From Micro to Meso-Level Blockchain Adoption: Redefining Supply Network Dynamics and Collaboration

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Acknowledgement

The journey toward academic achievement is rarely one walked alone, and as an international student pursuing my doctoral studies abroad, I have been fortunate to be supported by remarkable individuals whose guidance, encouragement, and care have made all the difference. As I reflect on this transformative experience, I am filled with profound gratitude for those who have helped me navigate this path and made it truly meaningful.

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This achievement is a reflection of the collective support I have received from both my academic mentors and my family. To my supervisors and my family, I extend my heartfelt thanks. Your belief in me, your guidance, and your endless encouragement have made this journey not just possible, but deeply meaningful.

Research Motivation

About seven years ago, I began exploring blockchain in food supply chains through a marketing lens, focusing on its potential to improve transparency, traceability, and consumer trust. My Master's research deepened this inquiry by examining how blockchain-facilitated transparency influenced consumer behavior, revealing the critical role of trust in adoption. I soon realized that understanding blockchain's impact required a broader perspective, one that considered the entire supply chain ecosystem rather than just consumer perceptions.

This realization shaped my PhD research, which explores blockchain adoption across supply chain stakeholders, including suppliers, manufacturers, retailers, and regulators. By integrating both individual and organizational perspectives, my research introduces a comprehensive model that captures main adoption drivers, such as trust, organizational readiness, and external pressures. Initially focused on the food and fashion industries both of which face challenges in traceability and ethical sourcing, I expanded my scope to automotive and pharmaceuticals, enabling comparative analysis of adoption patterns across sectors.

Engaging with industry professionals and mentors further refined my approach, highlighting the complexities of blockchain adoption and the need for a multi-dimensional framework. These discussions reinforced the importance of trust dynamics, regulatory constraints, and sector-specific challenges, shaping a model that offers actionable insights for both academia and industry. My research aims to bridge the gap between theoretical understanding and practical implementation, empowering organizations to navigate blockchain adoption with greater clarity and confidence.

1.Introduction

In recent years, blockchain technology has garnered widespread recognition for its transformative potential across various industries. Within the domain of supply chain management, blockchain presents an unparalleled opportunity to revolutionize traditional practices by addressing critical issues such as lack of transparency, limited traceability, and inefficiencies in data sharing. By leveraging blockchain's decentralized and immutable ledger, supply chains can improve trust among stakeholders, reduce the risk of fraud, and optimize operations across complex networks. These features are particularly relevant in industries where accountability and real-time data are paramount, such as food safety, pharmaceuticals, and automotive manufacturing.

Despite its evident promise, the adoption of blockchain technology in supply chains is neither uniform nor straightforward. Organizations face a diverse array of challenges and considerations when deciding whether to implement blockchain-based solutions. These decisions are influenced by a constellation of factors, including individual perceptions of utility, organizational readiness, regulatory environments, and sector-specific demands. The intricate nature of these factors often leads to significant variations in adoption rates across industries and geographic regions.

This research seeks to unravel the complexities underlying blockchain adoption in supply chains, providing a nuanced understanding of the motivations, barriers, and decision-making processes involved. It aims to investigate how individual actors, organizational entities, and sectoral dynamics converge to shape blockchain implementation. By adopting a mixed-methods approach, the study will explore the interplay between Micro-level motivations of individual actors, Meso 1-level organizational strategies, and Meso 2 power dynamics at a broader institutional level. Through this comprehensive examination, the research aspires to generate actionable insights and theoretical frameworks that advance both academic and practical understanding of blockchain adoption.

The scope of the study extends beyond a singular lens, exploring blockchain adoption from multiple perspectives to provide a holistic view. At the individual level, the research delves into personal attitudes, perceptions, and behavioral drivers that influence decisions regarding blockchain. At the organizational level, it examines how internal policies, resource availability, and strategic priorities affect the decision-making process. At the sectoral level, the study investigates external pressures such as market trends, regulatory frameworks, and competitive dynamics that drive or hinder adoption.

The findings of this research will not only enrich the scholarly discourse on blockchain technology in supply chains but offer practical value for businesses navigating the challenges of digital transformation. By identifying the critical factors that influence blockchain adoption and understanding their interdependencies, the study will provide organizations with a roadmap for implementation. The development of a comprehensive adoption framework applicable across diverse industries will contribute to bridging the gap between theory and practice, enabling more informed decision-making in the era of supply chain digitization.

1.1. Research Plan

With emphasis on various industries, this study explores the adoption of blockchain in supply network. In contrast to adaptation, which entails making technical changes to technology, adoption is the acceptance and application of blockchain technology (Greenhalgh et al., 2017). Using a 3 Arenas model, the study examines adoption dynamics at the sectoral (Meso2), organizational (Meso1), and individual (Micro) levels, focusing on four comprehensive aspects: industry adaptability, cross-level feedback loops, stakeholder inclusivity, and multi-method validation. To confirm the model's generalizability and guarantee depth in the primary analysis of food and fashion, comparative insights from the automotive and pharmaceutical industries are incorporated sparingly. To weigh the environmental advantages of blockchain technology against its practical drawbacks, the study critically evaluates its sustainability trade-offs, such as energy consumption (e.g., Proof of Work vs. Proof of Stake). A methodical and multi-layered research approach is required because of the complexity of blockchain adoption in supply chains.

The factors influencing adoption decisions, the interactions between important stakeholders, and the strategic considerations at different supply chain ecosystem levels are all investigated in this study using a mixed-methods approach. By combining qualitative and quantitative data, the research plan aims to guarantee a thorough analysis. This allows for the introduction of a conceptual model, which facilitates a thorough understanding of the complex adoption process. Four holistic features are highlighted in the study's analysis of adoption dynamics at the individual, organizational, and sectoral levels using a 3 Arenas model (Micro, Meso1, Meso2):

-Including viewpoints from a variety of actors, such as farmers, designers, and regulators, is known as stakeholder inclusivity.

-Cross-Level Feedback Loops: Combining knowledge from Meso1, Meso2, and Micro levels to improve tactics.

-Industry Adaptability: Customizing the model to meet the demands of a particular industry (e.g., food safety, fashion authenticity).

-Combining qualitative (focus groups, interviews) and quantitative (Surveys, AHP) techniques to obtain reliable results is known as multi-method validation.

1.1.1. Research Objectives

The primary objectives of this research are to:

This research investigates the multifaceted drivers, barriers, and impacts of blockchain adoption within supply chains, focusing on the different industries, like food, fashion, and automotive, across individual, organizational, and sectoral dimensions. It seeks to elucidate the micro-level factors shaping adoption, such as trust, cost, and technical expertise, with particular emphasis on decision-making dynamics in food and fashion supply chains. At the organizational level (meso1.2), the study explores enablers and barriers, including strategic alignment and regulatory compliance, through surveys and the Analytic Hierarchy Process (AHP), examining sectoral influences like power dynamics and regulatory pressures via focus group discussions. Moreover, it critically evaluates the sustainability implications of blockchain technologies by comparing the environmental impacts of consensus mechanisms, such as Proof of Work (PoW) and Proof of Stake (PoS), to assess their alignment with sustainable supply chain goals. The research appraises the maturity of blockchain applications across diverse industries to contextualize their practical viability. This thesis aims to synthesize these insights into a holistic, multidimensional framework that integrates findings from the various sectors in different countries, offering actionable suggestions for sustainably in supply chains.

1.1.2. Research Methodology

To achieve the research objectives, the study is structured into three levels of analysis: Micro-level, Meso1-level, and Meso2-level. A mixed-methods approach, integrating both qualitative and quantitative techniques, guarantees a comprehensive understanding maintaining generalizability.

Micro-Level Analysis (Individual Actors)

Data Collection: Qualitative - Interviews (FCM)

This study employs a qualitative grounded theory methodology to explore the personal attitudes, perceptions, and behavioral factors influencing blockchain adoption within supply chain management across industries such as food, fashion, and tech. Through semi-structured interviews with stakeholder's supply chain managers, IT professionals, and end users the research identifies themes like perceived benefits, trust, transparency, and technological challenges. Data analysis is conducted using Atlas.ti, applying a rigorous iterative coding process (open, axial, and selective coding) to uncover significant themes and relationships. Additionally, research hypothesis testing is incorporated to quantify and validate important findings, while a Fuzzy Cognitive Map (FCM) is introduced to model the complex interdependencies between factors such as trust, transparency, and reputation, offering a comprehensive understanding of the micro-level drivers of blockchain adoption in supply chains.

Meso 1-Level Analysis (Organizational Dynamics)

Data Collection: Quantitative - Surveys Questioners (AHP)

This stage will quantify the organizational factors that drive or hinder blockchain adoption and illuminate the decision-making frameworks firms employ. A large-scale survey will be distributed to organizations in Europe, the United States, Canada, Turkey, and the United Arab Emirates, covering a broad spectrum of industries for robust cross-regional and cross-sector insights. Survey items will draw on micro-level findings (Arena 1), ensuring that the most pertinent organizational dynamics are captured. Respondents will rate each factor on a concise three-point scale, enabling clear comparisons while dampening emotional bias. To prioritize these factors, the survey will incorporate the Analytic Hierarchy Process (AHP), prompting structured pairwise comparisons that reveal the relative importance of each element and further reduce socially desirable-response bias.

Meso 2-Level Analysis (Sectoral Power Influences)

Data Collection: Qualitative - Focus Groups Discussions (Triangulation)

Employs a qualitative, to explore how sector-specific power dynamics impact blockchain adoption across industries. This phase focuses on understanding the influence of regulatory challenges, market pressures, and hierarchical structures particularly between MNCs and SMEs on technology adoption. Data is collected through semi-structured interviews and focus group discussions (FGDs) with decision-makers from various sectors, ensuring a broad and diverse range of perspectives. Five focus groups, each with 4–6 participants, provide in-depth insights into the external and internal forces shaping adoption. The analysis uses Atlas.ti for thematic coding and interpretation, allowing for the identification of patterns and relationships. By applying a triangulation strategy, the study integrates qualitative findings from interviews (Arena1), FGDs, and Arena 2 survey data to cross-validate results and enhance interpretive reliability.

2.Blockchain Technology Role in Sustainable Supply Chains

Blockchain, often tied to cryptocurrencies, is revolutionizing supply chains by fostering transparency, traceability, and sustainability (Zheng et al., 2017). In the food and fashion industries, where ethical and eco-friendly products are in high demand, blockchain tackles fraud, waste, and opacity. Its immutable, decentralized records empower stakeholders to verify every step from farm to table or raw material to runway (Zhang et al., 2022). Yet, high costs, technical complexity, and regulatory hurdles slow adoption. This section weaves a narrative of blockchain's transformative impact, using real-world examples to illustrate its role in creating sustainable, trustworthy supply chains.

2.1. Blockchain's Transformative Potential

Blockchain's decentralized ledger guarantees data integrity through tamper-proof blocks validated by consensus mechanisms like Proof of Work (PoW) or Proof of Stake (PoS) (Cui et al., 2023). It addresses critical supply chain issues: food fraud costs $40 billion annually, and fashion's counterfeit market drains $30 billion (Aslam et al., 2023; Zhang et al., 2023). Environmentally, food waste accounts for one-third of global production, and fashion generates 92 million tons of textile waste yearly (Liu et al., 2023; Patil & Bhosale, 2023).

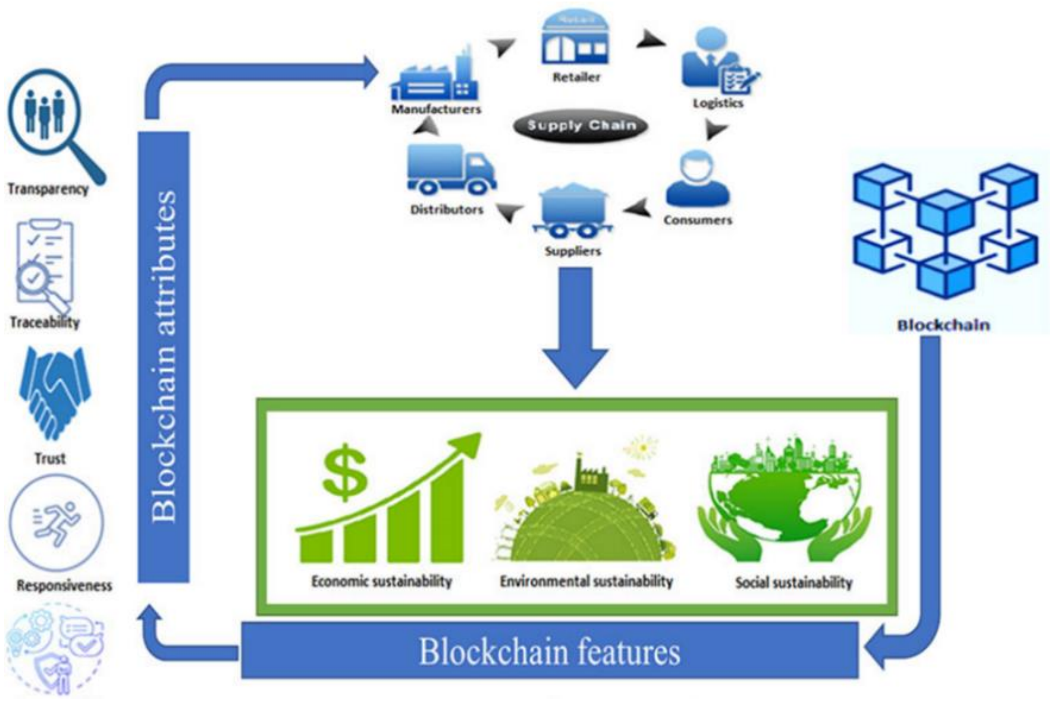


Figure 01. Blockchain Adoption for Sustainable Supply Chain Management

Source: Developed by the author based on a review of existing literature.

Figure 01: illustrates the multidimensional impact of blockchain adoption on supply chains, emphasizing economic, environmental, and social benefits. Economically, blockchain streamlines operations and reduces costs by automating verification and reducing intermediaries (Desplanques, Thienpondt, & Demuynck, 2020). Environmentally, it permits precise tracking of resources and waste, supporting sustainability initiatives (Martínez-Peláez et al., 2023). Socially, blockchain promotes trust by ensuring ethical sourcing and labor practices (Wade, 2022).

2.2. Applications in Food and Fashion Supply Chains

Blockchain's immutability, transparency, and automation address food and fashion challenges, from ethical sourcing to waste reduction. The following subsections explore its impact on transparency, ethical practices, efficiency, and sustainability, with vivid examples.

2.2.1. Transparency and Ethical Practices

Opaque supply chains erode trust by hiding product origins and labor conditions. Blockchain provides verifiable, end-to-end records. In food, Thai Union traces tuna from ocean to supermarket, ensuring ethical sourcing (Rowan, 2023). Nestlé tracks palm oil and cocoa to combat deforestation and verify organic/fair trade claims, using cryptographic signatures for data integrity (Wade, 2022; Saberi et al., 2018). This reduces food fraud, like mislabeling, which undermines markets (Aslam et al., 2023).

In fashion, Provenance's blockchain documents fair wages and safe workplaces for H&M (Ding et al., 2023). Counterfeiting, a $30 billion issue, is tackled by Avery Dennison's EVRYTHNG, authenticating luxury goods via digital certificates (Bhatia & Albarrak, 2023). These systems encourage accountability, aligning with consumer demands for ethical standards.

2.2.2. Efficiency and Sustainability

Blockchain streamlines operations and promotes sustainability. In food, smart contracts allow real-time inventory tracking, minimizing spoilage. Carrefour's blockchain optimizes stock visibility, reducing food waste a third of global production (Ayala et al., 2022). Food for All traces surplus food, facilitating charitable donations (Ayala et al., 2022). Safety is increased: Walmart's IBM blockchain isolates contaminated batches during outbreaks (Li et al., 2022).

In fashion, blockchain supports circular economies. Stella McCartney monitors organic cotton and recycled polyester, and Fashion for Good follows garment lifecycles to encourage recycling (Lee & Eum, 2023). Adidas uses SAP Leonardo's blockchain for efficient material sourcing and order processing (Kshetri, 2022). Sustainability depends on consensus mechanisms: PoW's high energy use clashes with eco-goals, but PoS minimizes consumption, ideal for green supply chains (Tian et al., 2023). Blockchain incentivizes sustainable agriculture CarbonX rewards organic farming, and AgriDigital optimizes water and fertilizer use (Wang et al., 2023; Gichuhi et al., 2023). In South America, blockchain verifies leather from responsible farms, curbing emissions (Zheng et al., 2017).

2.2.3. Challenges and Future Directions

Blockchain faces adoption barriers: high costs deter small enterprises, fragmented supply chains complicate integration, and regulatory inconsistencies hinder standardization (Chandan et al., 2023). Large transaction volumes strain scalability, requiring data compression, PoW's energy consumption raises environmental concerns, unlike PoS (Liao & Vaughan, 2023). Solutions include affordable platforms like Hyperledger for SMEs and ISO standards for regulatory harmony.

Future trends include permissionless blockchains for decentralized supply chains, tokenization to incentivize recycling, and AI-driven analytics for optimization, as seen in 2024 IBM and SAP pilots. Integration with IoT (e.g., food storage sensors) and AI (e.g., demand prediction) create smarter supply chains, explored further in Section 3 (Zheng et al., 2018). Blockchain's trajectory points to interconnected, sustainable supply chains, with Walmart's traceability and Stella McCartney's eco-materials as harbingers of a responsible future.

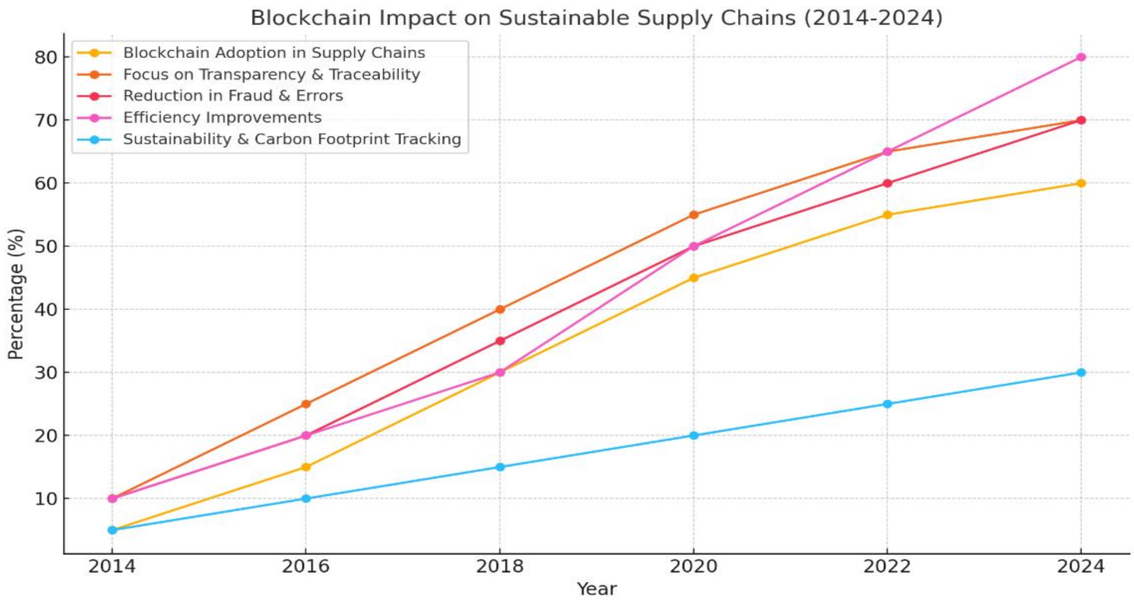


Diagram 01. Blockchain Impact on SSC

Source: World Economic Forum (WEF), Accenture Blockchain Reports and McKinsey & Company report.

Source: Developed by the author based on a review of existing literature.

Diagram 01*:* This line graph illustrates the growing impact of blockchain on sustainable supply chains from 2014 to 2024, based on five metrics: Blockchain Adoption in Supply Chains (*orange*), Focus on Transparency & Traceability (*yellow*), Reduction in Fraud & Errors (*red*), Efficiency Improvements (*pink*), and Sustainability & Carbon Footprint Tracking (*blue*). All metrics exhibit an upward trend, with adoption and transparency leading. By 2024, adoption reaches approximately 80%, transparency exceeds 70%, fraud reduction and efficiency are around 65%, and sustainability tracking approaches 30%. The steepest growth is observed post-

2018, reflecting increased recognition of blockchain’s role in enhancing transparency and reducing fraud. However, sustainability tracking lags, suggesting slower progress in environmental applications.

2.3 Blockchain Energy Consumption and Sustainability Trade-Offs

Blockchain’s sustainability benefits like improved traceability and ethical sourcing are counterbalanced by energy consumption concerns, which differ across consensus mechanisms such as Proof of Work (PoW) and Proof of Stake (PoS). This section examines their environmental impact and implications for food and fashion supply chains, highlighting trade-offs and future directions.

2.3.1 Proof of Work (PoW)

PoW requires miners to solve complex computational puzzles to validate transactions, demanding significant energy. Bitcoin’s PoW blockchain, for instance, consumes around 150 TWh annually comparable to Argentina’s national energy use (Vukolic, 2015). In supply chains, PoW is rare but appears in public blockchains for transparency. Provenance’s 2018 fish tracking project on Ethereum’s PoW platform, for example, required substantial energy per transaction, clashing with sustainability goals in food supply chains. For SMEs like small farmers or boutique fashion brands, PoW’s steep infrastructure costs, such as powerful servers, pose a challenge, and its carbon emissions are under review due to regulations like the EU Green Deal in 2020, which focuses on reducing carbon (Hainsch et al., 2022; Alexa et al., 2021).

2.3.2 Proof of Stake (PoS)

PoS selects validators based on staked assets, eliminating energy-intensive computations. Ethereum’s transition to PoS in 2022 reduced its energy use by 99.95%, consuming less than 0.01 TWh annually (Ethereum Foundation Teams, 2024). In supply chains, PoS is prevalent in permissioned blockchains. For example:

Food Industry: IBM Food Trust, used by Walmart, employs a PoS, like mechanism to track produce (e.g., leafy greens) with minimal energy, enabling rapid traceability across suppliers.

Fashion Industry: VeChain’s PoS blockchain allows brands like Stella McCartney to confirm sustainable cotton, lowering energy expenses and maintaining authenticity. PoS aligns with sustainability by lowering carbon footprints and operational costs, making it accessible for

SMEs. PoS requires governance to prevent centralization, as large stakeholders could dominate validation, potentially reducing trust in supply chains. For instance, a fashion consortium like Aura must secure equitable validator selection to maintain stakeholder confidence.

2.3.3 Implications for Supply Chains

Most supply chain blockchains are shifting toward Proof-of-Stake (PoS) or permissioned models to reduce energy consumption, increase accessibility for SMEs, and meet regulatory carbon goals such as those of the EU (Liu, Li, & Chen, 2023). In the food industry, PoS enables high-frequency traceability, crucial for monitoring perishables from farm to retailer, while in fashion, it supports low-impact verification of authenticity, such as certifying organic materials both aligning with growing consumer demand for sustainability (Kumbharkar et al., 2023). While public Proof-of-Work (PoW) blockchains offer high transparency e.g., allowing consumers to scan QR codes for supply data they come with steep energy costs, making PoS a more efficient yet less open alternative. These trade-offs highlight how supply chain blockchain choices reflect sector-specific priorities: food prioritizes traceability, fashion emphasizes authenticity. Regulatory pressure strongly influences the move toward PoS, creating feedback loops across organizational and individual levels (Liu, Li, & Chen, 2023). Future developments like IoT-integrated energy tracking and sharding techniques may further reduce environmental impact and expand adoption.

2.4 Significant Aspects: Security, Transparency, and Behavioral Factors

Blockchain technology transforms food and fashion supply chains by enabling transparency, traceability, sustainability, and ethical sourcing. Yet, its adoption requires navigating complex trade-offs between transparency and security, alongside behavioral and organizational barriers (Wang et al., 2022; Shahzad et al., 2023). This section explores these dynamics, examining how companies balance data sharing with confidentiality, overcome resistance, and leverage blockchain for efficiency and sustainability. Grounded in institutional theory, it analyzes multi-level influences individual, organizational, and sectoral shaping blockchain adoption.

2.4.1. Security vs. Transparency: Striking a Balance

Blockchain's immutable ledger fosters transparency, enabling stakeholders to trace products and verify ethical practices, which builds consumer trust in food and fashion supply chains (Agnihotri et al., 2023). IBM's Food Trust, used by Walmart and Nestlé, traces produce origins, enhancing safety without exposing sensitive data (Patil & Bhosale, 2023). In fashion, VeChain authenticates luxury goods for Louis Vuitton, reducing counterfeiting through transparent histories (She, 2022). Transparency demands data sharing, raising security concerns about commercial confidentiality and consumer privacy (Wang et al., 2022).

In food, Carrefour's blockchain- supported QR codes for chicken traceability risk consumer data misuse, potentially violating GDPR (Li et al., 2023). In fashion, Provenance's platform, which tracks labor conditions, may expose worker data, posing ethical risks (Smith & Jones, 2024). Blockchain counters these issues with cryptographic security and decentralization, preventing data tampering and single-point failures. Permissioned blockchains, such as IBM's Food Trust, restrict data access to approved parties, and zero-knowledge proofs validate data (e.g., authenticity) without exposing sensitive information, improving privacy in both sectors (Brown & Green, 2024). These solutions balance transparency with security, protecting commercial and consumer data.

2.4.2. Behavioral Factors in Blockchain Adoption

Blockchain's success depends on collaboration among supply chain actors, like suppliers, manufacturers, distributors, and retailers who must adopt new processes and share data (Shahzad et al., 2023). Behavioral barriers, such as perceived complexity, high costs, and resistance to change, hinder adoption, particularly for smaller firms (Vern et al., 2023). In food, small farms view blockchain as resource-intensive, lacking expertise or capital, which widens the digital divide (Afzal et al., 2023). In fashion, businesses with legacy systems resist blockchain's disruption (Meisenbach & Brandhorst, 2018).

Successful initiatives offer solutions. Walmart's Food Trust provides small suppliers with training, user-friendly tools, and subsidies, reducing complexity and showcasing benefits like developing traceability (Latha et al., 2023). In fashion, Provenance engages small suppliers through intuitive interfaces and partnerships with H&M, demonstrating increased consumer trust and market access (Ding et al., 2023). Institutional pressures, such as EU transparency regulations, further incentivize adoption (Murphy et al., 2021). Industry initiatives like Food Trust and Provenance encourage collaboration, build trust, and align blockchain with sectoral norms, encouraging diffusion (Babaei et al., 2023).

2.4.3. Blockchain's Role in Enhancing Supply Chain Efficiency and Sustainability

Blockchain strengthens efficiency and sustainability by automating processes and ensuring ethical practices. Smart contracts streamline tasks like payment verification, reducing delays and costs (Zhang et al., 2023). In food, blockchain optimizes inventory, minimizing waste (Hu, 2023). In fashion, material traceability improves sourcing efficiency (Kshetri, 2022). AI-driven analytics could further improve demand forecasting, as explored later. Blockchain combats fraud and promotes ethical sourcing: in food, it prevents mislabeling, ensuring authenticity (Li et al., 2023); in fashion, it verifies eco-friendly materials (Lee & Eum, 2023). Traceability empowers consumers to choose sustainably, pressuring businesses to adopt responsible practices.

Blockchain's potential hinges on addressing security, transparency, and behavioral challenges. Permissioned blockchains and zero-knowledge proof maintain a balance between openness and confidentiality (Wang et al., 2023). By enhancing efficiency, reducing fraud, and promoting sustainability, blockchain meets consumer and regulatory demands (Geissdoerfer et al., 2017; Onuora & Georgina, 2023; Eggleston et al., 2021). Future trends, like decentralized identity solutions, may further address privacy concerns (Orellana et al., 2023). Subsequent chapters analyze these dynamics using a multi-level adoption framework (Gilani et al., 2023).

3. Challenges and Opportunities in Technology Integration

Modern supply chains have evolved into complex, interconnected networks, driven by globalization and technologies like blockchain, IoT, AI, and cloud computing (Adebayo & Kırıkkaleli, 2021). In food and fashion, these innovations tackle safety, sustainability, labor ethics, and fraud, aligning with consumer expectations for clarity (Cobbe et al., 2023). Integration faces hurdles like cybersecurity risks, standardization gaps, and skills shortages (Huang & Zhao, 2022). This chapter explores technological evolution, industry-specific challenges and innovations, essential issues in safety and ethics, fraud and consumer behavior, and the future of digital transformation, emphasizing opportunities for transparent, sustainable supply chains.

3.1 Technological Evolution in Supply Chains

Digitization has revolutionized supply chain efficiency, transparency, and resilience, integrating IoT, AI, blockchain, and cloud computing to create value-driven networks (Adomako & Nguyen, 2023). IoT sensors monitor product conditions (e.g., temperature in food logistics), ensuring safety compliance (Palanisamy et al., 2023). Cloud computing facilitates seamless data access, reducing inefficiencies (Armbrust et al., 2010). AI optimizes logistics through predictive analytics, cutting costs via demand forecasting (Rasool et al., 2022). Blockchain promotes transparency, combating fraud with immutable records (Zheng et al., 2017). Maersk's Trade Lens platform, for instance, digitizes trade documents, reducing customs time by 40% and saving $6 billion annually (Saberi et al., 2018).

Real-world applications highlight these benefits. In food, a blockchain pilot reduced traceability time for leafy greens from days to seconds, saving $1.5 million in costs (Cui et al., 2023). In luxury goods, De Beers' Tracr blockchain certifies over 1 million diamonds, tackling a $500 billion counterfeit market (Lindner et al., 2023). In pharmaceuticals, blockchain prevents counterfeit drugs, reducing risks by 99% in EU pilots (Yaroson et al., 2023).

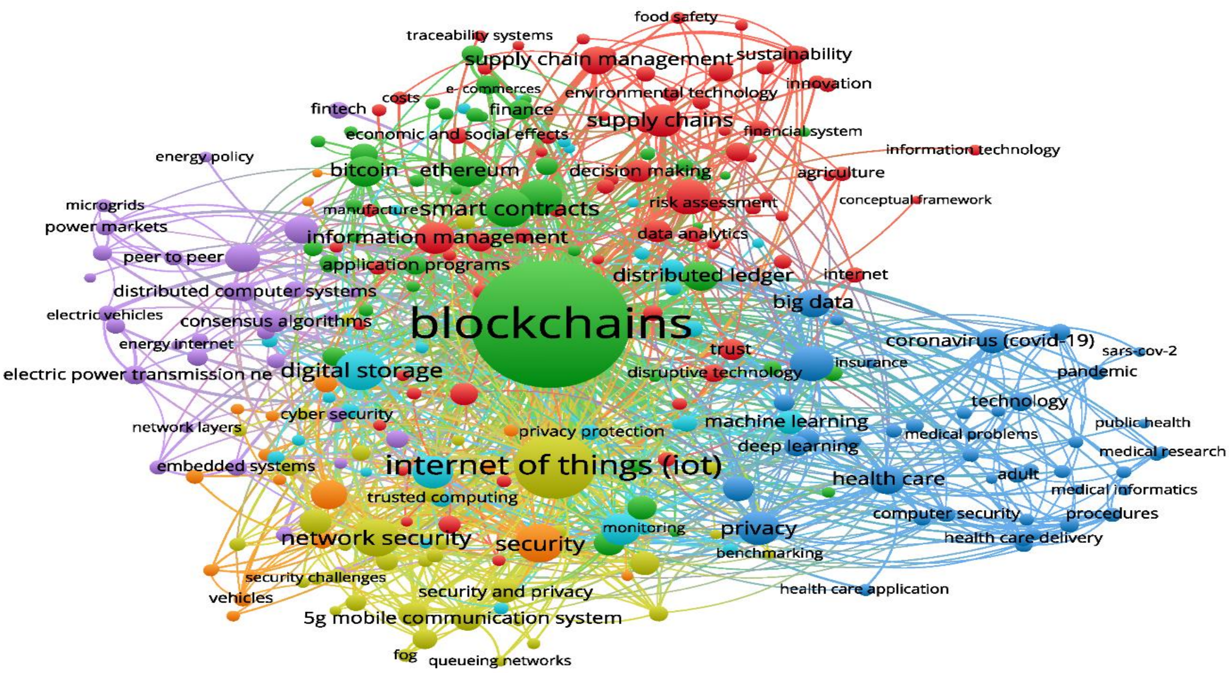


Figure 02: VOS viewer Map of Blockchain in Supply Chains, 2020-2023

Source: Developed by the author based on a review of existing literature.

VOS viewer *(figure 02),* Generated using VOS viewer from 300 articles (Scopus, 2020-2023), with a minimum of 5 occurrences per keyword, resulting in 60 keywords across 7 clusters. This map, created with VOS viewer, visualizes keyword co-occurrence based on their frequency and co-occurrence strength. The VOS (Visualization of Similarities) model groups terms into six clusters: *Red cluster (top):* Focuses on blockchain and supply chain management, emphasizing data exchange and sustainability (e.g., TradeLens for document processing). *Green cluster* (center-right): Centers on smart contracts and cryptocurrencies, relevant to blockchain frameworks (e.g., Ethereum smart contracts). *Blue cluster* (bottom-right): Explores healthcare, including medical informatics, health care delivery and problems (e.g., blockchain in medical records). *Purple cluster* (left): Covers energy and distributed systems, such as PoW vs. PoS comparisons. *Yellow cluster* (bottom-left): IOT and network security, highlights emerging technologies like 5G. *Orange cluster* (bottom): Highlights network security, including cybersecurity challenges and privacy (e.g., securing IoT data). *Light blue cluster* (center-left, smallest): Focuses on digital storage and monitoring, including terms related to data management and real-time tracking (Yang et al., 2021 Liu, al., 2023). The map supports the study's focus on blockchain adoption in food and fashion supply chains, aligning with the 3 arenas model's holistic features.

Integration faces challenges. Cybersecurity risks, like a 2020 ransomware attack on a trucking firm, cost $600 billion annually (Huang & Zhao, 2022). Standardization gaps across blockchain platforms hinder interoperability (Cacciamani et al., 2021). A skills gap affects 50% of supply chain leaders, causing inefficiencies (Nelson et al., 2022). Organizational inertia in smaller firms slows adoption because of costs and resistance (Rogers & Srivastava, 2021). Solutions include industry collaboration, standardized protocols (e.g., ISO blockchain standards), and training programs like IBM's blockchain certification.

Blockchain's maturity poses challenges. Food and fashion applications (e.g., VeChain for authenticity) show progress, but interoperability issues (e.g., Hyperledger vs. Ethereum), data quality errors, and scalability constraints limit adoption (Cacciamani et al., 2021; Smith & Jones, 2024). Organizational barriers, like skills shortages and high PoW costs, further hinder SMEs (Chandan et al., 2023). Industry standards and training can address these, as explored through Arena 2 surveys in this research.

3.2. Food and Fashion Supply Chains: Challenges and Innovations

Food and fashion supply chains share vulnerabilities in safety, sustainability, and ethical sourcing, driven by consumer demand for transparency (Friedrich, 2021). Technological innovations, particularly blockchain and IoT, address these challenges, fostering sustainable practices and aligning with circular economy principles (Geissdoerfer et al., 2017).

Shared Challenges: Both industries face environmental and ethical pressures. Food supply chains lose one-third of global production to waste, straining resources like water and energy (FAO)in 2023. Fashion contributes 10% to global carbon emissions, driven by water-intensive processes like cotton production, which require 2,700 liters per T-shirt (Qian et al., 2022). Ethical concerns, such as labor exploitation in fashion's developing-country factories, mirror food industry issues like unsustainable farming practices (Min et al., 2019; Guo et al., 2023).

Innovations for Sustainability: Blockchain strengthens traceability, with Walmart and Carrefour using IBM's Food Trust to track food origins, ensuring safety and sustainability (Musamih et al., 2023). In fashion, LVMH and Prada leverage blockchain to verify authentic, ethically sourced luxury goods (Ponte et al., 2023). IoT sensors track food storage conditions to minimize spoilage, and in fashion, they monitor production impacts to support sustainability (Neto et al., 2023). Circular economy models are gaining traction: Patagonia's Worn Wear program encourages garment repair and recycling, and food companies reuse by-products to cut waste (Seif et al., 2023; Bhatia et al., 2023).

Collaborative Solutions: Sustainability requires collaboration. Patagonia and Unilever embed sustainability in their business models, with Unilever aiming for carbon neutrality by 2039 and Patagonia using recycled materials (Veras et al., 2023). Industry-wide KPIs, such as carbon footprint and ethical labor metrics, support data-driven sustainability improvements (Robinson et al., 2023). High implementation costs and resistance to change pose barriers, necessitating stakeholder cooperation and standardized guidelines (Choi et al., 2023).

3.2.1. Key Issues

Safety, labor ethics, and quality are critical concerns in food and fashion, amplified by high-profile incidents and consumer expectations for ethical, high-quality products (Swink et al., 2023).

Food Safety: Foodborne illnesses, affecting 600 million people annually, underscore the need for traceability (Singha et al., 2022). The 2011 E. coli outbreak in Europe and the 2013 horse meat scandal exposed supply chain opacity, eroding trust (Kobayashi et al., 2018; Scott et al., 2019). Blockchain and IoT interventions, like Walmart's traceability system and IoT sensors for real-time monitoring, safeguard safety and compliance, reducing contamination risks (Yao, 2023; Xi et al., 2023). Certifications like Fairtrade and Organic further bolster consumer confidence (Murphy et al., 2022).

Labor Conditions in Fashion: The 2013 Rana Plaza collapse, killing over 1,100 workers, highlighted labor exploitation in fashion (Pham et al., 2023). Brands like H&M and Patagonia use blockchain and third-party certifications to guarantee fair wages and safe conditions, with Everlane's "Radical Transparency" model disclosing factory details (Husain et al., 2023; Kshetri, 2022). Consumer demand for ethical practices drives these changes, with 58% willing to pay more for responsibly produced garments (Jain et al., 2023).

Quality Expectations: In food, quality encompasses safety, nutrition, and ethical sourcing, with the organic market projected to reach $320 billion by 2025 (Tohidi et al., 2022). In fashion, consumers prioritize aesthetics, durability, and sustainability, with 77% concerned about environmental impacts (Jain et al., 2023). Technologies like blockchain and QR codes support quality and transparency, enabling brands to meet these expectations (Brandín & Abrishami, 2021).

3.3. Fraud, Counterfeiting, and Consumer Behavior

Fraud and counterfeiting erode confidence in food and fashion, as shifting consumer preferences call for increased clarity and ethical standards (Shahzad et al., 2023).

Fraud and Counterfeiting: Food fraud, such as honey adulteration, and fashion counterfeiting, valued at $509 billion in 2019, pose health and economic risks (Egido et al., 2023; Freitas, R., 2021). Carrefour upholds food integrity, and LVMH combats counterfeit luxury goods (Zheng et al., 2018). These solutions restore trust and protect brand value.

Consumer Expectations: Consumers increasingly prioritize health, safety, and sustainability. In food, Nespresso's blockchain-based Sustainable Quality Program traces coffee origins, aligning with demands for ethical sourcing (Ho et al., 2022). In fashion, 77% of consumers seek sustainable products, with brands like Patagonia using blockchain and QR codes to disclose production details (Lundén, 2021). Millennials and Gen Z drive this shift, favoring transparent, ethical brands (Gomes et al., 2023).

Technology's Role: Blockchain, IoT, and AI improve transparency and trust. IoT sensors maintain food safety during transport, and AI forecasts consumer trends to minimize waste (Akmandor et al., 2018; Ponte et al., 2023). Cloud computing permits real-time data sharing, empowering consumers with product information (Armbrust et al., 2010).

3.4 Digital Transformation and the Future of Supply Chains

Digital transformation is reshaping food and fashion supply chains, driven by consumer demands and technological advancements (Patil & Bhosale, 2023).

Current Trends: AI-driven forecasting reduces overproduction, with Amazon cutting inventory costs by 20% (Aguiar & Pérez-Juárez, 2023). Blockchain's market in supply chains is projected to grow from $3 billion in 2020 to $9 billion by 2025 (Qin et al., 2023). IoT and cloud computing increas visibility, supporting sustainability and efficiency (Karras et al., 2023).

Privacy and Governance: Data privacy is critical, with 81% of consumers valuing trustworthy data handling (Braulin, 2023). The 2022 Optus breach exposed risks in interconnected systems (Yeoh et al., 2023). Blockchain's secure architecture and robust governance frameworks, like GDPR compliance, mitigate these concerns (Zheng et al., 2017; Raghuwanshi, 2023).

Outlook: As consumer expectations evolve, technologies will drive ethical, transparent supply chains. Collaborative approaches, standardized platforms, and sustainability KPIs will guarantee long-term success (Martínez-Peláez et al., 2023). Companies like Walmart and Patagonia, leveraging blockchain and AI, exemplify how innovation encourages trust, efficiency, and sustainability, positioning them for leadership in a competitive, consumer-centric market (Hagiu & Wright, 2023).

The integration of blockchain, IoT, AI, and cloud computing transforms food and fashion supply chains, addressing safety, ethics, fraud, and sustainability challenges Cybersecurity risks, lack of standardization, and skill shortages remain challenges, but cooperative solutions and technological progress create substantial possibilities. By aligning with consumer demands for transparency and responsibility, companies can build resilient, value-creating networks, as explored further in subsequent chapters through an institutional lens.

3.5 Critical Assessment of Blockchain Maturity

Blockchain's potential in supply chains is tempered by its evolving maturity, technical challenges, and organizational barriers, particularly in food and fashion.

Maturity Level

Blockchain has progressed from experimental to operational stages in supply chains. Food applications (e.g., IBM Food Trust) and fashion platforms (e.g., VeChain) demonstrate maturity in traceability and authenticity. Widespread adoption is limited by technical and organizational constraints, varying by industry and region.

Technical Challenges

Interoperability: Diverse blockchain platforms (e.g., Hyperledger, Ethereum) lack standardized protocols, hindering data sharing across supply chains (Cacciamani et al., 2021). In food, this complicates multi-supplier traceability; in fashion, it affects global brand consortia.

Data Quality: Blockchain's immutability amplifies errors if inaccurate data is recorded, as seen in early food pilots where manual inputs led to discrepancies (Smith & Jones, 2024).

Scalability: High transaction volumes strain permissioned blockchains, increasing costs for SMEs in both industries (Joshi, 2023).

Organizational Challenges

Resistance to Change: Legacy systems in SMEs resist blockchain integration, particularly in food supply chains with traditional practices (Rogers & Srivastava, 2021).

Skills Shortages: Approximately 50% of supply chain leaders lack blockchain expertise, a barrier for fashion SMEs adopting platforms like Aura (Nelson et al., 2022).

Cost: Implementation costs, especially for PoW-based systems, deter adoption, though PoS reduces this barrier (Chandan et al., 2023).

Implications

Food and fashion benefit from established platforms, but technical challenges like interoperability require industry standards. Organizational barriers, particularly for SMEs, necessitate training and subsidies. These challenges link cross-level feedback loops, as sectoral (Meso2) standards influence organizational (Meso1) adoption, shaping individual (Micro) perceptions in this work. The holistic model's multi-method validation will assess these barriers through interviews and surveys, ensuring robust insights.

4. Individual vs. Organizational Adoption Factors

Building on the technological evolution, industry-specific challenges, and consumer-driven trends explored in Chapter 3, this chapter examines the factors influencing blockchain adoption in sustainable supply chains (SSCs) from both individual and organizational perspectives. The SSC perspective, defined as a holistic approach integrating environmental, social, and economic sustainability across supply chain actors (Khan et al., 2022), extends beyond ethical sourcing to encompass dynamic networks of upstream suppliers, downstream distributors, and other stakeholders. These actors shape blockchain adoption through trust, decision-making, and mental models, all critical to addressing transparency and sustainability challenges highlighted in Chapter 3 (Zheng et al., 2017). This chapter analyzes trust dynamics, individual vs. organizational perspectives, mental models, the interplay of past and future influences, and power dynamics, offering insights into maximizing blockchain's impact on resilient, ethical supply chains.

4.1 Trust and Decision-Makers

Trust is foundational to SSCs, prompting cooperation, reducing conflict, and ensuring reliable transactions (Khan et al., 2022). Blockchain's decentralized, immutable ledger improves trust by enabling secure data sharing, transparency, and fraud prevention, particularly in global networks with limited direct relationships (Buterin, 2015; Liao & Vaughan, 2023). Trust operates at two levels: interpersonal (based on personal relationships and experiences) and inter-organizational (driven by systemic factors such as certifications and compliance mechanisms) (Khan et al., 2022). Table 1 summarizes these distinctions, linking them to blockchain's role in addressing trust challenges identified in Chapter 3, such as fraud and counterfeiting.

Trust Type	Definition	Blockchain Role	Example
Interpersonal	Trust is built through personal relationships and shared experiences.	Provides verifiable records when relationships are disrupted, or new partners join.	Provenance platform for Stella McCartney's material traceability (Al-Issa et al, 2022).
Inter-organizational	Trust is based on systemic mechanisms like certifications, audits, or blockchain.	Guarantee secure, transparent data sharing across complex, multi-tiered supply chains.	Unilever's palm oil traceability for ethical sourcing (Khan et al., 2022).

Table 1: Interpersonal vs. Inter-Organizational Trust in Blockchain Adoption

Organizational Trust

Organizational trust stems from systemic factors such as corporate reputation, certifications, and industry standards (Wang et al., 2023). Multinationals like Nestlé and Unilever leverage blockchain to foster trust in ethical sourcing, as seen in Nestlé's IBM Food Trust initiative. This system traces palm oil to prevent deforestation and human rights abuses, saving $2 million annually in compliance costs (Kshetri, 2022; Pareira, 2023). Blockchain reduces fraud risks, safeguards data integrity, and provides stakeholders from farmers to consumers with immutable product journey data, reinforcing trust across the supply chain (Ridge et al., 2023; Zheng et al., 2018).

Individual Trust

Individual trust relies on personal relationships and experiences, often reducing the immediate need for blockchain in established partnerships (Lin et al., 2023). In extended or disrupted supply chains, blockchain's transparent transaction records mitigate fraud and foster responsiveness to issues like foodborne illnesses or counterfeits (Zheng et al., 2017). For example, QR codes allow consumers to verify the authenticity of luxury goods, addressing the $509 billion counterfeit fashion market noted in Chapter 3 (Chen et al., 2023; Freitas, R. 2021). This extends trust beyond direct relationships, aligning with consumer transparency demands.

4.2 Organizational Versus Individual Perspectives

The adoption of blockchain technology is shaped by distinct organizational and individual perspectives, driven by differing priorities, as summarized in Table 02 (Liu, Wang, & Xiong, 2023). Organizations focus on strategic, long-term benefits such as scalability, resilience, and alignment with corporate goals, whereas individuals emphasize immediate operational impacts like efficiency and trust (Zheng et al., 2017). Diagram 02 complements this by illustrating a multi-level model of influence, showing how individual behaviors, organizational strategies, industry norms, and societal systems interact through dynamics of power, politics, and learning to shape blockchain adoption.

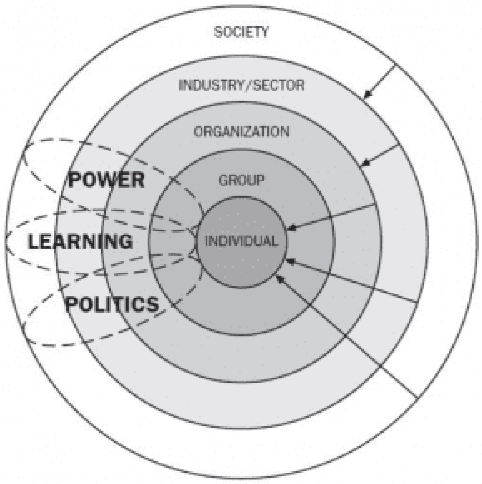


Diagram 02. The perspectives of organizational and individual actors

Source: Developed by the author based on a review of existing literature.

Diagram 02: visualizes the interconnected levels of influence individual, group, organization, industry/sector, and society showing how they interact bidirectionally in the context of new adoption. At the center, individuals drive group dynamics through their actions and learning, while groups shape organizational strategies, such as leveraging blockchain for competitive advantage. Organizations influence industry standards, which in turn affect societal trends and regulations, while societal shifts feedback to impact individual behavior. The forces of power, politics, and learning, depicted by arrows, highlight these mutual influences, noting that individuals may resist new technology like blockchain due to perceived barriers, while organizations focus on strategic benefits, emphasizing the need to analyze these interconnections for effective decision-making in complex systems. (Liu, Wang, & Xiong, 2023).

Actor	Focus	Blockchain Benefits	Challenges
Organizational	Scalability, resilience, CSR goals	Data integrity, contract enforcement, transparency	High costs, standardization gaps
Individual	Operational efficiency, trust	Streamlined workflows, fraud prevention	Perceived complexity, workflow disruption

Table 02: Organizational vs. Individual Perspectives on Blockchain Adoption

Organizational issues

Organizations seek long-term benefits, such as data integrity and supply chain resilience. Walmart's blockchain initiative, discussed in Chapter 3, traces leafy greens in seconds, reducing contamination risks and saving $1.5 million annually (Zheng et al., 2017; Ramasami et al., 2023). Blockchain supports Corporate Social Responsibility (CSR) goals, with 71% of consumers preferring sustainable, transparent brands (Accenture, 2020). Unilever's palm oil traceability aligns with these demands, enhancing brand reputation (Eggleston et al., 2021).

Individual Issues

Individual decision-makers, such as procurement officers or suppliers, prioritize operational efficiency but may resist blockchain because of perceived complexity or costs (Lee, 2023). In trust-based relationships, blockchain may seem unnecessary unless fraud or market changes disrupt operations (Zheng et al., 2018). Exposure to inefficiencies, such as delayed traceability, can shift perspectives, highlighting blockchain's value in improving data visibility.

4.3 Mental Models in Decision-Making

Mental models cognitive frameworks shaped by experience, culture, and industry context guide blockchain adoption decisions (Bansal et al., 2019).

4.3.1 Coercive Pressures

Coercive pressures stem from regulatory mandates and power dynamics. For example, EU food safety regulations (e.g., Regulation (EC) No 178/2002) mandate traceability, prompting firms to adopt blockchain (Smith & Jones, 2020). Fashion faces similar pressures from ethical sourcing laws. At the individual level (micro), people adopt blockchain to meet mandates, organizations at the sectoral level (meso) align with industry regulations.

4.3.2 Mimetic Pressures

Mimetic pressures lead firms to emulate industry leaders. Walmart's adoption of IBM Food Trust prompted competitors to follow, enhancing legitimacy (Zheng et al., 2021). Fashion brands emulate LVMH's Aura platform. Designers view blockchain as a competitive edge, and firms adopt it to maintain industry parity.

4.3.3 Normative Pressures

Normative pressures arise from professional standards and consumer expectations. In food, consumer demand for transparency drives blockchain use. Fashion brands adopt blockchain to meet ethical sourcing expectations (e.g., VeChain). Managers and organizations align with these norms to build trust and meet standards (e.g., GS1 protocols).

4.3.4 Application to Adoption

Isomorphism explains the differences in adoption motives. Individuals respond to normative pressures (e.g., trust, transparency), organizations face coercive (regulations) and mimetic (competitive) pressures. For instance, in food, safety laws dominate; in fashion, brand differentiation drives adoption. These dynamics create feedback loops, shaping micro-level perceptions through meso-level strategies.

Stakeholder	Mental Model Focus	Blockchain Perception	Example
Consumers	Transparency, ethical sourcing	Verifies sustainability claims	QR codes for Fair Trade products (Gaudeul & Krawczyk,2023)
IT Managers	Automation, efficiency, security	Simplifies procurement, reduces costs	Retail chain inventory management (Opazo-Basáez et al., 2023)
Supply Chain Managers	Reliability, risk management	Improves traceability, reduces fraud	Food safety tracking (Schilling & Seuring, 2023)
Manufacturers/Suppliers	Established relationships, cost concerns	Skeptical unless disruptions highlight benefits	Small suppliers facing market changes (Schwenteck et al., 2023)

Table 03: Summarizes Stakeholder Mental Models and Blockchain Adoption

4.4 The Role of Trust in Adoption:

The Shadow of the Past and Shadow of the Future

The shadow of the past (established practices and trust) and the shadow of the future (anticipated risks and opportunities) shape blockchain adoption (Kunzelmann, 2019). Table 04 summarizes their impact across industries.

Concept	Influence	Industry Example	Impact on Adoption
Shadow of the Past	Established trust, resistance to change, cultural norms	**Food**: Small suppliers rely on personal trust (Musamih et al., 2023). **Fashion**: Legacy practices in luxury brands (Kim & Lee, 2023). **Automotive**: Manual procurement systems (Smith & Jones, 2024).	Slows adoption due to inertia and comfort with routines.
Shadow of the Future	Market trends, risk mitigation, regulatory compliance	**Food**: Traceability for safety (Biswas et al., 2023). **Fashion**: Ethical sourcing demands (Muldoon et al., 2023). **Automotive**: Supply chain resilience (Smith & Jones, 2024).	Accelerates adoption to meet consumer and regulatory demands.

Table 04: Shadow of the Past vs. Shadow of the Future in Blockchain Adoption

4.4.1. The Shadow of the Past

The shadow of the past reflects accumulated experiences and routines that resist change (Piglowski et al., 2010). In food supply chains, small suppliers prioritize personal trust, viewing blockchain as overly complex (Musamih et al., 2023). In fashion, legacy practices in luxury brands promote skepticism toward blockchain (Kim & Lee, 2023). The automotive industry's reliance on manual procurement systems creates inertia, with 60% of suppliers citing familiarity as a barrier (Smith & Jones, 2024). Cultural norms in family-owned businesses further reinforce resistance, perceiving blockchain as impersonal (Gero et al., 2020).

4.4.2. The Shadow of the Future

The shadow of the future emphasizes future risks and opportunities, such as consumer demands and regulations (Dung, 2023). In fashion, Patagonia and Everlane adopt blockchain to meet transparency expectations, aligning with 77% of consumers prioritizing sustainability (Muldoon et al., 2023; Jain et al., 2023). In food, blockchain mitigates contamination risks, as seen in Walmart's traceability system (Biswas et al., 2023). The automotive industry uses blockchain for supply chain resilience, addressing disruptions like semiconductor shortages

(Smith & Jones, 2024). The EU's Green Deal and sustainability regulations further drive adoption, ensuring compliance (Saberi et al., 2018).

4.4.3. Interplay Between Shadows

The tension between the past and future influences adoption. The shadow of the past foster's resistance, but future demands transparency, compliance, and risk mitigation prompt reassessment (Jang et al., 2023). Gradual integration, such as blockchain for high-risk products, balances tradition and innovation, as seen in food suppliers transitioning to traceability systems (Inomata et al., 2019). Organizations like Unilever blend established practices with blockchain, ensuring competitive advantage (Manyika, 2011).

4.5 The Role of Power Dynamics and Leadership Ego

Power dynamics and psychological factors significantly influence blockchain adoption. Large organizations like Walmart mandate blockchain use, pressuring smaller suppliers lacking resources to comply (Ramasami et al., 2023; Ryu & Sueyoshi, 2021). Support mechanisms, such as training and financing, are very important for equitable adoption (Ouyang et al., 2022). Leadership ego plays a role, with traditional decision-makers resisting blockchain due to fears of obsolescence (Zhou et al., 2017). Reframing blockchain as a legacy-building tool, as Gucci and Burberry have done to develop transparency, mitigates resistance (Freitas et al., 2023; Sharma et al., 2023).

Blockchain's benefits transparency, fraud reduction, and traceability are evident in Walmart's food safety initiatives and Gucci's ethical sourcing, aligning with Chapter 3's consumer trends (Sharma et al., 2023). Collaboration and education are critical to overcoming power disparities and biases, ensuring blockchain's integration across supply chains.

Individual and organizational decision-makers approach blockchain adoption differently. Individuals, including suppliers and managers, prioritize short-term operational concerns and trust-based relationships, often resisting blockchain because of complexity or cost (Lee, 2023). Organizations focus on strategic benefits like resilience, transparency, and CSR alignment, driving adoption albeit initial barriers (Zheng et al., 2017). The shadow of the past reinforces resistance, and the shadow of the future accelerates adoption through the market with regulatory pressures. Power dynamics and leadership ego further complicate adoption, necessitating collaboration and support to realize blockchain's potential for sustainable, transparent supply chains, as explored further in Chapter 5's institutional analysis.

5. Problem statement

Following the exploration of technological evolution (Chapter 3) and individual vs. organizational adoption factors (Chapter 4), this chapter delineates the challenges and research gaps in blockchain adoption within supply chains (SCs). Blockchain technology promises transformative benefits developed transparency, traceability, security, and efficiency across industries like food, fashion, and automotive, where trust and data integrity are paramount (Zheng et al., 2017). For example, Walmart's blockchain tracks leafy greens to maintain food safety, and Gucci uses it to counterfeit and confirm ethical sourcing. (Ramasami et al., 2023; Sharma et al., 2023). These advantages and adoption remain inconsistent because of technological, organizational, and industry-specific barriers. Existing literature often examines isolated aspects technological feasibility, consumer behavior, or organizational challenges without capturing the systemic interplay among supply chain actors. This research aims to address this gap by developing a holistic, multilevel model that integrates micro-level (individual), meso1-level (organizational), and meso2-level (network) factors, contributing to both theoretical understanding and practical implementation strategies for blockchain in SCs.

5.1. Research Gap

The literature on blockchain adoption in supply chains reveals five critical gaps, each underscoring the need for a comprehensive, integrated approach to understanding adoption dynamics. The proposed holistic model, defined as a multidimensional, interactive framework synthesizing social, economic, and technological factors across stakeholder levels, will address these gaps by integrating qualitative data (e.g., stakeholder interviews) and quantitative metrics (e.g., adoption rates, cost-benefit analyses) to capture interdependencies among individuals, organizations, and industries.

1. Lack of comprehensive multi-level adoption models:

Most studies fail to provide models that encompass decision-making across *micro-level* (individual behaviors, e.g., trust and risk perception) and *meso-level* (organizational dynamics, e.g., culture and infrastructure) factors, limiting their ability to explain blockchain diffusion in supply chains (Khan et al., 2022). For instance, Chapter 4 highlighted how individual trust influences adoption differently from organizational strategies, yet existing frameworks rarely integrate these perspectives. A holistic model is needed to synthesize these levels, capturing how individual attitudes (e.g., a manager's skepticism toward blockchain complexity) interact with organizational goals (e.g., achieving sustainability targets) within broader industry contexts. This model will combine stakeholder perspectives from IT professionals to executives to provide a comprehensive view of adoption dynamics, addressing the interrelationships absent in current research.

2. Industry-Specific Adoption Challenges:

Blockchain adoption varies across industries owing to distinct supply chain characteristics, yet few studies explore these nuances in depth. Table 05 summarizes the main drivers and barriers in food, fashion, and automotive sectors, building on Chapter 3's discussion of industry challenges. In food, traceability for safety drives adoption, as seen in Walmart's blockchain reducing contamination tracing from days to seconds (Ramasami et al., 2023). In fashion, counterfeiting ($509 billion issue) and sustainability demands, as addressed by Gucci's blockchain, are essential motivators (Sharma et al., 2023; Freitas, R. 2021). The automotive industry prioritizes resilience against disruptions like semiconductor shortages, with blockchain enhancing supplier coordination (Smith & Jones, 2024). However, barriers like data security concerns (food), interoperability issues (fashion), and complex supply chains (automotive) hinder progress. This research will investigate these sector-specific dynamics to develop targeted adoption strategies.

Industry	Key Drivers	Key Barriers	Example
Food	Traceability, food safety	Data security, regulatory compliance	Walmart's leafy greens tracking (Ramasami et al., 2023)
Fashion	Counterfeiting prevention, sustainability	Interoperability, high implementation costs	Gucci's ethical sourcing verification (Sharma et al., 2023)
Automotive	Supply chain resilience, supplier coordination	Complex supply chains, technological readiness	Blockchain for semiconductor tracking (Smith & Jones, 2024)

*Table 05:*3 Industries-Specific Drivers and Barriers to Blockchain Adoption

3. Limited Investigation into Cross-Level Interactions:

Current research often isolates micro-level factors (e.g., individual trust, as discussed in Chapter 4) or meso-level factors (e.g., organizational culture) without exploring their interplay. Cross-level interactions defined as the reciprocal influence between individual behaviors and organizational strategies within industry contexts are critical to adoption. For example, a supply chain manager's risk aversion (micro-level) may delay an organization's blockchain investment (meso-level), particularly in highly regulated sectors like food (meso-level). This study will analyze these interactions, using case studies and stakeholder surveys to reveal how individual perceptions shape organizational decisions and vice versa, providing a more complete picture of adoption dynamics.

4. Inadequate Attention to Non-technological Factors:

Technological aspects (e.g., scalability, security) dominate blockchain research, but non-technological factors like trust, regulatory demands, and consumer behavior remain underexplored. Trust among supply chain actors, critical of food and fashion as noted in Chapters 3 and 4, drives adoption but varies by context (e.g., interpersonal trust in small suppliers vs. inter-organizational trust in multinationals). Regulatory pressures, like the EU's Green Deal, push blockchain for compliance, yet consumer expectations for transparency (e.g., 71% prefer sustainable brands) play a role (Hainsch et al., 2022; Alexa et al., 2021;2020; Saberi et al., 2018). This research will integrate these factors into its holistic model, ensuring a broader perspective on adoption drivers.

5. Lack of Practical Implementation Frameworks:

Blockchain's potential, few actionable frameworks guide organizations through adoption. Companies struggle to assess blockchain's feasibility, resource needs, or integration with existing systems. For example, small fashion suppliers face cost barriers, unlike large retailers like Walmart, which leverage resources for rapid implementation (Ryu & Sueyoshi, 2021). This research will develop a practical framework, outlining steps from feasibility assessment to full implementation, tailored to industry contexts and stakeholder needs. This framework will draw on insights from Chapters 3 and 4, addressing both technological and non-technological barriers to facilitate blockchain adoption.

The uneven pace of blockchain adoption in supply chains stems from a lack of comprehensive models, industry-specific insights, cross-level understanding, attention to non-technological factors, and practical frameworks. By proposing a holistic model that integrates micro-, meso1-, and meso2-level factors, this research will address these gaps, offering theoretical advancements and actionable strategies. Focusing on food, fashion, and automotive sectors, it will explore intersectoral dynamics and stakeholder interdependencies, building on Chapters 3 and 4 to develop transparency, efficiency, and sustainability in SCs.

6. Conceptual Model for Blockchain Adoption in Supply Chains

This chapter presents a holistic 3 Arena model for blockchain adoption in supply network (SCs), addressing Chapter 5's gap in comprehensive, multi-level frameworks. Defined as a multidimensional framework integrating micro-level (individual behaviors), meso1-level (organizational and network dynamics), and meso2-level (industry and regulatory contexts) factors, the holistic model captures social, economic, technological, and ethical dimensions to provide a complete understanding of adoption dynamics (Brown & Taylor, 2024). Building on Chapter 3's industry challenges (e.g., Walmart's traceability, Gucci's ethical sourcing), Chapter 4's trust and mental models, and Chapter 5's research gaps, the model (Figure 03) comprises Arena 1 (individual decision-making), Arena 2 (organizational strategies), and Arena 3 (network trust and power dynamics). Validated through qualitative interviews, quantitative surveys, case studies, social network analysis, and power analysis, it offers actionable insights for food, fashion, and automotive supply chains.

Meta analysis, Mind mapping and Participative discussions

ARENA 1: *MICRO:* THE MIND OF THE INDIVIDUAL DECISION MAKER
(1) Theoretical concepts
(2) Background variables
(3) Resulting reasons and arguments of individuals

ARENA 2: *MESO 1*: COMPANY LEVEL; WORLDVIEW AND HIERARCHY
(1) Resulting Company strategy;
(2) Type of network(s) selected for participation

ARENA 3: *MESO 2:* NETWORK LEVEL PARTICIPATION
(1) Network relation characteristics based on a diferentiated trust base
(2) Distribution of power and uniqueness in the network

Figure 03: The 4 steps taken and the 3 Arenas of decision making

6.1 Arena 1: Micro – Individual Level: The Mind of the Decision Maker

Arena 1 examines cognitive and behavioral factors shaping individual adoption, contributing to holism by capturing personal influences that interact with organizational and network levels, as noted in Chapter 4's mental models.

6.1.1 Theoretical Concepts

Individual attitudes toward blockchain are shaped by perceived ease of use, usefulness, and risk, per the Technology Acceptance Model (TAM) and Unified Theory of Acceptance and Use of Technology (UTAUT) (Liu & Ma, 2023). For example, Walmart's training programs reduced managers' skepticism by demonstrating traceability benefits, aligning individual perceptions with organizational goals (Ramasami et al., 2023). These frameworks facilitate the model holistically accounts for cognitive barriers, linking to Chapter 4's individual trust (Bhandal et al., 2022).

6.1.2 Background Variables

Personal characteristics professional background, technology experience, and biases influence adoption (Fresko & Levy-Feldman, 2023). IT professionals at Unilever, skilled in digital transformation, easily embrace blockchain, but traditional food suppliers hesitate due to dependence on outdated systems (Diaz-Serrano & Kallis, 2022; Chen et al., 2022). By including these variables, the model holistically captures individual diversity, feeding into organizational strategies.

6.2. Arena 2: Meso 1 – Organizational Level: Worldview and Hierarchy

Arena 2 examines organizational strategies and structures, contributing to holism by integrating meso-level priorities with individual and network dynamics, as per Chapter 5's call for organizational analysis.

6.2.1 Company Resulting Strategy

Organizational goals efficiency, transparency, sustainability drive blockchain adoption (Sullivan et al., 2012). Unilever's palm oil traceability program, saving $3 million annually, aligns with sustainability targets, influencing network partners and individual managers (Khan et al., 2022). Conservative firms resist because of costs, as noted in Chapter 4's inertia (Bhandal et al., 2022). This strategic focus supports the model holistically addresses organizational priorities, linking to Chapter 3's Walmart case (Ramasami et al., 2023).

6.3. Arena 3: Meso 2 – Network Level: Trust and Power Dynamics

Arena 3 explores network-level trust and power, contributing to holism by capturing inter-organizational relationships within industry contexts, aligning with Chapter 4's inter-organizational trust.

6.3.1 Network Relationship Characteristics Based on Differentiated Trust Base

Trust differs among actors, with major players like IBM Food Trust's partners (e.g., Carrefour) valuing blockchain's clarity, but small suppliers waver due to costs (Joshi, 2023; Yang et al., 2021). IBM Food Trust partners demonstrate network-wide traceability, but small farms require support, as discussed in Chapter 4 (Knezevic et al., 2023). This arena allows the model holistically address network dynamics, influencing individual and organizational levels (Saberi et al., 2018).

6.4 Achieving Holism in the 3 Arenas Model

The 3 Arenas model achieves holism by integrating micro-, meso 1-, and meso 2-level factors, synthesizing social, economic, technological, and ethical dimensions to address Chapter 5's gap in comprehensive models. Holism is defined as the model's ability to capture interdependencies among stakeholders (e.g., managers, organizations, suppliers) and contexts (e.g., industry regulations, consumer demands), providing a complete framework for blockchain adoption. *Table 06* outlines the model's holistic features, their mechanisms, and impacts, demonstrating practical applicability.

Feature	Mechanism	Example
Stakeholder Inclusivity	Incorporates diverse actors (individuals, organizations, networks) across supply chains.	Walmart's training for managers, Unilever's supplier mandates, IBM Food Trust's network collaboration (Ramasami et al., 2023; Khan et al., 2022).
Cross-Level Feedback Loops	Facilitates reciprocal influences between arenas (e.g., individual attitudes shaping organizational strategy, network trust influencing individuals).	Managers buy-in accelerates Unilever's blockchain pilot, IBM Food Trust's success encourages supplier adoption (Saberi et al., 2018).
Industry Adoptability	Tailors' adoption strategies to sector-specific needs (food, fashion, automotive).	Food: Walmart's traceability; Fashion: Gucci's counterfeiting prevention; Automotive: Volkswagen's resilience (Sharma et al., 2023; Ahmed, 2021).
Multi-Method Validation	Uses qualitative (interviews, FGD) and quantitative (surveys, network analysis) methods to synthesize data.	Surveys of manager perceptions, case studies of IBM Food Trust, network analysis of supplier trust (Brown & Taylor, 2024).

Table 06. Holistic Features of the 3 Arenas Model

The model's holistic approach is operationalized through:

***Data Integration**:* Qualitative interviews with managers and suppliers gather micro- and meso-level perspectives, and quantitative surveys and network analysis measure adoption trends, creating a thorough dataset (Brown & Taylor, 2024).

***Cross-Level Analysis**:* The model examines dynamic feedback loops such as individual resistance delaying organizational uptake, or network-level mandates influencing personal buy-in using social network analysis. These insights directly connect to the trust dynamics explored in Chapter 4.

Industry Contextualization: Sector-specific applications, informed by prior case studies (e.g., food traceability -Ramasami et al., 2023, fashion sustainability- Sharma et al., 2023), ensure the model adapts to diverse industry needs. This alignment responds to the contextual complexities outlined in Chapter 3.

***Ethical and Social Dimensions**:* By incorporating consumer trust and sustainability objectives, the model reflects broader CSR concerns, aligning with Chapter 4's focus on non-technological adoption of drivers.

By integrating these features, the model overcomes the isolated perspectives criticized in Chapter 5, providing a robust framework for understanding and implementing blockchain adoption across SCs.

7. Theoretical Framework: Foundations, Relevance, and Application

This chapter grounds the holistic 3 Arenas model (Chapter 6) in Institutional Isomorphism (DiMaggio & Powell, 1983), explaining how external pressures drive blockchain adoption in SCs. It addresses Chapter 5's gap in holistic models by analyzing mimetic, coercive, and normative pressures, linking to Chapter 4's trust and power dynamics and Chapter 6's arenas. The framework uses meta-analysis and mind-mapping to categorize adoption drivers and assess sustainability impacts, ensuring a comprehensive theoretical and practical approach.

7.1 Institutional Isomorphism

Institutional isomorphism shapes blockchain adoption in supply chains through mimetic, coercive, and normative pressures, operating within technological, regulatory, and professional arenas. These mechanisms integrate technological, regulatory, and ethical drivers into the holistic model, connecting micro-level decisions, meso-level strategies, and network dynamics (Chapter 6). By categorizing adoption drivers and evaluating their sustainability impact, this framework addresses Chapter 5's gap in non-technological factors and aligns with Chapter 4's CSR focus.

7.1.1 Mimetic Isomorphism in the Technological Arena: Innovation Through Imitation

Mimetic isomorphism drives firms to adopt blockchain by imitating industry leaders to reduce uncertainty. In the technological arena, fashion brands adopting Everledger's blockchain solutions exemplify this bandwagon effect, enhancing supply chain visibility (Zheng et al., 2017). This mechanism links micro-level managerial decisions to innovate with meso-level organizational strategies, as outlined in Chapter 6's Arena 2, fostering technological competitiveness.

7.1.2 Coercive Isomorphism in the Regulatory Arena: Compliance with Mandates

Coercive isomorphism compels blockchain adoption through regulatory requirements, such as the EU Green Deal. In the regulatory arena, Volkswagen's blockchain for tracking ethically sourced EV battery materials ensures compliance with transparency mandates (Hainsch et al., 2022; Chughtai et al., 2021). This pressure integrates meso-level regulatory contexts into the holistic model, influencing network dynamics (Chapter 6, Arena 3) and promoting sustainable practices.

7.1.3 Normative Isomorphism in the Professional Arena: Ethical Legitimacy Through Standards

Normative isomorphism encourages blockchain adoption to meet industry norms and consumer expectations. In the professional arena, Nespresso's blockchain for Fairtrade coffee traceability aligns with CSR standards, enhancing trust (Dionysis et al., 2022). This mechanism connects to Chapter 4's CSR framework and Chapter 6's Arena 3 trust dynamics, strengthening the model's ethical and social dimensions.

7.1.4. Blockchain as a Catalyst for Isomorphism Across 3 Arenas

Blockchain amplifies mimetic (industry trends), coercive (regulatory compliance), and normative (ethical alignment) pressures, integrating diverse drivers into the holistic model. A meta-analysis of these pressures underscores their role in advancing sustainability, addressing Chapter 5's focus on non-technological factors. For instance, EU regulations drive food retailers to adopt blockchain, prompting supplier compliance and building consumer confidence, while consumer expectations in fashion push brands to align with strategic goals.

7.1.5 Cross-Level Feedback Loops

The holistic model captures cross-level interactions among isomorphic pressures. Regulatory mandates (meso2) shape meso1 compliance priorities, influencing micro-level trust (Chapter 5). For example, EU regulations compel food retailers to implement blockchain, encouraging supplier alignment and enhancing consumer trust. In fashion, normative pressures from consumer expectations drive meso 1 strategic adoption. The holistic model's cross-level feedback loops are validated, as sectoral dynamics inform organizational and individual strategies.

7.2 Operationalizing Theory: Meta-Analysis and Mind Mapping in Research

Meta-analysis and mind-mapping (*Model 08, Appendix)* support the holistic model by synthesizing multi-level data, validating Chapter 6's 3 Arenas framework. The meta-analysis (Chart 01) reviews studies on traceability, trust, and technology acceptance across Scopus, Google Scholar, and other databases, using keywords like "blockchain effectiveness" and “supply chain transparency.” Mind-mapping (*Model 08, Appendix)* visualizes themes (e.g., trust, sustainability barriers), connecting micro-level perceptions and meso-level strategies, contexts to support a comprehensive analysis (Brown & Taylor, 2024). These methods contribute to holism by:

Synthesizing Diverse Data: Combining qualitative (case studies, interviews) and quantitative (surveys, network analysis) insights to capture all stakeholder perspectives.

Mapping Interdependencies: Visualizing how individual attitudes, organizational goals, and network trust interact, addressing Chapter 5’s cross-level gap.

Contextualizing Industry Needs: Tailoring findings to food, fashion, and automotive sectors, as per Chapter 3’s case studies.

Authors	Year	Method	Keywords
Xiaoning Qian and EleniPapadonikolaki	*2020*	Mixture of grounded theory research andnarrative research	Trust, Blockchain, Experience,Supply Chain
Alessandro Scuderi and Giuseppo Timpanaro	*2019*	A review of systematic literature; case studies	Blockchain, Traceability, Consumers, Security
Alexander Kharlamov andGlenn Parry	*2018*	The reviewed literaturestudied	Blockchain, SC, Habits, Biases
Viswanath Venkatesh andJames Thong	*2016*	The reviewed literaturestudied	Theory Evaluation, Technology Acceptance and Use, Unified Theoryof Acceptance and Use of Technology, Research Context, Literature Review, Multi-Level Framework
Sara Saberi, Mahtab Kouhizadeh, Jospeh Sarkisand Lejia Shen	*2018*	The reviewed literaturestudied	Blockchain, SCM, Sustainability,barriers
Kristoffer Francisco andDavid Swanson	*2018*	Introduction of Unified Theory of Acceptance(UTA)	Blockchain, Innovation, Traceability, Provenance, SCM, Transparency, Trust, UTA

Chart 01. Meta-analysis

8. Questions Raised

Research questions serve the purpose of showcasing the important questions that arise in the researcher's mind. Answering them can help understand the *From Micro to Meso-Level Blockchain Adoption: Redefining Supply Network Dynamics and Collaboration*. After reviewing the conceptual background and theoretical literature and concluding missing pieces in currently available academic results, research questions are formulated in accordance with the research purpose with the intent to scientifically improve examined areas. Table 07 presents the research questions of this dissertation.

RQ1:	**Given the blockchain capabilities, what is the motivation for actors to adopt the technology within supply networks?**
RQ1a:	What motivates upstream actors to adopt blockchain technology?
RQ1b:	What motivates downstream actors to adopt blockchain technology?
RQ1c:	How do differences in supply chain roles and responsibilities influence the adoption of blockchain technology?
RQ1d:	What external pressures (e.g., regulations, market competition) drive blockchain adoption in upstream and downstream actors?
RQ2:	**What goes on in the mind of the individual decision maker?**
RQ2a:	What factors (external / internal) affect the individual decision-maker's choice to adopt blockchain?
RQ2b:	What are the main arguments for and against adopting blockchain technology in the supply chain?
RQ3:	**Which factors are persuasive for participants to insert the required strategic information?**
RQ3a	How do economic and reputational factors influence the sharing of strategic information?
RQ3b	How does competitive pressure affect the willingness to share information?
RQ4:	**How does blockchain adoption contribute to sustainability goals in supply chains?**
RQ4a:	How does blockchain improve transparency and traceability of sustainable practices in supply chains?
RQ4b:	To what extent do stakeholders view blockchain as a tool for meeting sustainability requirements, such as ethical sourcing and energy consumption reduction?

Table 07. Research questions

8.1 Research Methodology

This study employs a stepwise mixed-methods (qualitative-quantitative) exploratory approach with a Grounded Theory lens to investigate blockchain adoption in supply chains (SC), supporting the holistic 3 Arenas model (Chapter 6). The methodology integrates micro-level (individual), meso 1-level (organizational), and meso 2-level (network) perspectives, addressing Chapter 5's gap in comprehensive models and Chapter 6's holistic features (stakeholder inclusivity, cross-level feedback loops, industry adaptability, multi-method validation). By combining qualitative narratives (interviews, focus groups) with quantitative analysis (Surveys, AHP), the approach fosters flexibility, validity, and real-world relevance, as outlined in Chapters 3–7.

8.2 Overview of Methodology

This section outlines the 3 methodological steps undertaken in the research and provides a detailed explanation of the validity measures implemented to boost the robustness and credibility of the findings. To establish the validity and reliability of the study, a multi-method approach was employed, incorporating both qualitative and quantitative techniques with built-in verification processes (*Table 11*. Methodology Support for Holistic Model Features-Appendix).

Qualitative Approach (Arena 1)

Considering the "Micro-level revolution" of blockchain technology adoption in supply networks as the focus of the study, the qualitative approach for data collection was multi-dimensional and diversified. The adoption process is so complex that the technical-only angle would not suffice for an adequate understanding of the various stakeholders' perceptions, motivations, and cognitive changes in the supply chain ecosystem.

Selection of Participants

In-depth interviews were carried out among a sampled range of participants to allow diverse representation of experiences and views concerning the blockchain and supply chain. The breakdown included the following categories:

1.Upstream Actors:

These are people or organizations who fall within production, manufacturing, sourcing, and distribution sections of the supply network. The focus was on food and fashion industries since these are very Crucial areas to understand in the applicability of blockchains. This category includes producers, manufacturers, logistics providers, and distributors, thereby providing insights into the operational perspectives and day-to-day realities of blockchain adoption.

2.Downstream Actors:

The respondents in this category represented "end-users" who interact directly with products and services within the supply network. This includes consumers, customers, retailers, and other stakeholders positioned toward the latter end of the supply chains. Engaging with downstream actors is crucial to assessing the impact of blockchain technology on customer experience, product transparency, and trust.

3. Experts:

Besides actors from the supply chain, an additional selection of industry experts was interviewed, which consisted of management, IT professionals, and other important decision-makers who drive the process of implementing blockchain solutions for organizations. Their insights offer a strategic perspective on challenges and opportunities that the adoption of blockchain presents across industries.

Atlas. ti Analysis Software

The interview data were analyzed qualitatively with the help of Atlas.ti software, a tool used for qualitative data management by coding (Soratto, Pires, & Friese, 2020). The steps involved in analysis included:

Coding: Major themes, patterns, and relationships were identified through systematic coding of interview transcripts (Baldoni et al., 2018). This allows the data to be organized in a manner that underlines critical insights and recurring motifs in the participants' narratives.

Theme Identification: The analysis sought to extract main themes related to the motivations, perceptions, and decision-making processes of the participants regarding blockchain adoption.

Fuzzy Cognitive Mapping (FCM) Model

One of the most important results of the qualitative analysis is the development of the FCM model. This model expresses in a complex way the interaction of factors that influence decision-making processes regarding blockchain adoption (Sagar et al., 2025). It covers the following aspects:

Interdependencies: The FCM model describes how different factors are interrelated and influenced by one another, providing a visualization of the main drivers for actors' decisions to adopt or not to adopt blockchain technology.

Motivations and Influences: The study extracted several reasons for the adoption of blockchain, supportive and inhibitive motivations. This would be very important for organizations considering how to get around the complexities of blockchain implementation.

Significance of Qualitative Methodology

The qualitative research methodology provides depth in the "microlevel revolution" occurring with blockchain adoptions in Arena 1 of the supply chain. It emphasizes perspectives not only from a technical point of view but discusses human aspects, like:

Motivation: "Participants' intrinsic and extrinsic motivations to adopt blockchain technology, an area critical for organizations considering successful implementation of technology,".

Perceptions: Understanding the perception of different actors about blockchain technology, its benefits, and challenges for their strategic decisions.

Cognitive Changes: Assessing changes in thinking patterns or cognition among stakeholders as an effect of the introduction of blockchain solutions in supply networks.

Quantitative Methodology (Arena 2)

In the second stage of the research, a quantitative approach is used to quantify perceptions and influences of decision-makers in the adoption of blockchain at an organizational level. In this regard, an online survey of large scale was designed based on the insights from the first qualitative study and an extensive literature review.

Survey Design

The survey questionnaire was designed to capture the perceived decision-making power of blockchain adoption across different functional areas within organizations. Some of the crucial attributes of the survey are as follows:

1. *Sample Size:* The sample size for the study is quite robust respondents, a sizeable number on which to base the analysis. This wide array of respondents covered professionals belonging to various industries such as fashion, food, pharmacy and automotive, which increases the generalizability aspect of the results.

2. *Demographic Diversity:* The survey had a heterogeneous sample drawn from various geographical locations, such as Europe, the USA, Canada, Turkey, and UAE, and from different company sizes (large and small). This diversity is important to support findings that are representative of various contexts and organizational settings.

Decision-Making Power Analysis

This questionnaire contained some qualitative aspects that asked the respondent to assess the relative powers of the different departments within their organization's perceptions of decision-makers about their influence on the blockchain adoption, for Arena 3 in explanation of Survey Questionnaire.

Analytic Hierarchy Process

Based on the scenario analyses, the overall hierarchical ranking was calculated using the Analytic Hierarchy Process (AHP) applied to the collective responses of all participants (Yu et al., 2019). AHP is a structured technique for organizing and analyzing complex decisions; it provides a systematic evaluation of options based on multiple criteria. In this study, a 3-point scale was used for participants to rate the relative importance of various organizational factors in each of the 10 scenarios presented that quantified the relative importance of various functional areas in driving blockchain adoption, providing a model of decision-making hierarchies. The pairwise comparison matrices were constructed using Excel to facilitate the AHP process, ensuring a structured and consistent analysis of the organizational factors.

Contextual Factor Considerations

To facilitate comprehensive analysis and deeper insights, the research examined several contextual factors influencing organizational decision-making:

1. *Sector:* Different industries may prioritize different departments based on their operational needs and unique market challenges. For example, a heavy marketing industry may reflect a stronger influence of that department in the decision-making process compared to others.

2. *Years of Experience:* This gives information about the job experiences of the respondents, authority, and influential levels in a hierarchy on a decision-making body. More seasoned decision makers may possess greater normative or actual power to drive adoption decisions.

3. *Gender:* Gender can provide an insight into how these gender roles, especially concerning the adoption of blockchain, can shape perceptions of powerful departments.

4. *Organization Size:* The size of the organization forms the basis of different layers and tiers in the company and makes many decisions. The bigger ones might have a more structural organization, whereas small-scale businesses may have flexible, fluid decision-making patterns.

5. *Geographic Location:* Cultural influence and substructures of local power are a further modification factor for the dynamics inside the organization. Technology adoption decisions can be influenced highly based on regional norms and practice guidebooks for doing business.

Rationale for Excluding a Literal Model

In this study, a literal model refers to an explicitly structured framework, such as the LISREL model, that directly represents power dynamics or departmental hierarchies in decision-making. Some models can provide clarity in structural analysis; their use carries the risk of influencing participant responses to social desirability bias. For instance, participants might overemphasize the role of highly regarded departments like Research and Development (R&D) or underreport the influence of less traditionally prominent departments, potentially distorting the authenticity of the findings.

To mitigate this bias, the study adopted scenario-based evaluations and the Analytic Hierarchy Process (AHP) instead. These methods permit an indirect assessment of decision-making hierarchies without making participants overtly aware of the framework being applied to their responses. This approach preserves the objectivity of the data collection process, ensuring that insights emerge naturally rather than being shaped by predefined structures.

Excluding a literal model aligns with the study's emphasis on contextually driven, data-derived insights. Rather than imposing a rigid framework that could precondition responses, this methodology allows for the organic identification of patterns and trends, enhancing the validity and reliability of the findings.

Qualitative Focus Group Discussions (Arena 3)

Arena 3 consisted of the final phase of qualitative research, wherein, based on findings from the previous stages in qualitative and quantitative ways, focus group discussions were undertaken. This phase of the research allowed us to deeply understand the communicative dynamics, power, and decision-making structures in supply chain networks, with particular emphasis on the use of blockchain. The triangulation of data sources and methods, combining both qualitative and quantitative findings, helped to enhance the reliability and validity of the results, ensuring a comprehensive understanding of the subject matter.

Participants in the focus group discussions were purposively selected to cover a broad range of sectors, geographical dispersion, gender balance, and firm size, with a group composition of 4 to 6 participants. This approach promoted diversity, capturing multiple viewpoints and factors affecting blockchain diffusion across varying contexts, thus ensuring that the findings were not limited to one perspective or sector.

Validity of Focus Group Discussions

Focus group discussions are one of the recognized qualitative research methods that offer several benefits in the investigation of complex social phenomena, such as blockchain adoption in supply chains. The application of focus groups in this study adds value to the issues of validity and data triangulation in the following ways:

1. Ensuring Rich and Diverse Data: The diverse pool of participants allowed the capture of multiple perspectives, hence increasing the richness of the data (Wu et al., 2023). It includes representatives of various industries, company sizes, and geographic locations, making the research findings representative of the variability in perceptions and adoption of blockchain across different types of supply chains. This variability is very relevant when researching technology such as blockchain that may be adopted in different ways depending on the challenges and needs of each industry.

2. Triangulation of Findings: The use of focus groups in addition to the earlier qualitative interviews and the survey data serves to increase the validity of the research findings (Lyon et al., 2019). By comparing insights from different data sources, such as interviews, surveys, and focus groups, the research is in a better position to triangulate findings and confirm patterns and relationships observed in earlier stages of the study. It confirms that the conclusions drawn are strong and based on multiple points, reducing any biases that may result from relying on a single source of data.

3. Building Consensus: Focus groups are very valuable in determining group interaction and building consensus in a group of participants (Davies et al., 2023). For this case, the discussion allowed interactions such that the responses of some participants were reacted to or built upon, enabling deeper investigation of factors contributing to blockchain diffusion. This kind of interaction helps in exploring shared understanding and conflicting ideas of perceptions about blockchain technology with a supply chain context.

4. Uncovering Hidden Factors: In group discussions, participants often bring up factors that may not have been directly addressed in individual interviews or surveys (Zhou et al., 2020). For instance, discussions of company size and strategic network positions showed how larger companies usually do not favor innovative but rather stable solutions-a pattern that was not as well-developed in earlier stages. By encouraging participants to elaborate on their views and interact with one another, focus groups are particularly effective at uncovering these subtle, yet important insights.

5. Encouraging Open Dialogue: The semi-structured format of the focus group interviews allowed flexibility in how topics were explored. The facilitators led the discussions through open-ended questions to get the participants to share their views freely, which is important in discussions that are sensitive, like those on power dynamics and pressures from suppliers and buyers .Informal discussions in focus groups can allow participants to speak more freely about the challenges they face, providing valuable insights into the barriers to blockchain adoption(Albayaydh & Flechais, 2023).

Advantages of Methodology

Completeness: The mixed-methods approach captures qualitative narratives (e.g., stakeholder perceptions) and quantitative patterns (e.g., adoption drivers), ensuring a comprehensive view of blockchain adoption across food, fashion, and automotive industries (Leso et al., 2022). This supports Chapter 6's stakeholder inclusivity by representing diverse actors.

*Flexibility**:*** The stepwise design adapts to emerging themes, ideal for exploration research into complex adoption dynamics (Uddin, 2021). This aligns with Chapter 6's cross-level feedback loops, allowing iterative analysis of stakeholder interactions.

*Grounded Theory Contribution**:*** Grounded Theory embeds findings in participant data, building theories from real-world experiences rather than preconceived frameworks, enhancing applicability (Soratto et al., 2020). This supports Chapter 6's multi-method validation.

*Enhanced Validity**:*** Triangulation of interviews, surveys, focus groups, and new methods reduces bias and strengthens credibility, addressing Chapter 5's call for robust frameworks (Lyon et al., 2019).

*Participative Data Collection**:*** In-depth interviews and focus groups capture stakeholder narratives, critical for understanding perceptions and motivations in blockchain adoption, as emphasized in Chapter 4's trust dynamics.

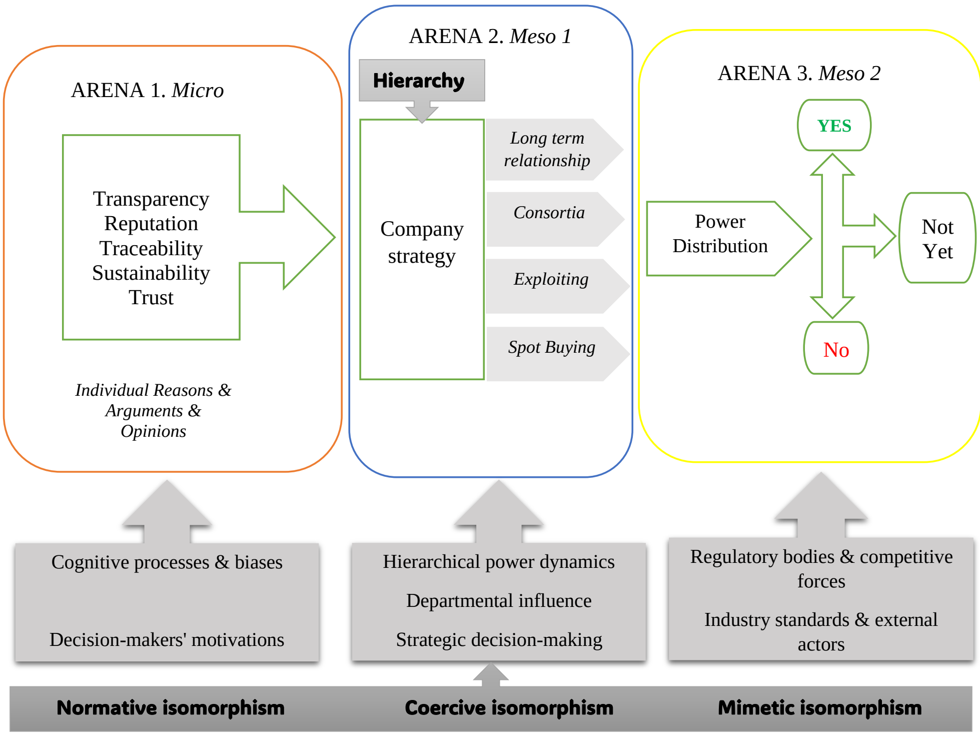
8.3.1. Validity Considerations of methodology

The qualitative interviews (FCM), quantitative survey and qualitative focus group discussions (FGDs) together form a holistic and multi-dimensional approach to understanding blockchain adoption in supply chains. Qualitative interviews offer deep insights into individual perspectives, shedding light on nuanced factors influencing decision-making. The quantitative survey applies Analytic Hierarchy Processing (AHP), to quantify the perceptions and decision-making power of diverse organizational stakeholders (Wang et al., 2018). These insights are further enriched by FGDs, which explore collective viewpoints and address communication and power dynamics within supply networks.

This methodology seamlessly integrates theoretical aspects with practical insights, effectively aligning with the concept of isomorphism. It provides a structured framework for examining organizational behavior and its alignment with broader institutional norms. By leveraging triangulation, the study maintains methodological rigor, with each approach validating and complementing the others. This integrated strategy develops the reliability and depth of the findings, offering a comprehensive understanding of the drivers of blockchain adoption across sectors.

8.3.2. Conceptual Layout for the Redesigned Figure 4: *The 3 Arenas Model*

Model 01 can be redesigned to illustrate the 3 Arenas Model (Gharehdaghi & Kamann ,2024a), which integrates three methodologies qualitative interviews, quantitative surveys using Analytic Hierarchy Process (AHP), and focus group discussions (FGDs) to provide a holistic view of blockchain adoption in supply chains. These methodologies are interconnected, with qualitative interviews offering individual insights, the survey quantifying stakeholder perceptions, and FGDs exploring group power dynamics. The concept of isomorphism ties these approaches together, emphasizing how organizational behavior aligns with institutional norms. Triangulation validates in Arena3 and reinforces the findings, ensuring methodological rigor by cross-verifying insights from each method, leading to a comprehensive, multi-dimensional understanding of blockchain adoption.



Model 01 - The 3 Arenas Model *(Gharehdaghi & Kamann, 2024a)*

9.Empirical research

The research was conducted in such a way to support that the results are valid at both individual and organizational levels of the supply chain, with 3 Arenas: Arena 1 (Micro-level), Arena 2 (Meso 1-level), and Arena 3 (Meso 2-level). Arena 1 concentrated on the individual actors' mindset, investigating how personal perceptions, behaviors, and decision-making affect blockchain adoption. This Micro-level analysis provided insight into the factors that drive or hinder blockchain acceptance at an individual level. Arena 2 shifts focus to the organizational level, examining how companies in the supply chain interact (Gharehdaghi & Kamann,2025) and how their internal structures and dynamics including their capabilities for opportunity sensing and seizing affect the adoption process (Semenova et al., 2023).In Arena 3, research was directed at the last decision-makers, or those at the top of the organizational hierarchy, and at the wider external forces, such as market pressures and sectoral trends, that influence strategic decisions on blockchain integration (Gharehdaghi & Kamann,2024b).

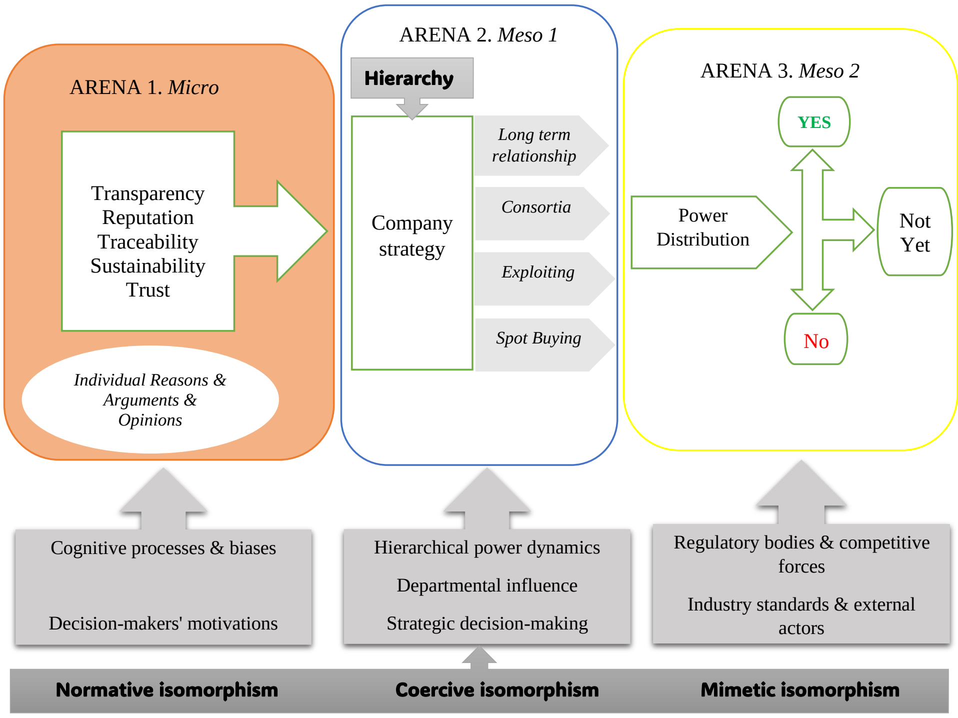
Together, these Arenas form a cohesive and layered analytical framework that substantiates the holistic nature of the model, capturing the multi-dimensional and interconnected processes influencing blockchain adoption in supply chains.

9.1 Arena 1: Micro Individual Level

9.1.1. The Genesis of Decision makers Mental Maps

Like human beings, perceive the world through subjective mental maps, which are shaped by personal experiences and social conditioning. These mental maps filter and prioritize information based on relevance or importance (Bakker & Kamann, 2007). Each actor’s perspective is guided by a unique reference model, influenced by their social environment or 'habitus' (Bourdieu, 1972, 1977; Kamann, 1995,1996). The habitus is a "structured structuring structure" (Bourdieu ,1977) that conditions individuals to solve familiar problems in established ways but influences how they tackle new, unfamiliar challenges.

The habitus carries with it a certain modus operandi, a sense in which behaviors and actions are conducted within any one social space. Such conditioning is not limited to present environments but is related to historical trajectories such as educational institutions, organizational cultures, and broader cultural experiences (Bakker & Kamann, 2007). The cues the manager observes, the values they embrace, and the actions they pursue have deep roots in their structured experience.



Model 02 -Arena 1. Micro Level - The 3 Arenas Model

(Gharehdaghi & Kamann, 2025)

9.1.2. Methodology

This study aims to capture the micro-level human dimensions of blockchain adoption within various industries. A qualitative research design was adopted, allowing for an in-depth exploration of stakeholder experiences, perceptions, and concerns. The methodology focused exclusively on qualitative data collection and analysis, with Atlas.ti used as the primary tool for data interpretation.

Data Collection

Data was gathered from a range of sources to capture the perspectives of diverse stakeholders:

Participant Diversity: The sample consisted of 34 individuals, including 23 upstream actors (e.g., producers, manufacturers, distributors) and 11 downstream actors (e.g., consumers, end-users) from sectors such as food and fashion.

Expert Knowledge: Input from professionals with expertise in blockchain technology, sustainable supply chains, and industry sectors was gathered to provide a comprehensive understanding of adoption dynamics.

Data Analysis and Principal Themes

Semi-structured and peer-to-peer interviews with open-ended questions were used to allow participants to freely express their beliefs, motivations, and attitudes towards blockchain adoption. This approach allowed that both technical and human dimensions of blockchain adoption were explored. The interview data were analyzed using Atlas.ti, a qualitative data analysis software. The analysis followed an iterative coding process:

Open Coding: The initial step involved identifying raw data segments and categorizing them into individual concepts (e.g., transparency, data privacy).

Axial Coding: Relationships between these initial concepts were examined to create broader categories (e.g., transparency as a trust factor, data privacy concerns as barriers to adoption).

Selective Coding: Central themes were refined and prioritized, focusing on factors most relevant to blockchain adoption.

To ensure rigor and traceability, each code was assigned whenever a relevant segment appeared in the transcript. Atlas.ti's code-frequency counting feature was then used to quantify how often each keyword or theme appeared in the dataset.

Example Calculation (Transparency): Across all interviews with SSC experts, the code "transparency" was applied 47 times out of a total of 233 coded segments. The share of references for "transparency" is calculated as:

Percentage of Keyword = (Number of times this code was applied) / (Total number of coded segments for the group) × 100

(47 / 233) × 100 = 20.2%

This calculation is based on the total number of coded segments identified in the data set, not the number of individual participants. This means that if a participant emphasized a theme multiple times, each mention was counted. As a result, the percentages reported here reflect the relative salience and emphasis of each theme in the full qualitative data corpus, rather than the proportion of participants who referenced it.

Chart 02 delineates how each stakeholder cohort prioritizes the factors shaping blockchain adoption. The varying degrees of emphasis expose the distinct concerns and interests of each group insights that are crucial for grasping the wider dynamics of blockchain integration across industries by Atlas.ti, that paired raw code-frequency counts with a salience metric that captures the relative "strength" of each keyword the intensity of its repetition and then calculated the share of references attributable to each stakeholder category.

Code	Key Words	Set 1: SSC Experts	Set 2: BC Experts	Set 3: End Users	Set 4: Org Experts
	Participants	9	10	11	4
T1	Transparency	**20.2%**	**21.5%**	2.8%	**36.5%**
T2	Traceability	14.8%	**26.6%**	3.6%	**17%**
B1	BC Advantages	9.6%	12.4%	3.2%	9.2%
B2	BC Disadvantages	4.3%	5.3%	2.4%	2.8%
S	Sustainability	**21.4%**	9.8%	14.8%	10%
U	Trust	9.7%	2.8%	**34.9%**	5.8%
O	Other technologies: QR Bar Code Scanning -RFID-Excel	12.6%	18.2%	12.5%	10.7%
R	Reputation	7.4%	3.4%	**25.8**%	8%
	Total	*100*	*100*	*100*	*100*

Chart 02. reveals factors most relevant to blockchain adoption

9.1.3. Chart 02 Outcomes

Set 1. Sustainable Supply Chain Experts: Emphasized ecological and social sustainability.

Set 2. Blockchain Experts and Set 4. Organizational Experts: Focused on transparency, traceability, and other technologies.

Set 3. End-user customers: Importance of trust and reputation.

The results showed that upstream players focus on operational and production efficiencies, and downstream players are mostly concerned with the trust and satisfaction of end-users.

9.1.4. Fuzzy Cognitive Mapping: Understanding the Interconnected Factors

To analyze the interconnected factors associated with blockchain adoption, Fuzzy Cognitive Mapping (FCM) was employed (Hu, Guo, & Fu, 2023). Using the software tool *Mental Modeler*, the FCM model graphically illustrates the relationships between drivers and interdependencies, shaping the nature of adoption decisions (Xu et al., 2023).

Mental Modeler is intuitive software designed for creating Fuzzy Cognitive Maps (Tyrovolas et al., 2023). It allows users to represent concepts as nodes and their relationships as weighted arrows, making it easy to visualize and analyze complex systems. It provides functionality to simulate *"what-if"* scenarios, helping to understand how changes in one factor might ripple through a system.

The FCM model provided several main insights into the dynamics of blockchain adoption:

Different Drivers: Upstream actors prioritize transparency and traceability, whereas downstream actors emphasize trust and reputation. In the FCM model, *Figure 04,* the arrows illustrate these dynamics: Transparency emerges as the most significant driver for upstream actors, and trust is the dominant factor influencing downstream demand.

Push-and-Pull Dynamics: The model highlights how technological benefits like transparency resonate strongly with upstream stakeholders, and downstream stakeholders focus on ethical practices, brand reputation, and sustainability to align with consumer expectations.

To represent the degree of emphasis each stakeholder group places on specific blockchain-related concepts, arrow strengths were categorized based on the values derived from the stakeholder data *(Table 13, Appendix)*. The values, which ranged from approximately 2% to 36.5%, represented the varying levels of importance assigned by different groups through the Mental Modeler tool. To visually represent these weights within the Fuzzy Cognitive Map, natural cutoffs were determined based on the distribution of the data. These cutoffs were then used to categorize the strengths of connections (e.g., light, medium, strong), allowing for a meaningful visual interpretation of stakeholder perspectives.

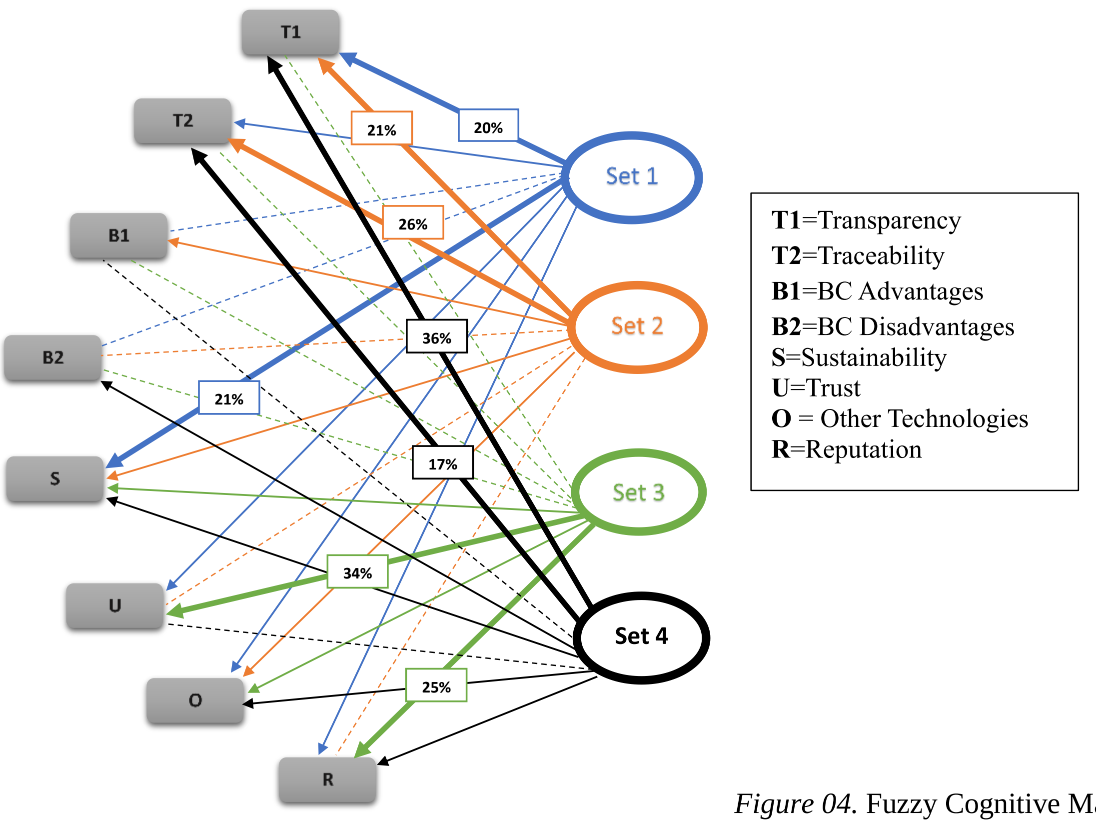


Figure 04. Fuzzy Cognitive Mapping

ARROWS	*EFFECT*	*LEVEL*
	Strong	+ + +
	Medium	+ +
	Light	+

9.1.5. Results of Analysis

Set 01: The interviews with SSC experts on the main driving forces of using blockchain technology pointed to transparency at 20.2%, traceability at 14.8%, and sustainability at 21.4% (Arrows: Blue Strong). This shows their commitment to establishing ethical supply chains that can be sustained. Acknowledging the beneficial aspects of blockchain, these experts recognize the need for due consideration of its comparative advantages against prospective disadvantages, especially with respect to issues on scalability, data privacy, and security concerns. SSC experts apply blockchain to build trust and accountability by enhancing transparency toward making more ethical and sustainable supply chains.

Set 02: BC experts in their technical knowledge about technology focused on functional aspects of blockchain adoption. Transparency and traceability were strongly stressed as facilitators by them at 21.5% and 26.6% (Arrows: Orange Strong), since it provides the facility to create verifiable and un-hackable records along the supply chains. They mentioned inherent advantages such as efficiency gains, cost reduction, and better collaboration, all at 12.4% each. They mention a number of possible disadvantages-such as scalability or security issues-their focus is on technological benefits. Sustainability, 9.8% (Arrows: Orange Medium), is another significant driver. Experts in BC are optimistic about blockchain bringing revolutionary change in chains, focusing on the technical capability and prospective sustainability of the future.

Set 03: The customers are the very end-users; they represent the last entity within the supply chain, which places trust in the supplier and reputation above all else in considering blockchain adoption at 34.9% and 25.8% (Arrows: Green Medium). Basically, assurance of the integrity and reliability of the products and services is needed. They believe in the potential benefits of transparency 2.8% and traceability 3.6% (Arrows: Green Light), it is less important than the assurance of trust and a good reputation for the brands they interact with. Sustainability at 14.8% is a significant driver impelled by the need to be ethical and ecologically responsible. In any case, for the end users, there is even less emphasis on technical aspects, such as advantages or disadvantages of blockchain, at 3.2% and 2.4%, than among upstream actors. Their interests remain with tangible implications for themselves, wherein trust and reputation are paramount in the decision-making process.

Set 04: From the perspective of the organizational experts, like managers, blockchain professionals, and other decision-makers in organizations that have already implemented blockchain solution offerings, the main drive toward the adoption decisions is based on the reasons of transparency. It accounted for a total of 36.5% of the responses (Arrow: Black Strong). This is to show how they are fully aware of clarity and verifiability in supply chains. The second best, traceability, was welcomed as a positive contribution to product and process tracking. The advantages of blockchain such as improved efficiency and reduced costs are significant, its drawbacks must also be considered, particularly in terms of implementation challenges and security risks. Sustainability concerns are increasingly relevant, driven by a growing awareness of environmentally responsible practices. The other less dominant motivations among them are those relating to trust and reputation, though important, at 5.8% and 8% (Arrows: Black Light), because organizational experts have shown greater interest in the operational and technical areas of blockchain implementation.

9.1.6. Hypothesis Validation:

RH1: Upstream actors prioritize transparency and traceability as important drivers for blockchain adoption.

RH2: Downstream actors prioritize trust and reputation in blockchain adoption.

RH3: Downstream decision-making is significantly influenced by the perceived reputation of the platform's providers.

RH4: Trust and reputation, when effectively communicated, boost downstream blockchain adoption.

RH5: Significant differences exist in the hierarchical importance of factors between upstream and downstream actors.

The results, developed from interview data, support the research hypotheses in a visual manner (FCM) by showing the priorities and drivers of upstream and downstream actors. Upstream Actors (Sets 1, 2, and 4): The use of blockchain is primarily driven by transparency and traceability, as denoted by strong arrows that connect upstream actors to this driver. And Downstream Actors (Set 3): Trust is the main enabler, having a strong link with brand reputation. It emphasizes how blockchain strategies need to be aligned with consumer needs and expectations.

9.1.7. Linear Structural Equation Modeling (LISREL)

LISREL is a statistical modeling tool used to analyze complex relationships between observed and latent variables. By enabling the construction and testing of hypothetical models, it allows researchers to evaluate the influence of specific factors and validate theoretical frameworks derived from qualitative data (Gale et al., 2013). The primary concept of a LISREL-style model provides a holistic understanding of the Micro-level revolution in blockchain adoption (Figure 05).

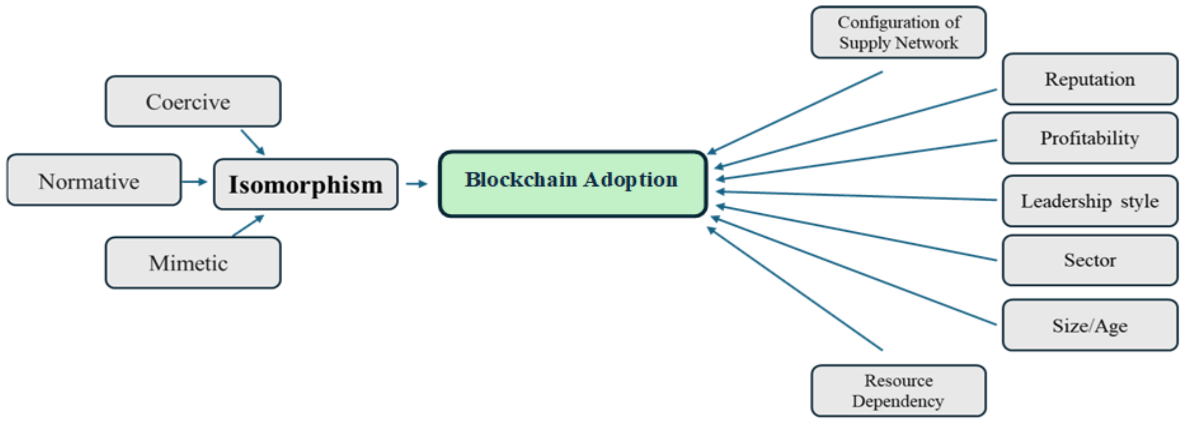


Figure 05. The LISREL-Style *(Primary Concept)*

9.1.8. Discussion of Significance and Practical implications

This approach not only bridges the gap between qualitative insight and conceptual clarity but also equips decision-makers with a grounded understanding of stakeholder-specific drivers. By making these mental models visible, the FCM offers a practical tool for designing more inclusive and targeted blockchain strategies that reflect the real-world concerns of those involved across the supply chain.

These findings contribute to and extend current knowledge by revealing the divergence between upstream and downstream priorities in blockchain adoption. Prior studies have highlighted the need for alignment across the supply chain, yet few have illustrated this as through qualitative modeling.

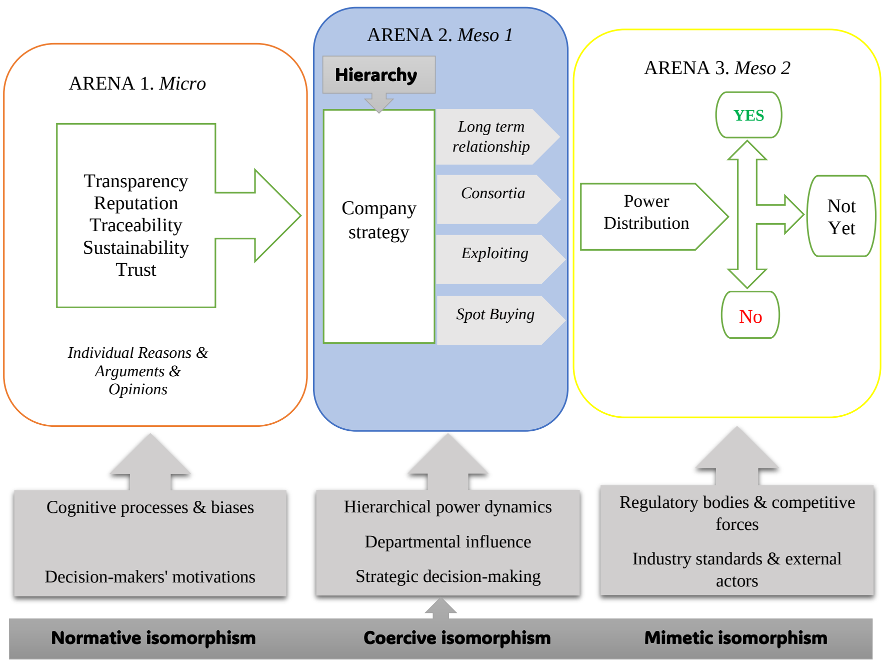
By constructing a Fuzzy Cognitive Map (FCM) based on codes and themes derived from Atlas.ti, this study visualizes how stakeholder groups perceive and influence adoption decisions. The map reveals differing mental models: upstream stakeholders are more concerned with operational transparency, traceability and sustainability, while downstream stakeholders are focused on trust and brand reputation. This layered understanding advances theoretical work by presenting a system-level view grounded in participant narratives, rather than statistical abstraction.

9.2 Arena 2: Meso 1 Organizational Level

9.2.1. The Battle of the Egos

The process-or 'battle'-that leads to the accepted and shared modus operandi of an organization includes the collective view on the usefulness or desirability of blockchain technology. This process can be seen as one of negotiation (Barnhill et al., 2021). The resulting worldview or 'order' is mainly determined by those who are leading the discussion. This leading is a matter of the hierarchical ranking within the organization. The CEO is usually at the top, other important functions include finance, marketing, and HRM. However, this hierarchy can change from organization to organization and may be re-negotiated over time.

In many organizations, the buying function has a lower level of influence than other functions such as finance and marketing (Zhu, Teng, Zhu, & Lu, 2019). There are obvious exceptions, such as trading and retailing firms where the buying function is more dominant and branding and high-fashion organizations where the marketing function will often have greater control (Bezuidenhout, Janse van Rensburg, Matthee, & Stolzenburg, 2019; Godart & Galunic, 2019). The interplay between these rankings and the influence of outside consultants and lobbyists creates a negotiated social order that dictates strategic decisions on adoption technology (Vrancken, 2014).



Model 03. Arena 2 – Meso Level. The 3 Arenas Model, (Gharehdaghi & Kamann, 2025)

9.2.3. Methodology

This study offers a rigorous empirical investigation into how organizational dynamics and hierarchical structures shape blockchain-adoption decisions (Li et al., 2023). Adopting a quantitative design, it combines structured questionnaires, scenario-based assessments, and a streamlined implementation of Saaty's Analytic Hierarchy Process (AHP) (Saaty, 1980; Forman & Gass, 2001). All AHP calculations were performed in Microsoft Excel on the raw survey data, ensuring transparent, step-by-step traceability throughout the analytic process.

Survey Design

The survey was designed to collect insights into how various functional areas influence decision-making concerning blockchain adoption, particularly focusing on hierarchical structures and inter-departmental influence.

To assess different functional areas power, respondents evaluated 10 scenarios comparing the influence of two departments using a three-point scale *(+/- 3)*:

- **Marketing > Finance** (Marketing has a stronger influence than Finance)
- **Marketing = Finance** (Both have equal influence)
- **Marketing < Finance** (Marketing has a weaker influence than Finance).

This scale, inspired by decision-making studies (Dawes, 2008), was chosen for its simplicity, reducing respondent fatigue and minimizing bias, particularly in diverse organizational contexts. While more granular scales (e.g., 7-point) could offer nuance, the 3-point scale's clarity ensured reliable responses, suitable for aggregation into a prioritization model (Forman & Gass, 2001). This approach simplifies complex decisions, akin to preference questions ("Do you prefer tea, coffee, or neither?"). The survey questions are detailed in Appendix, Arena 2.

Sample Diversity

The sample comprised 156 respondents from diverse industries and countries, capturing a wide range of perspectives on organizational dynamics that this diversity in the sample fosters the generalizability of the findings across different organizational contexts. Participants were selected through professional networks, industry events, and academic conferences to promote a diverse and representative sample. A stratified sampling approach was employed, ensuring balanced representation across industries and regions. The final sample *(Chart 03)* includes participants from, Netherlands (Utrecht- Amsterdam- Delft),USA(Los Angeles–SanFrancisco),UK(London),Germany(Frankfurt-Berlin-Dortmund),Turkey(Istanbul-Antalya),Hungary (Veszprem-Budapest) ,Canada (Toronto) ,Belgium (Antwerp),UAE (Dubai),Romania (Timisoara) , with the highest numbers from the Netherlands (22%), Germany (19%), and Turkey (12%). For instance, the survey was completed by 9 participants from Germany, all employed in the automotive sector, and 5 participants from Turkey working in the fashion industry.

SIZE	Industries	Netherlands	USA	UK	Germany	Turkey	Hungary	Canada	Belgium	UAE	Romania
L.S	Fashion	3				5					
L.S	Food	4					4		6		
L	Automotive				9			5		1	
L.S	IT	2			8						
L	Education			1			7				4
L.S	Finance		3							2	
L	Real state									6	
L	Quality control		2		1				1		
L	Construction- wood				4	7		2			
L	Social network	2			1						
L	Sustainable development	8									
L	Medical	1	2				1	1			3
L.S	E-commerce				4						
L.S	Design	7	1			2				3	1
S	Biotechnology		2	2					5		
S	Regulatory	1									
L.S	Customer Service	4				3		2			
L	Logistics	2	4		2	2		3			
	Total	**34**	**14**	**3**	**29**	**19**	**12**	**13**	**12**	**12**	**8**
	Participants	**22%**	**9%**	**2%**	**19%**	**12%**	**8%**	**8%**	**8%**	**8%**	**5%**

Chart 03. Distribution of Participants by Company Size, Sector, and Geographical Location

Most participants had more than six years of work experience (Figure 06), indicating that the study includes insights from experienced professionals who likely hold influential positions in their companies. The gender distribution was 67% male and 33% female, reflecting existing industry leadership demographics.

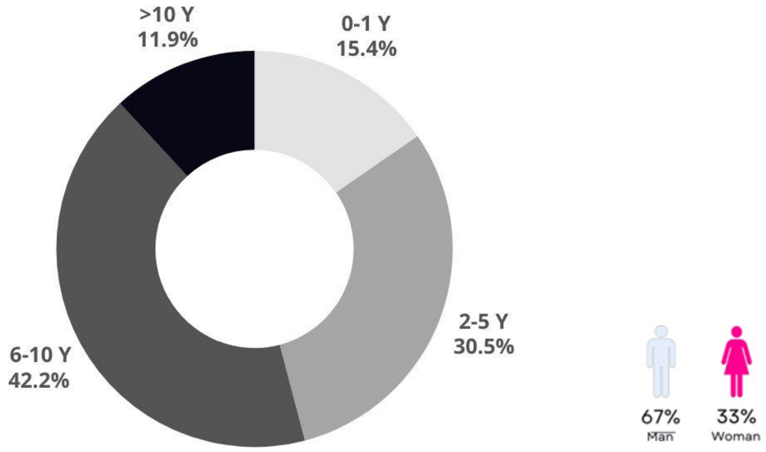


Figure 06. Respondents' job experience and genders

9.2.4 Process of Analysis Data:

This study investigates how organizational dynamics and hierarchical structures influence blockchain-adoption decisions through a quantitative approach, integrating structured questionnaires, scenario-based assessments, and a streamlined Analytic Hierarchy Process (AHP) (Li et al., 2023; Saaty, 1980; Forman & Gass, 2001). It evaluates the perceived influence of five organizational departments Finance, Marketing, Purchasing, Production, and Human Resource Management across ten decision-making scenarios, with 156 participants from diverse sectors assessing each department's impact using a simplified three-point AHP scale (+3, 0, –3) for enhanced clarity (Ishizaka & Nemery, 2013). All data processing, from raw survey responses to normalized weights and aggregated scenario scores, was conducted transparently in Microsoft Excel, ensuring traceable and reliable AHP calculations throughout the analysis.

9.2.5 Operationalizing the AHP:

To make the analytic-hierarchy-process (AHP) transparent, this section walks through the departments pair-wise comparisons step by step *(Model 11, Appendix).*

Example: The Finance department

Step 1: Based on initial data in excel, with 156 responses per scenario.

Scenario_1: Finance vs. Marketing (Finance >=< Marketing)

Numerical values were assigned as follows:

1 if the first department was more influential.

0.5 if both were equally influential.

0 if the second department was less influential.

Since Finance was deemed more influential in scenario 1, the assigned values were:

$$\text{Finance} > \text{Marketing}$$

$$\text{Department Score} = (\%\ \text{More Influential} \times 1) + (\%\ \text{Equal} \times 0.5) + (\%\ \text{Less Influential} \times 0)$$

Finance more influential: 80 out of 156 ($80 / 156 \approx 0.513$)

Equal: 40 out of 156 ($40 / 156 \approx 0.256$)

Marketing less influential: 36 out of 156 ($36 / 156 \approx 0.231$)

$Score = (0.513 \times 1) + (0.256 \times 0.5) + (0.231 \times 0) = 0.6026 + 0.1162 + 0 = 0.641$

Step 3: Normalize the Scores to support comparability, finance department score was normalized by dividing it by the number of appearance scenarios (4):

$$Normalized\ Score = Score / Number\ of\ Scenarios$$

Applying the formula for Finance in 4 Appearance Scenarios:

Scenario 1: 0.641

Scenario 5: 0.775

Scenario 6: 0.510

Scenario 7: 0.687

Total Finance Normalized Scores = 0.641 + 0.775 + 0.510 + 0.687 = 2.613

2.613 / 4 = 0.653

All departments' Total Normalized Scores passed the same process:

Marketing :0.500

Production:0.430

HRM:0.375

Purchasing:0.290

0.653 + 0.500 + 0.430 + 0.375 + 0.290 = 2.248

Step 4: Convert Normalized Scores to Percentages Each department's percentage influence was determined using:

*Percentage Influence = (Normalized Score / Total Normalized Scores) * 100*

Finance: *(0.653/ 2.248) × 100 ≈ 29.03%*

Marketing: (0.500/ 2.248) × 100 ≈ 22.24%

Production: (0.430/ 2.248) × 100 ≈ 19.13%

HRM: (0.375/ 2.248) × 100 ≈ 16.68%

Purchasing: (0.290 / 2.248) × 100 ≈ 12.90%

Department	Normalized Score	% Influence
Finance	0.653	29.03%
Marketing	0.500	22.24%
Production	0.430	19.13%
HRM	0.375	16.68%
Purchasing	0.290	12.90%
Total	2.248	**100%**

Table 08: AHP -Final Table Summary

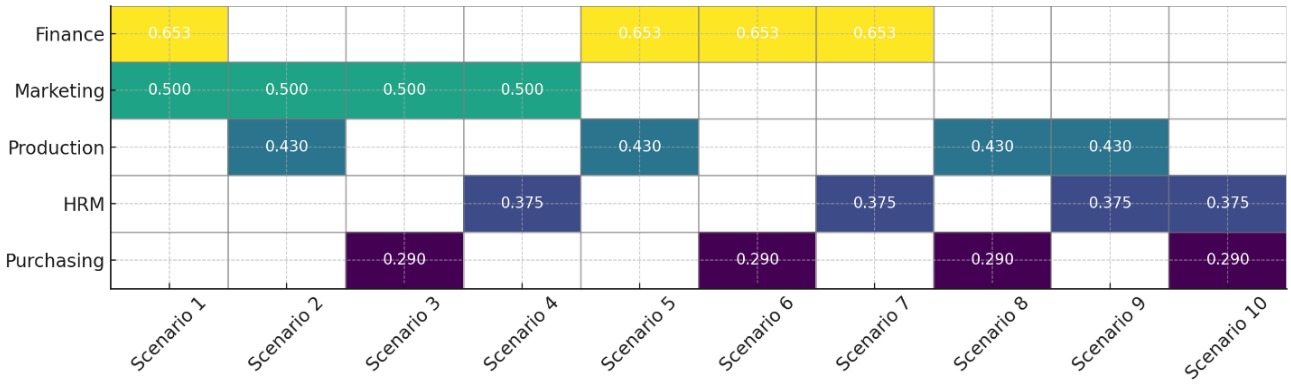
Step 5: Final Hierarchical Model After completing all calculations, the final ranking of departmental influence was established:

```
+-------------------+     +-------------------+     +-------------------+     +-------------------+     +-------------------+
  |   Finance     |------>|   Marketing     |------>|  Production    |------>|   HRM  |------>|  Purchasing     |
   |  (29.03%)      |      |   (22.24%)     |      |   (19.13%)    |      |   (16.68%)   |         |  (12.90%)   |
+-------------------+     +-------------------+     +-------------------+     +-------------------+     +-----------------+
```

Model 04. Hierarchical Model:

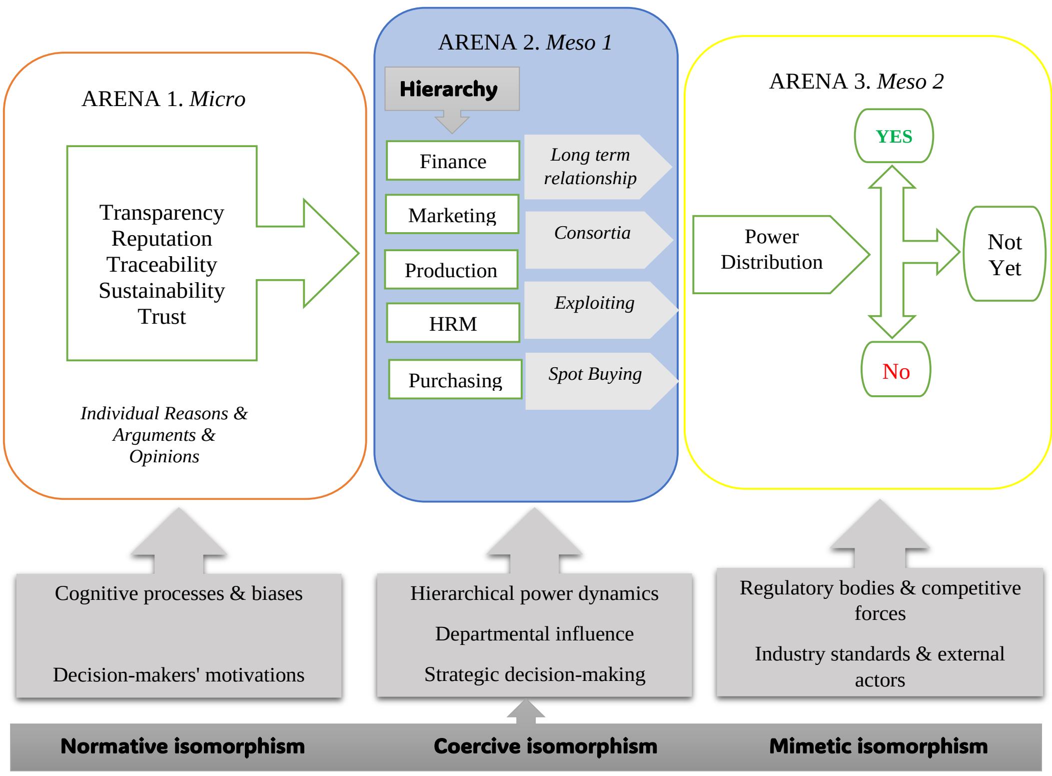
Departmental Influence (overall perceived influence based on aggregated data from all scenarios)

In conclusion, the application of a tailored Analytic Hierarchy Process (AHP) in this study provided a robust framework for evaluating the perceived influence of five organizational departments Finance, Marketing, Production, Human Resource Management (HRM), and Purchasing across diverse decision-making scenarios. By streamlining the AHP with a simplified three-point scale and processing 156 participant responses through systematic pairwise comparisons, the study effectively quantified departmental influence, with Finance emerging as the most influential (29.03%), followed by Marketing (22.24%), Production (19.13%), HRM (16.68%), and Purchasing (12.90%). The use of Microsoft Excel for data analysis ensured precision in calculating normalized scores and percentage influences, culminating in a clear hierarchical model that enhances understanding of departmental roles in strategic decision-making. This methodology not only offers transparency and reproducibility but also provides valuable insights for organizations seeking to optimize decision-making processes by leveraging departmental strengths.



Model 05: Departmental Scores per Scenario (AHP Model Output)

Model 05 illustrates the normalized scores of perceived departmental influences across 10 organizational scenarios, derived from the Analytic Hierarchy Process (AHP). Finance consistently shows the highest influence, with a normalized score of 0.653 across all scenarios, highlighted in yellow. Marketing follows with a steady score of 0.500 (teal), while Production (0.430, light blue), HRM (0.375, blue), and Purchasing (0.290, dark purple) exhibit lower and more variable influence. The color gradient from dark purple (0.30) to yellow (0.65) visually emphasizes Finance's dominant role in decision-making, with minimal variation across scenarios, underscoring its strategic importance.



Model 06. Arena 2, Meso 1 Level -The 3 Arenas Model,(Gharehdaghi & Kamann, 2025)

9.2.6. Discussion of Significance and Practical implications

The results highlight Finance as the most influential department, followed by Marketing, underscoring Finance's critical role in resource control, budgeting, and strategic decision-making. This aligns with Resource Dependence Theory Barney, J. B. (1991), which emphasizes financial control organizational success. Within the Arena 2 framework, Finance's centrality suggests a concentration of decision-making power that shapes both resource distribution and strategic initiatives such as technology adoption. Marketing's influence reflects its role in revenue generation and brand positioning. In contrast, the lower rankings of HRM and Purchasing indicate a perception of limited direct impact on external outcomes. Future research could explore how this varies across industries for example, whether these departments play stronger roles in manufacturing contexts. Practically, HRM and Purchasing must align their proposals with financial priorities, emphasizing cost-effectiveness and ROI to gain support and increase their strategic influence.

9.2.7. Conclusion

The "Battle of the Egos" at the company level illustrates the complex interplay of power and influence among organizational functions. The hierarchical dynamics and contextual factors identified in this study provide valuable insights for implementing blockchain technology within organizations. Understanding how various functions (Finance, Marketing, HRM, etc.) exert influence over decision-making processes can aid in aligning these functions with strategic goals for blockchain adoption.

The diverse decision-making processes highlighted in this research emphasize the need for a strategic and collaborative approach to technology adoption. This approach will increase the sustainability of blockchain implementation across different organizational contexts. The Analytic Hierarchy Process (AHP), combined with extensive contextual analysis, supports a thorough understanding of the organizational hierarchies and decision-making structures that are important when adopting innovative technologies like blockchain.

9.3 Arena 3: Meso 2: Network Level

Once a company decides on its external strategies-whether in procurement, marketing, or broader operations-it enters Arena 3: the network of which it becomes part. This involves the selection of specific relationship types with other actors of this network, such as opportunistic and cooperative, or even short-term and long-term partnerships. The assumption of temporal embeddedness is integral to comprehending these dynamics, as companies often engage in various types of networks simultaneously:

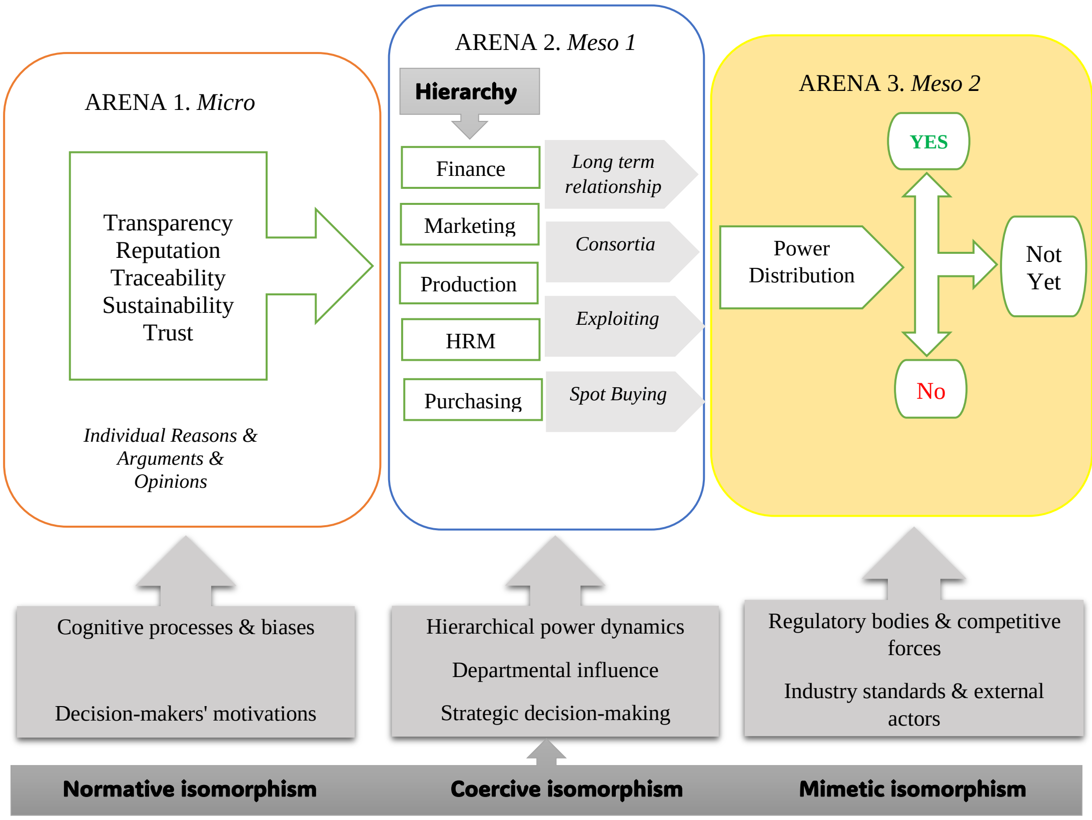
Long-term relational networks: These are stable networks that are based on trust and sustained cooperation over time.

Consortia with short-term relations: These are temporary alliances for specific projects or goals.

Exploitative networks: These are partnerships in which one party leverages its position for unilateral gain.

Volatile spot-buying networks: These are one-off transactions, usually driven by immediate needs rather than strategic alignment.

One company can be part of different network types at the same time. For instance, a fashion company may have long-term networks for core suppliers and exploit shorter-term partnerships for high-volume low-value goods. This is the duality that complicates the visualization of network dynamics. It is even more problematic when intangible aspects like trust are monitored.



Model 07. Arena 3: Meso 2 - The 3 Arenas Model

(Gharehdaghi & Kamann, 2024)

9.3.1. Power, Uniqueness, and Other Aspects

Interviews showed that power plays an important role in network interactions. In this respect, the degree of power can be determined by the elements of size, turnover, market share, product uniqueness, patents, and strategic positioning (Thommes et al., 2015). These elements provide a company with the ability to influence decisions in the network, such as adopting blockchain technology. For example, high market power from a company may force blockchain adoption on its supply chain, resistance from powerful third-party actors may slow down implementation.

This study does not attempt to assess the latent concept of power but instead identifies its observable components based on empirical insights. The role of power in blockchain adoption manifests its duality, be it as an enabling factor for adoption or a barrier imposed by influential players who resist change.

9.3.2. Methodology

In Arena 3, a qualitative research design was employed to enhance the validity, depth, and rigor of the study's findings on network-level dynamics influencing blockchain adoption in supply chains. To ensure methodological robustness, triangulation was used by cross-referencing insights from focus group discussions (FGDs) with findings from Arena 2 analyses *(Table 10 and Table 15 in the Appendix)* and earlier research conducted in Arena 1 *(Chart 02)*. This multi-source integration provided comprehensive context and reinforced the credibility of the results. Data collection involved purposefully selected FGDs to capture a wide range of perspectives across key organizational dimensions such as sector, geographic region, company size, and gender. The methodology followed a two-phase structure, designed to systematically explore and validate the factors shaping blockchain adoption at the network level.

Diverse Participant Selection for Comprehensive Insights

1. *Sectoral Diversity:* Participants were drawn from various industries such as fashion, food, automotive, and sustainable development. This allowed for an exploration of sector-specific influences on blockchain adoption, particularly contrasting relationship-driven sectors (e.g., fashion) that emphasize trust and long-term relationships versus commodity sectors (e.g., food) that prioritize cost efficiency.
2. *Geographical Diversity:* To account for regional differences, participants were selected from Netherlands, Hungary, Germany and Turkey enabling an exploration of how cultural norms, decision-making processes, and communication styles vary across regions.
3. *Organizational Diversity* (Company size): The sample included representatives from both large multinational corporations (L) and small-to-medium enterprises (SMEs) (S), ensuring that both ends of the organizational spectrum were considered.
4. *Gender Diversity*: Efforts were made to achieve a balance of male and female participants to capture any gender dynamics influencing blockchain adoption.

The participant selection was designed to prioritize theoretical saturation over statistical representativeness (Table 09). This approach ensured that the sample size was adequate to uncover key patterns and insights, focusing on in-depth understanding rather than large-scale generalizability (N = 5 FGDs, P = 21). The sampling strategy was purposive, targeting theoretical saturation across various dimensions of diversity rather than aiming for a statistically representative sample.

N	P	Company size	Gender	Location	Sector
1	5	L	*F/M*	Netherlands	Fashion/ Sustainable development/IT
2	3	L	*F/M*	Hungary	Food/ Education
3	4	S	*F*	Germany	Food/ Customer Service
4	6	L/S	*F/M*	Germany	Automative/Food/IT
5	3	S	*M*	Turkey	Customer Service/IT

Table 09. FGD-Participants Profile

Qualitative Data Analysis

Following the focus group discussions (FGDs), all data were transcribed and analyzed using a structured, three-stage inductive coding process grounded in the principles of grounded theory. This approach facilitated the emergence of themes directly from the data, allowing for a nuanced understanding of the organizational and contextual factors influencing blockchain adoption. The analysis proceeded through three stages:

1. Open Coding: Concepts were identified and labeled using in vivo and descriptive codes. Examples include *"cost-efficiency," "trust," "hierarchy," "CSR,"* and *"blockchain resistance."*
2. Axial Coding: Related codes were grouped into categories using Atlas.ti's "Code Groups" feature (e.g., "Sectoral Influences," "Ethical Motivations," "Geographical Decision Styles").
3. Selective Coding: The themes derived through selective coding informed the structure and interpretive lenses of the comparative analysis (an Interview sample, Appendix).

Thematic Analysis and Code Pattern Exploration in Atlas.ti

We used co-occurrence and frequency tools in Atlas.ti as post-coding validation techniques to enhance the transparency, depth, and stratified interpretability of our thematic analysis not to reduce qualitative insights to numbers, but to ensure they are grounded, comprehensive, and justifiable *(Table 10).*

Frequency (f) , of a code was calculated as:

$$f(Code_i) = \sum(\text{occurrences of the code across all documents})$$

Co-occurrence Index (CI) ,was used to determine the association between codes:

$$CI(A,B) = (\text{Number of co-occurrences of A and B}) / \sqrt{(\text{Frequency of A} \times \text{Frequency of B})}$$

Where:

$n(A \cap B)$: number of co-occurrences between codes A and B

$n(A)$, $n(B)$: total frequencies of codes A and B

For instance, the theme of "Ethical Sustainability" exhibited a notable co-occurrence with female participants ($CI \approx 0.73$), suggesting a potential gendered emphasis on ethical considerations in blockchain adoption. These co-occurrences were used to enhance the interpretive credibility of our themes and served as supporting evidence for identifying meaningful patterns in the data. Importantly, while co-occurrence values reflect thematic proximity, they were not used as standalone evidence, but rather triangulated with qualitative insights and contextual analysis.

Thematic Code	Interpretive Category	Indicator Description
Fashion sector	Sectoral Context	Emphasis on trust relationships
Cost-efficiency	Economic Priorities	Common in food
Female	Gendered Perspective	Linked to ethics/sustainability
Company Size	Organizational Profile	L = large, S = SME

Table 10. Illustrative Mapping of Themes to Participant Attributes

This qualitative approach, combining insights from FGDs with Atlas.ti coding and thematic analysis, provides a comprehensive understanding of the factors influencing blockchain adoption in supply chains.

9.3.4. Significant Findings from Focus Group Discussions

The triangulation of qualitative methods ensures robust validity for the research findings. Focus Group Discussions (FGDs) provided in-depth insights into the drivers of blockchain technology adoption in supply chains. Qualitative analysis of interview data conducted using Atlas.ti software, identified critical factors influencing blockchain adoption decisions. These qualitative findings were validated through thematic analysis and triangulation, which confirmed and enriched the understanding of the relationships among these factors. This triangulated approach ensures comprehensive and credible analysis.

Sectoral Differences (43%): Industries with high product differentiation, such as fashion, depend more on trust and long-term relationships, whereas commodity sectors like food prioritize cost efficiency.

Geographical Variations (42%): Cultural norms influence decision-making processes and communication styles, with some regions favoring hierarchical approaches and others emphasizing collaboration.

Gender Dynamics (15%): Female participants often emphasized ethical considerations and sustainability, aligning with broader trends in responsible supply chain management.

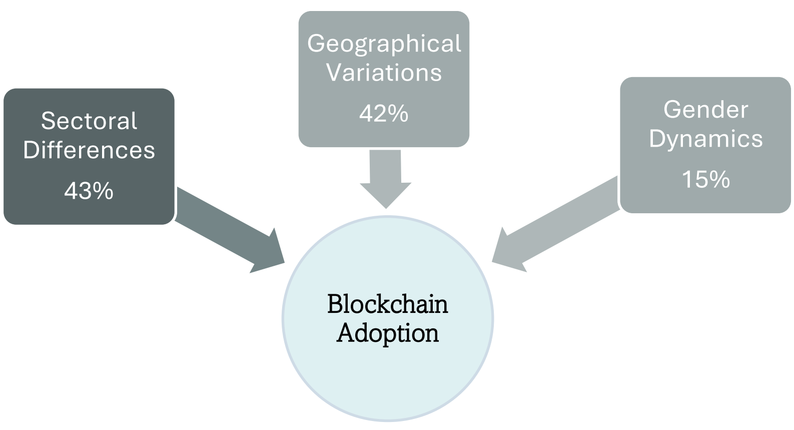


Figure 07. network-level dynamics in blockchain adoption

These factors contribute to a complex network of interactions affecting blockchain adoption, as detailed below:

1. **Supply Chain Power Asymmetry**: Larger corporations tend to resist blockchain adoption, prioritizing stability over innovation. Smaller firms, though more flexible and open to experimentation, often face strained decision-making as a result of limited negotiation power. This imbalance creates unequal power dynamics, where smaller companies must comply with unfavorable terms imposed by larger players.

2. **Company Size**: Discussions revealed that larger firms have greater resources and infrastructure to implement blockchain but are often resistant to change. Conversely, smaller firms, agile and willing to innovate, face resource constraints and challenges in negotiating favorable terms with larger partners.

3. **Strategic Network Positions**: Participants highlighted that firms occupying strong positions within their networks such as essential suppliers or distributors can drive blockchain adoption to strengthen transparency and efficiency. Opposite of that, firms in weaker positions struggle to initiate adoption owing to external pressures and limited influence.

4. **Individual Characteristics and Decision-Making**: Leadership styles, risk tolerance, and attitudes toward innovation were noted as critical factors influencing adoption decisions. These individual characteristics interact with organizational and industry-wide dynamics, shaping the overall pattern of adoption.

These findings underline the importance of understanding network-level dynamics in blockchain adoption. The diagram complements these insights by illustrating the relative influence of sectoral, geographical, and gender-related factors (figure 07). This integrated approach emphasizes how multifaceted interactions ranging from organizational power imbalances to cultural and individual considerations affect the trajectory of blockchain adoption in supply chains.

Relevance for Blockchain Adoption

Empirical evidence from this study indicates the importance of network dynamics in determining blockchain adoption. The most powerful actors can force or impede adoption through an intricate interaction of influence and negotiation. Successful implementation of blockchain requires overcoming power imbalances and opening symmetrical communication. The focus groups brought a level of detail in these dynamics and thus gave further face validity to the incorporation of multiple perspectives in the study. By investigating interactions at the network level, this study contributes to an in-depth understanding of the factors influencing blockchain adoption and, correspondingly, provides pragmatic recommendations for stakeholders navigating these challenges.

9.3.5. Discussion of Significance and Practical Implications

The findings within Arena 3 spotlight the dynamic and often conflicting relationships that define supply chain networks, particularly the power asymmetries between larger corporations and smaller firms. Larger corporations tend to resist blockchain adoption, prioritizing stability and established systems. Smaller firms demonstrate greater flexibility and openness to innovation but remain hindered by resource limitations and constrained negotiation power. Furthermore, firms occupying strategic positions such as important suppliers or distributors are uniquely positioned to drive blockchain adoption, leveraging their influence to strengthen transparency and efficiency. Conversely, weaker network participants face significant barriers, unable to overcome external pressures or assert influence. These insights underscore the need for collaborative frameworks to address imbalances and promote equitable blockchain implementation.

In addition to power dynamics, Arena 3 findings highlight the profound impact of individual leadership traits such as risk tolerance, strategic vision, and receptiveness to innovation on blockchain adoption. These personal attributes interplay with broader network-level forces, shaping organizational decision-making and the overall trajectory of adoption. By examining these Meso 2-level dynamics, the study offers actionable recommendations for overcoming systemic challenges. Strategies such as forward cooperative relationships, promoting symmetrical communication, and aligning leadership priorities with network objectives can help unlock blockchain’s transformative potential across supply chains.

9.3.6. Conclusion

Arena 3 emphasizes the Meso-level network dynamics, the conclusion weaves together the intricate interactions among organizational, cultural, and individual factors shaping blockchain adoption. The findings reaffirm the pivotal role of power dynamics, illustrating how asymmetrical relationships can either accelerate or hinder technological progress. The necessity for forwarding collaboration emerges as a takeaway, with the insights from focus group discussions reinforcing the importance of equitable partnerships to overcome systemic challenges.

Integrating sectoral differences, geographical variations, and gender dynamics into the broader research framework lends practical relevance to the study's findings. By illuminating the diverse factors influencing blockchain adoption across supply chains, this research provides both theoretical depth and a pragmatic roadmap for stakeholders. The results not only strengthen understanding of the barriers and opportunities but empower organizations to align network strategies with their broader strategic objectives. In doing so, the study contributes meaningfully to the discourse on disruptive technologies, offering actionable pathways for firms to harness blockchain's potential within a complex and interconnected supply chain ecosystem.

10. Research findings

This study investigates the adoption of blockchain technology within supply chains, exploring the influence of institutional isomorphism and the interplay between past practices and future expectations, ultimately testing the central research hypothesis (RH). Employing a mixed methods approach across three distinct arenas, the research delves into the complex dynamics shaping organizational responses to uncertainty in the face of technological innovation. Institutional theory, the concept of institutional isomorphism (mimetic, coercive, and normative), provides the foundational framework for understanding how firms converge towards similar strategies and structures in response to external pressures. This convergence is central to the study's analysis of blockchain adoption within supply chains. The mixed-methods approach, grounded in grounded theory, connects qualitative narratives with quantitative analysis for a robust exploration of complex data.

Arena 1 (Qualitative) This phase employed a qualitative approach to explore the nuanced narratives surrounding blockchain adoption and directly test the central research hypothesis. In-depth semi-structured interviews and case studies were conducted to gather rich, contextual data on the motivations, challenges, and decision-making processes involved in adopting blockchain technology. The aim was to uncover the *"why"* behind adoption decisions, revealing underlying factors such as the perceived legitimacy of blockchain, the influence of industry norms (normative isomorphism), and pressures from competitors (mimetic isomorphism).

These insights were critical in understanding the subjective experiences and perspectives of principal stakeholders, including upstream actors (e.g., producers, manufacturers) and downstream actors (e.g., consumers, retailers). By integrating these perspectives, qualitative data enriched the understanding of the human dimensions of blockchain adoption, providing a more holistic view of the implementation process. These findings were directly aligned with the central research hypothesis, offering context to inform later phases of quantitative analysis (Gharehdaghi & Kamann, 2025).

Arena 2 (Quantitative) A quantitative approach was used to analyze the influence of institutional isomorphism on blockchain adoption across five departments in the supply chain. The analysis leveraged department scores, percentages, and statistical results to quantify how coercive, mimetic, and normative pressures shaped adoption processes.

The statistical findings revealed that Finance and Marketing were most affected by external pressures, such as market regulations and peer behavior, driving their stronger blockchain adoption. HRM and Purchasing, with less exposure to such external forces, demonstrated slower adoption, influenced more by internal norms and organizational culture.

These findings provide a robust quantitative complement to the qualitative insights from Arena 1, offering a view of how institutional pressures, especially coercive and mimetic, drive adoption in Finance and Marketing, HRM and Purchasing are more influenced by internal normative forces. The integration of these results reinforces the understanding that institutional pressures shape blockchain adoption in varying degrees across departments (Gharehdaghi & Kamann, 2025).

Arena 3 (Qualitative) utilized focus group discussions (FGDs) to gather collective insights and perspectives from various stakeholders, building upon the findings from Arenas 1 and 2. By examining the power dynamics among actors based on their roles within the supply chain hierarchy, this arena refined the understanding of decision-making processes surrounding blockchain adoption. The FGDs allowed for the exploration of shared understandings, common challenges, and the dynamics of group consensus-building around technology adoption. Arena 3 built upon the individual actor mindsets explored in Arena 1, showing how those individual perspectives coalesced within the broader power structures of the supply chain. This revealed the influence of coercive isomorphism, as more powerful actors within the supply chain hierarchy could exert pressure on others to adopt blockchain. Arena 3 identified the most powerful decision-makers, contextualizing the findings from Arena 1 within the broader organizational context and providing a powerful means of validation for the initial hypotheses.

The integration of findings across these 3 Arenas is a critical aspect of the study's methodological strength. By triangulating qualitative and quantitative data, the research builds a comprehensive understanding of the complex interplay between institutional pressures, organizational choices, and the adoption of blockchain technology within supply chains. The findings contribute significantly to the existing literature on institutional isomorphism, supply chain management, and technological innovation, providing a nuanced analysis of the dynamics of blockchain adoption and its implications for future supply chain configurations. The consideration of the "shadow of the past" (existing infrastructure and practices) and the "shadow of the future" (anticipated benefits and competitive pressures) provides valuable insights for businesses navigating the complexities of blockchain integration and the evolutionary trajectory of supply chain management (Gharehdaghi & Kamann,2024b).

10.1. Novelty of the research

This research offers several innovative aspects that significantly advance the understanding of blockchain technology adoption in supply chains. These innovations extend beyond simply applying existing theories to a new context; they involve novel methodological approaches, a refined theoretical framework, and a focus on previously under-researched areas. An essential element of this innovation lies in the research design's strategic inclusion of data from diverse geographical and cultural contexts, encompassing the USA, Canada, Asian and European countries. This multi-regional approach allows for a rigorous test of the research model and significantly increases the generalizability of the findings.

10.1.1. Integrating Institutional Isomorphism with the "Shadows of the Past and Future":

Institutional theory and the concept of isomorphism have been applied to technology adoption. This research innovatively integrates it with a temporal framework considering both the "shadow of the past" and the "shadow of the future." This is not merely a chronological sequencing but a dynamic interplay. The "shadow of the past" encompasses legacy systems, established routines, organizational culture, and existing power structures that can significantly hinder or facilitate the adoption of blockchain. The "shadow of the future," encompassing anticipated competitive pressures, regulatory changes, and evolving industry standards, drives forward momentum. This research uniquely explores how these opposing forces interact to shape adoption decisions, moving beyond a static view of institutional pressures.

10.1.2. Multi-sector Comparative Analysis Using a Mixed-Methods Approach:

Existing literature frequently focuses on specific sectors or case studies. This research innovatively employs a mixed methods approach across multiple, strategically selected sectors within the supply chain. This allows for a comparative analysis, revealing sector-specific variations in the influence of isomorphic pressures and the interplay between the "shadows of the past and future." Comparative analysis generates more generalizable findings than single-sector studies, enhancing the practical relevance of the research for businesses across diverse industries. The mixed-methods approach (qualitative interviews and focus groups combined with quantitative analysis) provides a richer and more nuanced understanding than either approach could achieve independently, offering deep insights into the motivations behind decisions and broad statistical evidence of adoption patterns. The comparative analysis is further strengthened by the inclusion of data from different countries, allowing for an investigation of how national-level institutional contexts (regulatory frameworks, technological infrastructure, cultural norms) influence the impact of isomorphic pressures. This cross-national comparison provides a far more robust test of the research model than would be possible with data from a single country.

10.1.3. Incorporating Power Dynamics within the Supply Chain Hierarchy:

This research moves beyond a purely structural analysis of institutional isomorphism by explicitly incorporating the power dynamics within the supply chain hierarchy. Existing research often focuses on meso2 -level institutional forces, neglecting the influence of specific actors and their ability to shape adoption decisions. This research innovatively investigates how different stakeholders (suppliers, manufacturers, distributors, retailers) leverage their power to influence the adoption (or resistance) to blockchain technology. This nuanced perspective contributes significantly to a meso 1 complete understanding of the implementation process, recognizing the interplay between meso 2-level institutional pressures and Micro-level power relations. The analysis of power dynamics is improved by the cross-national perspective. This allows for the examination of how cultural differences and national-level institutional contexts influence the distribution of power within supply chain hierarchies and ultimately the adoption of blockchain.

10.1.4. Refining the Measurement of Isomorphism:

The research innovates by developing a more refined and context-specific measurement of isomorphic pressures. Instead of relying on generic indicators, the research likely employs proxies tailored to the supply chain context and the specific characteristics of blockchain technology. This results in more accurate and meaningful measurements of mimetic, coercive, and normative isomorphism, enhancing the precision and validity of the quantitative analysis. The specific metrics developed for measuring the “shadows of the past and future” represents a methodological innovation. The measurement of isomorphism is further refined by incorporating contextual factors related to national and regional differences

10.1.5. Cross-national Contextualization:

The inclusion of data from diverse geographical regions, each possessing unique technological infrastructure, cultural norms, and regulatory frameworks, adds a crucial layer of complexity and nuance to the analysis. This allows for a more thorough examination of how these contextual factors interact with isomorphic pressures to shape blockchain adoption patterns. The comparison of findings across these diverse settings boosts the robustness and generalizability of the research model, demonstrating its applicability beyond specific national or regional contexts. This aspect is crucial for enriching the theoretical contribution and improving the practical relevance of the research. The findings contribute not only to a more nuanced understanding of technology adoption within specific supply chain sectors but offer insights into how national and regional contexts mediate the effects of institutional isomorphism on technological innovation.

10.1.6. Contribution to Theoretical Development:

The integration of these innovative aspects, the temporal framework, the multi-sector comparison, the focus on power dynamics, and the refined measurement of isomorphism contribute to the theoretical development of institutional theory and its application to technology adoption in complex systems. The findings are expected to extend and refine existing models of isomorphism, offering a more nuanced and empirically grounded understanding of how institutional forces shape technological change. The cross-national dimension further strengthens the theoretical contribution, allowing for a more robust assessment of the generalizability and limits of institutional theory in explaining technological adoption across diverse socio-cultural and political contexts.

These innovative aspects contribute to a significant advancement in the field. The research is not merely replicating existing studies but offers novel insights, methodological approaches, and theoretical contributions that enrich the existing literature and provide valuable implications for practitioners and policymakers involved in the adoption and management of blockchain technologies within globally interconnected supply chains. The findings are expected to contribute significantly to the existing body of knowledge and provide actionable recommendations for firms, policymakers, and other stakeholders involved in the evolution of supply chain management on a global scale.

10.2. Limitations and challenges

This research, ambitious and innovative in its approach to understanding blockchain adoption in supply chains, faces several significant challenges. These challenges span methodological complexities, data limitations, theoretical nuances, and practical considerations. Addressing these challenges head-on is crucial for ensuring the rigor, validity, and impact of the research findings.

10.2.1. Methodological Challenges

Mixed-Methods Integration: The integration of qualitative and quantitative data presents significant methodological challenges. Ensuring the seamless integration and coherent interpretation of findings from diverse data sources (interviews, surveys, existing datasets) require careful planning, rigorous analysis, and an articulation of how qualitative insights inform and are informed by quantitative findings. The potential for misinterpretations or inconsistencies because of methodological differences needs to be addressed through robust triangulation strategies and justification of analytic choices.

Data Collection across Diverse Contexts: Gathering data from multiple countries (USA, Canada, Asian countries, and European countries) introduces challenges related to language barriers, cultural nuances, and differing regulatory environments. Ensuring data comparability and minimizing bias requires careful consideration of sampling strategies, translation procedures, and the development of culturally sensitive research instruments. The logistical complexity of coordinating data collection across multiple international sites necessitates detailed planning and significant resource allocation.

Defining and Measuring Isomorphism: Accurately measuring the different types of isomorphism (mimetic, coercive, normative) presents a significant challenge. Developing reliable and valid proxies for these constructions requires careful consideration of the specific context of blockchain adoption in supply chains. Operationalizing abstract concepts like "industry norms" or "competitive pressures" requires, measurable indicators, and the validity of these indicators needs to be thoroughly assessed.

Addressing Power Dynamics: The study's focus on power dynamics within supply chains introduces complexities in data collection and analysis. Gathering data on power relations requires sensitivity to potential biases and power imbalances between researchers and participants. Analyzing the influence of powerful actors requires careful consideration of their motivations, potential conflicts of interest, and the limitations of self-reported data.

10.2.2. Data Limitations

Data Availability: Access to relevant and reliable quantitative data on blockchain adoption across different sectors and countries may be limited. Publicly available data may lack the granularity or detail needed for robust statistical analysis, necessitating the use of surveys or other data collection methods which require additional resources and time.

Sampling Bias: Achieving representative samples across diverse sectors and countries presents significant challenges. The inherent biases in sampling methodologies need to be addressed and acknowledged in the interpretation of results. The potential for non-response bias and self-selection bias needs to be considered and mitigated through appropriate statistical techniques.

Data Quality: Ensuring the quality and reliability of qualitative data gathered through interviews and focus groups requires careful training of interviewers, the development of standardized protocols, and rigorous quality control procedures. Maintaining consistency across different interviewers and across various cultural contexts necessitates careful attention to detail and thorough training.

10.2.3. Theoretical Nuances

Complexity of Institutional Theory: Applying institutional theory to the context of blockchain adoption requires a nuanced understanding of its various components and limitations. The interaction of multiple isomorphic pressures and their complex interplay with other factors (e.g., technological capabilities, organizational culture) needs careful consideration. The theoretical model needs to be articulated and justified, acknowledging potential limitations and alternative explanations.

Unforeseen Factors: The rapid evolution of blockchain technology and the dynamic nature of supply chains may lead to unforeseen factors influencing adoption patterns. The research needs to account for the possibility of emergent phenomena and unexpected changes in the technological or regulatory aspects.

10.2.4. Practical Challenges

Resource Constraints: Conducting research on a global scale, involving multiple data collection methods, and employing rigorous statistical analysis requires significant financial and human resources. Securing funding and managing the logistical complexities of the research project can present significant challenges.

Time Constraints: The research timeline needs to be realistic, accounting for the time required for literature review, data collection, analysis, and writing. The dynamic nature of blockchain technology and the supply chain may necessitate adjustments to the research plan as new information emerges.

Ethical Considerations: Conducting research across diverse cultural settings requires careful consideration of ethical issues related to informed consent, data privacy, and cultural sensitivity. Ensuring ethical research practices necessitates adherence to strict guidelines and obtaining necessary approvals from relevant ethical review boards.

Successfully navigating these challenges requires robust research design, meticulous attention to detail, a articulation of methodological choices, and a careful interpretation of findings. Addressing these challenges head-on will significantly increase the credibility, generalizability, and impact of this research. Acknowledging and addressing these limitations upfront will strengthen the overall integrity and contribution of the study.

11.Future of study

This research, focusing on blockchain adoption in supply chains through the lens of institutional isomorphism, possesses significant potential for future development and extension. Its innovative mixed-methods approach, coupled with a multi-sector, multi-national perspective, provides a strong foundation for several avenues of future research. These future directions can be broadly categorized into: (1) extending the theoretical framework; (2) deepening the empirical investigation; and (3) exploring practical implications and policy recommendations.

I. Extending the Theoretical Framework:

Integrating Resource Dependence Theory: This research could be extended by integrating resource dependence theory with institutional isomorphism. Resource dependence theory posits that organizations' actions are influenced by their dependence on external resources. In the context of blockchain adoption, this dependence could manifest reliance on specific technologies, suppliers, or regulatory bodies. Examining how resource dependence interacts with isomorphic pressures could offer a richer understanding of the drivers of blockchain adoption. For instance, firms heavily reliant on a particular technology provider might be more inclined to adopt blockchain solutions offered by that provider (mimetic isomorphism), even if alternative solutions exist.

Exploring Institutional Logics: Future research could explore the interplay between different institutional logics in shaping blockchain adoption. Institutional logics are the taken-for-granted assumptions, values, and beliefs that shape organizational behavior. Supply chains often involve multiple institutional logics (e.g., market logic, regulatory logic, social responsibility logic). Investigating how these competing logics interact and influence decisions regarding blockchain adoption could provide valuable insights into the complexities of organizational change. For example, the adoption of blockchain might be accelerated by a shift towards a more data-driven and technologically advanced institutional logic within the industry.

Incorporating Institutional Entrepreneurship: The role of institutional entrepreneurs individuals or groups who actively promote and shape new institutional arrangements could be examined further. These actors play a crucial role in driving the adoption of innovative technologies by actively shaping norms, influencing regulations, and promoting the perceived legitimacy of new technologies like blockchain. By identifying and studying these influential actors, the research can gain a more nuanced understanding of the diffusion process.

Dynamic Model of Isomorphism: The current research could be extended by developing a dynamic model of isomorphism, explicitly incorporating the temporal dimension and feedback loops in the adoption process. This model would go beyond a static snapshot of isomorphism and instead capture the evolution of institutional pressures and their changing influence over time. Such a model would better capture the continuous adaptation and learning that occurs during technological adoption. For example, it could track the evolution of industry norms around data sharing and security and how these changing norms influence the adoption of different blockchain solutions.

II. Deepening the Empirical Investigation:

Longitudinal Study: A longitudinal study would track blockchain adoption over time, capturing the evolution of isomorphic pressures and their influence on organizational choices. This would provide a more dynamic perspective, revealing how the interplay of “shadows of the past and future” evolves during the adoption process. Longitudinal data would allow researchers to assess the long-term impacts of blockchain adoption on supply chain efficiency, resilience, and sustainability.

Comparative Case Studies: In-depth comparative case studies of organizations within the same sector but with different levels of blockchain adoption could offer detailed insights into the specific factors driving these differences. These case studies could investigate the internal organizational processes, decision-making structures, and the interplay of internal and external factors that shape adoption decisions.

Expanding Geographic Scope: This research includes multiple countries, further expanding the geographical scope to include regions with diverse levels of technological development, regulatory frameworks, and cultural contexts could strengthen the generalizability of findings and develop the understanding of context-specific factors influencing blockchain adoption. For example, focusing on emerging economies could reveal unique challenges and opportunities for blockchain implementation.

Examining Different Blockchain Implementations: This research could be expanded to investigate various blockchain implementations (public, private, permissioned) and their respective influences on supply chain operations. This might include examining factors influencing the choice of a specific type of blockchain implementation and the impact of that choice on efficiency, security, and cost.

III. Exploring Practical Implications and Policy Recommendations:

Developing Best Practices: Based on the research findings, the best practices for blockchain implementation in different supply chain sectors could be developed. These best practices could include guidelines for overcoming specific challenges, selecting appropriate blockchain solutions, and managing the risks associated with blockchain adoption.

Policy Recommendations: The research could inform policy recommendations to support or accelerate blockchain adoption in supply chains. These recommendations could include suggestions for regulatory frameworks, investment strategies, and workforce development initiatives aimed at encouraging innovation and addressing potential challenges associated with the widespread adoption of blockchain.

Sustainability and Ethical Considerations: Future research can focus on the sustainability and ethical implications of blockchain adoption. This could involve investigating the environmental impact of blockchain technology, exploring its potential to promote ethical sourcing and transparency, and addressing potential risks related to data privacy and security. The research could investigate how blockchain can contribute to building more sustainable and responsible supply chains.

Impact on Small and Medium-sized Enterprises (SMEs): Given the potential costs and technical expertise required for blockchain implementation, future research should assess the challenges and opportunities for SMEs in adopting this technology. Specific policies and support mechanisms could be designed to facilitate blockchain adoption among SMEs and promote equitable access to the benefits of this technology.

The future of this research lies in building upon its current strengths the rigorous mixed-methods approach and the multi-sector, multi-national perspective to further refine our understanding of blockchain adoption in supply chains. By addressing these future research directions, this study can contribute significantly to both theoretical advancement and practical applications, shaping the future of supply chain management in the age of blockchain technology.

12.Discussion

This dissertation investigated the adoption of blockchain technology within global supply chains, exploring the interplay of institutional isomorphism, the "shadows of the past and future," and power dynamics. Employing a rigorous mixed methods design across three interconnected arenas; this study generated a nuanced understanding of the complex forces shaping organizational responses to this transformative technology.

Arena 1 employed a qualitative approach, utilizing in-depth interviews and case studies to explore the motivations, challenges, and decision-making processes surrounding blockchain adoption. The analysis revealed a dynamic interplay between individual actor mindsets and contextual influences, shaped by both past experiences and future expectations. Established infrastructure**,** organizational routines**,** and cultural norms what can be termed "the shadow of the past" often acted as significant barriers to adoption, limiting flexibility and willingness to change. On the other hand, the anticipation of competitive advantages, evolving regulatory landscapes**,** and emerging industry best practices collectively referred to as "the shadow of the future" served as powerful drivers pushing organizations toward blockchain integration.

These qualitative insights offered a deeper understanding of the contextual factors influencing adoption decisions, providing critical background for the subsequent quantitative analyses**.** The integration of this contextual data was important in refining the understanding of power dynamics and stakeholder behavior, particularly as they related to factors influencing adoption, which were later quantitatively assessed.

Arena 2 adopted a quantitative methodology to analyze the influence of institutional isomorphism across five strategically selected sectors within the global supply chain ecosystem. This arena assessed the relative impact of mimetic, coercive, and normative isomorphism on blockchain adoption rates. The results demonstrated significant variations across sectors, revealing the nuanced interplay of institutional pressures and sector-specific characteristics. These quantitative findings offered a robust empirical basis for understanding the broader patterns of blockchain adoption and validated the initial qualitative observations.

Arena 3 leveraged focus group discussions to explore power dynamics within the supply chain hierarchy. By examining the perspectives and influence of various stakeholders (suppliers, manufacturers, distributors, retailers), this arena illuminated how the distribution of power shaped the adoption process. This analysis revealed that actors with greater market control or hierarchical authority often exerted disproportionate influence on the decision-making process, potentially accelerating or hindering adoption based on their individual incentives and strategic objectives. This finding provided a crucial contextual layer, integrating the Micro-level power dynamics with the meso-level institutional pressures identified in Arenas 1 and 2.

The integration of findings across these 3 Arenas provides a comprehensive and robust understanding of blockchain adoption, exceeding the scope of previous research by incorporating a multifaceted perspective. The study's multi-national scope, encompassing geographically and culturally diverse regions, demonstrated the significant role of contextual factors in shaping the impact of institutional pressures. The findings highlight the limitations of simplistic generalizations and emphasize the importance of considering the interplay between global and local contexts when analyzing technological adoption in complex supply chain networks.

13.Conclusion

This dissertation makes significant contributions to the literature on technological adoption within complex organizational networks. It offers a nuanced, multi-faceted perspective by integrating institutional theory with a temporal framework and a power dynamics analysis. The findings challenge overly simplistic views of technological adoption, revealing the complex interplay of individual motivations, institutional pressures, and power relations shaping decisions regarding blockchain integration. The multi-national, multi-sector approach develops the generalizability of the findings and simultaneously acknowledges the contextual heterogeneity of supply chains across different geographical and cultural settings.

Although these limitations, this research provides substantial implications for both academics and practitioners. The findings offer valuable insights for organizations navigating the complexities of blockchain integration, emphasizing the importance of understanding and managing both internal and external influences on adoption decisions. The rigorous theoretical framework and empirical findings inform the development of future research directions and offer valuable insights for policymakers seeking to promote responsible and effective adoption of blockchain technologies within global supply chains. This dissertation contributes significantly to the growing body of knowledge on technological innovation and its transformative impact on the modern global economy.

14. Summary Table of Research Findings

Research Questions	Important findings	3 Arenas
RQ1: Given the blockchain capabilities, what motivates actors to adopt the technology within supply networks?	Upstream actors are motivated by transparency and traceability, which improves supply chain visibility and reinforces blockchain adoption.	Arena 1 (Qualitative)
RQ2: What goes on in the mind of the individual decision-maker?	Downstream actors emphasize trust and platform reputation, with adoption decisions strongly influenced by these factors.	Arena 1 (Qualitative)
	The reputation of blockchain platform providers is a crucial determinant in downstream adoption decisions.	Arena 1 (Qualitative)
	Effective communication of trust and reputation fosters higher adoption rates among downstream actors.	Arena 1 (Qualitative)
RQ3: Which factors are persuasive for participants to insert the required strategic information?	The FCM analysis reveals hierarchical differences in decision-making factors between upstream and downstream actors.	Arena 2 (Quantitative)
RQ4: How does blockchain adoption contribute to sustainability goals in supply chains?	Blockchain increases transparency and traceability in sustainable supply chain practices, aiding compliance with ethical sourcing standards.	Arena 1 & Arena 2 (Qualitative & Quantitative)
	Stakeholders recognize blockchain as a tool for achieving sustainability goals, particularly in ethical sourcing and energy efficiency.	Arena 3 (Qualitative)

Summary of Fundamental Insights from Each Arena:

Arena 1 (*Qualitative*): Explored individual actors' motivations, focusing on upstream and downstream perspectives. Transparency and traceability were central for upstream actors, reputation and trust played a stronger role for downstream actors (Gharehdaghi & Kamann,2025a).

Arena 2 (*Quantitative*): Provided statistical evidence on how institutional isomorphism (mimetic, coercive, and normative pressures) influenced blockchain adoption across different supply chain sectors, highlighting the different roles of Finance, Marketing, HRM, and Purchasing (Gharehdaghi & Kamann,2025b).

Arena 3 (*Qualitative*): Focus group discussions refined the understanding of decision-making, particularly in how hierarchical power dynamics within supply chains affect blockchain adoption. Larger, more powerful actors could push others toward adoption, indicating a significant role of coercive isomorphism (Gharehdaghi & Kamann,2024b).

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16.Appendix

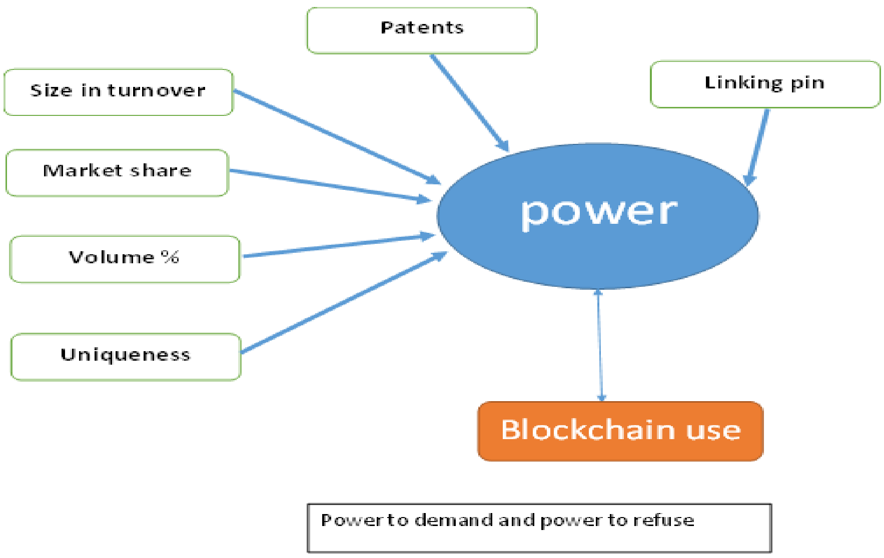
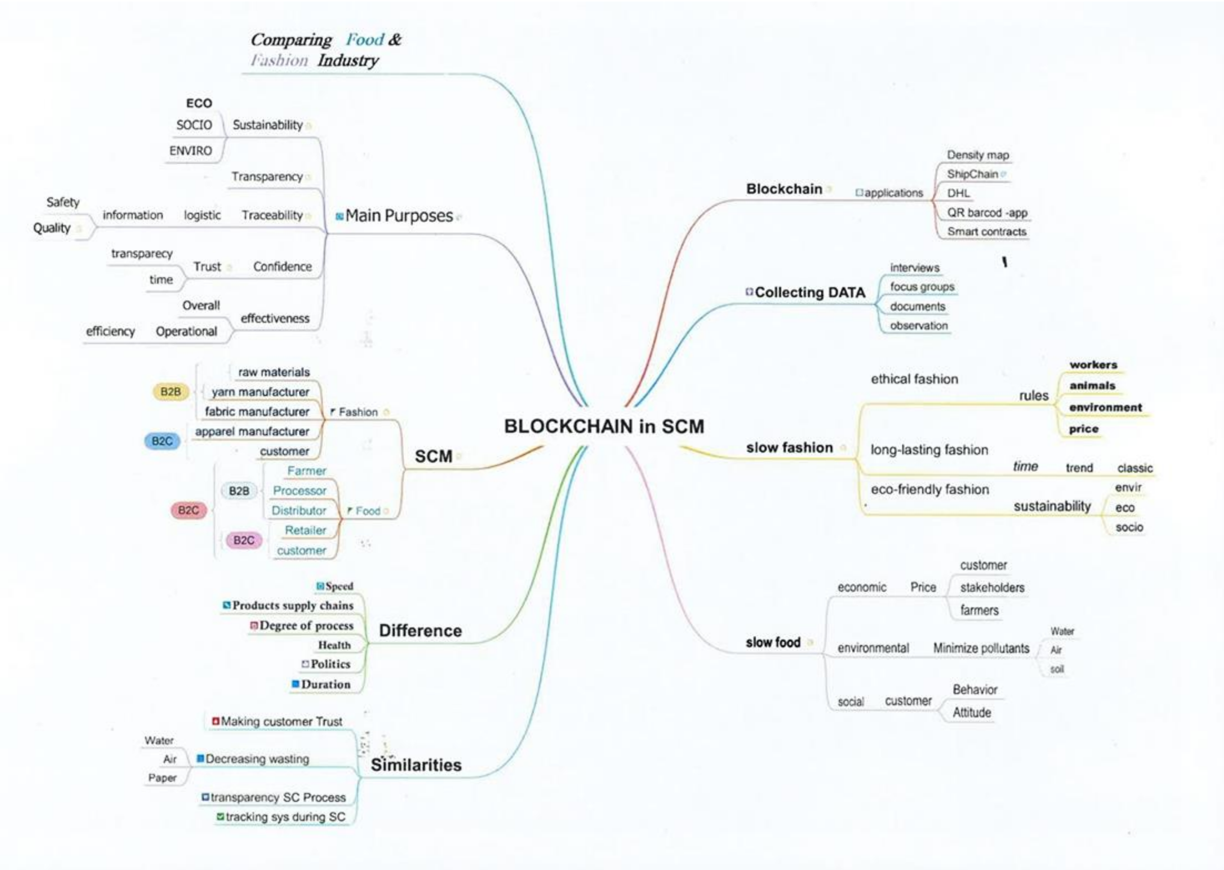
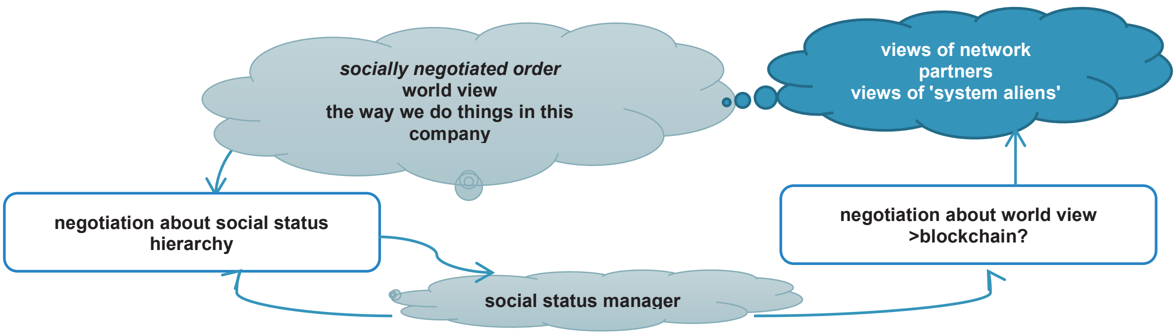


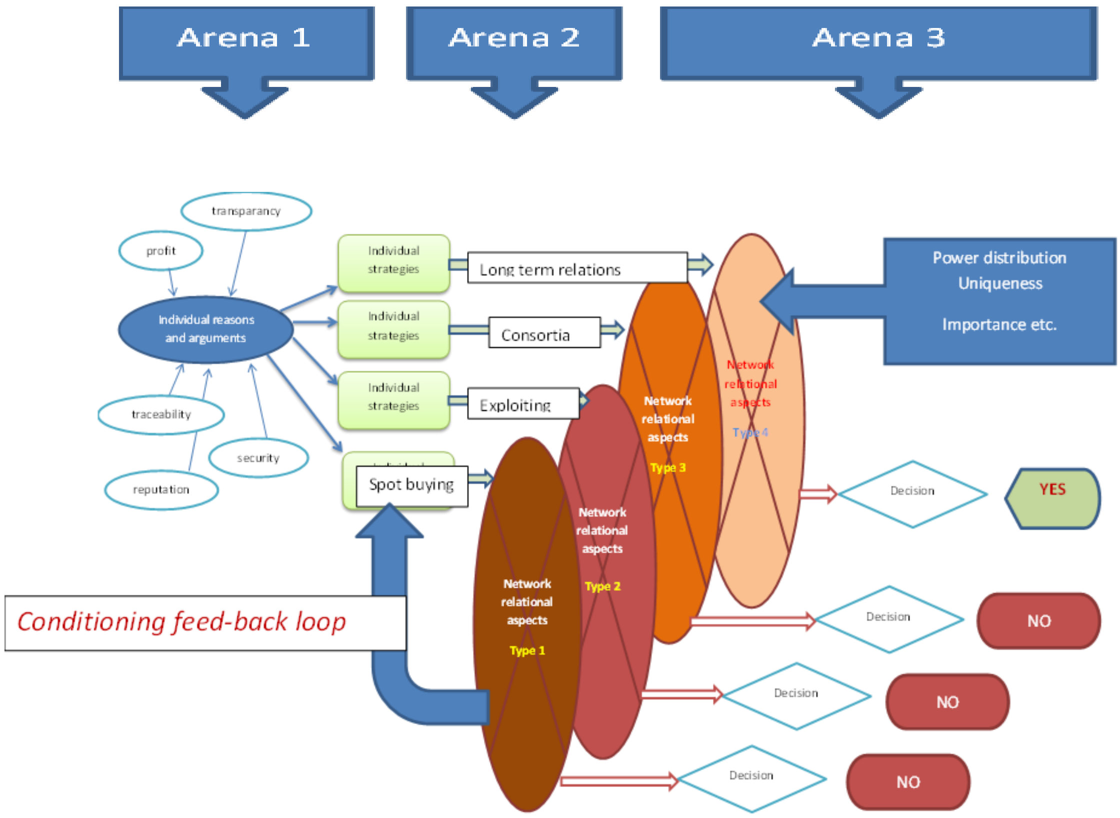
Figure 08: Factors determining the power of network participants



Model 08. Mind Map



Model 09: The Battle of the Egos: Socially Negotiated Order and Negotiated Social Hierarchy



Model 10: First Version of Arena 3: The decision flow about adoption of Blockchain technology

Holistic Feature	Methodological Support	Example	Impact
Stakeholder Inclusivity	Interviews, surveys, FGDs capture upstream, downstream, expert perspectives.	Walmart managers, Stella McCartney suppliers, IBM Food Trust partners (Ramasami et al., 2023).	Represents all actors, addressing Chapter 5's cross-level gap.
Cross-Level Feedback Loops	FCM, network analysis map micro-meso 1.2 interactions.	Manager resistance delays Unilever's pilot; network trust boosts adoption (Khan et al., 2022).	Captures dynamic influences, supporting Chapter 6's loops.
Industry Adaptability	Comparative case studies analyze food, fashion, and automotive challenges.	Walmart (food), Stella McCartney (fashion), Volkswagen (automotive) (Sharma et al., 2023; Ahmed, 2021).	Tailors' insights into sectors, per Chapter 3.
Multi-Method Validation	Mixed methods (interviews, surveys, FGDs, stochastic modeling) validate findings.	Atlas.ti codes, AHP rankings, MCMC simulations (Brown & Taylor, 2024).	Provides robust, comprehensive analysis, per Chapter 6.

Table 11. Methodology Support for Holistic Model Features

Arena 1, Interview Questions *(Qualitative)*:

Background Information

1. **Position and Role**:

What is your current role, and how does it relate to technological implementation within your company?

Are you involved in decision-making regarding technological adoption, such as blockchain?

2. **Experience and Company Context**:

How many years of experience do you have in this industry?

Could you describe your company in terms of size, structure, and focus areas?

Does your company have a history of being an early adopter of new technologies?

3. **Education and Knowledge**:

What is your academic background, and how has it influenced your understanding or adoption of blockchain technologies?

Have you or your team undergone any specific training related to blockchain?

Exploring Blockchain Usage

4. **Adoption Status**:Does your company currently use a blockchain platform?
    - **Yes**:
        - How long has it been in use?
        - What were the initial motivations for adopting it: marketing, logistics, strategic operations, or something else?
        - Can you share specific use cases where blockchain has been impactful?
    - **No**:
        - Why hasn't the blockchain been adopted?
        - Are you using other technologies like RFID, QR code scanning, or centralized databases?
        - Do you see a future for blockchain in your organization?
    - **Not yet**:
        - What barriers or concerns are delaying its adoption?
        - Are there ongoing discussions or pilots exploring blockchain integration?
5. **Characteristics of Products**: What are the main characteristics of your products (e.g., perishability, luxury, traceability)?

How do you think blockchain can or does increase these product characteristics (e.g., provenance, authenticity, safety)?

Blockchain and Sustainability

6. **Defining Sustainability**:

How does your company define sustainability in the context of your industry?

What are the most critical sustainability challenges you face today?

7. **Blockchain's Impact on Sustainability**:

In your view, does blockchain contribute to sustainability goals?

If Yes:

- In which dimensions (economic, social, environmental) does blockchain have the most significant impact?
- Can you provide specific examples or metrics of its effectiveness?

If No:

- What limits blockchain's potential as a sustainability tool in your industry?

Blockchain as a Solution

8. **Problems Solved by Blockchain**:

What are the major problems your company has solved (or could solve) using blockchain technology?

Are there any industry-wide problems that blockchain could address but has not yet?

9. **Future Potential**:

In your opinion, what new opportunities or innovations could blockchain unlock in the next 5–10 years?

What improvements or developments in blockchain technology would make it more valuable to your organization?

Motivations for Adoption

10. **Primary Motivations for Blockchain**:

What was the main driver for considering or adopting blockchain technology in your company?

Rank the following factors in order of importance:

- **Financial** (e.g., cost savings, revenue generation).
- **Social** (e.g., trust with end users, improved transparency).
- **Environmental** (e.g., reducing carbon footprint, promoting green practices).

11. **Challenges in Adoption**:

What challenges did your company face when adopting or considering blockchain?

Were these challenges technical, financial, cultural, or regulatory?

Open-Ended Exploration

12. **Perception of Blockchain**:

How do you see blockchain evolving in your industry?

Do you believe blockchain is overhyped, underutilized, or appropriately applied today?

13. **Advice and Insights**:

Based on your experience, what advice would you give to companies considering blockchain?

Are there any lessons learned or best practices you'd like to share?

14. **Future Outlook**:

How do you see blockchain intersecting with other emerging technologies like AI, IoT, or quantum computing?

What do you think the role of blockchain will be in creating more resilient and sustainable business models?

Topics:	Fashion				Food			Tech			HRM		Consumer			
Interviewee #	**1**	**4**	**9**	%	**2**	**10**	%	**3**	**5**	%	**6**	%	**7**	**8**	**11**	%
Transparency	8	6	10	20%	3	11	19%	4	3	10%	8	25%	8	6	2	12%
Traceability	5	3	7	12%	1	4	7%	2	2	**6%**	10	**31%**	2	3	2	5%
Advantages/Disadvantages	6	8	4	15%	7	5	16%	10	12	**32%**	1	3%	1	3	1	**3%**
Sustainability	7	14	7	**23%**	9	11	**27%**	6	3	13%	3	9%	8	4	9	16%
Trust	2	8	5	12%	6	8	19%	3	1	**6%**	7	22%	12	16	14	**32%**
Other technologies	5	3	1	7%	1	3	**5%**	9	6	22%	0	**0%**	2	4	4	8%
Reputation	2	8	2	10%	1	4	7%	5	3	12%	3	9%	12	10	8	23%

Selected interviewees, *M = Male interviewee F= Female ++ <> --- = advantages versus disadvantages; blue background: most mentioned topic*

Table 12: Frequencies of topics mentioned by clustered interviewee responses

Arrow Strength	Percentage Range	Interpretation
Strong (thick arrow)	≥ 25%	Indicates a high level of emphasis; the concept is prioritized by the stakeholder group.
Medium (normal arrow)	15% – 24.9%	Reflects moderate attention; the concept is relevant but not the primary focus.
Light (thin or dashed arrow)	< 15%	Signifies lower emphasis; the concept is of peripheral concern to the stakeholder group.

Table 13: Arrow Strength Categorization

Arena 2, Survey questionnaire *(Quantitative)*:

Decision makers Role in Organization

Mandana Gharehdaghi
Your insights are crucial to my research!

1. Email *

____

2. **Please choose your functional area :**

Mark only one oval.

- ◯ Marketing
- ◯ Finance
- ◯ Production
- ◯ Purchasing
- ◯ HRM
- ◯ Other: _______________________________

3. **Please choose your *sector***

Mark only one oval.

- ◯ Fashion
- ◯ Food Production
- ◯ Automotive
- ◯ IT
- ◯ Education
- ◯ Finance
- ◯ Food Retails
- ◯ Other: _______________________________

Untitled Section

4. **How long are you in this function**

Mark only one oval.

- 0-1 Year
- 2-5 Year
- 6-10 Year
- Other: ____________________

5. **Please encircle the department that, in general, has more status in the hierarchy of decision making in your company:**

Scenario 1: Marketing vs. Finance

Mark only one oval.

- Marketing < Finance
- Marketing = Finance
- Marketing > Finance

6. **Scenario 2: Marketing vs. Production**

Mark only one oval.

- Marketing < Production
- Marketing = Production
- Marketing > Production

7. **Scenario 3: Marketing vs. Purchasing**

Mark only one oval.

- Marketing < Purchasing
- Marketing = Purchasing
- Marketing > Purchasing

8. **Scenario 4: Marketing vs. HRM**

Mark only one oval.

- [ ] Marketing < HRM
- [ ] Marketing = HRM
- [ ] Marketing > HRM

9. **Scenario 5: Finance vs. Production**

Mark only one oval.

- [ ] Finance < Production
- [ ] Finance = Production
- [ ] Finance > Production

10. **Scenario 6: Finance vs. Purchasing**

Mark only one oval.

- [ ] Finance < Purchasing
- [ ] Finance = Purchasing
- [ ] Finance > Purchasing

11. **Scenario 7: Finance vs. HRM**

Mark only one oval.

- [ ] Finance < HRM
- [ ] Finance = HRM
- [ ] Finance > HRM

12. **Scenario 8: Production vs. Purchasing**

Mark only one oval

- Production < Purchasing
- Production = Purchasing
- Production > Purchasing

13. **Scenario 9: Production vs. HRM**

Mark only one oval.

- Production < HRM
- Production = HRM
- Production > HRM

14. **Scenario 10: Purchasing vs. HRM**

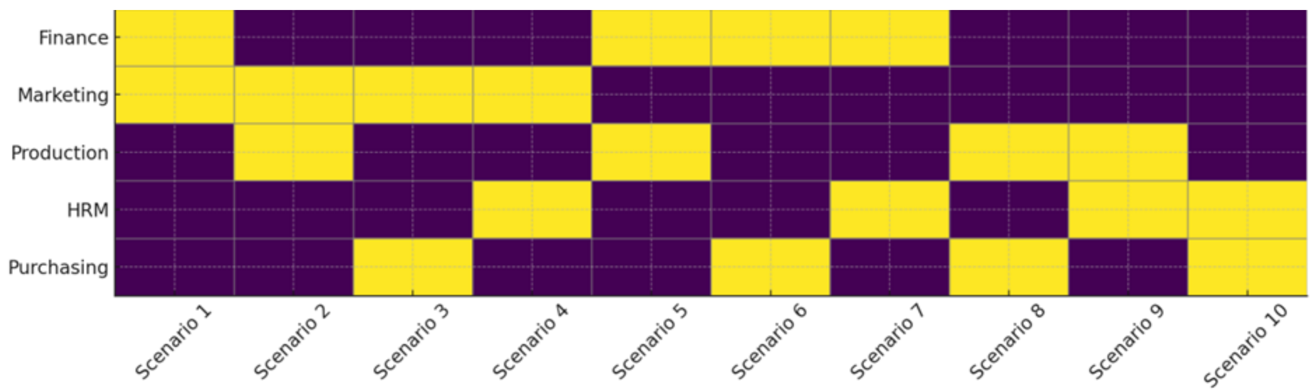
Mark only one oval.

- Purchasing < HRM
- Purchasing = HRM
- Purchasing > HRM

15. Please share with us if you have an idea or comment related to this research:

Scenarios	Finance	Marketing	Purchasing	Production	HRM	Equal
1	52	37	0	0	0	11
2	0	37	0	30	0	32
3	0	42	26	0	0	31
4	0	45	0	0	38	15
5	40	0	0	24	0	33
6	41	0	26	0	0	32
7	53	0	0	0	22	22
8	0	0	15	42	0	43
9	0	0	0	33	31	35
10	0	0	33	0	42	24

Table 14: Total Scenarios Scores, Preliminary Extracted data By Excel



Model 11: 5 Departments Across 10 Scenarios *(visualized Table 14)*

Countries	Netherlands	USA	UK	Germany	Turkey	Hungary	Canada	Belgium	UAE	Romania
Total Participants	**34**	**14**	**3**	**29**	**19**	**12**	**13**	**12**	**12**	**8**
Functional	M/F	M/F/ Pro	F/HR M	F/Pro/Pur	F/M/Pro	Pro/Pur/ HRM	F/M/HRM	Pur/M	M/F/ HRM	Pro/Pur

Table 15. Location and Functional areas

Arena 3, Interview Questions *(Qualitative)*:

Focus group discussion Design:

1. Introduction (2 minutes)

Briefly introduce the topic and participants.

2. Discussion Topics (16 minutes)

Topic 1: Compelled Terms (5 minutes)

Have you experienced situations where suppliers or buyers felt compelled to accept specific terms or relinquish demands? Why do you think this happened?

What factors like financial dependency or market conditions caused this dynamic?

How did this affect the long-term relationship?

Topic 2: Arrogance in Interactions (5 minutes)

Have you encountered buyers or suppliers exhibiting arrogance? How did it manifest in your interactions?

Was it through tone, demands, or other behaviors?

How did this impact negotiation or relationships?

Topic 3: Power Dynamics and Relationships (6 minutes)

Does the exercise of power influence negotiations or relationships? Could you share an example?

In what ways can power be used constructively?

Have you seen relationships damaged because of power misuse?

3. Conclusion (2 minutes)

What is the main takeaway from this discussion about managing power dynamics?

Responses: Example Derived from Interview Responses Prior to Analysis

1. **Fashion Brand Owner**
    - *Yes, as a fashion brand owner, suppliers sometimes have the upper hand, especially when they are exclusive fabric producers or manufacturers with limited capacity. There have been times when suppliers raised prices or reduced times, forcing me to accept their terms, even though it wasn't ideal for my margins. On the buyer side, large department stores and online retailers often impose strict terms, like demanding promotional discounts or extra inventory, and we had no choice but to comply to keep the relationship strong.*
    - *Definitely. Suppliers, particularly those who provide high-demand fabrics or trendy items, sometimes come across as arrogant, they know that fashion brands are dependent on the latest trends. They may limit the quantities they offer, raise prices, or impose higher minimum orders. Buyers often expect deep discounts or demand quick turnarounds for seasonal collections, knowing they control whether we get placed in major retail chains or not.*
    - *Yes, power plays a massive role in fashion. For example, if I'm dealing with a supplier who controls a unique fabric or a production method, they hold all the cards. A major department store chain that can showcase my collection in high-profile locations can demand discounts, faster shipping, and special deals since they know that their visibility can drive sales. I must comply with their terms; their size and market presence outweigh my individual power as a smaller brand.*

Sample Extract and Coding Illustration

"Suppliers, particularly those who provide high-demand fabrics or trendy items, sometimes come across as arrogant. They may limit the quantities they offer, raise prices, or impose higher minimum orders."

Open Codes Applied:

supplier dominance

price manipulation

scarcity tactics

trend dependency

Axial Code Category:

Sectoral Influences

Theme (Selective Coding):

Power asymmetries in fashion supply chain

16.1. The list of Figures, Charts and Models

16.2. List of the abbreviations

Supply chains	**SCs**
Sustainable Supply Chain	**SSC**
Blockchain	**BC**
Focus Group Discussion	**FGD**
Food/Fashion Supply chain	**FSC**
Analytic Hierarchy Processing	**AHP**
Internet of Things	**IOT**
Artificial intelligence	**AI**
Sustainable Quality Program	**SQP**
Food and Agriculture Organization	**FAO**
Technology Acceptance Model	**TAM**
Unified Theory of Acceptance and Use of Technology	**UTAUT**
Hazard Analysis and Critical Control Points	**HACCP**
European Blockchain Services Infrastructure	**EBSI**
Diligence Guidance for Responsible Supply Chains of Minerals	**OECD**
Linear Structural Equation Modeling	**LISREL**

16.3. List of the Publications

1. Behavioural and Organisational Factors Determining Blockchain Adoption,

   Journal: Current Journal of Applied Science and Technology. **Published ,2022.**

   DOI: 10.9734/cjast/2023/v42i74077

2. Blockchain adoption: the decision flows through three arenas,

   Journal: Journal of Economics, Management and Trade (JEMT). **Published ,2023.**

   DOI: 10.9734/jemt/2024/v30i71221

3. The impact of blockchain on transparency & trust in sustainable agri-food supply chains. **Book**: Springer: Web 3.0 and Metaverse. **Published ,2024.**

4. 3 Arenas Models. **Magazine**: Deal. Business and Economy ,**2024.**

5. Micro-Level Perspective on Blockchain Adoption: A Fuzzy Cognitive Map Analysis of Motivations. **Journal**: Prosperita, **Accepted**, *2025. PROSP-2025-0146*

6. How Finance stages and shapes strategic Blockchain technology adoption decisions

   Journal: Frontiers- **Published**,**2025**.

   DOI:10.3389/fbloc.2025.1578493

7. The role of power in market control in supplier-buyer relations

   Journal: Edelweiss Applied Science and Technology- **Published**, **2024**.

   DOI: 10.55214/25768484.v8i6.3858

8. How Isomorphism Forces Shape Blockchain Adoption for Sustainability in Supply Chains: A Multi-Level Analysis.

   Journal: Springer Nature, **Accepted** ,2025.

   DOI :22972-b97f-4e89-b96a-b04c3891e548

16.4. Conferences presentations

1. Pannon University National Conference

- Year: 2021
- Conference Date: 9th November 2021
- Location: National Conference (in-person)
- Mode: In-person
- Participation: Participated and presented

2. IKSAD INSTITUTE International Conference

- Year: 2021
- Conference Date: 9th October 2021
- Location: Izmir, Turkey
- Mode: Online
- Participation: Participated and presented

3. IPSERA International Conference

- Year: 2022
- Conference Date: 2nd – 5th April 2022
- Location: Jönköping, Sweden
- Mode: In-person
- Participation: Participated and presented

4. IKSAD INSTITUTE International Conference

- Year: 2022
- Conference Date: September 2022
- Location: Online
- Mode: Online
- Participation: Participated and presented

5. IPSERA International Conference

- Year: 2023
- Conference Date: 2nd – 5th April 2023
- Location: Barcelona, Spain
- Mode: In-person
- Participation: Participated and presented

6. MDI International Conference

- Year: 2023
- Conference Date: 5th – 7th January 2023
- Location: Online
- Mode: Online
- Participation: Participated and presented

7. IKSAD INSTITUTE International Conference

- Year: 2023
- Conference Date: 13th – 15th December 2023
- Location: Mardin, Turkey
- Mode: Online

- Participation: Participated and presented

8. UNeECC International Conference

- Year: 2024
- Conference Date: 9th – 11th October 2024
- Location: Timișoara, Romania
- Mode: In-person
- Participation: Participated and presented

9. BBU 1857 National Conference

- Year: 2024
- Conference Date: 14th November 2024
- Location: Budapest, Hungary
- Mode: In-person
- Participation: Participated and presented

10. IPSERA International Conference

- Year: 2024
- Conference Date: 5th – 9th April 2024
- Location: Rio de Janeiro, Brazil
- Mode: Online
- Participation: Participated and presented

11. IKSAD INSTITUTE International Conference

- Year: 2024
- Conference Date: 11th – 13th November 2024
- Location: Antalya, Turkey

- Mode: Online
- Participation: Participated and presented

12. AI-Hungary International Conference

- Year: 2024
- Conference Date: 11th – 13th September 2024
- Location: Berlin Germany
- Mode: In-person
- Participation: Participated and present

13. IPSERA International Conference

- Year: 2025
- Conference Date: 30th March – 4th April 2025
- Location: Rotterdam, Netherlands
- Mode: In-person
- Participation: Participated and present

14. IKSAD Conference

- Year: 2025
- Conference Date: 29 -31 May
- Location: Turkey
- Mode: Online
- Participation: Participated and present