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# Factors influencing blockchain implementation in supply chain management: An exploratory pilot study

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## Abstract

This study presents findings from a pilot study investigating key factors influencing the successful implementation of blockchain technology in supply chain organizations. Based on data collected from five participants, the pilot study offers valuable insights into the complex dynamics surrounding blockchain implementation. Through semi-structured interviews and grounded theory analysis, the study identifies key factors such as user adoption and acceptance, data integrity and protection, organizational strategy, strategic leadership, training, change management, and a supportive ecosystem. The findings highlight the multifaceted nature of blockchain implementation challenges and underscore the importance of comprehensive strategies for fostering user acceptance, aligning organizational goals, and navigating regulatory and technical complexities. By serving as a preliminary exploration, this pilot study lays the groundwork for future research aimed at further exploring the intricacies of blockchain implementation in the supply chain domain.

**Keywords**: blockchain technology, key factors, technology implementation, supply chain

## Introduction

Supply chain management (SCM) is crucial in ensuring the smooth flow of goods and services from suppliers to consumers. An effective supply chain involves collaboration and coordination between channel participants such as suppliers, producers, distributors, retailers, technology providers, investors, and ultimately the customers, to optimize processes, reduce costs, improve quality, and meet customer demands (Brasi, 2023). However, traditional supply chain systems often suffer from inefficiencies, lack of transparency, and limited stakeholder trust (Vela, 2023). These challenges can lead to discrepancies in inventory records and delays in order fulfillment, resulting in increased costs and dissatisfied customers.

Blockchain technology (BCT), initially popularized by cryptocurrencies like Bitcoin, has gained recognition for its potential to revolutionize SCM. At its core, BCT is a decentralized and immutable distributed ledger that allows secure and transparent recording, management, and tracking of data or transactions within a system that can be utilized by supply chain participants (Tripathi et al., 2023). Strategic use of BCT implementation for inventory control can bring about several benefits by leveraging the unique features of blockchain. From providing real-time visibility into inventory levels (Madhani, 2022) to implementing smart contracts to inventory management processes (Hasan et al., 2020) and creating a collaboration among different stakeholders in the supply chain using blockchain by providing seamless communication and coordination between supply chain participants (Omar et al., 2020), thereby creating economic value and securing a competitive edge. BCT promises significant benefits in logistics and SCM, such as increased sustainability, traceability, and verification (Helo and Hao 2019; Tijan et al. 2019). Blockchain can record and store information regarding the source and the flow of the material through the supply chain, and it can assist in swiftly pinpointing the problem's origin (Corkery and Popper 2018; Nestlé 2019).

### Objectives of the research

The primary objective of this exploratory qualitative pilot study is to identify key factors that influence an organization's implementation of BCT. We aim to uncover factors by analyzing real-world cases. By engaging with a small sample of participants, we seek feedback from professionals to understand how these factors interact and contribute to the overall implementation of BCT within the supply chain context. This pilot study serves as an initial exploration, laying the foundation for future research endeavors aimed at further exploring the intricacies of blockchain implementation and answering the research question: What are the key factors that collectively influence the implementation of blockchain technology in the supply chain?

## Literature Review

Implementing blockchain technology in the supply chain represents a pivotal shift towards greater transparency, efficiency, and trust in the management of goods and information flow. By providing a decentralized and immutable ledger of transactions, blockchain offers unprecedented transparency, traceability, and security throughout the supply chain ecosystem (Tsolakis et al., 2023). As organizations across various industries recognize the transformative potential of blockchain, the implementation of this technology in supply chain operations has become a focal point for enhancing efficiency, reducing costs, and ensuring ethical sourcing practices.

### Theoretical Foundation

Blockchain implementation often lacks strong theoretical foundations, and it is unclear which and to what extent organizational theories are used to investigate blockchain technology in the field (Kummer et al., 2020). For implementing BCT in organizations, organizational management theories in the information system (IS) world are crucial in understanding, planning, and evaluating the implementation to gain a competitive advantage (Gaur and Gaiha, 2020).

Organizational theories provide a valuable source of theoretical foundations and underpinnings for examining and expanding blockchain research (Kummer et al.,2020). By effectively understanding and applying these theories, organizations can optimize their information systems and processes, enhance their capabilities, and position themselves for success in today's dynamic business environment. The review of the available literature suggests that the resource-based view (RBV) information systems theory contributes to competitive advantage in organizations as a strategic framework (Davis and DeWitt, 2021).

Adoption theories offer insights into the motivators and barriers for companies adopting blockchain technologies for supply chains (Francisco and Swanson, 2018). Widely known theories, such as the technology acceptance model (TAM), the task–technology fit (TTF) theory, the diffusion of innovation (DOI) theory, the unified theory of acceptance and use of technology (UTAUT), and the social cognitive theory (SCT), assess user behavior and influences on implementation (Maruping et al., 2017; Venkatesh et al., 2012; Semenova, 2020). These models vary in benefits, predictive power, and limitations, with TAM, UTUAT, the technology–organization–environment framework, and inter-organizational system adoption theory being most applied. These theories help identify the factors impacting blockchain adoption decisions (Semenova, 2020).

Utilizing only one model might miss the benefits offered by other models (Nyimbili and Chalwe, 2023). As such, a multi-model integration method is crucial for a sound theoretical foundation, recurring predictive power, and robustness in studying a technology's potential acceptance or rejection (Alazab et al., 2021).

Organizational theories highlight the strategic use of resources for competitive advantage through blockchain implementation. Adoption theories like UTAUT and TAM focus on factors influencing technology adoption and usage, guiding user acceptance and engagement. Despite studies using multiple models, there's a gap in understanding successful blockchain implementation from both strategic and individual perspectives. Integrating these theories helps organizations address technological, organizational, and behavioral challenges, enhancing implementation strategies, user satisfaction, and organizational goals.

### Implementation of blockchain technology in supply chain sectors

A traceability system is necessary to obtain a reduction in costs, waiting time, and an overall improvement in quality and customer service, which would further enable organizations to develop a competitive advantage (Westerkamp et al., 2019) (Khan et al., 2018).

The impact of BCT on SCM includes improvements in data accuracy, inventory turnover, stockout reduction, order accuracy, and customer satisfaction. The extent of these benefits varies with the organization's industry and the complexity of its supply chain (Ada et al., 2021). Smart contracts automate inventory management tasks, such as reorder points and payment processing, reducing manual intervention and discrepancies (Frankenfield, 2023). Blockchain creates a transparent history of product movement, enhancing traceability and stakeholder transparency. Additionally, BCT combined with machine learning has been used for improved demand forecasting and efficient COVID-19 vaccine distribution (Meghla et al., 2021).

Madhani (2022) developed a customer-centric framework using blockchain to enhance competitive advantages in marketing, improving operational efficiency and customer satisfaction. Ho et al. (2020) created a blockchain platform for recording spare parts traceability, ensuring data integrity in aircraft parts management. Casino et al. (2019) proposed a blockchain-based VMI architecture to enhance inventory policies between vendors and retailers, boosting multi-firm supply chain performance. This approach improved logistics, information visibility, and security through a trusted data-sharing platform.

## Methodology

This pilot study aims to fill a research gap through an exploratory approach. While established theories provide a foundation, theory elaboration allows for new insights, aligning with our need for a deeper understanding (Fisher, 2017). Grounded theory methodology has been employed to achieve this goal, ensuring a thorough exploration of the research question.

For this study, a semi-structured, in-depth interview was chosen to enable detailed exploration. The format was based on the five phases suggested by Kallio et al. (2016) and allows probing deeper into responses for clarification, especially with complex matters (Naz et al., 2022). The framework was guided by prior studies identifying blockchain implementation and its impact on the supply chain. The research included drivers of BCT in the supply chain (Jardim et al., 2021), company motivation toward BCT (Sivula et al., 2020), and expert roles and opinions (Alvseike et al., 2017). Interviews were designed to explore nuanced insights on blockchain's impact in the energy domain (Edeland & Mörk, 2018), with Clohessy et al. (2018) highlighting technological, organizational, and environmental factors. The primary data sources were interviews with BCT experts selected for their supply chain background and blockchain implementation experience. This method is effective for gaining insights into complex issues through a flexible approach. Interviews were recorded, transcribed using Otter.ai, verified, and reviewed for accuracy (Yin, 2017).

### Data Analysis

In qualitative research, carefully examining the data is an important aspect that helps find important themes and patterns for better understanding. Data analysis was performed with the help of Atlas.ti software where texts were analyzed and interpreted using coding and annotating activities (Friese, 2002.). The analysis of the data collected followed Corbin and Strauss's (2008) guidelines, starting with open coding to identify and categorize phenomena in the text. Relevant information was labeled and refined through axial coding, identifying relationships between labeled codes, and forming interconnected groups for analysis. Theoretical coding was then used to make predictive statements about the phenomena. Prior research in blockchain implementation using semi-structured interviews provided a solid foundation, ensuring detailed and accurate expert perceptions. Reliability was ensured by meticulously documenting the interviews and every stage of data analysis, facilitating easy replication.

## Results

The pilot study involved semi-structured interviews with five supply chain consultants actively engaged in blockchain implementations across supply chain sectors, bringing a wealth of experience and expertise and offering valuable insights into the factors influencing blockchain implementation in SCM. Table 1 shows brief profiles of the participants.

**Table 1: Pilot Participant Profiles**

| Participant | Consulting Experience (In Years) | Blockchain Implementation Experience (In Years) | Industry |
|---|---|---|---|
| **Participant 1 (P1)** | 12 | 7 | Waste Management, FinTech |
| **Participant 2 (P2)** | 25 | 4 | Pharmaceutical Industry |
| **Participant 3 (P3)** | 10 | 7 | Multiple Industries - Natural Gas, Food Supply |
| **Participant 4 (P4)** | 7 | 5 | Retail Industry |
| **Participant 5 (P5)** | 5 | 5 | Automotive |

For successful qualitative analysis, data collection, documentation, analysis, and interpretation are the classical basic methods of research (Akinyode and Khan, 2018). Qualitative data analysis, generally described as a nonlinear, iterative process, is generally conducted in phases (Lester et al.,2020): data preparation, immersion in the data, coding, generation of themes, and abstraction to over-arching themes. For this analysis, this phased approach has been followed.

**Phase 1: Preparing and organizing the data.**

Semi-structured interviews often generate a large amount of data contributing to a rich dataset for analysis. The first step is to prepare and organize this data for analysis (Lester et al., 2020). The audio/video-recorded interview files were collected and converted into Word documents in this phase. This stage prepares the data for importing into ATLAS.ti, a qualitative data analysis software package.

**Phase 2: Transcribing the data.**

After every semi-structured interview, accurate and thorough transcription should be done immediately. This involves refinement procedures, including the exclusion of casual conversations and the elimination of redundant verbiage, to enhance the clarity and conciseness of the transcribed data converting spoken words into written text (Jamieson, 2016).

**Cleaning**: For this initial step, while the data was being transcribed, it was reviewed for any errors or inconsistencies and corrected as needed. The transcript, auto generated through Otter.AI, was compared with the original recording, and corrections such as typos, spelling issues formatting issues, or misinterpretations in the transcription process were made.
**Anonymization**: This is a critical step where any confidential identifying information from the transcripts is removed, to protect the privacy and confidentiality of participants. Each document shows the participant as P1, P2, and so on.
**Segmentation**: During transcribing, data associated with each question was taken out and added under individual responses to specific questions. This provided a clear format that showed the participant's response to each question, thereby making the analysis straightforward.
**Normalization**: To be consistent, terminology was standardized across the data to ensure consistency and comparability. This involved using consistent language and formatting conventions throughout the transcripts. Adjustments were made to the tone of sentences from direct conversation to a conversational style more closely aligned with the context of the interview questions.
**Verification**: After the data was completely transcribed, the accuracy and completeness of the transcribed data were validated by comparing it against the original recordings. This helped to ensure that the transcribed data reflected the content and context of the interviews accurately.

**Phase 3: Becoming familiar with the data.**

Once the collected data is organized and transcribed, it needs to be understood well via initial analysis (Lester et al., 2020). This generally starts when transcribing the data. While transcribing the collected data, the underlying information provided was highlighted and documented. Keywords from the interviews were identified and related key factors were noted at the end of each participant's transcription. These initial thoughts may be helpful in the later stage when completing the entire set of interviews - giving directions on where the data leads. It also helps us understand if we are moving in the right direction with the questions and potential limitations.

**Phase 4: Memoing the data**

As researchers review their data, it can be helpful to generate memos that describe initial reflections about the data, as well as any emergent interpretations (Lester et al., 2020). As part of the qualitative analysis, data was segmented by organizing individual responses according to specific questions This provided an opportunity to capture statements that are important from an analytic perspective based on an early interpretation of the data, as well as its connection to other aspects of the study.

**Phase 5: Coding the data.**

Atlas.ti was used to code data. As per Lester et al. (2020), the number of coding phases is to be done in at least three phases: 1) assign codes to the entire data set, 2) return and assign additional codes, 3) assign codes that align with the study's conceptual and/or theoretical ideas. This three-phase protocol was followed for our qualitative analysis as well. All five interview transcripts were uploaded into the Atlas.ti software. As part of the first phase, every important or useful word was assigned a code.

After going through the document line by line and reading other participant interviews, we developed an understanding of the linking statements, experiences, and reflections provided by participants in the research. This helps us move towards the second phase, assigning higher levels of codes that are more directly related to the study. In the final phase, we developed codes that align with the study's conceptual and/or theoretical ideas.

**Table 2: Concepts and supported categories**

| Category | Category Definition | Concept |
|---|---|---|
| **Data Integrity and Protection** | Data Integrity and Protection underscores the significance of safeguarding data integrity and security within blockchain systems, necessitating robust measures to thwart unauthorized access and potential threats. | Authorized people access, Controlled Blockchain, Controlled Encrypted Blockchain, Data cannot be modified or erased, DLT, Encryption, and data protection, Identify and mitigate security vulnerabilities, permissioned blockchain, permissioned network, protect patient privacy, restricts access to verified, smart contract audit, Thorough audits, and code reviews |
| **Organizational Strategy** | Organizational Strategy encompasses a wide array of concepts crucial for effectively navigating the complexities of blockchain implementation within an organization. It involves aligning strategic interests and priorities to ensure that blockchain initiatives are in sync with the overall organizational goals. Key concepts within this category include change management expertise and clear risk management processes | Aligning interests, change management, change management expertise, Clear Risk Management, Competitive disadvantage, Data Governance, Data Management, Defined change management process, Defined risk management, Frontline Employee Engagement, Future Proofing, Identifying risks, Implementations are adaptable for changes, Importance of end-user Engagement, Importance of Frontline Employee Engagement, misalignment, mitigating risks, overall strategic interests, remain competitive, Revenue streams from Data, Strategic Alignment and Leadership Support, strategic partnership. |
| **Strategic Leadership** | Effective leadership involves allocating budget and resources, investing in individual training, and fostering engagement and collaboration among key stakeholders. Leaders must also demonstrate unwavering support during challenges, building trust through transparent communication and stakeholder engagement | Allocating budget, allocating resources, championing benefits of BCT, clear vision, engagement, and collaboration, Investing in Individual training, lack of leadership support, leadership, and key stakeholders misalignment, Leadership strategic objective, Leadership support, leadership support during challenges, Leadership support in building Trust, Leadership with a clear vision, Need for cultural transformation, stakeholder engagement, Team aligned with a vision, Transparent communication, willingness to invest time and resources |

| Category | Category Definition | Concept |
|---|---|---|
| **Supportive Ecosystem** | This category involves building partnerships and collaborations, engaging stakeholders, and leveraging external resources and expertise to facilitate implementation and overcome challenges. It highlights the importance of commitment to sustainability and regulatory compliance, ensuring that blockchain initiatives align with ethical and legal standards | Commitment to Sustainability, consensus mechanisms, Existing Ecosystem, fostering collaboration, Lack of collaboration, Leadership support in regulations, regulatory compliance, Regulatory expertise, and Supportive ecosystem. |
| **System Vitality** | System Vitality underscores the need for robust and resilient blockchain systems. Ensuring scalability, interoperability, and sustainability are critical for maintaining the long-term viability and effectiveness of blockchain solutions within the organization | Architecture, Blockchain development, Blockchain Maturity, Fragmented blockchain impede efforts, High Interoperability for Transparent Flow, Highly Scalable for Competitiveness, Increased transaction volume - Scalability, latency, network congestion, Overlooking can hamper effectiveness, Robust IT systems, Technical Expertise, Without IO, multiple blockchain. |
| **User Adoption and Acceptance** | This category makes us understand how users interact with and embrace new blockchain technology in the supply chain. It highlights the importance of designing user-friendly, accessible systems that address pain points and create tangible value for end-users. This focus helps achieve smoother implementation and higher acceptance rates, ultimately contributing to the success of the blockchain implementation. | Ability of user to perform actions, accessible, addresses pain points, awareness of system, Clear Usability and accessibility, Continuous User Training, create value, Encouraging Pilot Outcomes, friendly interfaces, Identify Pain Points, improve efficiency, intuitive design, intuitive interfaces, pilot projects, understand benefits, understandable for users, user centered design, User experience and usability, User guides, User Training and support, User Training for knowledge |
| **Training and Education** | This category is vital for equipping users with the necessary knowledge and skills to effectively implement and utilize blockchain technology in the supply chain. By investing in continuous training options, organizations can ensure a well-informed and capable user base, facilitating smoother technology implementation. | Clear training and awareness, Comprehensive training, Education and training, Effective training programs, Empowering users with knowledge and skills, Filing knowledge gaps, guidance and support, Guiding the design and implementation, Hands-on experience, Importance of training, invest in training and change management, Tailored documents, Training enhances user confidence, Training increases value, Training reduces resistance to change, Training with SMEs, Training and Education, Multiple training options |
| **Change Management** | The Change Management category focuses on effectively guiding users and organizations through the transition to blockchain technology in the supply chain. By managing these elements well, organizations can ensure smoother transitions and sustain progress, minimizing disruptions during implementation. | Clear documentation, concerns about transaction throughput, constant feedback, Continuous support, encourage innovation, End-user Engagement, Help Desk to assist users, increased confusion, Open and Transparent communication, sense of ownership, Transparent processes, undermine progress |

As a better understanding of the analyzed data is formed, codes were created related to the key factors that participants have identified that can create an impact on implementing blockchain in organizations.

**Phase 6: Moving from codes to categories and categories to themes.**

This process involves the application of codes, the development of categories, and ultimately the production of themes (Lester et al., 2020). 125 codes were created from the five interview documents. Using ATLAS.ti, distinct code groups emerged, signifying pivotal themes within our study. Each code was then analyzed and assigned based on its thematic relevance and alignment with the overarching objectives of this analysis. Table 2, details code groups that have been identified which provide a structured framework for understanding the influential factors driving blockchain implementation in supply chain contexts.

## Data Integrity and Protection

Data Integrity and Protection underscores the significance of safeguarding data integrity and security within blockchain systems, necessitating robust measures to thwart unauthorized access and potential threats. It encompasses various strategies aimed at ensuring data security and integrity, involving measures to safeguard against unauthorized access and modification, thus upholding system trustworthiness. Key concepts within this category include controlling access to the blockchain, employing encryption techniques to protect data, and conducting thorough audits and code reviews to identify and mitigate security vulnerabilities. Additionally, the use of permissioned blockchains and networks helps restrict access to verified participants, enhancing data security and privacy. All participants stressed the importance of a “Controlled encrypted blockchain”. P2 says that “access control mechanisms are created that restrict data access to authorized users only, mitigating the risk of unauthorized data breaches. In the pharmaceutical industry that implements blockchains, organizations go for permissioned blockchain networks. This restricts access to verified participants, ensuring that only authorized parties can participate in the network and access sensitive data”. Measures such as smart contract audits and encryption further contribute to data protection, ensuring that sensitive information remains confidential and tamper-proof.

## Organizational Strategy

Organizational Strategy encompasses a wide array of concepts crucial for effectively navigating the complexities of blockchain implementation within an organization. It involves aligning strategic interests and priorities to ensure that blockchain initiatives are in sync with the overall organizational goals. P3 says “Organizations must have interoperable systems, and scalable blockchain solutions to remain competitive”. Key concepts within this category include change management expertise and clear risk management processes, which are essential for mitigating risks and facilitating smooth transitions during periods of change. Furthermore, emphasis is placed on frontline employee engagement and end-user engagement to foster buy-in and support for blockchain initiatives. Future-proofing strategies and identifying revenue streams from data underscore the importance of remaining competitive and adaptable in dynamic market environments. Additionally, strategic alignment and leadership support are critical for driving successful blockchain adoption, often through strategic partnerships and collaborations with industry stakeholders. P5 says “Strategic objectives and potential benefits of blockchain technology in enhancing transparency, efficiency, and trust within the automotive supply chain, is a very important action from leadership”.

### Strategic Leadership

Strategic Leadership is essential for navigating the complexities of blockchain implementation. At its core lies the need for leaders to champion the benefits of blockchain technology and articulate a clear vision that aligns with strategic objectives. Effective leadership involves allocating budget and resources, investing in individual training, and fostering engagement and collaboration among key stakeholders. Leaders must also demonstrate unwavering support during challenges, building trust through transparent communication and stakeholder engagement. P4 says "Transparent communication helps create partnerships and collaboration between organizations and users, facilitating smoother acceptance of blockchain technology". Additionally, there is a recognition of the need for cultural transformation and a willingness to invest time and resources in fostering a team aligned with the vision. However, challenges may arise from a lack of leadership support or misalignment among key stakeholders, emphasizing the importance of strong leadership and strategic alignment to drive successful blockchain integration within the organization. P2 says "Misalignment between leadership and key stakeholders has resulted in situations where insufficient allocation of resources, including funding, talent, and time, for blockchain projects. This has hampered progress and limited the ability of project teams to address critical technical challenges".

**Supportive Ecosystem**

Supportive Ecosystem involves building partnerships and collaborations, engaging stakeholders, and leveraging external resources and expertise to facilitate implementation and overcome challenges. It highlights the importance of commitment to sustainability and regulatory compliance, ensuring that blockchain initiatives align with ethical and legal standards. Key concepts within this category include fostering collaboration among stakeholders and leveraging existing ecosystem resources to support blockchain adoption. P4 says "Bringing all collaborators under one roof for this new implementation will make a huge difference in making it a successful implementation. Keeping the External partners, industry people, and regulatory bodies, updated with the future implementation, is crucial for facilitating smooth transitions". Leadership support in navigating regulatory frameworks and providing regulatory expertise is crucial for overcoming compliance challenges and fostering innovation. P4 also says "Blockchain implementation in the retail industry often involves navigating complex regulatory and legal landscapes. Leadership support is crucial for understanding and addressing regulatory requirements, compliance issues, and potential legal risks associated with adapting blockchain in an organization". Additionally, consensus mechanisms play a pivotal role in ensuring transparency and trust within the ecosystem, facilitating decision-making processes, and enhancing overall governance.

**System Vitality**

System Vitality underscores the need for robust and resilient blockchain systems. Ensuring scalability, interoperability, and sustainability are critical for maintaining the long-term viability and effectiveness of blockchain solutions within the organization. P1 says "This was critical during our implementation. During the initial analysis, we noticed that without properly addressing interoperability issues, the organization's blockchain platform may struggle to integrate with external systems, such as payment gateways, supply chain management tools, or government database". Fragmented blockchain architectures can impede efforts, highlighting the importance of high interoperability for transparent data flow.

Scalability is crucial for handling increased transaction volumes and mitigating issues such as latency and network congestion. Overlooking these factors can hamper the effectiveness of blockchain solutions, emphasizing the need for robust IT systems and technical expertise. P1 also says "Scalability issues could impede the growth and expansion particularly as the volume of transactions and users increases over time. Without the ability to handle a growing workload efficiently, we may run into performance bottlenecks, slow transaction processing times, and increased costs associated with scaling infrastructure". Without interoperability, multiple blockchains can lead to inefficiencies and hinder overall system vitality.

**User Adoption and Acceptance**

This category encompasses a range of concepts that ensures that users effectively adopt and engage with a blockchain system. Key elements include the system's ability to perform actions, making it accessible, and addressing user pain points. Awareness of the system and clear usability and accessibility are vital, along with continuous user training to create value and enhance user experience. P5 says "Organizations generally are ready with workshops, seminars, webinars, and online courses designed to familiarize stakeholders with blockchain concepts, use cases, and implementation best practices. These education and training programs are necessary to incentivize the stakeholders to understand the technology and also to make them confident in the new systems". Concepts such as encouraging pilot outcomes, providing friendly interfaces, and identifying pain points are essential for improving efficiency. P1 says "implementing pilot programs and proof of concepts by demonstrating the value and feasibility of blockchain technology with a focus on specific processes. This will build confidence and trust among all involved stakeholders. During our implementation, we noticed that offering incentives and rewards motivated users to engage with the blockchain platform and adopt new behaviors, thereby providing tangible benefits". The design should be intuitive and user-centered, with pilot projects helping users understand the benefits. Overall, this category highlights the importance of a seamless user experience, supported by comprehensive user guides and continuous training, to foster acceptance and proficiency. User Adoption and Acceptance stand at the intersection of technical, strategic, and organizational efforts, making it the core category that integrates and influences all other aspects of successful blockchain implementation.

**Training and Education**

The category of Training and Education is essential for the successful implementation and user adoption of blockchain technology within an organization. This category includes concepts such as clear training and awareness initiatives, comprehensive and effective training programs, and a strong emphasis on education. Empowering users with knowledge and skills through tailored documents, hands-on experience, and continuous guidance and support is crucial. P4 says "All end users in the retail industry are generally given basic training on blockchain fundamentals. By increasing users' understanding of blockchain concepts and principles, organizations facilitate greater acceptance of blockchain solutions". Effective training programs help to fill knowledge gaps, enhance user confidence, and increase the overall value derived from the technology. Additionally, investing in training and change management, guided by SMEs, is critical for reducing resistance to change. P4 says "workshops, training programs, and informational materials, play a crucial role in shaping stakeholders' perceptions. User-friendly interfaces including accessibility, intuitiveness, and functionality influence stakeholders' perceptions of blockchain technology as well". Providing multiple training options ensures that users receive the necessary education and support in a manner that best suits their needs, ultimately facilitating a smoother transition and greater user engagement.

**Change Management**

The category of Change Management encompasses various essential aspects to ensure a smooth transition and successful implementation of blockchain technology within an organization. Key concepts include clear documentation to guide users, addressing concerns about transaction throughput, and providing constant feedback and continuous support to alleviate any issues. P1 says "Leadership should have a clear and documented change management and risk management process that we can go back and look at during times when the implementation is not going as we intend it to". Encouraging innovation and fostering end-user engagement are critical for gaining user buy-in and ensuring they feel a sense of ownership over the process. Establishing a help desk to assist users and maintaining open and transparent communication channels can significantly reduce confusion and resistance. P2 says "User-friendly interfaces, intuitive design, and clear documentation can help mitigate concerns about the ease of use of blockchain applications, making them more accessible and understandable for users using the technology". Transparent processes and an emphasis on continuous feedback help build trust and mitigate challenges, preventing factors that could undermine progress. Overall, effective change management ensures that users are supported throughout the transition, fostering a positive environment for adopting new technology.

### Core Category

A distinctive characteristic of grounded theory is the constant comparative method. The constant comparative method, which can be seen as the "core category" of grounded theory, includes that every part of data, i.e. emerging codes, categories, properties, and dimensions are constantly compared with all other parts of the data to explore variations, similarities, and differences in data (Hallberg, 2006). The core category is the concept to which all other concepts relate, and theory is generated around a core category (Noble and Mitchell, 2016) (Scott, 2016). From our pilot study, we choose "User Adoption and Acceptance" as the core category as it intertwines with the other identified categories. This is critical because the success of blockchain implementation heavily depends on whether users embrace the new technology. Without users accepting the system, even the most technically sound and strategically aligned initiatives can fail.

**Training and Education** directly feed into User Adoption and Acceptance by preparing users to utilize the blockchain technology effectively.
**Change Management** supports User Adoption and Acceptance by helping users transition smoothly and addressing their concerns.
**Strategic Leadership** influences User Adoption and Acceptance by providing the vision and support needed to improve user engagement.
**Organizational Strategy** aligns resources and objectives to support user needs, making adoption smoother.
**Supportive Ecosystem** ensures that the external and internal environments are conducive to user acceptance.
**System Vitality** and **Data Integrity and Protection** ensure that the technology is reliable and secure, which are crucial for gaining user trust and acceptance.

A focus on users ensures that all other categories are aligned to meet their needs and enhance their experience, thus driving the overall success of blockchain implementation in the supply chain.

## Limitations and Discussion

This study had a small sample size of only five participants, which may not fully capture the diverse perspectives and experiences necessary for a comprehensive understanding of the factors influencing blockchain implementation in supply chain organizations. However, participants were interviewed across diverse industries to provide a broader view. Expanding the sample size across various industries in future research will help us better understand the phenomenon. Furthermore, as a pilot study, this research is preliminary and intended to lay the groundwork for future investigations, meaning that the conclusions drawn are tentative and require further validation through larger-scale studies.

This pilot study makes several significant contributions to the field of blockchain technology implementation in SCM. Firstly, it provides a foundational framework for understanding the key factors influencing successful blockchain implementation, including data integrity and protection, organizational strategy, strategic leadership, supportive ecosystems, system vitality, user adoption and acceptance, training, and change management. By identifying these categories and their associated concepts, the study enriches the theoretical understanding of blockchain implementation processes and challenges. This pilot study also highlights the importance of user acceptance as a core category, suggesting that future research should focus on this aspect to ensure successful technology integration.

For practitioners, this pilot study provides actionable insights into the practical considerations necessary for successful blockchain implementation. The identified key factors and their associated concepts serve as a comprehensive guide for decision-makers, helping them to prioritize areas such as data security, organizational alignment, strategic leadership, and user engagement. The study emphasizes the importance of robust training programs, clear communication, and continuous support to enhance user acceptance and confidence. Furthermore, the findings underscore the need for a supportive ecosystem and strategic leadership to navigate the complexities of blockchain technology. By addressing these practical aspects, organizations can improve their operational efficiency, enhance transparency, and achieve competitive advantages.

## Conclusion and Future Research

We aim to expand our research by working with more participants to further explore and refine the key factors influencing the implementation of blockchain technology in supply chain organizations. By engaging with additional participants from diverse backgrounds and industry sectors, we anticipate uncovering a broader spectrum of insights and perspectives. This iterative process will allow us to delve deeper into the complexities of blockchain implementation, identifying nuanced factors that may have been overlooked in earlier stages of the research. Through continued data collection and analysis, we seek to enrich our understanding of the challenges and opportunities, ultimately contributing to the development of more robust and effective strategies for implementation.

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