sum up, both frameworks help to explore how blockchain reshapes behavioral models and patterns in a personal and interorganizational levels across different industries.

1.5 Research Methods

This research is based on four case studies and supported by two expert interviews. Secondary data was collected from multiple resources including company reports, press releases, official websites, and relevant academic articles. When it comes to primary data, was collected by conducting semi-structured interviews with a logistics expert from K3 Business Solutions with hands-on experience in the supply chain at IKEA in the past and a consultant dedicated to tracking and tracing technology from KEPT (formerly KPMG Russia).

Conducted interviews were analyzed thematically in order to evaluate the role of blockchain in traceability, resilience, trust, and challenges related to its adoption. This

approach enabled a separate analysis of each case and allowed for the comparison of insights across the cases.

Further details regarding the method, data collection, and analysis are provided in the Methodology chapter.

1.6 Structure of the Thesis

This thesis is outlined by five main chapters. The chapters follow the structure to explore how blockchain technology effect transparency, trust, and resilience in supply chain management. The next chapter after the introduction is Literature review that examining the theoretical and empirical findings of blockchain technology in supply chain management from existing peer-review articles. It explores transparency, trust, risk management, and adoption challenges, and outlines the theoretical frameworks as Supply Chain Risk Management (SCRM) Theory and Trust Theory that underpin the study.

The next one is Methodology chapter that describes the research methodology, explains the reason of applying a qualitative, multiple case study approach. It describes the data collection methods, including secondary data analysis and semi-structured interviews, and thematic analysis approach to interpret the outcomes and findings.

Findings chapter follows after methodology part and presents the empirical findings from the four case studies such as Terra Delyssa, Maersk, Walmart, and Volvo as well as insights from two expert interviews. The findings are presented in thematical order, focusing on blockchain's impact on transparency, risk mitigation, trust-building, and adoption constrains.

The final chapter, Discussion of Findings and Conclusion, brings together and discusses the key insights from the research. It answers the main research questions by analyzing insights and findings through theoretical framework lenses. Also, this chapter compares the primary and secondary data results with existing literature identifying similarities and discrepancies with its broader implications. This chapter summarizing the study's

contributions from theory and practice perspective reflecting on its challenges, and offering guidelines and recommendations for practitioners and future research.

2 Literature review

2.1 Introduction

Blockchain technology is one of the emerging transformative forces in supply chain management enhancing security, resilience, transparency, and trust. This literature review examines how blockchain mitigates risks through Supply Chain Risk Management (SCRM) and fosters trust among stakeholders by applying Trust Theory.

Traceability, security, and transparency are crucial requirements for global supply chain network. Blockchain technology enhances traceability and transparency in supply chains by providing all participants with equal access to verified information, reducing communication gaps, and minimizing data errors, and loss. (Kalpana et al., 2023)

Academic research and hands-on industry expertise evaluate blockchain as a key solution for addressing transparency, security, and traceability challenges in supply chain management. (Budler et al., 2024)

On top of that, blockchain technology plays a crucial role enhancing data security and authenticity, minimizing supply chain risks and losses. Additionally, blockchain improves supply chain visibility and transparency, reducing supply chain risks. Also, blockchain allows to minimize costs by preventing data tampering improving overall supply chain risk management. (Hong & Hales, 2024)

Numerous studies highlight that blockchain fosters trust, collaboration, and traceability across supply chains by enabling stakeholders to share information, ensuring product provenance, reducing costs, and improving overall efficiency. (Kalpana et al., 2023; Liu et al., 2024; Montecchi et al., 2019).

Another research states that blockchain adoption empowers focal companies to manage and guide their supply chain partners more effectively (Liu et al., 2024).

And finally, blockchain strengthens trust and collaboration within supply chains by enhancing transparency, security, and decentralization (Centobelli et al., 2022).

Researchers argue that blockchain creates a single, reliable, and transparent source of data completely reshaping how information, knowledge, and resources are shared, thereby fostering greater trust (Batwa & Norrman, 2021; Brookbanks & Parry, 2022a; Montecchi et al., 2019).

Furthermore, blockchain's immutable ledger securely records every transaction, ensuring transparency, reducing fraud, and strengthening trust between consumers and businesses (Hao et al., 2024).

2.2 Theoretical Background

The application of blockchain technology in supply chain management (SCM) is supported by several theoretical perspectives that explain its effectiveness in reducing risks, enhancing transparency, and building trust among stakeholders. This section outlines two theoretical frameworks: Supply Chain Risk Management (SCRM) Theory, which explores blockchain's role in risk mitigation and resilience, and Trust Theory which evaluates how blockchain promotes trust among supply chain stakeholders. Applying both theories, helps to understand better the transformative potential of blockchain in SCM.

2.3 Supply Chain Risk Management (SCRM) Theory

Overview of SCRM Theory

Supply Chain Risk Management (SCRM) is a structured and systematic approach that helps organizations identify vulnerabilities and mitigate supply chain risks effectively. It involves proactive actions towards supporting supply chain robustness and enhancing its agility by assessing potential disruptions, evaluating their impact, and implementing strategic risk mitigation. (Jüttner et al., 2003; Wieland and Wallenburg, 2012)

Readiness and ability of taking risks is a crucial feature of effective supply chain management. (Jüttner et al., 2003)

Studies agree that one of the key factors for successful implementation of a Supply Chain Risk Management (SCRM) is a strong commitment among all stakeholders. (Kwon and Suh 2005) Hence that supply chain risks arise from various sources, including operational failures, cyber threats, demand fluctuations, and supplier disruptions. (Nagariya et al., 2024)

With the ongoing globalization and the rise of online consumption, supply chains are evolving from local to global networks, destroying traditional borders. However, increasing numbers of enterprises involved in the supply chain makes it vulnerable and fragile. (Wang and Bai, 2023) In this respect every day companies struggle with operational and supply chain challenges across the globe. (Al-Swidi et al., 2024)

In order to effectively respond to disruptions companies must proactively identify supply chain risks and establish strategic plans in advance. Proactive and reactive strategies, including flexibility, visibility, and agility, help mitigate risks and enhance supply chain performance. (Nagariya et al., 2024)

In today's unpredictable and turbulent environment resilience has become extremely crucial for supply chain management. (Liu et al., 2024).

In general, resilience has a broad concept that spans multiple disciplines and dimensions. One of supply chain resilience definitions is the ability of a supply chain to adapt, foresee, and respond to disruptions, enabling promptly and sufficiently recovery and making supply chain more robust than before the disruption. (Liu et al., 2024)

Several authors argue the importance of fostering supply chain resilience (SCR), which refers to a supply chain's ability to anticipate, adapt to, and recover quickly from unexpected disruptions such as environmental disasters, global events, or epidemics. A growing body of research claims that strengthening SCR is crucial for companies to respond

to unforeseen challenges and maintain operational issues effectively. (Al-Swidi et al., 2024; Liu et al., 2024; Shahzad et al., 2024)

To sum up, supply chain resilience (SCR) technologies help improve overall performance by reducing risks, offering transparency data, and allowing firms to adapt and optimize their processes more effectively. Blockchain contributes to this resilience by providing transparent, real-time data across the supply chain, making visible its execution through smart contracts, and ensuring the integrity and security of shared information.

Studies confirm that during the COVID-19 pandemic, supply chains with adopted blockchain adapted faster by tracking inventory and managing supplier disruptions in real-time. (Nagariya et al., 2024)

Research on supply chain resilience often focuses on how risks effect on operations and how to manage these risks. These studies highlight the importance of improving communication, collaboration, trust by adopting blockchain technology to reduce vulnerabilities across the supply chain. (Shahzad et al., 2024)

Another research article mentions that due to increasing risks in supply chains leadership such strategy as Transformational Supply Chain Leadership (TSCL) might be applied. It plays a crucial role in ensuring resilience and adaptability in turbulent environments. Recognized it as an effective strategy, TSCL plays a crucial role in enhancing supply chain resilience and supporting its scalability. TSCL helps to inspire and guide supply chain members to achieve better performance by adding flexibility in uncertain market environments. (Liu et al., 2024)

Furthermore, marketing strategy plays a significant role in enhancing supply chain resilience (SCR) by influencing customer demand, revenue management, and market adaptability. Particularly, in order to enhance supply chain risk management benefits risk identification and mitigation must be integrated at all organizational levels. This requires top management support, staff trainings to risk management team and fostering a risk-aware organizational culture. As a result, by building resilience to anticipate and manage

potential disruptions, supply chains can achieve better operational performance and have more predictable financial outcomes, regardless of economic conditions. (Nagariya et al., 2024)

Integrating suppliers can significantly enhance supply chain resilience by improving the ability to handle uncertainties and respond swiftly to disruptions. Building long-term partnerships with innovative and reliable suppliers is particularly priceless. Strong collaborative relationships allow the focal company to adapt more effectively and recover more quickly if disruptions occur. (Wang and Bai, 2023)

Blockchain's Role in SCRM

Blockchain technology enables companies to handle information and data securely and transparently, improving overall supply chain resilience. To do so, firms are able to predict unforeseen disruptions and restore supply chain process faster. Previous researchers have found that blockchain technology significantly improving supply chain resilience by mitigating risk management, transparency, data sharing, collaboration, tracking and tracing, and internal integration. (Al-Swidi et al., 2024)

Studies show that improving visibility and transparency through blockchain can help prevent unethical actions and ensure that environmentally responsible actions are properly recorded and verified. By fostering trust, promoting data integrity, and enhancing operational efficiency, blockchain supports the development of more resilient and sustainable supply chains. This, in turn, helps reduce environmental impact and contributes to broader sustainability goals. Companies that focus on green supply chain resilience through blockchain innovation can achieve a competitive advantage by meeting market demands, attracting to environmentally conscious consumers, and establishing themselves as leaders in sustainability. (Chelh and Ababou, 2023)

For example, Maersk Line, as one of the leaders of the shipping industry has adopted blockchain technology to improve logistics security, efficiency, and sustainability through its TradeLens platform, which was developed in collaboration with IBM. This innovation

has significantly improved risk management, green logistics, and supply chain transparency in international shipping. Blockchain technology allows track and share shipment risk data in a verifiable and secure manner, which helps to reduce paperwork, human errors and lower carbon emissions. Additionally, green logistics practices for saving energy, preventing damage, and managing waste can be supplemented with blockchain technology. For instance, GPS sensors installed on container ships can detect if vessels are approaching hazardous zones. In this case, blockchain can immediately alert stakeholders allowing ships to reroute and avoid potential risks.

Moreover, the use of blockchain promotes immutable audit trails for shipment risk records and secure documentation for all stakeholders, including Maersk and insurance providers. Such transparency makes claims processing and payment easier and also reduces energy consumption and environmental impact. (Wong et al., 2023)

In order to increase blockchain's long-term benefits in supply chain risk management companies should focus on integrating and investing in emerging technologies. This can be achieved by applying blockchain and integrating these technologies into operations. Technology infrastructure is essential for staying competitive. By doing so, firms can enhance readiness, improve response capabilities, and accelerate recovery from disruptions. However, blockchain has a great potential for strengthening supply chain resilience (SCR), improper implementation can lead to potential risks and reduce investment effectiveness. (Liu et al., 2024)

Despite the fact that many studies highlight the benefits of adopting blockchain technology, some of them declare its potential drawbacks. Although, some studies argue that despite its advantages, adopting blockchain technology can create new risks and potentially hinder supply chain resilience. In other words, blockchain technology may not always be beneficial for enhancing supply chain resilience (SCR), particularly in cases where collaboration efficiency within the supply chain is lacking. (Liu et al., 2024)

One of the primary risks facing supply chains is the increasing prevalence of cyber-attacks, which lead to operational disruptions, financial losses, decreasing productivity,

and losing trust among partners. To address these challenges, future research should explore blockchain solutions, focusing on its immutability, auditability, and redundancy to strengthen supply chain resilience against cyber threats. (National School of Business and Management, Sidi Mohamed Ben Abdellah University, Fez, Morocco, El Ouarrak, and Hmioui, 2024)

Additionally, researchers propose that blockchain technology can help overcome various supply chain management challenges, particularly by enabling upstream enterprises to gain better access to market demand information. Some research indicates that businesses can strengthen supply chain resilience by adopting blockchain technology, while policymakers can facilitate this process by providing government subsidies. Studies explore how financial support impacts supply chain disruptions for suppliers and manufacturers. Findings show that innovation subsidies in technology contribute significantly to social prosperity. Lastly, government subsidies for manufacturers' wholesale prices can play a crucial role in stabilizing local supply chains and reducing disruptions. However, while blockchain technology and government subsidies can improve supply chain resilience, they do not completely eliminate disruption risks. (Wang and Bai, 2023)

When it comes to real-world cases studies, IBM Food Trust demonstrates blockchain's transformative impact on food safety and supply chain transparency. By leveraging decentralized and immutable record-keeping, it enables end-to-end traceability from farm to fork, ensuring greater trust, efficiency, and accountability among all stakeholders. According to Scott Gottlieb, FDA Commissioner:

"IBM Food Trust achieves new levels of trust and transparency, making food safer and smarter from farm to fork."

This highlights how blockchain enhances food safety by reducing contamination risks, improving recall efficiency, and fostering consumer confidence through real-time data access. (IBM, 2023)

Another example is a blockchain-based Intelligent Automated Transportation System (IATS), integrated with the Light Gradient Boosting Machine (LightGBM) algorithm. This system demonstrates how blockchain can enhance supply chain operations by improving security, efficiency, and decision-making. It helps optimize how vehicles and cargo are traced, reducing delays and increasing accuracy in logistics processes. By combining blockchain with machine learning, the system strengthens transparency, boosts operational reliability, and improves overall supply chain performance. (Zhou et al., 2022)

In food supply chains, blockchain has been proven as effective tool to reduce traceability time, lower operational costs, and strength trust among stakeholders. Its decentralized and tamper-proof structure ensures accurate record-keeping, removes the need for intermediaries, and supports smoother collaboration across the supply chain. As a result, businesses are better handle risks, promote sustainability, enhance resilience, and encourage ethical practices. (Rakhra et al., 2024)

The blockchain integration in Indonesia's pharmaceutical supply chain demonstrates transparency, security, and accountability. With blockchain technology, companies can securely track and verify drug shipments, ensuring product authenticity and compliance with safety regulations. This significantly reduces the risk of counterfeiting, enhances inventory management, and strengthens quality control through real-time monitoring and tamper-proof records. In addition, smart contracts streamline distribution processes by automating transactions and compliance verification. As a result, blockchain adoption in the pharmaceutical sector not only enhances operational efficiency and regulatory compliance but also fosters trust among manufacturers, distributors, healthcare providers, and patients. (Abidin, Alamsyah, and Irawan, 2024)

2.4 Trust Theory

Overview of Trust Theory

Trust plays a crucial role in supply chain relationships, significantly impacting collaboration, decision-making, and overall operational performance. Many researchers state that the main reason of destroying supply chain relationship is lack of trust between stakeholders.

Trust is an interdisciplinary concept, influences various dimensions of both interpersonal and economic interactions across different industries. There are multiple perspectives on trust, including interpersonal trust, interorganizational trust, and digital trust, each of which shapes how companies collaborate and exchange information within the supply chain. (Brookbanks & Parry, 2022)

Several research articles highlight that interorganizational trust plays a crucial role in reducing transaction costs and strengthening long-term relationship commitment. Such negative factors as incomplete contracts, mistrust, asymmetric information sharing, conflicting objectives, and unforeseen market disruptions are often led to higher costs and weak relationships between stakeholders. In other words, a high level of interorganizational trust helps to reduce transactional costs improving negotiations and cooperation between partners. In contrast, the low level of trust increases inefficiency, complexity leading to higher costs and uncompetitive performance on the market. Additionally, trustful environment provides less time for conflict resolution, adapting to changes, transparency improving overall business partnership. (Shahzad et al., 2018)

Digital trust is another form than traditional form of trust due to digital foundation of transactions between stakeholders. Some of the recent research propose digital trust as a human-technology perspective suggesting that technology adoption helps to improve trust between collaborating companies. Therefore, digital trust in business environment enforces not only partnership collaboration but technology process by secure, responsible and reliable behavior. (Shahzad and Hafeez, 2022)

Trust in supply chains has been studied through multiple lenses, including psychology, sociology, and management. However, trust is widely recognized as a complex, multidimensional, and often unknown concept which is difficult to define universally. Some scholars describe trust as “a willingness to be vulnerable” or “the willingness to rely on an exchange partner in whom one has confidence,” particularly in situations involving risk and interdependence. (Batwa and Norrman, 2021; Yavaprabhas et al., 2023)

Other literature sources describe trust as the willingness to rely on business partner in whom one has confidence. In other words, trust is defined as customer’s belief in a company’s reliability, competence, and commitment to fulfilling expectations and delivering consistent, positive outcomes. (Hao et al., 2024).

Actually, trust involves two parties: the trustor, who accepts a degree of vulnerability due to risk and interdependence, and the trustee, who is expected to act in a way that meets the trustor’s expectations.(Yavaprabhas et al., 2023) As it was mentioned earlier, trust plays a key role in business cooperation and fosters strong relationships. Many corporations evaluate trust as a crucial driver of their success due to transparency and collaboration among stakeholders. In fact, CEOs and senior executives of large corporations often consider trust as a crucial factor for successful supply chain operations and overall performance. (Yavaprabhas et al., 2023)

However, on the other side, despite trust benefits, consumers often find it challenging to understand how trust adds value within the supply chain because they often lack access to supply chain data. This makes it difficult to verify whether brands truly adhere to ethical sourcing practices and quality standards. Blockchain helps bridge this gap by offering real-time, transparent verification of product origins, empowering consumers to make more informed and confident purchasing decisions.(Montecchi, Plangger, and Etter, 2019)

Basically, trust in supply chains is based on to transparency, traceability, and visibility. To achieve this, companies invest and develop modern technologies such as AI, IoT, and blockchain to enhance trust and regulatory compliance. (Xu et al., 2021)

As supply chains become more digitized, traditional trust tools have to provide more security and accountability. In this respect, the digital trust started to play an essential role in managing risks, protecting data, and enabling secure interactions between stakeholders. Digital trust and cybersecurity are crucial for managing technology security and data risks, driving innovation, and protecting organizational assets. Trust in data governance, digital identity, and cybersecurity frameworks enhances performance, customer relationships, and business resilience. As organizations adopt emerging technologies like cloud computing, AI, and blockchain, the need for digital-trust technologies grows. However, there are challenges in blockchain adoption such as integration issues, skill shortage, and organizational barriers. In order to fully integrate digital trust, companies should significantly focus their efforts on leadership skills, management tools, and technology investments. As according to several research, many companies struggle with implementing digital trust due to old infrastructure, fragmented security protocols, and a shortage of skilled professionals in cybersecurity. To overcome these challenges, companies need strong support from executive management. This includes a clear top-down commitment to digital trust, the implementation of standardized governance policies, and targeted investments in the technologies and skills required to build secure and trustworthy digital systems. (McKinsey & Company, 2024)

Blockchain's Role in Trust Theory

As it was mentioned above, trust plays a crucial role in supply chain relationships between stakeholders. The following section explores how blockchain technology impact on trust across entire supply chain network.

In today's globalized supply chain, traceability and transparency are essential requirements. Blockchain technology enhances these aspects by providing all participants in the supply chain access to the same information. This reduces communication gaps and minimizes data loss. (Kalpana et al., 2023)

Several studies propose that blockchain increases trust, transparency, and traceability across the supply chain by sharing information among stakeholders. This improves not only confidence in product origin for customers but also reduces costs, and enhances overall traceability. (Kalpana et al., 2023; Montecchi et al., 2019)

Trust is as a key element of blockchain technology. Blockchain consists of series of interconnected blocks, which allows transaction history to be easily traced through previous blocks fosters security and decentralization in order to strengthen trust and collaboration within supply chains. (Centobelli et al., 2022)

This immutable blockchain structure called as "trusted technology" or "consensus mechanism". (Dutta et al., 2020)

Consensus mechanism is built on smart contracts, which requires agreement from all network participants before a transaction is executed. Smart contracts help organizations, known as trustors, prevent unfair partners' trading behavior in supply chain. As a result, the use of blockchain platforms is expected to strengthen the perceived trustworthiness of trustee parties in business transactions. Overall, blockchain and smart contracts provide effective solutions to challenges related to counterfeiting, data security, and trust. By implementing blockchain and smart contracts, transactions between supply chain parties become faster and more efficient. (Centobelli et al., 2022)

With their robust processing and monitoring capabilities, blockchain platforms are expected to gain greater trust from users compared to traditional supply chain systems that operate without smart contracts. (Yavaprabhas et al., 2023)

Blockchain technology fosters "digital trust" and defenses from unethical behavior among supply chain partners. Each transaction is recorded and builds upon previous ones, making any misconduct immediately visible to the entire network. Only authorized parties have access to these records, which cannot be changed, tampered, hacked, or manipulated without notifying other users (Batwa and Norrman, 2021; Kalpana et al., 2023; Yavaprabhas et al., 2023).

Numerous studies have highlighted a strong relation between trust and blockchain technology. Many researches have introduced the concept of digital trust, which reshape traditional trust in business relationships. Traditional trust, which requires years to develop, can be destroyed in moments, and is challenging to be rebuild. In contrast, digital trust is created immediately and can be lost also very quickly, but it is always ready to adapt to new technology environments. (Batwa and Norrman, 2021)

Blockchain technology makes transactions faster and more transparent by processing data in real time. Unlike traditional systems, it allows every stakeholder to see up-to-date information about a product at each stage of the supply chain. This enhances transparency both in the data and the movement of goods, building trust across the entire supply network.(Kalpana et al., 2023) So, blockchain technology significantly reduces fraud in the supply chain and enhances trust and transparency within the system. (Yavaprabhas et al., 2023)

Fraud and counterfeiting are the major challenges across many industries, particularly in markets dealing with high-value goods like diamonds, luxury products, pharmaceuticals, and fine art.

One of the examples how actually blockchain helps to prevent fraud and counterfeiting is Everledger company. It successfully prevents diamonds fraud and counterfeiting. Everledger records each diamond's origin and characteristics on a blockchain, ensuring immutability, traceability, and transparency throughout the supply chain.

Another example is Louis Vuitton. It is producer of luxury goods and one of the most counterfeited in the world. Due to high value of the goods, desired fashion styles and outstanding materials, counterfeiters have developed advanced techniques to replicate the brand. To overcome this challenge, LVMH, Louis Vuitton's parent company, took a significant step forward in the fight against counterfeiting. In May 2019, LVMH collaborated with Microsoft and the software company ConsenSys to introduce a blockchain-based platform designed to authenticate luxury goods. (Thanasi-Boçe, AL-Issa, and Ali, 2022)

Again, according to many research articles, blockchain technology is declared to design reliable, and transparent source of information fostering trust between stakeholders. (Batwa & Norrman, 2021; Brookbanks & Parry, 2022; Montecchi et al., 2019).

However, opinions among different scholars and experts differ on how blockchain influences trust. Some of them state that trust is the primary driver of blockchain adoption, while others highlight the opposite and declare numerous challenges and potential negative effects. Despite the benefits of applying blockchain technology to increase trust, there might be barriers and risks related to information sharing and can negatively impact trust among supply chain partners. This particularly makes sense when handling sensitive or confidential data. While blockchain creates a secure and verifiable ledger, it also affects data privacy and control. Organizations may hesitate to share sensitive data creating barriers to trust among supply chain partners (Batwa and Norrman, 2021)

As it was already mentioned, blockchain is still new and evolving technology. Rather than replacing existing systems, it should be used supplementary to the current existing systems to add greater transparency, security, and data integrity.

In contrast, some researchers propose that blockchain implementation enhances information authenticity and transparency within the supply chain, potentially increasing competition among external stakeholders. This happens due to blockchain ability to facilitate information sharing across all supply chain members while mitigating the risks of fraud or counterfeit. (Yavaprabhas et al., 2023)

From the one hand, some studies suggest that blockchain technology is unable to replace emotional or interpersonal trust among supply chain members. They highlight that despite blockchain adoption, in order to build long-term, trusting relationships among supply chain actors the human factor, collaboration and cooperation are still essential. (Yavaprabhas et al., 2023). From the other side, there is an opinion among researches that supply chain partners can trust the blockchain system itself and the information exchanged within the platform. So, they do not necessarily need to trust each other. In

other words, since blockchain ensures secure and verifiable transactions, partners can interact trustfully without interpersonal or interorganizational trust.

So, when it comes to real life blockchain application enhancing digital trust there are following examples across such industries as food and logistics that demonstrate its transformative potential in fostering transparency and reliability.

In the food industry, data recorded on blockchain includes such details as farm origin details, crop growing conditions, factory processing information, batch numbers, storage temperatures, required conditions, and shipping data. This ensures comprehensive traceability. To guarantee safety supply chains of high-quality food products, blockchain enhances operational efficiency across the entire farm-to-fork supply chain by transparency and traceability at every stage. (Gupta and Shankar, 2024)

Blockchain securely stores each transaction within the supply chain, providing a transparent and verifiable record of ingredient origins, quality, and safety in the food industry. This technology allows businesses to track the lifecycle of ingredients, from production to consumption, ensuring authenticity and quality. By doing so, blockchain reduces the risk of food fraud and strengthens trust between consumers and businesses. (Hao et al., 2024)

Modern supply chains integrate IoT devices, robotics, artificial intelligence, and blockchain technology to establish an immutable and trusted data source, enhancing transparency and reliability for supply chain participants. (Kalpana et al., 2023)

For instance, in the wine industry, it is essential to track and share important information such as temperature, humidity, and storage and transportation conditions. (Brookbanks and Parry, 2022a)

However, according to numerous studies, there is a gap in the literature, as no case study has comprehensively explored the impact of digital technologies and blockchain on trust and trust relationships within complex supply chains. This gap exists in supply chains

involving multiple stakeholders, such as vendors, producers, logistics providers, government entities, including customs and border operations. (Brookbanks and Parry, 2022a)

To sum up, blockchain is a powerful tool for strengthening supply chain security, transparency, resilience, and trust. However, its successful adoption facing challenges such as regulatory barriers, cybersecurity risks, investments, and technological and institutional integration. Future research should explore blockchain's impact in developing economies and analyze its long-term effects on supply chain ecosystems.

2.5 Constrains and Barriers to Blockchain Adoption

Despite the growing interest to blockchain technology as a tool for enhancing transparency, improving resilience and building trust, its adoption faces several barriers and constraints. These challenges are technical, organizational, financial, and institutional varying by industry and governance context.

One of the most common challenges in blockchain adoption is integration to already existing digital infrastructure. Many companies still rely on legacy ERP or IT systems that are not easily compatible with blockchain platforms. (Kamath, 2018a). Another constraint is interoperability between blockchain solutions and interaction among supply chain stakeholders, particularly in global supply chains without universal standard. (Rakhra et al., 2024)

Additionally, blockchain successful implementation requires close collaboration between supply chain members. However, levels of digital maturity, interest, or trust in the blockchain technology may vary among stakeholders in less digitized environments making barriers for its successful adoption. (Francisco and Swanson, 2018)

Also, blockchain adoption can be expensive for companies with limited investments or technological resources. Infrastructure, staff training and systems costs are often main constraints to blockchain adoption. (Kshetri, 2018)

Although, according to research studies, in some cases blockchain's transparency can conflict with confidentiality requirements. In this respect, companies may refuse to share sensitive or competitive data on decentralized network. (Batwa and Norrman, 2021)

And finally, operating across multiple countries with different legal rules and regulating blockchain faces additional constraints. As a result, blockchain adoption is very limited in such contexts. (Xu et al., 2021)

These barriers and constrains are directly addressed to the second research question of this study. Understanding these challenges is essential for evaluating blockchain's practical value beyond its theoretical potential.

2.6 Conceptual Framework

Purpose of the Framework

The aim of this section is to synthesize and summarize the literature review from different perspectives, identify key research gaps, and highlight how this study may contribute for future blockchain technology in supply chains.

Literature integration and conceptual gaps

Numerous literature articles highlight blockchain technology as a transformative force in supply chain management enhancing transparency, security, resilience and trust. Its decentralized and immutable nature plays a key role in addressing a wide range of supply chain risks, aligning closely with Supply Chain Risk Management (SCRM) Theory. At the same time, blockchain enhances trust among stakeholders, which reflects the core principles of Trust Theory.

Despite the growing scholarly interest in blockchain technology, most existing research either focuses on its technical applications or discusses its impact on supply chains in

theoretical point of view. However, there is a lack of in-depth research how blockchain strengthens trust within complex inter-organizational networks and supports supply chains in regions with lower levels of digital literacy. This study aims to address these gaps by exploring the dual role of blockchain as a risk management and trust tool. By utilizing Supply Chain Risk Management (SCRM) and Trust Theory, the aim of this research is to provide a more holistic understanding of how blockchain supports resilience, transparency, and security in supply chains.

Conceptualizing the framework

The conceptual framework of this study is based on reducing risks and building trust. SCRM Theory focuses on secure information sharing, traceability and foreseen potential disruptions. Meanwhile, Trust Theory underlines the importance of transparent transactions, collaboration, relationships commitment between stakeholders in supply chains. These two theories are deeply interconnected and significantly influence each other. As it was discussed earlier, increasing transparency supports trust, traceability supports risk mitigation, and data integrity positively effects on resilience and collaboration.

Framework application in this study

The conceptual framework plays essential role in the research design and analytical approach of this study. Supply Chain Risk Management (SCRM) Theory is used to assess how effectively blockchain can identify and mitigate risks within the supply chain. At the same time, Trust Theory offers a perspective for understanding how blockchain contributes to building confidence among supply chain stakeholders. By combining these two theoretical lenses, this study is able to evaluate blockchain's impact on critical operational aspects such as transparency, security, trust, and resilience. This framework is a foundation for exploring real-world blockchain applications and understanding expert perspectives and insights gathered during the empirical phase of the study.

Contribution of the Framework

The conceptual framework adds value by combining these two theoretical lenses - Supply Chain Risk Management (SCRM) and Trust Theory in order to explore the complex impact of blockchain technology on supply chains. It offers a structured approach for analyzing how blockchain reshapes information exchange, inter-organizational relationships, and risk management practices within supply chains. In addition, the framework offers a foundation for evaluating and designing blockchain strategies that can be applied across both developed and developing economies. To support this conceptualization, this section presents a visual diagram illustrating the connections between blockchain, supply chain risk management, and trust.

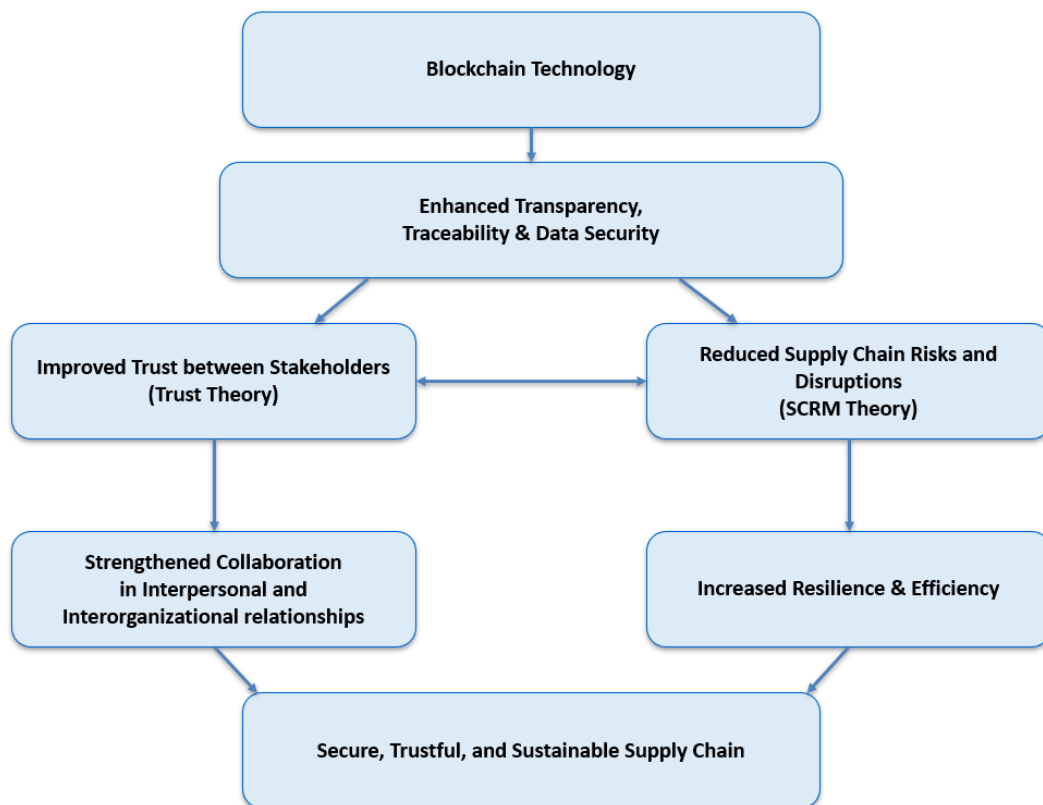


Diagram 1. Contribution of the Conceptual Framework

This visual diagram illustrates the conceptual framework guiding this research. Blockchain technology creates transparency, traceability, and data security across supply chain

network. There are two main outcomes applying theoretical framework: increased trust among stakeholders allied with Trust Theory, and reduced supply chain risks and disruptions allied with Supply Chain Risk Management (SCRM) Theory.

If to summarize, building trust and mitigating risks significantly improve collaboration and resilience across supply chain. These factors create security, transparency, and trustfulness across entire supply chain. The relationship between trust and risk management highlights how modern supply chains depend on secure, immutable, tamper-proof data for overall supply chain efficiency.

Based on this conceptual framework, the next chapter presents the methodology used in this study. It explains how the research was designed, how the data was collected and analyzed, and how these methods explore the role of blockchain for supply chain security, transparency, and resilience through the lens of Supply Chain Risk Management (SCRM) Theory and Trust Theory.

3 Methodology

3.1 Introduction

This chapter presents methodology used in research and the role of blockchain technology in improving supply chain security, transparency, and resilience. It provides research design overview, data collection, and analysis methods of this research. This chapter also explains the reason of the chosen approach and how it fits the goals of the study with detailed exploration of the complex and evolving nature of blockchain adoption in the supply chain. (Yin R. K., 2014)

To structure the research design, this study applies a qualitative multiple case study approach. This approach is well-suited for exploring contemporary phenomena in real-world settings, especially when the boundaries between the phenomenon and its context are blurred. (Yin R. K., 2014)

Multiple case studies allow to identify common patterns as well as case-specific differences, which enhances the robustness and external validity of the findings. Exploring various blockchain implementations across different industries allows this study to replicate each case study as a separate experiment with cross-case thematic analysis. This approach improves the credibility and supports the outcome performance of the research. (Yin R. K., 2014)

A qualitative case study approach was chosen due to exploratory nature of the study and the limited empirical research at the intersection of blockchain, trust, and supply chain risk management. This method based on inductive logic, allowing data to "speak" through detailed analysis of real-world practices, expert insights, and contextual factors influencing blockchain implementation. Basically, such approach is well-suited for exploratory research exploring complex phenomena in details and providing comprehensive research than quantitative methods. (VanderStoep, 2008)

The chapter also explains the reason behind chosen research method and the application of theoretical frameworks - Supply Chain Risk Management (SCRM) and Trust Theory. These frameworks help to interpret the data and better understand the blockchain integration in supply chain systems (Creswell, 2018)

The research is guided by five core objectives:

- (1) To evaluate the effectiveness of blockchain in improving supply chain transparency and security,
- (2) To analyze current gaps in transparency, security, and trust,
- (3) To explore technical, financial, and organizational barriers to blockchain adoption,
- (4) To assess and explore implementation challenges, and
- (5) To provide recommendations for successful blockchain integration with a focus on scalability, integration, and sustainability.

These objectives shape the overall methodological approach, ensuring alignment between the research goals, the data collection, and data analysis.

3.2 Research Design

This research adopts a qualitative, multiple case study approach to gain comprehensive insights into blockchain adoption within supply chain management. This design allows to achieve an in-depth and comparative analysis of blockchain implementations across different industries such as agri-food (Terra Delyssa and IBM Food Trust), logistics and shipping (Maersk and TradeLens), Walmart and blockchain adoption, and automotive manufacturing (Volvo's ethical sourcing initiatives).

As it was already discussed, a multiple case study approach is particularly well-suited for exploring complex, contemporary phenomena in real-world contexts where the boundaries between phenomenon and context are not clearly defined (Yin R. K., 2014).

By studying different blockchain implementations across the industries, this design supports detailed research of industry-specific experiences, expert opinions, and secondary

data sources, focusing specifically on blockchain's impact on security, transparency, trust, and resilience.

This approach provides comprehensive insights, industry-specific challenges related to evolving blockchain's nature.

Additionally, this design enhances the credibility and allows to replicate the findings by cross-case comparisons. Also, the qualitative method was selected because it offers a descriptive and inductive approach that enables a deeper understanding of real-world practices, stakeholder perceptions, and challenges influencing blockchain implementation. (VanderStoep, 2008)

In addition, qualitative research highlights the depth of human experience with emerging technologies and focuses on concepts such as transparency, trust, and resilience, while avoiding premature generalizations drawn from limited datasets. (Lincoln, 2021)

Notably, that structured interviews serve as a valuable qualitative research tool, allowing supply chain professionals and blockchain experts to discuss barriers, trust issues, and implementation concerns beyond numerical measurement. (VanderStoep, 2008)

Moreover, blockchain technology is continuously evolving, and qualitative methods offer the flexibility to adapt to unexpected findings as new themes emerge. The following table compares qualitative and quantitative research approaches, highlighting the reason behind selecting a qualitative strategy for this study:

Aspect	Qualitative Research	Quantitative Research
Objective	Explore concepts, experiences, and meanings deeply	Measure and analyze numerical data
Nature of Data	Subjective, descriptive, non-numerical (words, themes, opinions)	Objective, numerical, measurable (statistics, percentages)
Data Collection Methods	Interviews, case studies, observations, document analysis	Surveys, experiments, structured questionnaires
Flexibility	More flexible, open-ended, exploratory	Structured, predetermined variables
Sample Size	Smaller sample, detailed insights	Larger sample, statistical generalization
Outcome	Provides deep understanding, identifies patterns and themes	Tests hypotheses, provides statistical validation

Table 1. Qualitative Research vs. Quantitative Research

This comparison clearly explains the choice of qualitative research by emphasizing its strengths in capturing nuanced and detailed human experiences. Unlike quantitative methods, which focus on hypothesis testing and statistical validation, qualitative research explores the underlying reasons, motivations, and contextual factors affecting blockchain adoption. Its flexibility allows researchers to adapt to the evolving dynamics of supply chain environments, providing complex, industry specific insights that quantitative approaches may overlook.

To sum up, the qualitative multiple case approach provides more comprehensive analysis especially for identification new opportunities and challenges in supply chain adoption and scalability.

3.3 Data Collection Methods

Primary Data Collection

This study adopts a qualitative methodology within a multiple case study design. In order to provide comprehensive analysis of secondary data and real-world implementations, the primary data was collected through semi-structured interviews with two industry experts who have hands-on professional experience in supply chain management and blockchain related fields.

Interviewee	Company	Position	Duration	Interview Format
Expert 1	Kept Tech (ex-KPMG RU)	Director, technology support (Track&Trace)	~60 minutes	Phone call
Expert 2	K3 Business Solutions	Logistics Consultant	~60 minutes	Phone call

Table 2. Overview of Expert Interview Participants

The first interview was conducted with the director of technology support (Track & Trace) from Kept Tech (formerly KPMG Russia), who is currently responsible for supply chain tracking and QR code traceability systems and regulatory compliance. He shared insights into centralized, government-led systems in Russia.

The second interview was with logistics consultant from K3 Business Solutions, who has expertise in warehouse operations and supply chain at IKEA. He provided detailed insights of blockchain' adoption challenges in decentralized franchise model and existing ERP systems providing traceability and managing operational risks.

Both interviews were scheduled and conducted over the phone call and lasted approximately 60 minutes each. Although, both conversations were allied with the research objectives and structured thematically around four core topics: blockchain adoption, transparency and traceability, organizational and technological challenges, its' value and

feasibility. During the interviews the detailed notes were taken for the further thematic analysis. The interview outcomes were used to support the secondary data findings to provide holistic overview in cross-case comparison of blockchain adoption in supply chains.

Secondary Data Collection

Secondary data plays a crucial role in this research enabling to provide rich, real-world insights of blockchain adoption across different industries and sectors. The limited number of expert interviews with credible case study analysis helped to develop holistic and comprehensive understanding of the research topic. This data was collected through systematic document analysis of publicly available materials such as company reports, whitepapers, industry publications, press releases, academic articles, and relevant online resources like official company websites, blogs, and news portals related to blockchain applications in supply chains. Thus, detailed case study analysis offered real-world use of blockchain, including implementation processes, benefits, challenges, and current development in blockchain technology for supply chain management, that expert interviews may not provide alone.

The document analysis based on four key cases: Terra Delyssa's adoption of IBM Food Trust in the agri-food sector, Maersk's implementation of the TradeLens platform for global shipping and logistics, Walmart's application of IBM Food Trust for food safety and traceability, and finally Volvo's blockchain-based traceability system for ethical cobalt sourcing in the automotive industry.

Secondary sources were selected based on their credibility, relevance, and publication date, with priority given to peer-reviewed articles, official company reports, and respected industry analyses. By combining information from diverse and reliable sources, document analysis helps to gain deeper understanding and supports the analytical interpretation of results across multiple cases.

By analyzing and comparing case studies this approach supported the primary data, added logic and depth of the findings and contributed to building a comprehensive view of blockchain's role in improving transparency, trust, security, and resilience within different supply chain sectors.

3.4 Data Analysis Methods

As already mentioned above, this study based on qualitative approach analyzing both primary and secondary data. The analysis was conducted through thematic coding and cross-case synthesis to identify key patterns allaying with conceptual framework of the study.

Primary Data (Expert Interviews)

Two expert interviews of 60 minutes each long were conducted over the phone. During the conversation, the detailed notes have been handwritten. The questions were prepared in advance based on interview script that later were used as a basis for thematic analysis. The responses were reviewed and grouped into four key themes:

- Enhancing traceability and transparency
- Reducing supply chain risk and supply chain resilience
- Building trust
- Adoption challenges and barriers

Later, these findings were synthesized and integrated with case study analysis to triangulate findings and enhance reliability and credibility of the study.

Secondary Data (Case Studies and Document Analysis)

Secondary data was analyzed through publicly available documents including press releases, company reports, newsletters, industry publications, peer-reviewed articles, websites, blogs, and social media resources. Particularly, the case study analysis was focused to evaluate and assess the use of blockchain, its benefits, weaknesses, challenges,

constraints across different industries (Terra Delyssa, Maersk, Walmart, and Volvo). Data were combined and identified by repeatable patterns and concepts and then contrasted to highlight industry-specific differences.

Contribution of the Findings

This two-stage analytical approach enabled to provide cross-case validation between expert insights and real-world case studies. By combining and synthesizing both primary and secondary data, the research illustrated comprehensive and structured outcomes allied with core study themes.

3.5 Ethical Considerations

Due to chosen the qualitative and exploratory approach of this study, ethical considerations was the priority. All participants were clearly informed about the purpose of the study, the procedure, potential risks, and their right to refuse the participation at any stage without any consequences. Confidentiality was strictly maintained by anonymizing participant responses and securely storing the data, respecting participant autonomy, privacy, and dignity. In addition, situational ethics were practiced to address unforeseen ethical challenges that might be arisen during data collection and analysis challenges that are common in qualitative research due to its immersive and evolving nature. (Reid et al., 2018)

Ethical reflexivity was continuously practiced during research process with potential awareness of personal biases, power dynamics, and the influence of researcher-participant relationships. Such approach with ethical standards were used not only during data collection but also throughout data analysis and interpretations. Findings were reported with transparency and integrity while keeping participant anonymity and confidentiality. By applying ethical reflexivity and situational ethics into the research process, this study enables to present both the validity of its findings and the ethical integrity of the research process (Creswell, 2018).

3.6 Validity and Reliability of the Data

Validity and reliability of the research process play essential role in the rigor of this qualitative study. In qualitative research, validity refers to the credibility and authenticity of the data and interpretations, while reliability pertains to the consistency and dependability of the data collection and analysis procedures (Yin R. K., 2014).

This study follows the four principles of high-quality case study research as outlined by Yin (2014), which supports findings validity and reliability:

Use of Multiple Sources of Evidence (Triangulation):

The research integrates multiple data sources, including expert interviews, document analysis, and case studies from the blockchain industry. Triangulation allows for cross-verification of findings, enhancing validity and providing robust understanding of blockchain's impact on supply chain transparency, security, and trust.

Creation of a Case Study Database:

All raw data including interview notes, and analyzed documents were systematically organized and securely stored. This structured documentation enhances reliability through traceability and ensuring that the research process can be audited and replicated by external reviewers.

Maintaining a Chain of Evidence:

A clear and logical link is maintained between the research questions, the collected data, and the conclusion.

Critical Evaluation of Electronic Sources:

Due the nature of blockchain evolving, data from company websites, industry blogs, and online news platforms were included with careful evaluation. Each electronic source was critically assessed for credibility, authorship, and potential bias to ensure data authenticity, particularly when such sources are not peer-reviewed.

Additionally, preliminary findings were shared with participants to validate the accuracy and interpretations relevance. Reflexivity was also applied through researcher journaling to maintain awareness of personal assumptions, values, and potential biases during data collection and analysis (Lincoln, 2021).

Thus, by applying these rigorous methodological principles, this study demonstrates credibility, validity, and reliability of its findings. The use of triangulation, systematic documentation, traceability, and critical evaluation of the sources provides a strong foundation for conducting credible and trustworthy multiple-case study research.

3.7 Summary

This chapter discussed the methodological framework that supports the study, highlighting the reason of qualitative, multiple case study approach. This approach is effective for exploring the complex and evolving nature of blockchain adoption in supply chain management across different industries.

Although, the chapter describes how multiple data sources including expert interviews and secondary document analysis were integrated to ensure methodological rigor. Also, this section provides research quality tools, such as triangulation, systematic data organization, transparent chain of evidence, and critically evaluation of secondary sources. Ethical considerations, including informed consent, confidentiality, reflexivity, and situational ethics, were also addressed to uphold the integrity of the research process throughout the study.

Based on methodological framework outlined in this chapter, the next chapter presents the empirical findings of the study, analyzing the real-world applications of blockchain technology across multiple industries and exploring challenges and opportunities related to its adoption in supply chain management.

4 Empirical Findings

4.1 Introduction

This chapter presents the empirical findings of the study, resulting from a qualitative analysis of both primary and secondary data sources.

Primary data was collected through semi-structured interviews with experts in blockchain and supply chain management, including the director of technology support from Kept Tech (formerly affiliated with KPMG Russia) and a logistics consultant from K3 Business Solutions. These interviews provided practical insights on real-world barriers, governance structure, adoption challenges, and potential opportunities related to blockchain traceability systems.

Secondary data was collected from credible and current sources such as company reports, official websites, whitepapers, press releases, media articles, and peer-reviewed articles. The analysis based on four case studies presented by Terra Delyssa, Maersk, Walmart, and Volvo and covered the agri-food, logistics, retail, and automotive sectors. These cases provide diverse insights into the technical, institutional, and operational aspects of blockchain implementation.

The findings are presented thematically according to the research objectives and the conceptual framework. The framework consists of two theories - Supply Chain Risk Management (SCRM) Theory and Trust Theory which guide the identification and interpretation of key themes. Thematic analysis consists of blockchain's contribution to improving traceability, reducing supply chain risks, enhancing resilience, and building trust among stakeholders.

The themes explored in this chapter are directly aligned with the core research objectives, focusing on blockchain's influence on transparency and trust, and challenges related to its scalability. This thematic outline provides a clear and structured foundation for discussion and theoretical analysis presented in the next chapter.

4.2 Case Study Overview - Terra Delyssa

Terra Delyssa is a premium olive oil brand in agri-food sector owned by CHO Group and based in Tunisia. The company operates across 4,000 hectares and exports olive oil to over 40 countries. Thus, Terra Delyssa plays a significant role in the global olive oil market with focus on quality, sustainability, and transparency. In order to prevent and respond to concerns around food fraud, traceability, and consumer trust, CHO Group implemented IBM Food Trust, a blockchain built on Hyperledger Fabric. The primary value was to ensure full product traceability and verify product authenticity from orchard to bottle. By adopting blockchain, the company managed to strengthen supply chain visibility, reduce fraud and counterfeiting, and build consumer trust through transparent, tamper-proof product information via QR codes on each bottle. (CHO Group, 2023; IBM, 2020).

4.2.1 Thematic Findings

Theme 1: Enhancing Traceability and Transparency

Terra Delyssa uses blockchain technology through the IBM Food Trust platform to make every step of its olive oil production fully traceable - from the orchard to the bottle. Each stage from harvesting, milling, testing, bottling to logistics is recorded immutably, allowing consumers to scan a QR code on the bottle and access verified production and quality data. (CHO Group, 2023)

This means that consumer could scan the QR code on a bottle and get access to verified information about how and where the product was made. (IBM, 2023)

Such transparency supports the goals of Supply Chain Risk Management (SCRM) by reducing gaps in information data and enabling faster recover if disruptions occur. Furthermore, align with Trust Theory, blockchain helps to build interorganizational trust by replacing reliance on human error or factor to tamper-proof technological verification. (Montecchi et al., 2019).

Theme 2: Risk Reduction and Supply Chain Resilience

Terra Delyssa uses IBM Food Trust to enhance supply chain resilience by reducing risks such as counterfeiting, mislabeling, and traceability gaps in the olive oil sector. By recording each step of the process in a secure, time-stamped blockchain transaction, the company can guarantee product authenticity and data security across the entire supply chain network. (Kshetri, 2018)

Tracing helps to detect disruptions faster and improves recall responses and operational flow. (Hao et al., 2024)

These features align with SCRM Theory by minimizing both reputational and logistical risks. From a Trust Theory perspective, blockchain strengthens trust by tamper-proof technological verification and reduces intermediaries or human factor. (CHO Group, 2023).

Theme 3: Building Consumer and Stakeholder Trust

Blockchain technology helps Terra Delyssa to build consumer trust by providing transparent, verifiable product data accessible through QR codes, preventing mislabeling or counterfeiting. (IBM, 2023)

The shared ledger structure also enhances interorganizational trust, as all supply chain members access the same tamper-proof data in real time. (Montecchi et al., 2019)

To support this trust, smart contracts are used to enforce agreements. (Centobelli et al., 2022).

So, this approach aligns with Trust Theory by fostering cognitive trust (confidence based on reliable data) and institutional trust (confidence based on system's structure and processes). At the same time, it supports Supply Chain Risk Management (SCRM) Theory by reducing risks and increasing transparency across the entire network.

Theme 4: Challenges in Blockchain Adoption

However, despite Terra Delyssa's successful implementation of IBM Food Trust within its own operations, further scalability faces challenges, particularly in extending blockchain to smaller suppliers lacking the financial, technical, or digital capacity to participate. (Rakhra et al., 2024)

There are challenges such as low digital literacy, difficulties integrating with legacy systems, and concerns about data privacy and competitive sensitivity create barriers to blockchain scalability. (IBM, 2020)

This highlights the crucial factors for blockchain integration not limited only technical infrastructure but also on stakeholder readiness and digital literacy of the regions.

4.3 Case Study Overview – Maersk and TradeLens

Maersk, one of the world's largest integrated logistics and most innovative shipping company, was the first in the industry to launch a blockchain-based solution by partnering with IBM to develop TradeLens. The primary aim of TradeLens was to transform global container logistics and promote global trade. TradeLens was designed to reduce shipping delays and detentions, improving document flow, mitigate trade vulnerabilities through secure, transparent, and trustful platform for all stakeholders, including shippers, freight forwarders, customs authorities, port operators, and carriers. (A.P. Moller - Maersk, 2019a)

A significant milestone followed in 2019 when CMA CGM and MSC, two of the largest global shipping lines, joined the platform and as a result collectively represent nearly half of the global container shipping capacity.

Thus, TradeLens was expected to enhance trade transparency, increase efficiency, and build interorganizational trust. (A.P. Moller - Maersk, 2019a)

4.3.1 Thematic Findings

Theme 1: Enhancing Traceability and Transparency

Maersk partnership with IBM enabled to provide transparency across global shipping transactions by immutably recording shipping milestones, customs documentation, and logistics data on a blockchain. TradeLens platform was design to provide stakeholders access to verified data, significantly reducing information delays and document fraud. (A.P. Moller - Maersk, 2019a) This enhanced transparency aligns with SCRM Theory by reducing information gaps and supports Trust Theory by shifting trust from personal intermediaries to tamper-proof technological platform. (Montecchi et al., 2019)

Theme 2: Risk Reduction and Supply Chain Resilience

Blockchain integration helped Maersk to reduce operational risks by reducing shipping delays, minimizing manual paper workload, and mitigating vulnerabilities. Real-time tracking allowed Maersk early identify bottlenecks and delays, making shipping process resilient to disruptions. (Hackius and Petersen, 2017)

This increased transparency allied with Supply Chain Risk Management (SCRM) Theory by reducing information gaps and making global logistics operations more resilient to disruptions. (Montecchi et al., 2019)

Theme 3: Building Consumer and Stakeholder Trust

TradeLens helped to build interorganizational trust by providing secure, transparent access to shipment data for all supply chain members. Its decentralized, tamper-proof blockchain architecture enhanced trust between stakeholders. (Brookbanks and Parry, 2022a)

However, Maersk's dominant role in TradeLens platform created concerns that it could about its neutrality.

This directly reflects to key idea of Trust Theory when trust depends not only on the data reliability, but also on how this system is fair with open governance. (Montecchi et al., 2019; A.P. Moller - Maersk, 2019a)

Theme 4: Challenges in Blockchain Adoption

However, even though TradeLens was technologically advanced, it faced serious adoption challenges due to stakeholder resistance. Many stakeholders complained about lack of standardization, legacy IT system compatibility, and data security. Furthermore, Maersk and IBM officially discontinued TradeLens in 2023 due to inability to achieve global industry collaboration and commercial sustainability. (Maersk, 2022)

This outcome highlights that successful blockchain adoption depends not only on innovation but also widely stakeholder alignment, maintenance neutrality and commercial viability.

4.4 Case Study Overview – Walmart and Blockchain Adoption

Walmart, one of the world's largest retail chains has adopted blockchain technology to enhance food safety and traceability. In response to growing concerns over foodborne illnesses and supply chain inefficiencies, Walmart partnered with IBM to develop transparent, responsive, secure food tracking system. (Kamath, 2018b)

The initiative began with pilot projects focused on tracing mangoes in the United States and pork in China, and later expanded to leafy greens, dairy products, and seafood. By using blockchain technology, Walmart dramatically reduced the time required to trace the origin of products - for example, tracking the source of mangoes dropped from seven days to just 2.2 seconds. (Kamath, 2018b; Walmart, 2019)

This outcome in real-time traceability demonstrated how blockchain could improve food safety, reduce waste, and build trust among consumers.

4.4.1 Thematic Findings

Theme 1: Enhancing Traceability and Transparency

Blockchain implementation allowed Walmart to provide transparency and traceability across fresh food supply chain. By digitizing supply chain records on a blockchain, Walmart enabled the secure sharing of accurate and verifiable data such as farm origin, batch numbers, processing dates, storage temperatures, and transportation conditions. (Walmart, 2019)

This contribution allies with SCRM Theory by reducing information asymmetry and supports Trust Theory through greater by fostering cognitive trust through verifiable, tamper-proof data. (Montecchi et al. 2019)

Theme 2: Risk Reduction and Supply Chain Resilience

Blockchain adoption helped Walmart mitigate foodborne illness risks and foreseen disruptions by identification and isolation of contaminated products. As a result, these initiatives improved recall responsiveness and contributed to overall supply chain resilience. (Walmart, 2019)

The immutability of blockchain entries prevented tampering and ensured authenticity across records, supporting SCRM Theory objectives by enhancing operational risk control and reducing reputational damage from food safety incidents (Galvez et al., 2018).

Theme 3: Building Consumer and Stakeholder Trust

Walmart's blockchain pilot project directly addressed the growing demand for transparency and accountability in food supply chain. By traceable data via QR codes allowed consumers verify product provenance and handling process. This visibility enhanced consumer confidence and aligned with Trust Theory by shifting trust from traditional

intermediaries to a decentralized, tamper-proof system. (Kamath, 2018b; Shahzad and Hafeez, 2022)

Theme 4: Challenges in Blockchain Adoption

However, despite its success, Walmart's blockchain initiative faced challenges related to scalability, data standardization, and stakeholder cooperation within supply chain. Achieving consistent data input across all members of the supply chain required investments in training, digital infrastructure, and clear maintenance guidelines. Additionally, the blockchain value needed to be clear for all participants, from farmers to retailers, to encourage full ecosystem adoption. (Sharma and Kumar, 2021)

4.5 Case Study Overview – Volvo and Blockchain for Ethical Sourcing

Volvo Cars was the first carmaker to adopt blockchain for tracing the ethical sourcing of cobalt, a critical material in electric vehicle batteries production. In 2019, the company partnered with Circular to implement end-to-end cobalt traceability using a blockchain system that records data such as origin, weight, and transport details. (Shahzad et al., 2024; Volvo Cars, 2019a) This initiative was designed to prevent unethical practices in cobalt mining, in high-risk like the Democratic Republic of Congo.

So, this solution enhanced visibility, accountability, and alignment with Volvo's sustainability goals. (Shahzad et al., 2024) Additionally, Volvo has explored the use of blockchain in logistics operations to reduce fraud, enhance transparency, and improve overall supply chain efficiency. (Volvo Trucks, 2019)

4.5.1 Thematic Findings

Theme 1: Enhancing Traceability and Transparency

Volvo's blockchain implementation allowed for real-time, end-to-end traceability of cobalt, providing stakeholders verifiable data in the supply chain. This level of transparency helped reduce information gaps and supported Supply Chain Risk Management (SCRM)

Theory by improving visibility and transparency. (Montecchi et al., 2019; Shahzad et al., 2024)

Theme 2: Risk Reduction and Supply Chain Resilience

By ensuring that raw materials met ethical and environmental standards, blockchain helped Volvo reduce reputational and operational risks. The ability to identify and prevent disruptions supported operational resilience that is core focus of SCRM Theory framework. (Shahzad et al., 2024)

Theme 3: Building Consumer and Stakeholder Trust

Blockchain allows Volvo to demonstrate accountability and responsible sourcing to stakeholders by providing transparent, verifiable proof of ethical practices throughout the supply chain. Its tamper-proof architecture supports Trust Theory by shifting reliance away from institutional intermediaries toward a transparent and trustworthy system. (Montecchi et al., 2019; Xu et al., 2021)

Theme 4: Challenges in Blockchain Adoption

Despite clear benefits, Volvo's blockchain initiative faced several practical challenges such as difficulties in collecting reliable data from remote mining regions, resistance from some supply chain partners to fully participate, and the complexity of integrating blockchain with legacy IT systems. Again as it was discussed earlier, successful blockchain adoption in supply chains depends not only on technological maturity but also on stakeholder alignment, effective governance frameworks, and overall ecosystem readiness. (Shahzad et al., 2024; World Economic Forum, 2020)

4.6 Expert Interview Findings

This section presents the findings from two expert interviews conducted to complement the multiple case studies analysis. Each interview lasted for 60 minutes and was

conducted via phone call. The main goal of these interviews was to provide practical, firsthand insights into blockchain adoption within supply chains, with a focus on traceability, risk management, trust, and implementation challenges.

The first interviewee was technology director from Kept Tech (formerly KPMG Russia) who is in charge of regulatory compliance and traceability systems. And the second was logistics consultant from K3 Business Solutions with expertise in supply chain operations and warehouse logistics at IKEA.

Their responses are organized thematically according to the core categories used in the case studies analysis.

Theme 1: Enhancing Traceability and Transparency

Both interviewees emphasized the importance of transparency and traceability in modern supply chains, particularly in relation to consumer confidence and government control. The consultant from K3 Business Solutions confirmed that IKEA's values are based on traceability but currently achieves this through Microsoft-based ERP system not blockchain. He noted that while blockchain technology could enhance traceability and transparency, it seems unrealistic in IKEA's nearest future due to infrastructure limitations among suppliers' system complexity and general slow approach to innovation.

"IKEA is very customer-oriented, and transparency is a key value, but ERP systems already handle most of the traceability."

In contrast, the technology director from Kept described the implementation highly centralized a state-driven QR code-based system in Russia called "Честный Знак" (Honest Sign) created on blockchain principals of traceability and transparency. He noted that this QR track and trace systems operates for over five years and covers more than 70% of industries. When it comes for import, each good based on HS code must be marked and traced through this system as well. It means, that all domestic and import goods are

fully tracked and traced, as items can be marked during customs clearance or directly by foreign manufactures.

"Each import product that has an HS code must be marked and traced through the 'Честный Знак' system."

He also highlighted that while this platform prevents counterfeiting but also provides access into financial transactions and control over distribution channels to the government.

Theme 2: Risk Reduction and Supply Chain Resilience

The K3 Business Solutions consultant noted that IKEA's current ERP infrastructure already supports effective risk management across its supply chain, including warehouse operations and inventory replenishment. However, he also emphasized that such company as IKEA is slow to adapt to changes that makes additional barriers to respond to emerging risks or disruptions.

"IKEA is extremely standardized and slow in process... even for opening city stores, there's still no unified guideline."

The Kept consultant did not comment directly on operational risk mitigation but noted that government control over traceability systems in Russia contributes to resilience by enabling oversight of production, and distribution processes.

Theme 3: Building Consumer and Stakeholder Trust

Both experts expressed differing points of views on how trust is built in supply chains. The Kept technology director highlighted that in centralized systems like Russia's, trust is enforced institutionally through top-down governance, completely contrasting with blockchain's distributed trust model which relies on transparency and technological

consensus. The centralized "Честный Знак" system ensures compliance and data integrity, leaving little room for blockchain or decentralized trust.

Meanwhile, the K3 Business Solution consultant pointed out that IKEA builds trust through consistent use of standardized ERP systems, which support internal accountability and data integrity without using blockchain.

"Transparency is a key value, but IKEA already achieves it through strong processes."

Thus, these perspectives suggest that trust is still primarily shaped by institutional or system-based mechanisms rather than technological decentralization like blockchain technology.

Theme 4: Challenges in Blockchain Adoption

Challenges in blockchain adoption emerged as the most prominent theme across both interviews. According to K3 Business Solutions consultant emphasized several barriers of blockchain adoption including low digital literacy among suppliers, reliance on legacy systems, and the company's slow pace of innovation.

"You might be surprised how little IKEA invested in technical innovation in the last couple of decades."

The Kept Tech expert reinforced this by proposing that blockchain is unlikely to be developed in environments dominated by centralized regulatory frameworks. Since the government already benefits economically and politically from existing systems, blockchain adoption is not prioritized.

"Blockchain is not in the government's interest, and it hasn't had a chance to exist."

In summary, both interviews revealed that blockchain adoption faces significant structural and contextual barriers. These insights highlight that beyond technology, successful blockchain adoption depends on ecosystem readiness, governance models, and stakeholder alignment.

4.6.1 Summary of Interview Findings and Cross-Case Comparison

The expert interviews reinforced and contrasted findings of the four case studies (Terra Delyssa, Maersk, Walmart, and Volvo). While both interviewees acknowledged the blockchain value in enhancing transparency and trust, their expertise highlighted significant limitations related to infrastructure, standardization, and governance.

Theme	K3 Business Solutions logistics consultant	Kept Tech (former KPMG RU) Director, technology support	Case Study
Traceability & Transparency	Achieved via ERP systems; blockchain not adopted	Enforced via centralized system (Честный Знак)	Terra Delyssa, Walmart
Risk Management	ERP systems help manage risks effectively	Centralized oversight mitigates risks	Maersk, Volvo, Walmart
Trust	Built through brand and process standardization	Institutional trust through gov- ernment control	Terra Delyssa, Volvo, Walmart
Adoption Barriers	Low digital readiness, lack of technology investments, supplier onboarding issues	Blockchain not aligned with government interests	All cases, espe- cially Maersk

Table 3. Interview Findings and Cross-Case Comparison

This cross-case and interview summary table illustrates how governance structure and technological readiness effect on blockchain adoption.

Interviews highlight that even in organizations where transparency is a priority, blockchain may not be adopted due to systemic and operational constraints. In contrast, centralized systems like "Честный Знак" provide traceability without decentralization. These nuances are crucial in terms of blockchain's practical viability across industries and countries.

5 Discussion of Findings and Conclusion

5.1 Introduction

This chapter brings together the main findings from the case studies and expert interviews to explore how blockchain technology enhances transparency, strengthens risk management, and fosters trust within supply chains across different industries. The discussion is structured thematically based on the conceptual framework designed in the literature review chapter, with a focus on Supply Chain Risk Management (SCRM) Theory and Trust Theory. Each theme is explored through cross-case analysis and supported by expert insights, and then compared with existing research. The chapter concludes with reflections on theoretical and practical implications, study limitations, and recommendations for future research.

5.2 Synthesis of Findings

Theme 1: Enhancing Traceability and Transparency

The findings of this study demonstrate that blockchain adoption enhances traceability, strengthens resilience, and builds trust in supply chains across different industries. However, implementation outcomes vary significantly depending on sector-specific factors, stakeholder readiness, and governance models.

In the food and retail sectors, as seen in Terra Delyssa and Walmart study cases, blockchain technology improved product traceability from origin to shelf, helped to enhance food safety, and gave consumers greater transparency through QR codes. These examples demonstrate how blockchain can build consumer trust and improve the efficiency of product recalls. In the logistics sector, Maersk used blockchain to streamline document handling and reduce trade-related inefficiencies. However, the TradeLens platform faced significant challenges to scalability due to governance issues, lack of alignment among stakeholders, legacy IT system compatibility, and commercial sustainability. In

the automotive industry, Volvo applied blockchain technology to support ethical sourcing and meet regulatory requirements, helping manage reputational risks and aligning to sustainability values.

The expert interviews emphasized that traceability, trust, and risk management are crucial in both highly standardized environments like IKEA and in centralized government systems such as those in Russia.

In addition, consultant from K3 Business Solutions highlighted potential value of blockchain adoption for traceability in terms of complex supply chains like IKEA's, but meanwhile noted that such benefits are unrealistic at the moment and the nearest future due to legacy systems, standardized environment, and lack of scalability.

The expert from Kept Tech (formerly KPMG) presented an alternative model, describing how centralized government systems using QR codes to prevent counterfeiting can provide transparency and traceability for state oversight and control.

These findings align with previous research that highlights blockchain's role in increasing traceability by creating immutable, time-stamped records in supply chains. (Batwa and Norrman, 2021; Budler, Quiroga, and Trkman, 2024; Centobelli et al., 2022; Hao et al., 2024; Kalpana et al., 2023; Montecchi et al., 2019) Likewise, in the food industry, blockchain enhances transparency and traceability providing access to data across the entire farm-to-fork supply chain. (Gupta and Shankar, 2024)

However, the case studies also show that the scope and focus of traceability vary by industry, with food supply chains emphasizing consumer transparency and automotive supply chains focusing on regulatory compliance and sustainability goals. (Gupta and Shankar, 2024)

Blockchain's decentralized and tamper-proof nature helps companies provide accurate and transparent data, which is especially valuable in managing risks, promoting sustainability, and ensuring ethical practices. (Rakhra et al., 2024) In Volvo's case, this

technology played a key role in tracking the responsible sourcing of cobalt, supporting both regulatory compliance and the company's sustainability values.

In conclusion, the findings from both the industry case studies and expert interviews align with conceptual literature framework. The Supply Chain Risk Management Theory is supported by the findings, which confirm that improved traceability leads to better decision-making, more effective disruption prevention, and risk mitigation. At the same time, Trust Theory is supported by how blockchain fosters both interpersonal and inter-organizational trust through shared access to secure, tamper-proof, and verifiable data.

Theme 2: Risk Reduction and Supply Chain Resilience

The case studies demonstrate how blockchain can enhance supply chain resilience and transparency by improving traceability and data accuracy. For example, Terra Delyssa and Walmart use IBM Food Trust to prevent counterfeiting, mislabeling, and traceability gaps by ensuring product authenticity, product provenance, processing, storage, and logistics processes through secure, time-stamped blockchain records. Similarly, Maersk blockchain adoption through the TradeLens platform highlights how the technology can reduce operational risks in global logistics. It helped to reduce manual paperwork, mitigate shipping delays, improve the ability to detect bottlenecks enhancing overall resilience against disruptions.

The findings of existing research also highlight that resilience is a crucial element for supply chain management. To prevent disruptions and recover faster companies must proactively assess risks and implement strategic actions that emphasize flexibility, visibility, and agility. Blockchain supports these goals by fostering trust, improving collaboration, and enhancing traceability. By sharing secure and transparent information among stakeholders, blockchain helps ensure product authenticity, lower operational costs, reduce operational risks, and improve overall supply chain efficiency. (Kalpana et al., 2023; Liu et al., 2024; Montecchi et al., 2019; Nagariya et al., 2024)

When it comes to theoretical framework of this research, the risk-mitigation goals align with SCRM Theory, where information asymmetry and data inaccuracy are significant contributors to supply chain vulnerability.

Expert interviews supported these observations but meanwhile introduced another perspective highlighting why blockchain still hasn't been widely adopted in real-world supply chains. The logistics consultant from K3 Business Solutions noted that IKEA already handles supply chain risks effectively using existing ERP systems. He noted that although blockchain has a significant potential, its added value is not enough to justify major changes to the current infrastructure. The director of technology support from Kept Tech similarly pointed out that centralized, government-led traceability systems can also support operational risk management effectively, but they rely more on regulatory oversight than on the decentralized transparency that blockchain provides. Both experts emphasized that the practical adoption of blockchain is currently limited by technological, organizational, and institutional barriers.

When it comes to theoretical framework behind this research, the risk-mitigation goals align with SCRM Theory, which emphasizes that information asymmetry and data inaccuracy are key contributors to supply chain vulnerability. At the same time, Trust Theory adds contribution on how blockchain's shared, tamper-proof data can help build both confidence in the information itself (cognitive trust) and trust in the systems that handle it (institutional trust), making supply chain relationships more resilient and reliable.

Theme 3: Building Consumer and Stakeholder Trust

Based on all four case studies, blockchain is a powerful tool for building trust among both consumers and stakeholders. In the food and retail sectors, Terra Delyssa and Walmart used blockchain to boost customer confidence by making product information transparent and easily accessible through QR codes. This allowed consumers to verify where a product came from and how it was handled. Likewise, Volvo and Maersk used blockchain

to strengthen trust between suppliers, customs authorities, and partners by providing access to reliable, and tamper-proof data. These examples demonstrate how blockchain helps shift trust from intermediates toward technology based on transparent and trustful data.

These findings align with literature review highlighting that blockchain improves trust in supply chains by enabling accountability through shared, tamper-proof records offers strong potential to address trust-related challenges such as counterfeiting, data manipulation, and information asymmetry. (Centobelli et al., 2022; Dutta et al., 2020; Yavaprabhas et al., 2023)

However, in real-world building trust varies by context. According to interviews with experts from Kept Tech and K3 Business Solution in practice, trust can be built not only through decentralized solutions like blockchain but also via centralized platforms regulated by the government or through ERP systems and standardized business processes.

These findings support existing literature that present blockchain as a tool for strengthening trust in fragmented supply chains. However, several scholars argue that blockchain does not automatically guarantee trust and depends on the integrity of data inputs, governance structures, and stakeholder cooperation. (Batwa and Norrman, 2021)

From the perspective of SCRM Theory, trust is a key element of risk mitigation. When stakeholders have access to verified information, it helps reduce uncertainty and prevents opportunistic behavior building strong, resilient supply chain relationships.

Theme 4: Challenges in Blockchain Adoption

Despite the benefits of blockchain across all case studies, its adoption and scalability faced significant challenges. Terra Delyssa and Walmart cases demonstrated successful implementations in highly structured supply networks. However, there are challenges related to onboarding small suppliers, ensuring data quality, and maintaining

interoperability across different platforms were noted. At the same time, Maersk's TradeLens platform, despite its technical robustness, faced difficulties in scaling due to limited competitor participation and concerns over data control and platform governance. Similarly, Volvo's case revealed challenges in collecting accurate data from remote mining regions, where blockchain's effectiveness depends on trustworthy initial inputs.

Conducted interviews reinforced these findings highlighting blockchain challenges adoption in real-world environment. The supply chain consultant from K3 Business Solution on IKEA's example highlighted the complexity of implementing blockchain the global franchisee network despite the company's strong value on transparency and trust which currently supported by Microsoft ERP systems. Additional barriers were also discussed including scalability, digital literacy, issues with integrating blockchain with existing infrastructure.

The Kept expert offered a governance perspective, explaining that in state-driven economies like Russian, centralized traceability systems are often preferred over decentralized models. He noted that this labeling and traceability system was introduced five years ago and has already covered more than 70% of all industries. He summarized that in such a state-controlled centralized system, the implementation of blockchain is unlikely to be feasible.

The interview findings suggest that in some cases, blockchain doesn't add much value in terms of transparency or trust, and in centralized government systems, it may not be needed at all. This highlights a key point from the conceptual framework: technologies like blockchain should complement existing organizational and institutional systems, but not try to replace them.

These findings align with existing literature that highlights stakeholder alignment, system integration, and governance as critical factors for successful blockchain adoption. Studies emphasize that a strong commitment among all stakeholders is essential for implementing effective Supply Chain Risk Management (SCRM) strategies (Kwon and

Suh, 2005). Also, it was mentioned that blockchain may not always improve supply chain resilience especially in environments where collaboration and information-sharing are weak. (Liu et al., 2024)

However, meanwhile, some studies propose that businesses can enhance supply chain resilience through blockchain adoption, while policymakers can support this process by offering government subsidies. Several studies have explored how financial assistance can reduce the impact of supply chain disruptions on suppliers and manufacturers (Wang and Bai, 2023) This approach is in contrast to the Kept tech interview, where the expert emphasized that in state-led economies, blockchain adoption is seen as unnecessary due to existing centralized systems.

Overall, the findings demonstrate that despite the benefits of blockchain's theoretical value, its practical implementation is still limited by economic, technological, and institutional factors.

5.3 Cross-case Comparison and Literature Integration

Across the four case studies, several cross-cutting themes emerged. All organizations implemented blockchain to address traceability gaps, manage supply chain risks, and build trust. Terra Delyssa and Walmart cases demonstrated how blockchain can improve consumer transparency and trust, while Maersk and Volvo emphasized operational efficiency and ethical compliance. However, as it was already mentioned, successful blockchain adoption significantly depends on legacy IT system compatibility and stakeholder alignment.

These patterns supported by existing literature emphasizing that successful blockchain implementation depends on system readiness, governance alignment, and stakeholder commitment. (Batwa and Norrman, 2021; Kwon and Suh, 2005)

The comparative analysis demonstrates that supply chains with higher levels of coordination and traceability focus (e.g., Terra Delyssa, Volvo) achieved more consistent blockchain benefits, while more standardized or fragmented networks (e.g., Maersk, IKEA)

faced greater implementation challenges. The interview outcomes also reinforced the constraints such as legacy systems, platform fragmentation, and resistance from smaller partners, scalability issues.

However existing research highlights that companies have increasingly invest in emerging technologies such as AI, IoT, and blockchain to enhance trust and regulatory compliance (Batwa and Norrman, 2021) but such approach has not been proven by interview findings as traceability is currently achieved by existing ERP systems and centralized government tracing system.

Furthermore, the failure of Maersk and TradeLens blockchain adoption reinforced the literature gap highlighting the lack of comprehensive case studies on blockchain adoption in complex supply chains involving suppliers, logistics providers, freight forwarders, and customs authorities. (Brookbanks and Parry, 2022a)

The present study contributes to addressing this gap by adding empirical findings that explore blockchain's role in building trust relationships in both centralized and decentralized supply chain environments.

5.4 Theoretical Implications

This study contributes to theoretical understanding of blockchain adoption through Supply Chain Risk Management (SCRM) Theory and Trust Theory. By applying these frameworks on real-world cases and expert interview, the research helps to deep existing knowledge in several ways.

Contribution to Supply Chain Risk Management (SCRM) Theory

This research reinforced theoretical understanding of blockchain adoption in supply chains based on Supply Chain Risk Management (SCRM) Theory and Trust Theory. SCRM

Theory highlights the importance of transparency, risk mitigation, response to disruptions in managing supply chain vulnerabilities. Through real-world case studies and expert interviews, this research supports and extends SCRM theory by demonstrating how blockchain can contribute to these goals in several important ways.

Firstly, enhances traceability and real-time data sharing enabling earlier risk detection for more effective mitigation. Also, it strengthens resilience by reducing bottlenecks (as it was demonstrated in Maersk and Walmart cases by improving recall efficiency, and ensuring ethical sourcing in Volvo case. Additionally, blockchain reduces information asymmetry which is a key risk element of supply chains disruptions.

However, the study also illustrates that blockchain's ability to support supply chain risk management isn't obvious and really depends on the context. As it was discussed in expert interviews, blockchain's impact is limited in environments where legacy systems are still dominant, digital maturity is low, or stakeholders are not aligned.

Overall, the research findings contribute to SCRM Theory by demonstrating how blockchain can help reduce different types of risks by improving visibility, traceability, and the accuracy of data. For instance, in the food and retail sectors, blockchain enabled faster recall and fraud prevention, while in logistics and automotive sectors helped to reduce bottlenecks and ensured ethical sourcing. At the same time, the study makes it clear that blockchain's ability to manage risk depends and build trust varies a lot on how the supply chain is structured, governance model, cooperation between partners, and how digitally mature the system is and proposing that blockchain isn't a one-size-fits-all solution.

Contribution to Trust Theory

Trust Theory emphasizes two key dimensions of trust in supply chains: cognitive trust, which is based on the reliability of data, and institutional trust, which is based on structures and systems that support collaboration. This study contributes to Trust Theory

development illustrating how blockchain technology can influence both forms of trust and also identifying barriers and limitations.

First, the research provides empirical evidence that blockchain helps build cognitive trust by offering verified, tamper-proof data. Cases such as Terra Delyssa and Walmart demonstrate how trust helps shift from traditional, relationship-based models to trust in secure and immutable digital records.

Second, the study shows that institutional trust can be also supported through blockchain especially if platforms are built on transparent governance structures. So, trust is not only about the technology but also about how it's managed and who has access.

At the same time, the research highlights that blockchain doesn't always function as a "trust machine". In certain contexts, such as government-led countries like Russia, trust is built through top-down, centralized systems. In these cases, blockchain could not be a solution rather than threat. So, it means that Trust Theory can't be applied by default, rather depends on its form (centralized vs. decentralized) that plays a crucial role in how blockchain can be evaluated and adopted.

New Theoretical Insights

This study offers three key theoretical contributions of trust in supply chains:

1. **Contextual Integration of Theory and Practice:** By combining and analyzing real-world and industry-specific issues (like franchise models or regulatory constraints) with theoretical frameworks, the research presents a holistic and nuanced points of view of how trust operates in practice.
2. **Complementary Trust Systems:** Rather than replacing existing trust systems, blockchain often works in parallel. This is essential where trust is built through both centralized systems and decentralized technologies.

3. **Highlighting Theoretical Tensions:** The study highlights a key tension within Trust Theory itself. In other words, there is a discrepancy between trust that is based on institutions and centralized systems, and trust that is built through blockchain's decentralized verification. This contrast illustrates the need to rethink and refine the Trust Theory in order to better reflect how trust builds in evolving digital environments.

5.5 Practical Implications

For supply chain managers, this study underscores the importance of aligning blockchain initiatives with operational realities and stakeholder capabilities. Blockchain is more likely to deliver value when there's a clear traceability goal, when partners are digitally prepared, and the technology can be smoothly integrated with existing platforms across entire supply chain.

It is also important to note that the effective implementation of blockchain technologies is most feasible in open ecosystems without heavy centralized government control. In such environments, issues like clear standards and strong data governance are essential for improving transparency and building trust between supply chain stakeholders. Moreover, wide geographical distribution of the supply chain when it involves countries with different regulatory regimes and levels of digital infrastructure can make blockchain implementation across the entire network more complex or even unaffordable.

5.6 Limitations of the Study

This study is based on a limited number of case studies and expert interviews, which may affect broadly findings in general. It focuses primarily on early-stage or pilot implementations of blockchain, meaning that long-term outcomes are not fully captured. Additionally, access to some confidential data was limited, and not all relevant stakeholders

were available for interviews. So, as a qualitative study, it prioritizes depth over breadth, which means that some topics and variables might not be fully explored.

5.7 Recommendations for the Future Research

Future research should examine the impact of blockchain on supply chain performance overtime through empirical real-world long-term case studies. Quantitative research could also add value and supplement future research study measuring changes in trust, transparency, and resilience before and after blockchain implementation. Additionally, greater attention should be given to governance models, data standards, and how blockchain interacts with other technologies like the Internet of Things (IoT), Artificial Intelligence (AI), or with existing Enterprise Resource Planning (ERP) systems.

Comparing different regions could help to explore how cultural, legal, and institutional factors shape the challenges and limitations of blockchain adoption. Finally, the future research should focus on the growing complexity of global supply chains to better understand how it affects the real-world scalability and impact on blockchain solutions.

5.8 Summary

This chapter provided a comprehensive discussion of the study's findings, structured around four key themes: traceability, risk management, trust, and adoption challenges. By comparing results across case-studies and expert interviews, and aligning them with existing literature and theoretical frameworks, the chapter highlighted both the potential and limitations of blockchain technology in the supply chains. While blockchain can support transparency, resilience, and trust, its successful adoption depends on context-specific factors such as governance, system maturity, and stakeholder alignment. The next and final chapter will summarize its main contribution and reflect on the original research objectives.

Restating the Research Aim and Objectives

The aim of this study was to explore how blockchain technology can enhance supply chain security, transparency, and resilience, with a particular focus on its role in building trust and reducing risk. To achieve this, the research explored blockchain adoption across four case studies: Terra Delyssa, Maersk, Walmart, and Volvo using a multiple case study approach complemented by expert interviews. The study was guided by five core objectives: (1) evaluate the effectiveness of blockchain in improving transparency and security; (2) analyze current gaps in trust and traceability; (3) explore the barriers to blockchain adoption; (4) examine implementation challenges across sectors; and (5) offer recommendations for successful and sustainable blockchain integration.

Summary of Key Findings

The study explored that blockchain technology enables significantly enhance traceability, particularly in food and retail supply chains, by creating, immutable and data-proof records accessible to stakeholders across entire supply chain network. It also helps to reduce risks by increasing transparency and enabling faster responses to disruptions, such as product recalls or counterfeit prevention. In addition, blockchain allows shift trust from interpersonal or technology-immutable systems.

Despite its benefits, blockchain adoption faces barriers and constraints such as high integration costs and investments, digital literacy gaps, platform fragmentation, and data governance concerns. These challenges are especially found in decentralized or franchise-based networks, as demonstrated in the IKEA example.

In contrast, there are another example of traceability that is observed in vertically integrated or government-controlled systems. It is important to underline, however, that those are not examples of blockchain technology, but rather centralized government-run marking and tracking systems. While these systems are effective at preventing counterfeiting but also allow government to have full control over company operations,

including financial flows. However, such tracking system doesn't provide transparency for citizens, clients, or end consumers, as the data remains centralized and inaccessible outside of government oversight.

Original Contribution of the Study

This thesis contributes to the academic literature by offering a comparative, cross-case analysis of blockchain adoption in supply chains based on practical case-study data and theoretical frameworks. It explores Supply Chain Risk Management (SCRM) Theory by highlighting blockchain's ability to manage reputational and operational risks through immutable and temper-proof data access. It also investigates Trust Theory by demonstrating how blockchain fosters cognitive and institutional trust in complex supply chain environments.

Furthermore, this research offers comprehensive insights from industry experts, whose expertise highlighted that success of blockchain adoption depends on organizational readiness, governance context, and stakeholder alignment rather than on technology itself. By comparing centralized and decentralized models, the study offers a holistic view of how blockchain's value is shaped by institutional dynamics.

Reflections and Final Remarks

Blockchain has a transformative force for supply chain management, however it is still in infancy stage and faces significant challenges when it comes to adoption and scalability. Its success depends not only on its technical strengths but also on human factors, organizational readiness, and institutional factors. As this research has shown that blockchain adoption is more about social and strategic challenges. It means that future research should explore blockchain technology beyond the innovations and also focus on education, collaboration, and improvements in governance.

While the study's findings demonstrate that there is no one-fit-all approach due to its qualitative nature, they offer meaningful insights for researchers and practitioners interested in how blockchain can help to build more transparent, secure, and trustworthy supply chains.

And finally, the evolving blockchain nature proposes the continuous evaluation and adaptive approach in globalized and complex supply chain environment.

References

- Abidin, Adinda Amalia Putri, Andry Alamsyah, and Herry Irawan. 2024. "Blockchain for Traceability and Security in Pharmaceutical Supply Chain." Pp. 235–40 in *2024 IEEE International Conference on Industry 4.0, Artificial Intelligence, and Communications Technology (IAICT)*. BALI, Indonesia: IEEE.
- Al-Swidi, Abdullah Kaid, Mohammed A. Al-Hakimi, Hussam Al Halbusi, Jaithen Abdullah Al Harbi, and Hamood Mohammed Al-Hattami. 2024. "Does Blockchain Technology Matter for Supply Chain Resilience in Dynamic Environments? The Role of Supply Chain Integration" edited by K. Jermsittiparsert. *PLOS ONE* 19(1):e0295452. doi: 10.1371/journal.pone.0295452.
- A.P. Moller - Maersk. (2019, May 28). *CMA CGM and MSC to join TradeLens digital shipping platform*. <https://www.maersk.com/news/articles/2019/05/28/cma-cgm-and-msc-to-join-tradelens-digital-shipping-platform>
- Batwa, Abbas, and Andreas Norrman. 2021. "Blockchain Technology and Trust in Supply Chain Management: A Literature Review and Research Agenda." *Operations and Supply Chain Management: An International Journal* 203–20. doi: 10.31387/oscm0450297.
- Brookbanks, Mike, and Glenn Parry. 2022a. "The Impact of a Blockchain Platform on Trust in Established Relationships: A Case Study of Wine Supply Chains." *Supply Chain Management: An International Journal* 27(7):128–46. doi: 10.1108/SCM-05-2021-0227.
- Budler, Marko, Bernardo F. Quiroga, and Peter Trkman. 2024. "A Review of Supply Chain Transparency Research: Antecedents, Technologies, Types, and Outcomes." *Journal of Business Logistics* 45(1):e12368. doi: 10.1111/jbl.12368.
- Centobelli, Piera, Roberto Cerchione, Pasquale Del Vecchio, Eugenio Oropallo, and Giustina Secundo. 2022. "Blockchain Technology for Bridging Trust, Traceability and Transparency in Circular Supply Chain." *Information & Management* 59(7):103508. doi: 10.1016/j.im.2021.103508.
- Chelh, Sara, and Mariame Ababou. 2023. "Improving Green Supply Chain Resilience through Blockchain Innovation: A Risk Mitigation Perspective" edited by S. Bourekadi, M. L. Kerkeb, O. El Imrani, N. Rafalia, O. Zubareva, S. Khouliji, and J. Abouchabaka. *E3S Web of Conferences* 412:01056. doi: 10.1051/e3sconf/202341201056.
- CHO Group. (2023). *Our blockchain-powered traceability system*. <https://group-cho.com/home/>
- Creswell, J. W. (2018). *Research design: Qualitative, quantitative, and mixed methods approaches*. Sage.
- Dutta, Pankaj, Tsan-Ming Choi, Surabhi Somani, and Richa Butala. 2020. "Blockchain Technology in Supply Chain Operations: Applications, Challenges and Research Opportunities." *Transportation Research Part E: Logistics and Transportation Review* 142:102067. doi: 10.1016/j.tre.2020.102067.

- Francisco, Kristoffer, and David Swanson. 2018. "The Supply Chain Has No Clothes: Technology Adoption of Blockchain for Supply Chain Transparency." *Logistics* 2(1):2. doi: 10.3390/logistics2010002.
- Galvez, Juan F., J. C. Mejuto, and J. Simal-Gandara. 2018. "Future Challenges on the Use of Blockchain for Food Traceability Analysis." *TrAC Trends in Analytical Chemistry* 107:222–32. doi: 10.1016/j.trac.2018.08.011.
- Gupta, Rachita, and Ravi Shankar. 2024. "Managing Food Security Using Blockchain-Enabled Traceability System." *Benchmarking: An International Journal* 31(1):53–74. doi: 10.1108/BIJ-01-2022-0029.
- Hackius, N., & Petersen, M. (2017). *Blockchain in logistics and supply chain: Trick or treat?* In W. Kersten, T. Blecker, & C. M. Ringle (Eds.), *Digitalization in Supply Chain Management and Logistics: Proceedings of the Hamburg International Conference of Logistics (HICL)* (pp. 3–18). epubli.
- Hao, Fei, Yueming Guo, Chen Zhang, and Kaye Kye Sung Kye-Sung Chon. 2024. "Blockchain=better Food? The Adoption of Blockchain Technology in Food Supply Chain." *International Journal of Contemporary Hospitality Management* 36(10):3340–60. doi: 10.1108/IJCHM-06-2023-0752.
- IBM. (2020). *Focus on food safety*. IBM Corporation. <https://www.ibm.com/food>
- IBM. (2023). *IBM Food Trust documentation*. Retrieved from <https://www.ibm.com/docs/en/food-trust?topic=overview>
- Jüttner, Uta, Helen Peck, and Martin Christopher. 2003. "Supply Chain Risk Management: Outlining an Agenda for Future Research." *International Journal of Logistics Research and Applications* 6(4):197–210. doi: 10.1080/13675560310001627016.
- Kalpana, K., R. Maruthi, R. Sophia Janit, and S. Vinita Sushila Devi. 2023. "Implementation of Blockchain Technology for Safe Supply Chain Transactions." Pp. 1232–35 in *2023 5th International Conference on Inventive Research in Computing Applications (ICIRCA)*. Coimbatore, India: IEEE.
- Kamath, Reshma. 2018a. "Food Traceability on Blockchain: Walmart's Pork and Mango Pilots with IBM." *The Journal of the British Blockchain Association* 1(1):1–12. doi: 10.31585/jbba-1-1-(10)2018.
- Kshetri, Nir. 2018. "1 Blockchain's Roles in Meeting Key Supply Chain Management Objectives." *International Journal of Information Management* 39:80–89. doi: 10.1016/j.ijinfomgt.2017.12.005.
- Kwon, Ik-Whan G., and Taewon Suh. 2005. "Trust, Commitment and Relationships in Supply Chain Management: A Path Analysis." *Supply Chain Management: An International Journal* 10(1):26–33. doi: 10.1108/13598540510578351.
- Lincoln, Timothy. 2021. *Qualitative Research: A Field Manual for Ministry Students*. Atla Open Press.
- Liu, Yang, Wei Fang, Taiwen Feng, and Mengjie Xi. 2024. "Blockchain Technology Adoption and Supply Chain Resilience: Exploring the Role of Transformational Supply Chain Leadership." *Supply Chain Management: An International Journal* 29(2):371–87. doi: 10.1108/SCM-08-2023-0390.

- Maersk. (2022, November 29). *Maersk and IBM to discontinue TradeLens*. A.P. Moller - Maersk. <https://www.maersk.com/news/articles/2022/11/29/maersk-and-ibm-to-discontinue-tradelens>
- McKinsey & Company. (2024, July). *Technology trends outlook 2024*. <https://www.mckinsey.com/>
- Montecchi, Matteo, Kirk Plangger, and Michael Etter. 2019. "It's Real, Trust Me! Establishing Supply Chain Provenance Using Blockchain." *Business Horizons* 62(3):283–93. doi: 10.1016/j.bushor.2019.01.008.
- Nagariya, Ramji, Subhdeep Mukherjee, Manish Mohan Baral, and Venkataiah Chitipaka. 2024. "Analyzing Blockchain-Based Supply Chain Resilience Strategies: Resource-Based Perspective." *International Journal of Productivity and Performance Management* 73(4):1088–1116. doi: 10.1108/IJPPM-07-2022-0330.
- National School of Business and Management, Sidi Mohamed Ben Abdellah University, Fez, Morocco, Yasser El Ouarrak, and Aziz Hmioui. 2024. "Blockchain Technology and Supply Chain Resilience: A Bibliometric and Visualization Analysis." *Logforum* 20(1):117–32. doi: 10.17270/J.LOG.000960.
- Rakhra, Manik, Pritpal Singh, Aseem Khanna, Prikshat Kumar Angra, Ashwani Kumar, and Navneet Katoch. 2024. "Developing a Blockchain Framework for Enhancing Security in Food Supply Chains." Pp. 1–6 in *2024 International Conference on Electrical Electronics and Computing Technologies (ICEECT)*. Greater Noida, India: IEEE.
- Reid, Anne-Marie, Jeremy M. Brown, Julie M. Smith, Alexandra C. Cope, and Susan Jamieson. 2018. "Ethical Dilemmas and Reflexivity in Qualitative Research." *Perspectives on Medical Education* 7(2):69–75. doi: 10.1007/S40037-018-0412-2.
- Reid, K. B. (2018). *Ethical practice in qualitative research*. Sage.
- Saunders, M. L. (2019). *Research methods for business students*. Pearson Education.
- Shahzad, Khuram, Tahir Ali, Josu Takala, Petri Helo, and Ghasem Zaefarian. 2018. "The Varying Roles of Governance Mechanisms on Ex-Post Transaction Costs and Relationship Commitment in Buyer-Supplier Relationships." *Industrial Marketing Management* 71:135–46. doi: 10.1016/j.indmarman.2017.12.012.
- Shahzad, Khuram, and Shahid Hafeez. 2022. "Digital Trust in Business Ecosystem Collaboration." Pp. 242–54 in *Trust, Digital Business and Technology*. New York: Routledge.
- Shahzad, Khuram, Petri Helo, Mikko Ranta, and Essi Nousiainen. 2024. "Blockchain Technology for Operational Excellence and Supply Chain Resilience: A Framework Based on Use Cases and an Architecture Demonstration." *Technology Analysis & Strategic Management* 1–18. doi: 10.1080/09537325.2024.2304698.
- Sharma, Minky, and Pawan Kumar. 2021. "Adoption of Blockchain Technology: A Case Study of Walmart." Pp. 210–25 in *Advances in Marketing, Customer Relationship Management, and E-Services*, edited by R. Bansal, P. Malyadri, A. Singh, and A. Pervez. IGI Global.
- Thanasi-Boçe, Marsela, Nermain AL-Issa, and Omar Ali. 2022. "Combating Luxury Counterfeiting Through Blockchain Technology." Pp. 1–16 in *Blockchain Technologies*

- in the Textile and Fashion Industry, Textile Science and Clothing Technology*, edited by S. S. Muthu. Singapore: Springer Nature Singapore.
- VanderStoep, S. W. (2008). *Research Methods for Everyday Life: blending qualitative and quantitative approaches*.
- Volvo Trucks. (2019, August). *How can blockchain transform the logistics industry?* <https://www.volvotrucks.com/en-en/news-stories/insights/articles/2019/aug/how-can-blockchain-transform-the-logistics-industry.html>
- Volvo Cars. (2019a, October 18). *Volvo Cars to implement blockchain traceability of cobalt used in electric car batteries*. <https://www.media.volvocars.com/global/en-gb/media/pressreleases/260242>
- Walmart. (2019, June 13). *How Walmart is using blockchain to improve food safety*.
- Walmart Newsroom. <https://corporate.walmart.com/newsroom/2019/06/13/how-walmart-is-using-blockchain-to-improve-food-safety>
- Wang, Ziqi, and Yang Bai. 2023. "Enhancing Supply Chain Resilience through Government Subsidies and Blockchain Adoption: Ensuring Sustainability and Preventing Disruptions." *Managerial and Decision Economics* 44(7):3979–96. doi: 10.1002/mde.3932.
- Wieland, Andreas, and Carl Marcus Wallenburg. 2012. "Dealing with Supply Chain Risks: Linking Risk Management Practices and Strategies to Performance." *International Journal of Physical Distribution & Logistics Management* 42(10):887–905. doi: 10.1108/09600031211281411.
- Wong, Simon, John Kun-Woon Yeung, Yui-Yip Lau, and Tomoya Kawasaki. 2023. "A Case Study of How Maersk Adopts Cloud-Based Blockchain Integrated with Machine Learning for Sustainable Practices." *Sustainability* 15(9):7305. doi: 10.3390/su15097305.
- World Economic Forum. (2020). *Redesigning trust: Blockchain deployment toolkit*. <https://www.weforum.org/whitepapers/redesigning-trust-blockchain-deployment-toolkit>
- Xu, Pei, Joonghee Lee, James R. Barth, and Robert Glenn Richey. 2021. "Blockchain as Supply Chain Technology: Considering Transparency and Security." *International Journal of Physical Distribution & Logistics Management* 51(3):305–24. doi: 10.1108/IJPDLM-08-2019-0234.
- Yavaprabhas, Kongmanas, Mehrdokht Pournader, and Stefan Seuring. 2023. "Blockchain as the 'Trust-Building Machine' for Supply Chain Management." *Annals of Operations Research* 327(1):49–88. doi: 10.1007/s10479-022-04868-0.
- Yin, R. K. (2014). *Case study research: Design and methods*. Sage.
- Zhao, Ruijuan, Jay Bal, and Xiao Ma. 2021. "Creating Lean and Agile Supply Chains with Blockchain." Pp. 135–46 in *2021 The 3rd International Conference on Blockchain Technology*. Shanghai China: ACM.

Zhou, Zhili, Meimin Wang, Jingwang Huang, Shengliang Lin, and Zhihan Lv. 2022. "Blockchain in Big Data Security for Intelligent Transportation With 6G." *IEEE Transactions on Intelligent Transportation Systems* 23(7):9736–46. doi: 10.1109/TITS.2021.3107011.

Appendix

Appendix 1. Interview Questionnaire

The following questions were used during the semi-structured interviews with industry experts. The goal was to explore blockchain adoption in supply chains, focusing on transparency, risk management, trust, and adoption challenges.

Background and Experience

- Can you tell me a bit about your professional background and your current role?
- Have you ever had any experience working with blockchain or traceability systems?

Blockchain Adoption

- Has your organization implemented blockchain in its supply chain? If so, how was it used?
- What motivates your company to explore or avoid blockchain implementation?

Transparency and Traceability

- In your opinion, how does blockchain affect traceability and transparency in supply chains?
- Do you think existing systems like ERP provide enough traceability without the need for blockchain?

Risk and Resilience

- How do you think blockchain can help manage risks and strengthen supply chain resilience?
- Can you share any examples where blockchain helped identify or prevent disruptions, if you have those?

Trust among Stakeholders

- Do you think blockchain can help build trust among stakeholders? In what ways?

Challenges and Barriers

- What are the biggest challenges your company faces when it comes to blockchain adoption?
- Are there any specific concerns related to costs, integration with existing systems, digital readiness, or getting stakeholders on board?

Future Perspectives

- Do you see a future for blockchain in your company or industry?
- What factors do you believe could make blockchain implementation more feasible?