

Trustworthiness in Supply Chains: Leveraging Private Blockchain Solutions

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Abstract

This research aims to explore how private blockchain technology can enhance trust among supply chain partners. Trust plays a crucial role in building long-term relationships with customers, business partners, and other stakeholders. In this context, the sustainability and growth of a company heavily depend on its ability to maintain high levels of trust in technology, operational records, and platform reliability. The novelty of this research lies in the qualitative case study approach used to explore how collaboration and innovative solutions can improve overall performance and competitive advantage in the rapidly changing world of supply chain management. The research method employed a qualitative research approach with a case study approach. Data collection techniques involved interviews and direct observations to understand the implementation and impact of private blockchain technology in the supply chains of leading companies such as Amazon, Maersk, Microsoft, Walmart, and Alibaba. Our research shows that using blockchain in supply chains enhances transparency and builds trust among partners. It does this by offering unchangeable records that remove the necessity for third-party intermediaries, enabling business partners to engage confidently, knowing that the data exchanged is secure and accurate. Leading companies like Maersk have successfully integrated blockchain-based digital solutions such as TradeLens to improve customer trust and operational efficiency.

Keywords: Private Blockchain; Supply Chain Management; Trust Theory.

1. INTRODUCTION

The supply chain has undergone significant transformations in the last two decades with the ongoing globalization and increasing competition dynamics. On the other hand, world-class logistics is not limited to company boundaries but has expanded into a complex network. Collaboration is considered a crucial approach to enhancing overall performance and achieving competitive advantage throughout the chain, making various companies increasingly emphasize the importance of collaborative relationships with their partners to achieve superior performance (Alshurideh et al., 2022). Blockchain allows each party in the supply chain to access the same data in real-time, reducing uncertainty and strengthening confidence that the information received is accurate and reliable. Effective teamwork allows partners in the supply chain as mean to enhance their abilities in meeting customer requirements and promptly seizing market opportunities. Therefore, collaboration has become a key element in supply chain management. For instance, joint problem-solving can expedite product launches to the market, and collaboration among supply chain partners can result in the development of innovative new products (Solaimani & van der Veen,

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2022). Prominent firms like Google, Amazon, and Alibaba showcase enhanced cooperation as a means to gain a competitive edge (Li, 2022). The positive outcomes of the collaboration among these supply chain partners include reduced costs, more streamlined inventory management, and enhanced order lead times (Tarigan et al., 2021). However, the main challenge faced by supply chains today is the lack of trust and transparency in sharing information among companies in the chain because the involved partners in collaboration may introduce the risk of conflicts in business objectives (Qian & Papadonikolaki, 2021). Supply chain management and supply chain collaboration continue to be the focus of research with proven positive outcomes on overall chain performance (Sharma et al., 2021).

In this context, the increasing demand for trust becomes increasingly significant as supply chain partners strive to gain a deeper understanding of each other's capabilities, needs, and weaknesses (Alshurideh et al., 2022). Companies in the supply chain are investing in new technologies to enhance transparency and trust, particularly through innovations in information sharing and communication. Alongside the challenge of improving performance throughout the supply chain, consumer and end-user demand for transparency also continues to grow. According to (Laroiya et al., 2020) buyers and sellers need to establish a dependable system for verifying and validating the actual value of products or services. In line with (Waerness et al., 2023) who emphasize that trust and openness are key factors in inter-organizational collaboration within the supply chain. To address this, companies need to seek governance or standard structures that can strengthen relationships and reduce threats in transactions. Blockchain technology emerges as a recent innovation with the potential to enhance trust through transparency and tracking each transaction (Tarigan et al., 2021). Although many consider blockchain as a revolutionary solution to trust issues, the complex relationship between this technology and trust in the supply chain still requires a better understanding. Some researchers, such as (Rejeb et al., 2021; Waerness et al., 2023) suggest that although blockchain has the potential to serve as a reliable tool by replacing legal frameworks and intermediaries, a hindrance to effective information sharing in the supply chain arises from a lack of trust. The persistent challenge of a trust deficit can be mitigated through the adoption of new technologies.

While many studies have investigated the potential of blockchain technology in various sectors, there is still a significant gap in understanding how private blockchain technology specifically affects trust dynamics within the supply chain. Most previous research has focused on public blockchain systems, leading to a limited examination of how private blockchains can improve transparency and reduce transaction risks. This study aims to address that gap by exploring the impact of private blockchain on trust among supply chain partners, offering new insights into the relationship between technology and trust in business practices.

This research has several main contributions, including:

- **Enhanced comprehension of trust dynamics within the supply chain:** This study contributes to elucidating the essence of trust in the supply chain and examining the impact of blockchain technology on the dynamics of trust among business partners.
- **Investigation into the influence of blockchain technology on trust:** This research offers valuable perspectives on how incorporating blockchain technology can impact the trust levels among companies within the supply chain.
- **Development of an investigative model:** This study contributes to constructing an investigative model that establishes connections between trust literature and blockchain technology within the supply chain context. It serves as a basis for future research in this domain.

2. LITERATURE REVIEW

2.1 Blockchain

Blockchain technology has emerged as a revolutionary solution for recording data in a decentralized and secure manner. On a blockchain platform, every transaction within each system is documented in a decentralized ledger, and the aggregation of diverse transaction activities constitutes blocks (Aviv, 2022). Every fresh block contains designated addresses for the exchange of value, along with preserving the digital address (hash) of the preceding block (Vadher & Parekh, 2020). In this context, everyone connected to the network can access all historical activities and transactions, as well as specific details, such as block creation time and value (Bharathi Murthy et al., 2020). Within a blockchain

network, the encryption of data before each transaction can be achieved using private keys. The process in blockchain entails utilizing private keys for encrypting data before every transaction, with the sender needing both their private key and the recipient's public key. The transaction process involves two phases: signing by the sender using the private key and verification to complete the unique transaction (Bhushan & Sharma, 2021). Blockchain applications run on platforms connected to specific blockchains to provide additional functionality. Blockchain technology is used to enhance transparency and transaction accuracy across platforms, with limitless potential. Blockchain can streamline the generation, transfer, and management of digital assets through automated validation, allowing for the development of new services characterized by minimal transaction expenses and swift execution. Many blockchain-based applications and services, with case studies implementing blockchain for the Internet of Things (IoT) and smart contracts, showcase its versatility.

In the realm of blockchain network structures, there are two main distinct types. Public networks, as used by Bitcoin, are open to all participants, while private networks, often tailored for corporate purposes, restrict access to specific user groups. Key components of the blockchain structure include nodes, responsible for validating transactions, and the blockchain itself—a chain of blocks connected by transactions (Aviv, 2022). The technological foundation of blockchain heavily relies on cryptography to ensure transaction security and access control; in this context, consensus algorithms play a crucial role in achieving agreement among network nodes (Jayabalan & Jeyanthi, 2021). Security in blockchain is realized through decentralization, which can reduce the risk of manipulation, and the use of asymmetric cryptography, securing transactions and user identities (Yang et al., 2022). In another example, Ethereum, a prominent blockchain platform emphasizing smart contracts, provides a versatile foundation for decentralized applications (Ibba et al., 2023). Other blockchain platforms, such as Hyperledger designed for enterprise applications, and Binance Smart Chain, emphasizes transaction speed, are also noteworthy in this context (Bouras et al., 2021). Ongoing developments in this field encompass various projects. In the financial sector, Ripple facilitates secure and instant cross-border transactions, while Chainlink enables decentralized oracle services, enhancing smart contract reliability (Charles & Fortin, 2023). Supply chain management benefits from VeChain, ensuring transparency and tracking, while in healthcare, MedRec uses blockchain for secure health data sharing (Abouali et al., 2021).

Blockchain is characterized as a trustless technology by (Kolade et al., 2022), addressing concerns related to trust by eliminating the need for users to establish trust mechanisms. IBM sees blockchain as a potential enabler of a sharing economy through its trustless system (Kolade et al., 2022). (Toufaily et al., 2021) highlight how blockchain expedites trust development among individuals, while (Sedej & Dk, 2021) conceptualize it as a Truth Machine within organizational relationships, addressing trust issues in digital transactions. The technology allows secure sharing of transaction data through a shared ledger without reliance on a trusted third party, with distinctions in public and private blockchains based on accessibility and permissions. Blockchain transactions can represent various exchanges, and smart contracts, embodied in algorithms, execute actions based on specified conditions. The technology's core characteristics include decentralization, transparency, openness, autonomy, immutability, and privacy, allowing each node to independently view, update, and trust data. The consensus mechanism controls access to transactions, ensuring data integrity, and privacy is implemented through public mode, enabling anonymous transactions between nodes (Sedej & Dk, 2021).

2.2 Supply Chain

Blockchain has become a pivotal force in transforming supply chains, offering enhanced transparency, security, and efficiency (Yang et al., 2022). It facilitates secure and measurable transaction recording, tracking goods from source to destination, improving inventory accuracy, and minimizing risks of data loss or fraud. Recent developments, such as smart contracts and secure digital identities, automate agreement execution, increase process speed, and ensure authenticity in transactions. Combining blockchain with technologies like the Internet of Things (IoT) further improves supply chain visibility, allowing real-time monitoring of goods and environmental conditions for optimized logistics and timely delivery (Kumar et al., 2023). This continuous evolution in blockchain technology is expected to bring significant benefits in terms of operational efficiency and overall supply chain resilience. Effective supply chain management requires a consistent engagement framework and collaboration with business partners (Kumar et al., 2023). Organizations should adopt coordinated management practices, optimize internal and external processes, and establish robust relationships with partners (Jabbar et al., 2021). Process optimization involves integrating information systems and technologies that support inventory management, transportation, and overall coordination of supply chain

activities. Collaboration is crucial for overall performance, as efficient information flow relies on both collaboration and coordination. Transactional coordination is considered vital for reducing costs and risks and gaining a competitive advantage, with contracts serving as a fundamental approach between partners (Jayabalan & Jeyanthi, 2021). The interplay between contractual and relational dimensions in strengthening cooperation remains an area that needs further exploration (Yang et al., 2022). Despite the growing interest in blockchain technology for supply chain applications, the role of private blockchains in addressing trust issues remains underexplored. This study addresses this gap by providing empirical evidence of how private blockchain technology enhances trust by increasing transparency, security, and accountability

2.3 Trust Theory

Trust refers to the confidence that business partners in the supply chain will act as expected and fulfill agreed-upon obligations. Trust dimensions include factors such as integrity, predictability, and transparency, which are crucial for sustaining long-term business relationships in the supply chain. Private blockchain technology is defined as a blockchain system with restricted access, where only authorized participants can validate transactions, ensuring data immutability and enhancing transparency among trusted partners in the supply chain. Trust plays a crucial role in various contexts, encompassing business, technology, and interpersonal relationships. Trust theory explores how individuals or entities establish, maintain, or undermine trust, with applications ranging from organizational strategies to personal and professional interactions. In transaction cost economics, trust serves as a regulatory mechanism facilitating effective coordination and mitigating opportunistic decisions. Trust is seen as complementary to contracts, reinforcing collaboration, and being essential for initiating contractual and collaborative arrangements. Within the realm of supply chain management, trust is identified as a key factor in the effectiveness of business relationships (Wu et al., 2023). Research by (Centobelli et al., 2022; Mallet et al., 2022; Mollajafari & Bechkoum, 2023; Yang et al., 2022) highlights its sustainability as a fundamental strategic asset, fostering enduring relationships and reducing risks in the supply chain. Empirical studies confirm that high levels of trust among business partners enhance buyer satisfaction and decrease perceived risks, contributing to effective collaboration and reduced transaction costs (Centobelli et al., 2022; Mollajafari & Bechkoum, 2023). The integration of blockchain technology in the supply chain emerges as a potentially revolutionary force, providing transparent and decentralized evidence to reduce data manipulation risks and enhance collaboration efficiency among all involved parties. Trust in blockchain records involves considerations of reliability and authenticity, addressing challenges such as transaction manipulation and errors. The need for trust in a shared platform remains a critical aspect in the evolving landscape of blockchain technology.

2.4 Trust Construct

The Trust Construct Model is a conceptual framework crucial in understanding, measuring, and managing trust levels in technology, particularly in supply chain management. Recent research underscores its significance, highlighting factors like integrity, capability, and predictability as essential elements in building trust (philsoophian et al., 2022; Ting et al., 2021). The model is also integrated into blockchain technology's development, aiding in identifying trust dimensions related to security and transparency (Chowdhury et al., 2023; Sharma et al., 2021). Trust in supply chain management involves interrelated forms of integrity, capability, and predictability, mutually reinforcing solid business relationships. In the context of trust development, the model recognizes evolving dynamics at each partnership stage, emphasizing factors like integrity, competence, and commitment during initiation, performance and commitment in the growth stage, and deeper engagement in the maturity stage (Alshurideh et al., 2022; Giraldi et al., 2023; Yazdanshenas & Mirzaei, 2023). Understanding these phases is crucial for effectively managing and strengthening trust in supply chains, fostering strong and sustainable relationships.

2.4.1 Trust and Contracts

Trust and contracts are two key elements in supply chain management that complement each other to form the foundation of an effective business relationship. Trust plays a crucial role in reducing uncertainty and risk in interactions between partners, while contracts provide a legal framework to define and regulate the rights and obligations of each party. Trust in the context of supply chain management involves the belief that business partners

will act as expected and fulfill agreed-upon obligations. Trust enables collaboration and more open information exchange, reducing uncertainty, and enhancing operational efficiency (Pološki Vokić et al., 2021). It is important to note that trust can develop and change over time based on experiences and interactions between partners. While trust involves interpersonal and psychological dimensions, contracts have more formal legal aspects. Contracts in the supply chain serve as documents that define the rights, obligations, and responsibilities of each party. In situations where trust has not fully formed or to mitigate specific risks, contracts can be a crucial instrument to address uncertainty and provide a clear foundation for collaboration (Mwesigwa et al., 2020). However, there is a conception that trust and contracts are not alternatives but should support each other. An optimal business relationship often requires a combination of both. Contracts provide a clear legal foundation, while trust enables more flexible and effective interactions. In some situations, contracts may not cover all aspects of complex cooperation, and this is when trust becomes particularly important (Nooteboom, 2022). In conclusion, research indicates that trust and contracts complement each other in supply chain management. Trust creates the interpersonal and psychological foundation, while contracts provide the necessary legal and operational framework. The combination of both elements establishes the groundwork for a robust business relationship, serving as the basis for effective collaboration within the supply chain.

The main aspects of trust in the supply chain involve several dimensions that underlie and form the basis for the sustainability of business relationships among partners in the supply chain. Understanding these aspects is crucial in building and maintaining trust, which, in turn, can strengthen collaboration, efficiency, and overall supply chain performance. The review of literature and classification outcomes reveals extensive and unclear definitions. In alignment with the research goals, the emphasis is placed on trust dimensions as perceived by chain members in their relationships with immediate business partners. The analysis will specifically delve into trust dimensions associated with the attributes of Blockchain Technology, as these dimensions offer insights into pertinent literature regarding signals within the supply chain and Blockchain Technology, along with trust-related behaviors in diverse forms. Trust within the realm of blockchain technology encompasses multiple aspects pertinent to supply chain management, and the incorporation of blockchain into the supply chain holds significant potential for fostering and sustaining trust. In this research, literature discussing various aspects of trust in blockchain technology applicable to the supply chain context was found.

Table 1. Main Trust Concept in Supply Chain and Blockchain

Trust Concept in Supply Chain		
<i>No</i>	<i>Trust Concept</i>	<i>Description</i>
1	Integrity	It reflects the quality of honesty and ethics in actions and business behavior. In the supply chain, business partners with integrity are considered reliable and consistent in fulfilling commitments and adhering to high business ethical standards. Integrity builds the foundation of confidence that partners will act per shared values and recognized business norms (philsoophian et al., 2022).
2	Capability	It refers to the belief that business partners have the capabilities and resources needed to fulfill responsibilities and obligations in the supply chain. Partners deemed to have good capabilities are believed to overcome operational barriers, deliver products or services to standard, and respond quickly to changing situations within the supply chain (Ting et al., 2021).
3	Predictability	It refers to the belief that business partners can be predicted in their behavior and responses in various situations. Partners considered predictable provide peace of mind due to certainty in business relationships. Predictability minimizes uncertainty and paves the way for more effective and structured collaboration (philsoophian et al., 2022).
4	Consistency	This describes the partner's ability to act consistently over time. Consistency is key to building long-term trust and indicates that business partners can be consistently relied upon. Consistent behavior builds the foundation to strengthen relationships and enhance trust among partners (Giraldi et al., 2023).

Table 1. Main Trust Concept in Supply Chain and Blockchain (*Continued*)

5	Transparency	It involves openness and the ability to share information honestly within the supply chain. Transparent partners are believed to provide necessary insights, facilitate better communication, and minimize the risk of uncertainty (Mwesigwa et al., 2020).
6	Responsiveness	This reflects a partner's ability to respond quickly to changing needs and conditions in the supply chain. Responsive partners can proactively address challenges and adapt to changes, strengthening confidence in the sustainability and flexibility of the business relationship (Pološki Vokić et al., 2021).
Trust Concept in Blockchain		
1	Transparency and Immutability	Blockchain technology provides mechanisms for transparency and immutability, where every transaction or change in data in the supply chain is recorded openly and cannot be altered. This creates trust that the recorded data is accurate and reliable (Centobelli et al., 2022).
2	Decentralization and Reduction of Opportunistic Risks	With the decentralized nature of blockchain, trust can grow as the risk of data manipulation or opportunistic behavior can be reduced. Each entity in the supply chain has the same copy of the data, and no single party can manipulate information (Sharma et al., 2021).
3	Smart Contracts and Automated Execution	The use of smart contracts in blockchain allows for the automated execution of agreements and contract obligations. This creates trust that agreements will be complied with without the involvement of third parties or the risk of non-compliance (Centobelli et al., 2022; Sharma et al., 2021).
4	Cryptography for Security	Transaction security in blockchain is supported by cryptography, assuring that data and information in the supply chain are secure and encrypted. This supports trust related to data security and user identity (Yang et al., 2022).
5	Facilitation of Openness and Collaboration	Information openness in blockchain facilitates better collaboration among partners in the supply chain. This openness creates trust because each entity has the same visibility into the recorded information (Mallet et al., 2022).
6	Reduction of Data Manipulation Risks	With the distribution and consensus characteristics among nodes in the blockchain network, the risk of data manipulation can be reduced. Trust in data accuracy and integrity can grow as each transaction is verified by the network (Sharma et al., 2021).

2.5 Investigation Model for Trust among Supply Chain Partners

Information Availability and Quality

A decentralized information platform is a crucial component of private blockchain technology. Blockchain technology ensures the high availability of transaction-related information recorded within the network. This implies that every authorized participant possesses identical records of transactions and can oversee and regulate interactions. According to (Lee & Kim, 2023) the act of sharing information in supply chain relationships contributes to the gradual development of trust. Indeed, the enhancement of trust in transactions can be achieved through the sharing, monitoring, and control of information. Within the supply chain, the absence of accessible information and information imbalances contribute to increased operational inefficiencies, transaction risks, and coordination expenses. It is reasonable to infer that these conditions result in imperfect interaction forms, thereby diminishing the level of trust (Lee & Kim, 2023). Blockchain technology is an encrypted and immutable database that cannot be corrupted. Additionally, information can be tracked, verified, and secured. According to (Huo et al., 2021) the presence of information can enhance adaptability within the supply chain, but the information's accuracy and validity are crucial. Distorted information undermines the advantages of information sharing. When information is misleading, members of the chain are unable to rely on it for making informed decisions. state that information availability can facilitate flexibility in the supply chain, but the information must be accurate and valid. Distorted information diminishes the benefits of sharing information. With misleading information, chain members will not be able to trust the information to make decisions.

Trust in Technology

Trust in the platform and records will make users more willing to trust or accept the transition to blockchain technology. Figure 1 depicts a two-part investigative model concerning the influence of blockchain technology on trust. The trust investigation model within the supply chain is constructed by considering two effects of blockchain on information characteristics: information quality and information availability.

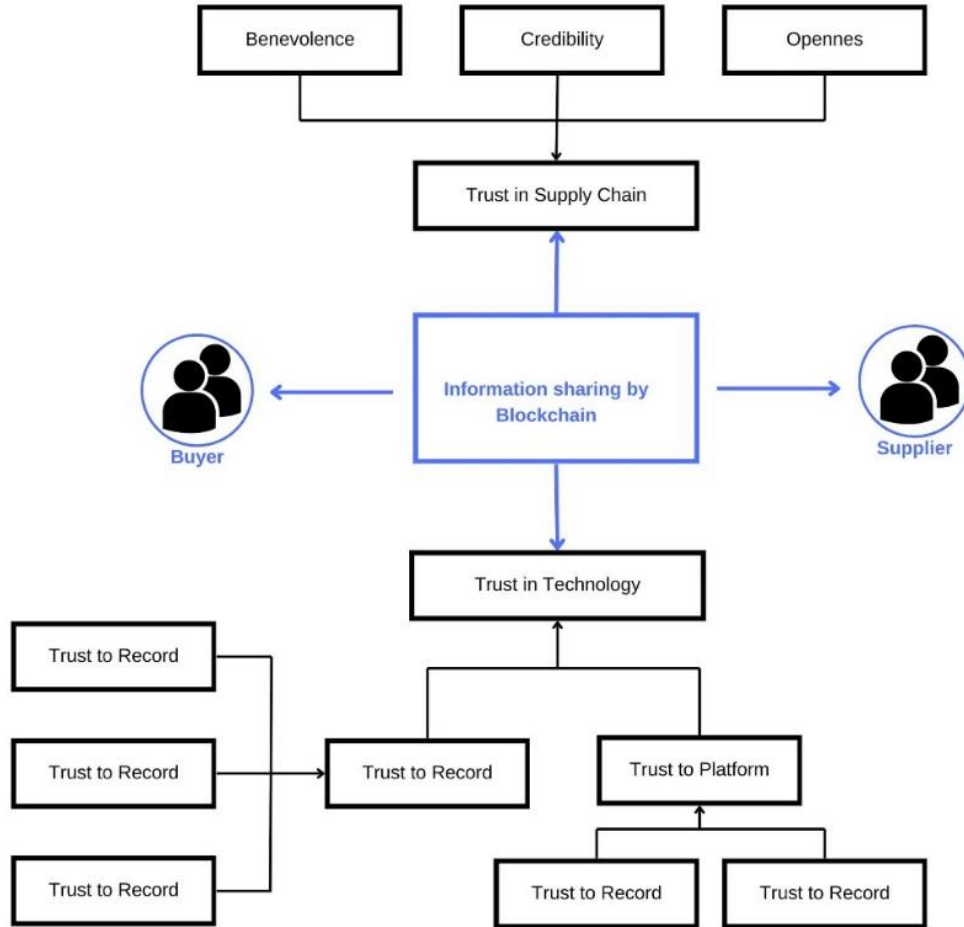


Figure 1. Analytical model designed to examine how the use of private Blockchain Technology affects trust in a supply chain.

3. METHODOLOGY AND DATA

The research methodology utilized in this investigation is qualitative, employing literature review techniques and semi-structured interviews with companies serving as case studies. The qualitative research approach is intended to delve into the impact of blockchain technology on trust within the supply chain. Qualitative research proves effective in exploring various facets of a research subject and delving into the intricacies of phenomena (Levitt, 2021). Additionally, this study embraces a case study method to gain a comprehensive understanding of how blockchain technology influences trust in the supply chain. This choice is informed by the suitability of case studies for examining complex phenomena in authentic contexts. The research further incorporates semi-structured interviews to glean insights from industry experts and practitioners, given that such interviews are apt for exploring participants' experiences and perspectives, providing a profound comprehension of the research topic. Figure 2 delineates the

methodological approach adopted in this study, outlining the key steps to be taken in addressing the research questions. The companies chosen for this study—Amazon, Maersk, Microsoft, Walmart, and Alibaba—are significant players in industries that have embraced blockchain technology early on. They were selected because of their large-scale supply chain operations, their pioneering role in implementing blockchain solutions, and the various ways in which blockchain is utilized, offering a solid foundation for analyzing its effects on trust.

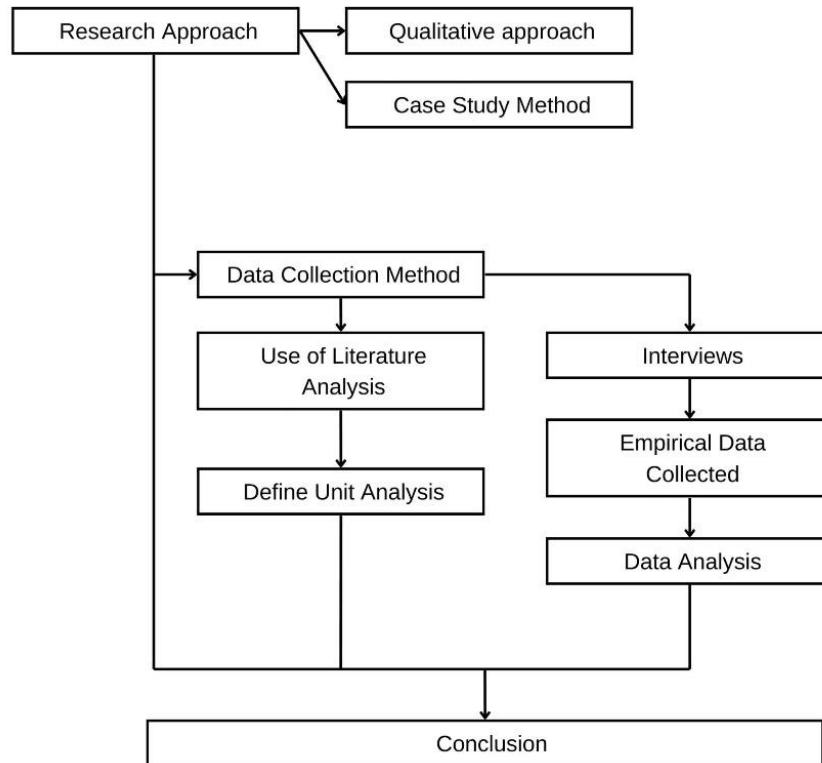


Figure 2. Research Approach

Before initiating a comparative analysis aimed at identifying patterns, similarities, and differences, individual interviews were conducted within each company. These interviews took into consideration the current business landscape and the characteristics of the supply chain. To grasp respondents' experiences regarding the impact of blockchain technology on trust within the supply chain, semi-structured interviews were employed. These interviews incorporated carefully crafted questions designed to implement a more structured and flexible closed-ended approach, aligning with the research objectives. As (Adeoye-Olatunde & Olenik, 2021) highlight the effectiveness and flexibility of semi-structured interviews in gathering empirical data, emphasizing its popularity in qualitative research, this method was chosen to establish an environment that enables interviewers to uphold the authenticity and validity of research data. Furthermore, the interview results were used to investigate how extensively the case companies use blockchain technology and identify various challenges they face. Additionally, the analysis of trust theory in the supply chain within the case companies was further examined to explore emerging impacts.

In this research, a total of 5 interviews were conducted across various industries, and the use of dual data sources was employed to enhance the depth of the study. These interviews were conducted to comprehend the significance and influence of blockchain technology on trust within diverse companies. Dual interviews were employed as a strategy to examine the perspectives of various top managers concerning blockchain technology, to identify common themes through insights gathered from different interviews and additional sources (Guest et al., 2020).

Semi-structured interviews and direct observations were chosen as the primary data collection techniques due to their ability to capture in-depth insights into the participants' experiences with blockchain technology. However, complementary methods, such as surveys or quantitative analysis, could further enhance the robustness of the findings. The primary focus of analysis in this research is the level of trust within the supply chain. Participants included both managers and high-ranking personnel with direct access to and understanding of blockchain and the supply chain within the respective companies. The selection of case companies was based on their interest and expertise in blockchain technology and its applications, their collaboration within the supply chain, and their investment in a shared database to enhance performance, trust, and transparency.

For the literature review, data was obtained from three major journal databases, namely Google Scholar, ScienceDirect, and IEEE, in the form of research journals and conference proceedings. Advanced search strings were used with keywords such as "Supply Chain Management" and "Trust," "Blockchain" and "Blockchain Application," "Blockchain Application" and "Supply Chain," "Blockchain Technology" and "Supply Chain Management." The data were analyzed through abstracts and main texts initially, followed by a comprehensive analysis of the body text. As for interviews, they were conducted with selected participants who had different understandings of trust and the trust concept related to blockchain technology in the supply chain. As a result of data collection, a total of 29 articles were chosen for further review.

4. RESULTS ANALYSIS

4.1 Description Analysis

4.1.1 Alibaba

The Supply Chain and Blockchain at Alibaba

The Alibaba Group has a complex and integrated supply chain to support its e-commerce and technology business operations. This includes connections with various sellers, manufacturers, and global distributors, inventory management involving stock, order processing, and inventory monitoring. Alibaba also relies on an extensive logistics network, such as Cainiao, to enhance delivery efficiency. Distribution centers in various locations, data analysis to understand market trends, and key payment solutions like Alipay are also integral parts of Alibaba's supply chain. The use of blockchain technology, especially for tracking and ensuring product authenticity, helps ensure the integrity of information and data security across the network. Alibaba continues to develop its supply chain with a focus on technological innovation, data analytics, and logistics integration to maintain its position as a global leader in e-commerce and technology. Alibaba's use of blockchain reflects the company's efforts to enhance transparency, security, and efficiency in their supply chain. By leveraging blockchain technology, Alibaba aims to build trust among customers, suppliers, and business partners, while also supporting sustainability and innovation in the global supply chain.

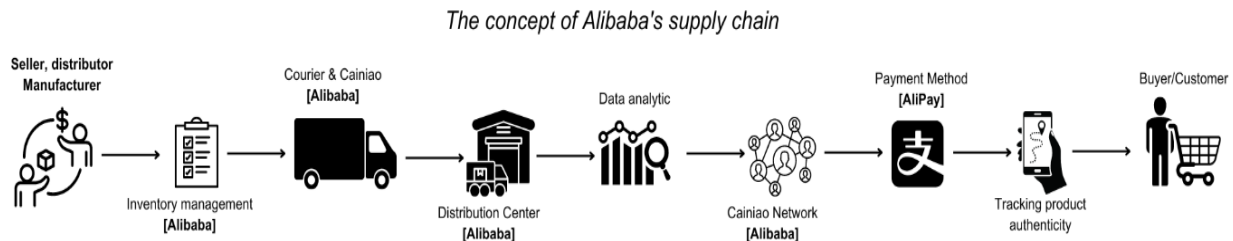


Figure 3. Alibaba's supply chain network

Table 2. Blockchain at Alibaba

No	Blockchain Apps - Alibaba	Description
1	Ant Blockchain	This blockchain platform is designed to support applications across various industries, including the supply chain.
2	Food Trust Framework	This is Alibaba's cloud blockchain, a project aimed at enhancing transparency and security in the food supply chain. It helps ensure the authenticity and safety of food products throughout their journey from manufacturers to consumers.
3	Product Tracking	Alibaba utilizes blockchain technology to facilitate product tracking in its supply chain. This provides consumers with the ability to verify the authenticity and history of a product, which can be beneficial in ensuring quality and safety.
4	Ant Financial's Blockchain Lab	This is a blockchain laboratory engaged in researching and developing blockchain solutions for the financial and supply chain sectors.
5	Green Logistics	This Green Logistics initiative employs blockchain technology to improve efficiency and sustainability in the logistics supply chain. This involves monitoring and managing carbon emissions as well as optimizing delivery routes.
6	Cross-Border Trade Platform	Alibaba uses blockchain technology on its cross-border trading platform to enhance transparency and efficiency in import and export processes. This can expedite customs procedures and minimize the risk of fraud.

Business Context Alibaba

E-commerce: Alibaba is known for its e-commerce platforms, especially Alibaba.com and Taobao. Alibaba.com focuses on global trade between businesses, while Taobao is more consumer-oriented. Alibaba provides a platform for sellers and buyers to conduct online transactions, creating a large trading ecosystem.

Cloud Computing: Alibaba Cloud, or Aliyun, is the cloud computing business of the Alibaba Group. Alibaba Cloud offers cloud computing services, including computing, data storage, and security services, supporting digital business and technological transformation across various sectors.

Digital Media and Entertainment: Alibaba also has a presence in the digital media and entertainment industry through Alibaba Pictures and Alibaba Music. This includes film production, digital content distribution, and music streaming services.

Financial Services: Alibaba owns Ant Group, which provides various financial services, including digital payments (Alipay), online loans, and asset management. Ant Group has a significant impact in expanding access to financial services among the public.

Alibaba Trust Analysis

Technology Trust

Alibaba plays a significant role in driving technology adoption across various sectors. Alibaba's success in developing and implementing technology solutions such as artificial intelligence (AI), data analytics, and cloud computing builds trust in its technological capabilities.

Trust in Record

Alibaba establishes trust through its strong track record in managing transactions and customer data. Transaction security and privacy protection are primary focuses, helping build trust among customers and business partners.

Trust in Platform

As an e-commerce and digital services platform, Alibaba requires trust from all parties involved, including sellers, buyers, and partners. Alibaba's success in facilitating secure transactions, providing quality services, and maintaining platform integrity supports trust within its entire ecosystem. In this context, the sustainability and growth of the Alibaba Group heavily depend on its ability to maintain high levels of trust in technology, operational track record, and platform reliability. This trust plays a key role in building long-term relationships with customers, business partners, and other stakeholders.

4.1.2 Maersk

Supply Chain and Blockchain at Maersk

Maersk's supply chain model consists of several key stages, starting from sourcing or manufacturing of goods by suppliers, manufacturers, or third parties. The goods or products are then transported using various land transportation methods to a consolidation point at Maersk's distribution center, where they are processed and prepared for shipment. Subsequently, the goods are transported to the port, where Maersk utilizes its sea freight services to transport them to destination ports worldwide. Upon arrival at the port, the goods may be further transported to the destination using land transportation. Maersk provides customs handling services to ensure smooth customs processes and security. Finally, the end products are delivered to the ultimate customers according to their requests. Maersk offers high visibility into the supply chain through digital technology solutions, enabling customers to monitor shipment status in real-time. With this model, Maersk aims to deliver an integrated, efficient, and reliable end-to-end supply chain service. Maersk has taken significant steps in leveraging blockchain technology to enhance transparency and efficiency in its supply chain. The company is involved in a joint initiative with IBM called TradeLens, a global blockchain platform designed to improve collaboration and tracking in the logistics and supply chain industry. The implementation of blockchain in Maersk's supply chain reflects efforts to enhance efficiency, transparency, and security in global logistics.

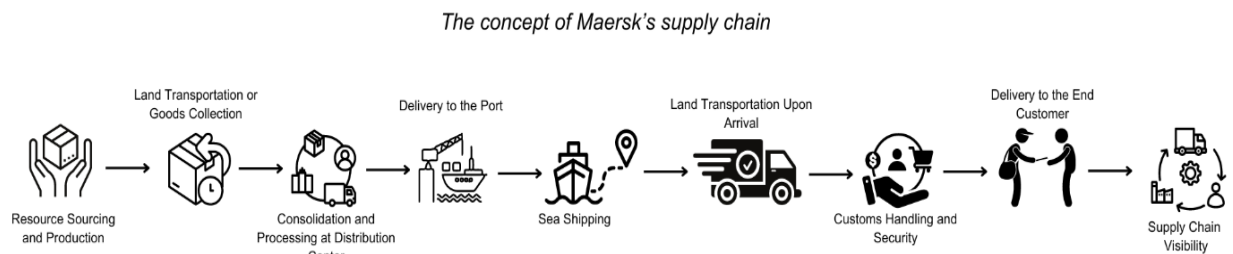


Figure 4. Maersk's supply chain network

Table 3. Blockchain in Maersk

No	Blockchain Apps - Alibaba	Description
1	Tracking and Transparency	By utilizing blockchain, Maersk can provide real-time tracking of goods to relevant parties throughout the supply chain. Information such as container location, shipping status, and related documents can be accessed directly and transparently.
2	Document Management and Bureaucracy Reduction	Blockchain is used to store shipment-related documents, such as invoices, certificates, and permits. This helps reduce bureaucracy, speed up document processing, and decrease the risk of human errors.
3	Security and Fraud Prevention	Information recorded in the blockchain is distributed and tamper-resistant, helping prevent forgery or manipulation of data. This enhances security and trust in transactions across the supply chain.
4	Supply Chain Optimization	Blockchain can be employed to collect and analyze supply chain data, aiding in inventory monitoring and more efficient inventory planning.
5	Inter-Party Collaboration	The TradeLens platform enables better collaboration among various stakeholders in the supply chain, including manufacturers, suppliers, logistics parties, and government authorities. Through this initiative, Maersk and IBM aim to create an open and collaborative ecosystem where all stakeholders can participate and share information securely.

Business Context Maersk

International Supply Chain: Maersk is involved in providing international supply chain solutions for various industries. The company assists customers in managing and optimizing their supply chains from start to finish, with a focus on visibility, efficiency, and sustainability.

Business Diversification: In addition to shipping and logistics, Maersk has undergone significant business diversification. This includes its presence in the oil and gas sector through subsidiaries like Maersk Drilling, which provides offshore drilling services.

Innovation and Technology: Maersk actively adopts innovation and technology in its operations. Technological usage includes the implementation of advanced supply chain management systems, blockchain-based platforms like TradeLens, and other digital solutions to enhance efficiency and add value for customers.

Sustainability: Sustainability is a crucial focus in Maersk's business context. The company is committed to reducing the environmental impact of its operations and assisting customers in achieving their sustainability goals within the supply chain.

Strategic Partnerships: Maersk engages in strategic partnerships with various stakeholders, including logistics partners, authorities, and technology providers. These partnerships help enhance global coverage, expand service reach, and improve adaptability to market changes.

Business Resilience: Operating in the global market, Maersk faces various challenges, such as fuel price fluctuations, regulatory changes, and geopolitical uncertainties. Therefore, the company builds resilience in its business to swiftly and efficiently cope with changes in market conditions.

Trust Analysis of Maersk

Trust Analysis of Technology

Deployment of Advanced Technology: Maersk actively implements advanced technology in its operations, such as integrated supply chain management systems, digital solutions, and blockchain-based platforms like TradeLens. The success and reliability of these technology implementations can enhance customer trust.

Data Security: Data security is a crucial aspect of technology. Maersk must demonstrate a commitment to protecting customer data and business information from security threats. Effective data protection efforts will increase customer trust in the company's use of technology.

Trust to Record

Supply Chain Transparency: Utilizing blockchain technology, Maersk can provide high confidence in the records or traceability within the supply chain. Customers can monitor the real-time movement of goods and documents, creating transparency and reliability.

Accuracy of Information: Trust in records is also related to the accuracy of information. Maersk needs to ensure that the data recorded in its system is accurate and reliable. This can be strengthened through the implementation of validation processes and data quality monitoring.

Trust to Platform

Collaboration and Interoperability: Trust in platforms like TradeLens can be strengthened by demonstrating the ability to collaborate with business partners and third parties. Platform interoperability with other systems can also enhance customer trust in the platform's capability to integrate with a larger ecosystem.

Customer Support and Services: The availability of customer support and good after-sales services can also enhance trust in the platform. Prompt responses to customer issues or inquiries can build positive trust.

From the trust analysis of Maersk, the company has successfully enhanced customer trust through the implementation of advanced technology in its operations. Maersk actively utilizes integrated supply chain management systems, digital solutions, and blockchain platforms like TradeLens. Data security is a primary focus, with a commitment to protecting customer data and business information from security threats. Transparency in the supply chain through blockchain technology creates high trust in records and traces, enabling customers to monitor the movement of goods in real time. The importance of information accuracy is also emphasized, with Maersk needing to ensure that the data recorded in its system is accurate and reliable through the implementation of validation processes and data quality supervision. Trust in platforms like TradeLens also depends on the ability to collaborate and interoperability with business partners and third parties. Responsive customer support and good after-sales services also contribute to building positive trust in the platform.

4.1.3 Walmart

Blockchain and Supply Chain at Walmart

Walmart is renowned for its efficient supply chain system and technological innovations, including the use of blockchain. Walmart's Supply Chain network includes strong relationships with global suppliers, strategically positioned distribution centers, and efficient inventory management with advanced technologies such as RFID. The integration of technologies, including blockchain, enhances food transparency and security. The use of cross-docking reduces handling costs, while advanced forecasting helps optimize inventory. Supply chain responsiveness is emphasized through data analytics and real-time information sharing. Sustainability practices include waste and energy reduction, as well as encouraging suppliers to adopt environmentally friendly practices. Active collaboration with suppliers, including the use of technologies like blockchain, supports transparency. Investments in last-mile delivery through partnerships and a self-owned delivery network enhance customer satisfaction. All of these reflect

Walmart's commitment to operational efficiency, transparency, and sustainability in its supply chain. In the context of the supply chain, blockchain is utilized to improve visibility and efficiency. Walmart's implementation of blockchain reflects the company's efforts to enhance transparency, security, and efficiency in their supply chain. By leveraging blockchain technology, Walmart aims to create a more connected and reliable supply chain system.



Figure 5. Walmart's supply chain network

Table 4. Blockchain at Walmart

No	Blockchain Apps - Alibaba	Description
1	Food Traceability	Walmart has been utilizing blockchain technology to trace food in its supply chain, particularly focusing on fresh products such as vegetables and meat. This helps ensure the safety and authenticity of products, as well as expedite the identification and handling of food safety issues.
2	IBM Food Trust Project	Walmart has collaborated with IBM on the Food Trust project, a blockchain platform designed to enhance transparency and accountability in the food supply chain. Using this platform, information can be shared in real time among stakeholders, including farmers, distributors, and retailers.
3	Non-Food Product Tracking	In addition to food, Walmart also employs blockchain to track non-food products, such as textiles and electronics. This enhances visibility into the origin of products and facilitates more efficient inventory management.
4	Hyperledger Fabric Project	Walmart is also involved in the Hyperledger Fabric project, an open-source project under the Linux Foundation that provides a framework for the development of blockchain applications. Participation in this project reflects Walmart's commitment to the development and implementation of blockchain technology in the supply chain.
5	Smart Contracts	Walmart is considering the use of smart contracts in its supply chain operations. Smart contracts can help automate processes such as payment processing, inventory management, and contract fulfillment.
6	Supplier Integration	Walmart encourages its suppliers to adopt blockchain technology. By enhancing integration with suppliers, Walmart can achieve higher levels of transparency and expedite responses to changes in the supply chain.

Business Context Walmart

Business Scale: Walmart is one of the world's largest retail companies with a global presence. Its vast business scale influences pricing policies, supply chains, and expansion strategies.

"Everyday Low Prices" Business Model: Walmart is known for its "Everyday Low Prices" (EDLP) business model, prioritizing consistent and low pricing for consumers. This strategy shapes the company's image and competitive advantage.

Integrated Supply Chain: Walmart's supply chain is efficiently integrated from suppliers to stores. This system creates efficiency in inventory management and product distribution.

Technological Innovation: Walmart adopts advanced technology, including the use of blockchain, to enhance transparency, security, and efficiency in its supply chain and business operations.

Global Expansion Strategy: Walmart has adopted a global expansion strategy by opening stores in various countries. This includes adapting to local market needs and global competition.

Impact on the Retail Industry: Walmart has a significant impact on the retail industry. Its approach to low prices, efficient supply chain management, and business innovation has become a model for other companies in the industry.

Commitment to Sustainability: Walmart is committed to sustainability with a focus on environmentally friendly business practices and corporate social responsibility.

Competitive Dynamics: Walmart competes in a dynamic and competitive business environment with other companies, including physical stores and e-commerce platforms.

Local Social and Economic Impact: Walmart's presence in local communities has economic impacts through job creation and engagement in social activities at the local level.

Digital Transformation: Walmart is engaged in digital transformation with increased investment in e-commerce platforms and digital technology to meet the demands of a constantly changing market.

Trust Analysis

Trust Technology Analysis

Technology Usage: Walmart has demonstrated a commitment to technological innovation, including the use of blockchain technology to enhance transparency in the supply chain. The level of acceptance and trust in this technology by consumers and business partners can influence the company's image.

Trust to Record

In the context of trust in data records, Walmart's use of blockchain can provide benefits due to the decentralized and immutable nature of this technology. The assurance of data authenticity through blockchain can build trust that the information provided by Walmart is accurate and reliable.

Trust to Platform

Walmart, with its business model and retail ecosystem, functions as a platform for both consumers and suppliers. Sustainability, security, and the quality of services provided through this platform can influence the level of trust. The use of technology to facilitate transactions and interactions on the platform, such as e-commerce or mobile applications, can also play a crucial role in building trust. Consumer trust in Walmart is closely tied to its effective management of user data security and privacy. The company's commitment to safeguarding personal data and transactions enhances trust in its platform and services. Transparent communication regarding technology use and security policies is vital, fostering understanding and confidence. Walmart's overall reputation, reliability, and security of technology usage contribute to shaping trust levels. The company's swift and transparent responses to security or privacy issues further demonstrate its commitment to security and integrity, influencing consumer trust. Moreover, Walmart showcases a strong dedication to technological innovation, especially using blockchain for enhanced supply chain transparency. Utilizing decentralized and immutable blockchain ensures the authenticity of information, contributing to trust in data records. Sustainability, security, and service quality within the Walmart ecosystem are pivotal factors influencing trust, along with robust management of consumer data security and privacy. Transparent communication, positive company reputation, and prompt responses to security issues play crucial roles in shaping and maintaining customer trust in Walmart.

4.1.4 Amazon

Blockchain and Supply Chain at Amazon

Amazon explored and implemented blockchain technology in its supply chain operations. Amazon's supply chain network is a complex and sophisticated system designed to efficiently deliver a variety of products to global customers. Storage facilities, inventory processing, and fast order fulfillment take place in strategically distributed warehouses and fulfillment centers. Robotics and automation technologies enhance efficiency in fulfillment centers, while last-mile delivery is supported by a network of vans, drones, and third-party delivery partners. Advanced inventory management, high-tech integration, and data analytics help Amazon optimize its supply chain. Strong relationships with global suppliers, the Amazon Prime program, and a marketplace model with third-party sellers add complexity but support the growth and responsiveness of the supply chain. Sustainability is implemented through environmentally friendly initiatives, and acquisitions and vertical integration complement Amazon's supply chain strategy to remain a leader in the e-commerce industry. With its operational scale and complex supply chain, Amazon continues to explore innovative ways to leverage blockchain technology to improve efficiency, transparency, and security in its operations.

The concept of Amazon's supply chain

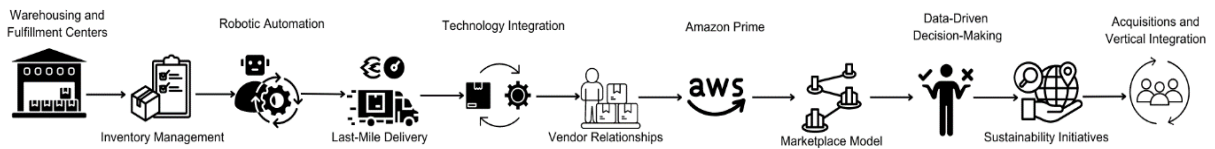


Figure 6. Amazon’s supply chain network

Table 5. Blockchain at Amazon

No	Blockchain Apps - Alibaba	Description
1	Product Tracking	Amazon has been exploring the use of blockchain for product tracking in its supply chain. This helps improve the transparency and authenticity of products, allowing customers to trace the journey of a product from the manufacturer to their doorstep.
2	Inventory Management	By utilizing blockchain technology, Amazon can enhance its inventory management. This includes real-time monitoring and tracking of inventory, aiding in stock management and operational efficiency improvements.
3	Quantum Ledger Database (QLDB) Project	Amazon is developing the Quantum Ledger Database (QLDB), which, while not a traditional blockchain technology, is a database service that leverages transparency and integrity principles like blockchain. It can be applied in supply chain applications to store immutable transaction records.
4	Smart Contracts	Amazon can employ smart contracts, which are self-executing codes when specific conditions are met. Smart contracts can assist in automating various processes in Amazon's supply chain, such as order processing and contract management.
5	Environmental Tracking	Amazon can also use blockchain technology to track environmental impact and sustainability in its supply chain. This can help understand carbon footprints and promote sustainable practices.
6	Security and Document Validation	Blockchain can enhance the security and validation of documents in Amazon's supply chain, including invoices, contracts, and other documents. This can reduce the risk of data leaks or manipulation.

Business Context Amazon

E-commerce: Amazon is known as one of the global leaders in e-commerce. They provide a platform for sellers and buyers to transact online and also operate efficient warehouses and logistics systems for product delivery.

Cloud Computing: Amazon Web Services (AWS) is one of the largest cloud service providers in the world. AWS offers cloud computing infrastructure, data storage, and various other services for businesses and individuals.

Digital Media: Amazon has Amazon Prime Video, Amazon Music, and Kindle, showcasing its presence in the digital media and entertainment industry.

AI and Technology: Amazon utilizes advanced technology, including artificial intelligence (AI), to enhance customer experiences, personalize recommendations, and improve operational efficiency across various business segments.

Trust Analysis of Amazon

Technology Trust Analysis

Technology Trust: Amazon has built a strong reputation for adopting and developing cutting-edge technology. AWS, as a leader in the cloud services market, reflects customer trust in Amazon's ability to provide reliable and secure infrastructure.

Trust in Record

Amazon has a good track record in managing transactions and customer data. Online transaction security and customer privacy protection are key focuses for Amazon, supporting customer trust in the integrity and security of its business processes.

Trust in Platform

As an e-commerce platform and cloud service provider, Amazon requires a high level of trust. Amazon has successfully built trust by providing reliable services, excellent customer support, and prioritizing customer satisfaction. In the context of trust in the platform, Amazon has become a crucial space for sellers and buyers, as well as businesses relying on AWS services for their computing infrastructure needs. This level of trust creates an environment supportive of Amazon's business ecosystem growth. Amazon's success relies not only on the scale of its business but also on its ability to nurture and enhance trust among customers, business partners, and other stakeholders through the implementation of secure and innovative technology and responsible data management."

4.1.5 Microsoft

Blockchain and Supply Chain at Microsoft

Microsoft's supply chain network is a global and complex system designed to efficiently manage the production and distribution of hardware and software products. Key aspects include global sourcing involving components and materials from around the world, manufacturing through collaboration with contract manufacturers in various regions, and logistics and distribution through strategically placed distribution centers worldwide. Microsoft also relies on digital distribution for its software products, such as Windows and Office, to reduce the need for extensive physical logistics. Cloud service infrastructure, especially Azure, supports global operations with strategically located data centers. Strong relationships with suppliers and technology integration, such as data analytics, IoT, and AI, form the foundation of supply chain management. Sustainability efforts, including the use of renewable energy, reinforce Microsoft's commitment to environmentally friendly practices. Security is a primary focus in the supply chain, and Microsoft engages in strategic alliances with key partners and suppliers to enhance its supply chain capabilities. Collaboration with technology and logistics partners significantly contributes to the overall efficiency of Microsoft's supply chain. Microsoft has also explored and integrated blockchain technology into its supply chain, providing solutions and services through its platform, Azure Blockchain. Microsoft's role in the supply chain through blockchain

is more focused on providing a platform, tools, and services that enable others to develop and implement blockchain solutions. By offering Azure Blockchain Service and related tools, Microsoft helps support innovation in the supply chain and related industries.

The concept of Microsoft's supply chain

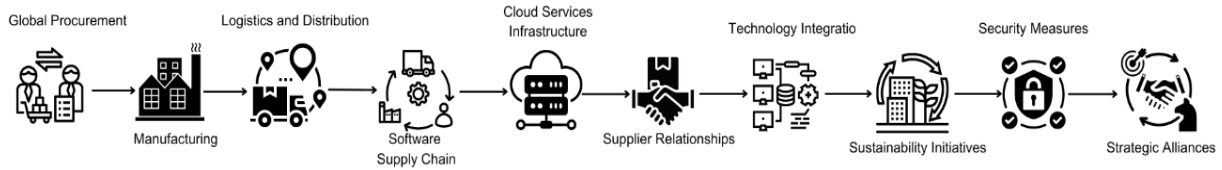


Figure 7. Microsoft's supply chain network

Table 6. Blockchain at Microsoft

No	Blockchain Apps - Alibaba	Description
1	Azure Blockchain Service	This is Microsoft's cloud computing platform that offers a service called Azure Blockchain Service. This service allows developers and companies to easily create, manage, and use secure blockchain networks. It provides flexibility for companies to design blockchain solutions tailored to their supply chain needs.
2	Coco Framework	This is a Microsoft initiative aimed at improving the performance and security of blockchain networks. While not specifically focused on the supply chain, this framework can contribute to blockchain solutions requiring high security and scalability, which can be relevant for complex supply chains.
3	Smart Contracts and Azure Logic Apps	Microsoft Azure supports the development and implementation of smart contracts, which can be used to automate various processes in the supply chain. By using Azure Logic Apps, companies can integrate smart contracts with other systems in the supply chain.
4	Partnerships and Collaborations	Microsoft has engaged in partnerships with blockchain and supply chain companies, particularly in the food and production sectors. By collaborating with these partners, Microsoft contributes to the development of solutions that can be applied to the supply chain
5	Decentralized Identity	Microsoft has invested in decentralized identity projects that can be beneficial in identity and access management throughout the supply chain.

Business Context Microsoft

Software: Microsoft has dominated the software market with the Windows operating system, the Microsoft Office suite, and various other software applications.

Cloud Services: Azure, Microsoft's cloud computing platform, has become a leader in the industry, providing cloud infrastructure, application development services, and AI solutions.

Hardware: Microsoft is also involved in the hardware business with products like Surface, Xbox, and other accessories.

Microsoft Trust Analysis

Technology Trust

Microsoft has built trust in developing cutting-edge technology. Windows and Office are widely used products, demonstrating consumer and business trust in Microsoft products. Azure is also known as a reliable and secure cloud service provider.

Trust in Record

Microsoft has focused on security and data privacy in its products and services. They provide high-level security tools and features to protect the data of users and businesses using Microsoft products.

Trust in Platform

In the context of trust in the platform, Microsoft plays a crucial role as a platform provider for various business and development needs. Azure provides reliable cloud infrastructure for organizations, and the Windows and Office ecosystem creates a powerful platform for personal and business use. Microsoft has also demonstrated trust through its involvement in industry standards and compliance with regulations. Openness to collaboration and interoperability with products from other providers also plays a role in building trust among customers and partners. Microsoft's success largely lies in its ability to continually deliver innovation, prioritize security and privacy, and provide reliable technological solutions for consumers and businesses worldwide. Through this approach, they can maintain and strengthen the level of trust among customers and partners.

4.2 Comparison Analysis

Research findings suggest that despite variations across industries, concerns regarding data sharing security and access levels remain significant. Trust emerges as a factor that can be bolstered through blockchain technology. While blockchain presents a novel solution to trust issues, customers may also have other motivations for its implementation, such as addressing information asymmetry, speeding up processes, gaining increased control, or reducing costs. The primary driver for adopting blockchain technology seems to be the desire for enhanced control, as current situations often lack sufficient visibility into data flows. Users of blockchain technology typically possess a certain level of trust when opting for its implementation, as it provides a secure means to enhance or uphold trust. In earlier discussions, the relationship between contracts and trust was explored within the survey. Blockchain technology shares similarities with contracts; if applications could exert complete control over transactions, additional trust would not be necessary. In such cases, trust and control could be interchanged; however, complete control is not always feasible due to ongoing interactions between humans and systems, and data reliability cannot be always guaranteed. From the perspective of service providers, the primary reasons for companies to embrace blockchain technology include augmented control for performance management, cost reduction, and minimizing losses in collaborations. To achieve this at the initial stages, they need to have trust in the promise and competencies of their partners.

4.3 Business Context Analysis

A comparison of company characteristics shows that the core businesses of all case companies are completely different, which means that they have different requirements when they ask for blockchain technology. Additionally, companies are at different positions in their life cycles, so process maturity is also different. Each company's situation is different based on the company's life cycle stage.

4.3.1 Analysis of Case Company Supply Chain Characteristics

Table 7. Characteristics of the Supply Chain in Interviewed Companies

No	Company	Supply chain characteristics			
		Business and Industry primary focus	Technology and Innovation	Global Reach and Distribution	Retail management and Supplier
1	Amazon	<ul style="list-style-type: none"> e-commerce Cloud services 	<ul style="list-style-type: none"> Utilizes advanced technology Automation for fast delivery 	Global distribution with logistics centers worldwide	<ul style="list-style-type: none"> Customer experience Close relationships with suppliers
2	Maersk	<ul style="list-style-type: none"> Shipping International Logistics 	Innovates in maritime transportation and logistics	Involved in international shipping through global sea routes	Relationships with suppliers related to maritime transportation
3	Microsoft	<ul style="list-style-type: none"> Software Hardware Cloud services 	<ul style="list-style-type: none"> Innovates in hardware management Innovative in cloud technology development 	Global distribution through hardware products and cloud services	Partnerships with suppliers in hardware and software management
4	Alibaba	<ul style="list-style-type: none"> e-commerce Cloud computing Technology 	Utilizes big data and artificial intelligence for e-commerce operations	<ul style="list-style-type: none"> E-commerce operations with global penetration 	<ul style="list-style-type: none"> Engages with numerous sellers and suppliers on the e-commerce platform
5	Walmart	<ul style="list-style-type: none"> Physical retail e-commerce 	<ul style="list-style-type: none"> Adopts technology for inventory management Operational efficiency in retail. 	Integrated supply chain with a retail network in many countries	Maintains close relationships with suppliers for inventory management and competitive pricing

Amazon, Maersk, Microsoft, Alibaba, and Walmart exhibit diverse supply chain strategies tailored to their respective industries and business models. Amazon, a global e-commerce leader, prioritizes rapid delivery and customer experience using cutting-edge technologies like automation and artificial intelligence, seamlessly integrating retail operations with advanced logistics centers worldwide. Maersk, a shipping and logistics leader, focuses on maritime transportation innovation, emphasizing global supply chain efficiency through intricate sea route management. Microsoft, a technology conglomerate, leverages its supply chain for the global distribution of hardware, software, and cloud services, collaborating strategically with suppliers to maintain robust operations. Alibaba, an e-commerce and technology giant, utilizes big data and artificial intelligence to enhance its global e-commerce operations, engaging numerous sellers and suppliers on its platform. Walmart, a retail giant, integrates technology for inventory

management and operational efficiency, maintaining close supplier relationships for an integrated supply chain across its extensive global retail network.

4.4 Motivations and Challenges of Blockchain Technology

Amazon is driven by the motivation to enhance transaction security and product traceability using of blockchain technology. This can provide customers with certainty about product origins and secure transaction data. However, the challenge lies in efficiently integrating blockchain across Amazon's vast operational scope. In contrast, Maersk, an international shipping company, aims to boost efficiency and transparency in its supply chain by implementing blockchain. This facilitates cargo tracking and optimizes international logistics, addressing coordination challenges with business partners. Microsoft utilizes blockchain to enhance data security, primarily motivated by providing secure solutions for customers. Challenges for Microsoft include integrating blockchain with existing cloud services and diverse hardware and software products. Alibaba sees blockchain as enhancing customer trust and product traceability, but scalability challenges arise due to the massive transactions on their e-commerce platform. Walmart advocates for blockchain adoption to improve supply chain transparency but integrating with its complex global supply chain and diverse supplier base presents a significant challenge. While the motivation for adopting blockchain technology centers on security and efficiency, challenges in integration and scalability persist for Amazon, Maersk, Microsoft, Alibaba, and Walmart.

4.5 Trust Analysis

In this research, trust is examined on two distinct levels. The initial level pertains to the confidence in the platform, while the second involves the trust established among various partners within the supply chain when information is exchanged using private blockchain technology. Three major companies in logistics and retail, namely Maersk, Alibaba, and Walmart, demonstrate a strong commitment to technological innovation, particularly the use of blockchain in their supply chains. By leveraging this technology, they aim to enhance transparency, security, and efficiency in their operations, which can strengthen trust among customers and other stakeholders. The implementation of blockchain creates a decentralized and immutable record, ensuring the authenticity of the information provided by the companies. This has the potential to boost trust in data integrity, product authenticity, and responsiveness to changes in the supply chain. Sustainability and environmentally friendly business practices are also part of the companies' strategies, creating trust that their operations are conducted with social and environmental responsibility. Trust recipients don't have to be human; they can take the form of processes, algorithms, or structures. If service providers meet the trust requirements for trust recipients. Having the intention to trust the platform is contingent on meeting other prerequisites (such as provider trust, certification of trust recipient, etc.). Following this, users may demonstrate behavior associated with trust. The consequences of trust-related behavior can result in collaboration and the sharing of information. The implementation of blockchain has greatly enhanced trust among business partners. This improvement can be attributed to key features such as information transparency and the unchangeable nature of records. With blockchain, every transaction is accurately recorded and cannot be modified, instilling confidence that the data accessed is trustworthy. Furthermore, smart contracts facilitate the execution of agreements without the need for third parties, which minimizes the risks of non-compliance and boosts trust between business partners. The relationship between blockchain technology and trust in supply chains is facilitated by several key mechanisms. First, the transparency offered by blockchain ensures that all participants have access to the same information, reducing the risk of miscommunication or fraud. Second, the immutability of blockchain records guarantees that data cannot be altered once it has been entered, providing a reliable source of truth for all parties. Third, smart contracts automate the execution of agreements, minimizing the need for third-party intermediaries and reducing the risk of non-compliance, further enhancing trust between supply chain partners.

4.5.1 Trust to Record and Trust to Platform

Maersk, Alibaba, and Walmart leverage blockchain technology to instill customer trust by ensuring data security and integrity through a decentralized system. The tamper-proof ledger establishes authenticity, fostering confidence in the accuracy of provided information, particularly beneficial for managing complex supply chains. Alibaba and Microsoft, as prominent cloud service providers, build trust through reliable platforms – Alibaba Cloud and Azure. These

platforms support business growth by encouraging collaboration, and seamless integration, and creating ecosystems that enhance customer and stakeholder trust. In the supply chain context, institutional trust in blockchain technology shapes interactions and relationships, offering robust control against opportunistic behavior and transforming company structures. As blockchain technology projects are in an experimental phase, the impact on user behavior and trust in business collaboration remains uncertain. The transition to blockchain technology raises questions about its ability to sustain trust or introduce added complexity. The author highlights the importance of exploring whether trust in the platform influences dispositional trust within the supply chain. Despite diverse industries expressing concerns about data reliability, blockchain technology transcends its initial role, evolving into a highly institutionalized structure with the potential to achieve user trust and empower interactions, despite challenges in ensuring reliability.

454.2 Trust among Partners in the Supply Chain

The analysis of trust within the supply chain partnerships of Maersk, Alibaba, Amazon, Microsoft, and Walmart reveals a shared commitment to transparent and efficient collaboration. Each company employs distinct strategies to foster trust, such as Maersk's open TradeLens platform, Alibaba's collaborative e-commerce model, Amazon's use of blockchain technology, Microsoft's Azure Blockchain Service, and Walmart's integrated supply chain approach. Trust considered foundational for operational efficiency and business sustainability, is influenced by the level and nature of information sharing among stakeholders. The positive impact of information sharing on collaboration is highlighted, emphasizing the importance of the depth and quality of exchanged information. Blockchain technology emerges as a key enabler, offering real-time connectivity, data synchronization, and improved efficiency. Despite the perceived transparency in information sharing, there are reservations among participants, particularly from Walmart and Amazon, about the long-term positive shifts in relationships due to the early stage of blockchain technology. Alibaba faces challenges in validating relationships and trust levels, but both Alibaba and Amazon are actively working on enhancing trust through blockchain technology. The study underscores the necessity of building trust in the supply chain before implementing blockchain technology, emphasizing the importance of confidence in partners' consistent fulfillment of obligations for efficient collaboration. Ongoing transactions and enduring partnerships are seen as fostering gradual trust development, with regional and cultural differences influencing power dynamics and the integration of blockchain technology. The author suggests further exploration is needed to understand the role of trust in scenarios marked by power asymmetry.

4.6 The Impact of Blockchain Technology on Trust in Supply Chain Management

Blockchain technology, functioning as an information-sharing platform, ensures transparency and visibility in the supply chain through meticulous monitoring of processes and direct transaction execution. Consequently, there is a reduction in the demand for high working capital and resources. Enhanced performance contributes to efficient collaboration, and the pursuit of long-term relationships and collaboration within the chain is primarily aimed at increasing efficiency. This results in heightened dependence, increased investment in relationships, and a boost in trust among partners. The potential impact of information sharing on different performance levels catalyzes altering the level of trust among partners. Through analysis and comparison of trust levels in interviews, it is evident that professional relationships exhibit the highest level of trust. Blockchain technology, by enhancing the availability and quality of information, can facilitate progress toward this elevated level of trust. Trust assumes a crucial role in the health and food industries due to stringent standards necessitating a dependable supply chain. Hence, blockchain technology can contribute to improving accuracy and reliability, infusing more credibility and benevolence into the supply chain. It can be asserted that all case companies operate at the Knowledge-Based Trust level. Respondents in company interviews assert that the level of trust has surpassed the perceived risk threshold, attributed to long-term relationships, process maturity, and product characteristics fostering deep interdependence among partners. Additionally, all companies exhibit a commitment to enhancing performance in the chain, underscoring trust as a fundamental prerequisite for collaboration. Comprehending the features of blockchain technology and assessing its effects reveals the potential for blockchain technology to augment trust. However, organizations must be open to cultivating more profound connections. Becoming part of a blockchain technology network is perceived as an investment in relationships, demanding substantial resources for implementation. Participants aim to establish enduring partnerships by collaborating effectively and preventing opportunistic behavior, thus advancing their mutual interests. The analysis underscores that achieving trust based on calculations is a prerequisite for implementing

blockchain technology. Following this, as relationships progress, partners may choose to deepen their engagement with blockchain technology. The primary drivers for enhancing inter-organizational trust include shared goals, incentives, and common values. In this business context, blockchain technology is seen as an opportunity to address challenges and achieve improvements, such as cost reduction and enhanced transparency.

5. DISCUSSION

Numerous researchers underscore the critical nature of trust within the supply chain, emphasizing its significance in sharing sensitive information and fostering openness among various entities (Abouali et al., 2021; Huo et al., 2021; Kolade et al., 2022; philsoophian et al., 2022; Wan et al., 2020). This underscores the substantial impact of technology on behavioral intent. While literature acknowledges that blockchain technology can elevate trust levels in supply chain relationships, achieving complete reliance on records may be hindered by human errors in data entry. A key conclusion drawn from this specific research is the interconnectedness of trust and information sharing among supply chain partners. The extent of information sharing varies across industries, with trust emerging as a pivotal factor in managing positive and negative aspects of collaboration, encompassing concepts like increased profits and emerging risks. One catalyst for transitioning from traditional information sharing to blockchain technology is consumer trust, driven by heightened consumer interest in understanding the origins of products and the desire for clear information on production and delivery conditions. Companies respond by enhancing transparency in their supply chains, with blockchain technology serving as a solution to bolster trust by facilitating transparency and traceability. While private blockchain offers numerous benefits in terms of trust and transparency, it also presents several challenges, including scalability, integration with existing systems, and privacy concerns. Scalability remains an issue as private blockchain networks may struggle to handle large volumes of transactions without compromising performance. Integration with legacy systems can be complex, requiring significant investment in technology and infrastructure. Privacy is another concern, as private blockchains, while restricted in access, still require robust mechanisms to ensure data security and prevent unauthorized access. Future research should focus on developing scalable solutions, improving integration strategies, and enhancing privacy protocols for private blockchain implementation in supply chains.

6. CONCLUSION AND RECOMMENDATION

Establishing trust is essential for nurturing cooperative connections among partners within the supply chain. It is vital to comprehend the elements that contribute to the formation of trust in relationships where information sharing relies on a shared ledger. The mechanisms of blockchain technology influence the dynamics of information sharing, impacting both the accessibility and quality of shared information. The research has delved into the level of trust within the case companies, examining the key attributes of blockchain technology that affect trust. The findings suggest that trust levels are influenced by supply chain and industry characteristics, and blockchain technology can serve as a tool to elevate trust levels. Blockchain technology securely maintains transaction history between partners using algorithms, code, and decentralized transaction verification. According to interview respondents, blockchain technology can contribute to performance and relationships that serve as drivers for increased trust. However, It introduces fresh concerns related to privacy, governance, and legality while also posing challenges to the reliability of information in records, thereby presenting potential obstacles to its implementation. Nevertheless, there are various ways to mitigate misleading information through protocols and algorithms. The investigative model created in this study offers a robust framework for comprehending the connection between trust and blockchain technology in supply chain management. This model can act as a basis for future research focused on examining how blockchain affects trust dynamics across various industries or among business partners with differing traits. By merging trust literature with technological innovation, this model provides a new viewpoint on how technology can enhance business relationships in the digital era.

6.1 Limitation

This research has limitations due to insufficient literature and knowledge. The central issue is the ambiguous use of terms like trust in the relationship between trust and blockchain. The study is limited to three companies in three industries, a small sample size, with specific industries that are highly regulated, potentially introducing bias. The author couldn't reach more respondents from various supply chain levels, and the selected companies' blockchain

projects are still in the trial phase, hindering the research. Despite these limitations, respondents showed good knowledge of trust-related issues, though some areas may remain unexplored. Due to time constraints, only three dimensions of trust were investigated with overlapping definitions.

6.2 Recommendation

While this study provides valuable insights into the role of private blockchain in enhancing trust within large multinational supply chains, its findings may not be directly applicable to smaller companies or industries with less technological infrastructure. Future research should explore how private blockchain can be adapted to different contexts, including smaller-scale businesses or industries with limited access to advanced technology, to determine whether similar trust-enhancing effects can be achieved.

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