Journal of Business Research 217 (2026) 116473

Contents lists available at ScienceDirect

Journal of Business Research

journal homepage: www.elsevier.com/locate/jbusres

The impact of blockchain technology on supply chain trust formation and development: The case of the pharmaceutical network

Benjamin Dehe [a,*], Jason X. Wang [b], Samuel Heath [c]

[a] Management, Technology and Organisation Department, Auckland University of Technology, WY Building, City Campus, 42 Wakefield Street, Auckland City, New Zealand
[b] Sheffield University Management School, Conduit Road, Sheffield S10 1FL, UK
[c] Procurement and Contract Specialist, City of London, England, UK

ARTICLE INFO

Keywords:
Blockchain technology
Trust
Pharmaceutical supply chain
MediLedger

ABSTRACT

This study explores the role of blockchain technology's (BCT) in trust formation and development within the U.S. pharmaceutical supply chain (PSC), using the MediLedger network as a case study. Grounded in socio-technical systems (STS) theory, we develop a conceptual model, which serves as the analytical framework to examine how supply chain trust evolves within a BCT-based ecosystem. We triangulate data from seven in-depth elite interviews with senior executives, alongside secondary data from company reports, case studies and white papers. The findings indicate that BCT significantly influences trust within the PSC, particularly by redistributing and reconfiguring trust across socio-technical boundaries and fostering a new dimension of trust: trust in network. This is facilitated through BCT-enabled mechanisms that accelerate trust formation processes, which is particularly important in the contingent PSC environment. Finally, we propose a BCT-based hierarchical supply chain trust framework that articulates and conceptualises the different mechanisms and dimensions of trust.

1. Introduction

Blockchain technology (BCT) can arguably revolutionise supply chain practices and is recognised as one of the most disruptive technologies underpinning Industry 4.0 (Mathivathanan et al., 2021; Wang et al., 2021; Wong et al., 2020). By creating decentralised and cryptographic platforms, BCT ensures secure and transparent supply chain operations and transactions (Tan et al., 2024). It can address complex supply chain challenges such as integration, visibility, transparency, and trust. For instance, BCT further emphasises decentralised systems by minimising intermediaries, shifting trust from central authorities (Gligor et al., 2021). In the pharmaceutical industry, the MediLedger network exemplifies this decentralised concept, transferring trust from traditional organisations to the blockchain. Some studies have explored the integration of BCT in various aspects of supply chain management, such as sustainable supply chain management (Cao and Shen, 2022), supply chain risks (Choi et al., 2019), and counterfeit products (Klöckner et al., 2023). However, this study extends the literature by focusing specifically on supply chain trust formation and development as a fundamental aspect of information sharing and collaboration within a given ecosystem (McEvily et al., 2003; Kotcharin et al., 2024). We argue that the real significance of the study resides in examining the mechanisms by which BCT shapes the formation and development of inter-organisational trust within pharmaceutical supply chains (PSC) (Yavaprabhas et al., 2023).

The PSC is crucial to the global economy and public health, encompassing the discovery, development, and manufacturing of drugs, vaccines, and medicines (Anand et al., 2025; Papalexi et al., 2026). However, managing PSC operations is challenging due to complex financial flows, reverse logistics, and the involvement of multiple entities, including manufacturers, distributors, wholesalers, government agencies, group purchasing organisations (GPOs) and biotech companies. A significant issue within the PSC is the lack of trust, which adversely affects supply chain performance (Yaroson et al., 2021). Poor buyer–supplier relationships reduce data sharing, decrease visibility, and contribute to bottlenecks, leading to quality issues (Alkalha et al., 2025a) and fuelling a counterfeit drug market (Alkalha et al., 2025b). These trust issues ultimately diminish consumer confidence in the pharmaceutical industry (Chang et al., 2020).

There is growing interest in leveraging BCT to enhance trust and supply chain performance (Dwivedi et al., 2023; Yavaprabhas et al., 2023). BCT is associated with features such as decentralised data

* Corresponding author.
E-mail addresses: benjamin.dehe@aut.ac.nz (B. Dehe), jason.x.wang@sheffield.ac.uk (J.X. Wang), sami.heath99@gmail.com (S. Heath).

https://doi.org/10.1016/j.jbusres.2026.116473
Received 25 January 2025; Received in revised form 28 July 2026; Accepted 6 August 2026

management, increased transparency and visibility, enhanced security and privacy, and more efficient data sharing, all of which are believed to contribute to the creation of a shared "source of trust" (Ahmed et al., 2022; Bai and Sarkis, 2020; Van Hoek, 2019; Mirzaei et al., 2025). However, despite the potentials, the practical application of BCT remains emergent, and its actual impact on trust dynamics is still debated (Dehghani et al., 2022; Werbach, 2018; Bai and Sarkis, 2020; Wang et al., 2021). In particular, the mechanisms by which trust is formed, developed, or reshaped within BCT-enabled supply chains remain under-explored. This study addresses this gap by focusing on trust formation and development as a foundational, yet under-theorised, process in supply chain management, particularly in environments where timely, accurate, and secure information exchange is critical for coordination and regulatory compliance. In doing so, it responds to calls from both scholars and practitioners for more empirical insights into BCT-enabled trust (Batwa and Norrman, 2021; Batwa et al., 2021; Chang et al., 2020; Yavaprabhas et al., 2023) and contributes to the ongoing development of theory-building in this area (Gefen et al., 2003; Benbasat et al., 2008).

Integrating trust and BCT has emerged as a significant research agenda due to the technology's multidimensional aspects, encompassing social norms, technological features, and operational and governance processes (Tandon et al., 2020). Precisely, this study investigates trust dynamics within a BCT-enabled PSC, using the MediLedger network as a case study. The MediLedger is a blockchain solution developed by Chronicled and adopted by industry leaders like Pfizer, GSK, Walmart, FedEx, and Sanofi. Our objective is to provide evidence on how supply chain trust formation and development evolve within a BCT-enabled network. Specifically, we focus on addressing the following research question: *How does BCT influence the nature and dynamics of supply chain trust development and formation across the pharmaceutical supply network?*

Employing the socio-technical systems (STS) theory (Griffith and Dougherty, 2001; Minshull et al., 2022), this study examines the interplay between humans, organisations, and technology to understand BCT's impact on workflows, governance, decision-making processes, and ultimately, supply chain trust within the pharmaceutical industry. The research is based on seven semi-structured interviews with key executives, granting high information power (Malterud et al., 2016), supplemented and triangulated with secondary data from company reports, white papers, and publicly available documentation related to the MediLedger. Data analysis was conducted abductively to fulfil the study's aims and address the research question (Van Hulst and Visser, 2025).

We found different dimensions associated with BCT-based supply chain trust. 'Trust in technology' is achieved through the reliability and accuracy gained by the cryptographic features and the safety features built into it (Gefen et al., 2003). 'Trust in institutional governance' emerges through shared rules, standards, and oversight mechanisms, such as permissioned access, and platform governance structures, that help ensure transparency, accountability, agility and collaboration across the supply chain (Yavaprabhas et al., 2023). 'Trust in partners', enhanced by smart contract features and the decentralisation in data management between supply chain partners fosters stronger trust between buyers and suppliers. Finally, 'trust in network' represents a higher-order, systemic form of trust that emerges from the convergence of technological infrastructure, institutional safeguards, and collaborative behaviours. This dimension reflects the emergence of a digitally mediated trust environment that supports scalable, consistent, and efficient interactions across complex supply chain networks. Additionally, a novel concept of 'BCT-enabled swift trust' surfaced as a mechanism accelerating the evolution of supply chain trust dynamics within the system (Yavaprabhas et al., 2023). We developed a socio-technical spectrum linking and articulating these trust dimensions to supply chain objectives (e.g.: efficiency, agility, transparency and collaboration), in our conceptual model.

This study contributes to the growing literature on BCT and supply chain trust by evidencing how BCT reshapes trust formation and development within the PSC. Our goal is not generalisability, but conceptualisation and theory-building (Andersen and Kragh, 2010). First, the study advances the understanding of supply chain trust by conceptualising it as a multi-level socio-technical construct encompassing trust in technology, trust in institutional governance, trust in partners, and trust in network. Building on this framing, we develop a BCT-based hierarchical supply chain trust framework that articulates the mechanisms, interactions, and impacts of these trust dimensions within digitally mediated ecosystems. Moreover, the study extends trust theory by demonstrating that BCT does not eliminate trust, as suggested in "trustless" blockchain narratives, but rather redistributes and reconfigures trust across socio-technical boundaries. In particular, our findings reveal how technological features, governance mechanisms, and collaborative practices interact to support more transparent, reliable, and scalable trust formation processes across organisational boundaries. Finally, the study introduces the notion that BCT accelerates trust evolution by enabling a rapid transition from initial and fragile forms of trust toward more stable, institutionalised, and network-level trust. The emergence of concepts such as 'trust in network' and 'BCT-enabled swift trust' provides novel empirical and theoretical insights into how BCT-enabled ecosystems support coordination, transparency, agility, and collaboration in complex supply networks. Ultimately, this study advances the theorisation of inter-organisational trust in digitally mediated environments and provides a foundation for future research on BCT-enabled trust ecosystems.

2. Literature review

2.1. *Supply chain trust – a predominantly social component*

We conceptualise supply chain trust primarily as an inter-organisational phenomenon, rather than as inter-personal trust between individual actors (Zaheer et al., 1998; Kotcharin et al., 2024). We focus on trust that emerges between firms, shaped by institutional arrangements, shared expectations, technological infrastructures (e.g.: BCT), as well as social features (Yavaprabhas et al., 2023). This organisational basis of trust involves beliefs about a partner's reliability, competence, and commitment, formed through systemic features such as compliance with standards, data transparency, and reputational signals (Kwon and Suh, 2004). While inter-personal trust remains important in many supply chain settings, particularly where face-to-face interactions are common, our study views supply chain trust as a multifaced construct critical for effective and efficient supply networks and is mediated by innovation and new technologies (Zaheer et al., 1998; Hou et al., 2018; Fawcett et al., 2017). The supply chain trust literature feels fragmented, with ongoing debates about the conceptualisation, operationalisation, measurement of trust, as well as its contingent nature influenced by new technologies like AI and BCT (Weisz et al., 2024; Yavaprabhas et al., 2023). In 1999, Jarvenpaa and Leidner published an article exploring the challenges of creating and maintaining computer-mediated organisational trust within virtual environment and found that while teams may experience forms of 'swift' trust it remained fragile and temporal. Furthermore, Gefen et al. (2003) integrated and examined factors and antecedents required to build 'online' trust. More recently, a systematic review undertaken by Batwa and Norrman (2021) led to ten key propositions, and the development of a Conceptual Trust Framework (CTF), which includes three social aspects of inter-organisational trust: openness, credibility, and benevolence. These features are associated with the 'trusting beliefs' as defined and summarised by McKnight et al. (2002). Openness focuses on the extent to which parties can establish formal and informal information sharing, such as plans, goals, and procedures. Credibility focuses on the expectancy that one party's promises, and written documents can be relied on. It includes the aspects of predictability and confidence. Finally, benevolence is the extent to which one party is genuinely interested in developing mutual benefits and avoids exploiting the counterparty's vulnerabilities through opportunistic behaviour. It can be associated with goodwill, which indicates an open-ended and non-contractual commitment to establish social controls between the parties. While these trust dimensions are widely used in the information systems (IS) and supply chain management (SCM) literature, their contextual relevance varies. It is also argued that these features have a primarily social component. Interestingly, Fawcett et al. (2017) suggested that benevolence does not exist between companies in fiercely competitive marketplace. They found that trust is built over time through relationship-building behaviours rather than benevolence. In contrast, Awasthy et al. (2019) focused on humanitarian supply chains and identified 'companion trust' contributing to high-quality and effective relief during disaster periods. The specific context of the humanitarian supply chain embeds strong social factors, and benevolence is a prominent trust dimension. A key challenge in defining supply chain trust is its variable and complex nature. Trust sources and antecedents differ for buyers and suppliers, affecting trust in distinct and opposing ways (McEvily et al., 2017). For instance, disproportionate trust attention can deter supply chain partners in their trust construction (Ireland and Webb, 2007). Moreover, trust can be contingent and short-term. The concept of swift trust refers to trust developed ex-ante in temporary settings to manage specific uncertainties, risks, vulnerabilities, and expectations (Ruesch et al., 2022). In an increasingly complex environment, swift trust is used to quickly enhance supply chain flexibility and resilience, such as establishing new buyer–supplier relationships for dual sourcing or creating supplier integration for new product development. However, swift trust is fragile and requires adjustment in subsequent interactions between supply chain partners and is difficult to achieve (Meyerson et al., 1996; Schiffling et al., 2020; Jarvenpaa and Leidner, 1999). While it increases the probability of trust construction, its contingent nature and short-term focus discourage long-term asset-specific investment in trust development (Tatham and Kovács, 2010). These attributes indicate high uncertainty in trust formation and development at the supply chain level.

Trust in supply chain contexts is highly contingent upon sector-specific dynamics, regulatory pressures, and inter-organisational histories, (e.g.: technology and institutional governance) (Kwon and Suh, 2004). This context-dependence has often complicated efforts to develop widely applicable trust-building mechanisms. However, rather than seeing this complexity as a limitation, it provides a strong rationale for conceptual inquiry, specifically, for examining how emerging technologies, like BCT, can shape supply chain trust formation and development in nuanced and structured ways. By examining the PSC, a sector characterised by high complexity, regulatory sensitivity, and fragmented trust, we identify key mechanisms through which BCT fosters trust at different levels. While rooted in this specific context, our analysis aims to conceptualise the phenomenon by highlighting mechanisms, such as secure data sharing, automated consensus, and swift trust facilitation, that may be applicable or adaptable to other industries.

2.2. Pharmaceutical supply chains (PSCs) and their trust components

PSCs are among the most complex and regulated supply networks, characterised by high-value products, strict quality and compliance requirements, long production cycles, and the involvement of diverse actors across multiple jurisdictions (Anand et al., 2025; Nollet and Beaulieu, 2005). Moreover, group purchasing organisations (GPOs) consolidate purchasing volume and supply management of multiple buyers (e.g.: individual hospitals) and negotiate pricing, quality, and lead times with large pharmaceutical manufacturers on the buyers' behalf (Schotanus et al., 2010). In the group purchasing literature, the PSC is widely studied from the organisational behaviour perspective (Hu and Schwarz, 2011). These features create a trust environment that extends far beyond dyadic buyer–supplier relationships, requiring confidence not only in the competence and intentions of partners but also in the reliability of systems, protocols, and governance mechanisms. Trust in PSCs must therefore be conceptualised as multidimensional, encompassing inter-organisational trust (e.g.: between firms), trust in institutional governance (e.g.: in regulatory bodies and governance structures), and technological trust (e.g.: in digital infrastructures), as depicted in our Fig. 1. For example, trust in product integrity is contingent not only on suppliers' reputations but also on the robustness of tracking and verification systems. Similarly, trust in data accuracy and traceability increasingly relies on digital infrastructures, particularly as PSCs adopt decentralised technologies like BCT. Moreover, due to the global nature of PSCs and the high stakes associated with product safety and efficacy, trust in institutional governance, in standards, certifications, and compliance frameworks plays a vital role in facilitating coordination and mitigating risks. As such, a unidimensional view of supply chain trust is insufficient to account for the nuanced and overlapping mechanisms through which trust is formed, maintained, and disrupted in this context. Incorporating multiple trust dimensions is essential to capture the layered and socio-technical nature of trust dynamics in PSCs.

2.3. Blockchain technology (BCT) and its governance model

BCT provides an immutable, decentralised, and transparent distributed ledger where digital transactions are tamperproof and permanently recorded (Mathivathanan et al., 2021; Baharmand et al., 2021; Xiong et al., 2021). The key BCT attributes about trust include i) a decentralised structure, ii) a cryptographic system, iii) a consensus mechanism and iv) smart contracts (Jain et al., 2022). The decentralised structure leads to disintermediation where peer-to-peer (P2P) transactions do not require a third party (Zhao et al., 2022; Yuan and Wang, 2016), thus 'reducing the cost of building trust' (Xiong et al., 2021). It also increases visibility and transparency as all P2P network participants can see all recorded transactions (Wang et al., 2019). Furthermore, it acts as a data security mechanism, as multiple copies are stored across the network, which cannot be tampered with Danese et al. (2021). In terms of cryptography, BCT offers an immutable, time-stamped, and real-time record of the transactions as blocks are added in chronological order using hash values (Dehghani et al., 2022). This significantly strengthens the traceability and provenance of products and assets, which is particularly valuable in complex supply chains (Martinez et al., 2019). Consensus mechanisms, which vary depending on the blockchain architecture (e.g.: permissioned vs permissionless and private vs public), serve the essential function of validating and securing data across the network, ensuring that only legitimate transactions are recorded (Wang et al., 2019). In parallel, smart contracts, self-executing scripts that enforce predefined agreements, can automate business processes, reduce administrative overhead, and remove reliance on central oversight (Collomb and Sok, 2016). However, while these technical aspects are often presented as neutral or self-governing, they are embedded within evolving governance models that shape how trust is managed and distributed in blockchain ecosystems. Unlike in traditional supply chains governed by contractual authority, BCT introduces a new logic of decentralised governance, where control is distributed among network participants. Yet, in practice, many enterprise applications, such as the MediLedger, operate on permissioned and private blockchains with selective participation and bespoke and hybrid governance structures. These models often involve a mixture of arrangements where a coordinating entity (e.g.: Chronicled) facilitates rule-setting, onboarding procedures, and voting mechanisms to balance neutrality and control. Thus, while BCT reduces reliance on centralised trust mechanisms, it does not eliminate the need for governance; rather, it reconfigures it, shifting trust from single actors to protocol-level agreements and shared oversight structures. This raises important questions about how these forms of digital governance influence social and technical constructs such as inter-organisational trust. The governance of blockchain is defined as the means of achieving the direction, control, and coordination of stakeholders within the context of the given blockchain project to which

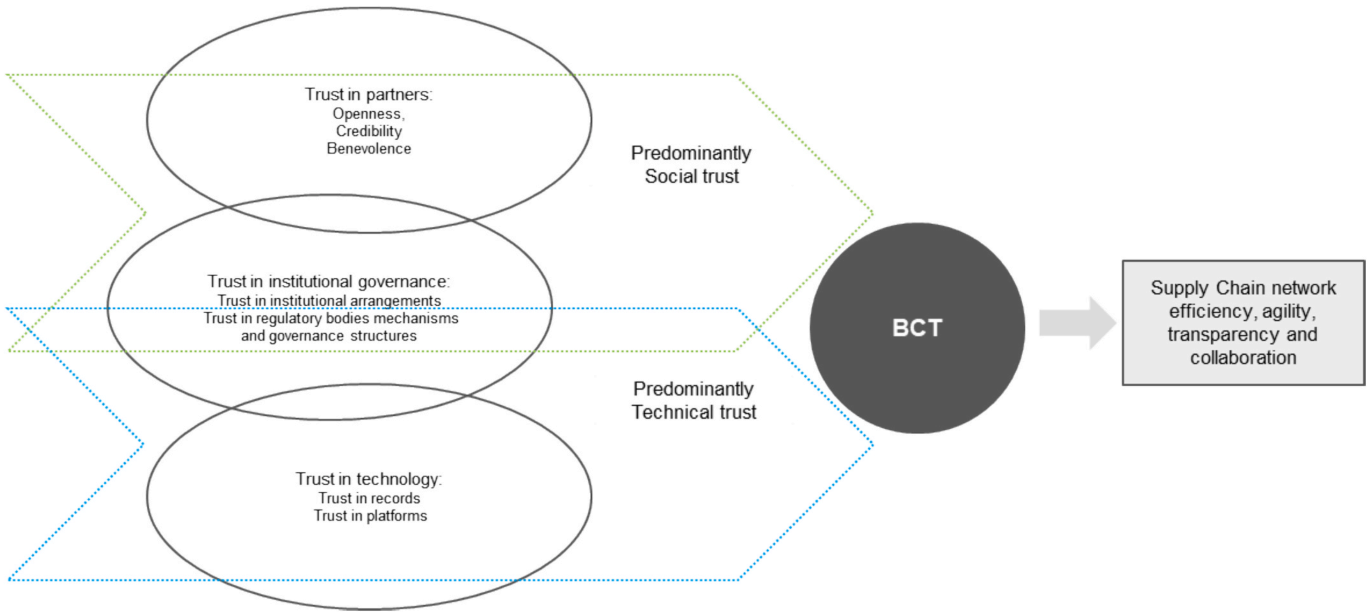

Fig. 1. A BCT-mediated Supply Chain Trust Conceptual Framework.

they jointly contribute (Pelt et al., 2021). In the applications of BCT-based transactions or 'blockchain economy', Beck et al. (2018) discussed three dimensions of governance. The first dimension is 'decision rights,' capturing the degree of centralisation/decentralisation in the blockchain. It importantly defines how decisions are made, monitored, and agreed upon. More specifically, it involves the settings of voting and consensus mechanisms and procedures to solve arising conflicts. The second dimension is 'accountability,' referring to the hierarchical structure across nodes in the blockchain and their responsibilities. Finally, 'incentive' is the motive for participating in the blockchain. A governance model is necessary to integrate the technical attributes with relational norms in line with the social ones. Specifically, while BCT may automate technical trust, its effectiveness in motivating and sustaining social trust among supply chain actors remains under-explored. This study seeks to examine how BCT interacts with human and organisational dynamics to support supply chain trust formation and coordination in complex networks.

2.4. Theoretical foundation – integrating BCT and supply chain trust

We consider trust as an emergent property shaped within a broader socio-technical system (STS) that mediates human interactions through technological infrastructures (Reijers and Coeckelbergh, 2018). STS theory offers a lens through which to examine the dynamic and reciprocal relationships between humans, technologies, and organisational environments, highlighting how each component influences, and is influenced by, the others (Baxter and Sommerville, 2011). From this perspective, BCT is not viewed in isolation, but as part of a complex socio-technical configuration that affects key contextual conditions such as trust, interoperability, collaboration, efficiency and transparency. Trust, in this framing, is not treated as a system per se, but as a relational and situated construct that develops through interactions among various system elements, including technologies, protocols, governance rules, and the diverse stakeholders who engage with them (Werbach, 2018).

BCT provides a promising solution to the complex formation and development of trust, from both technical and social perspectives. Most of the technical perspectives regarding trust in BCT are rooted in the Technology Management literature (Heim and Peng, 2022). Scholars have suggested that BCT creates trust-free and trust-less economic systems (Beck et al., 2016; Zhu et al., 2022). They contended that trust shifts away from social actors towards technical features, proclaiming 'trust in algorithms' (Lustig and Nardi, 2015). This stream in the literature suggests that cryptographic protocols and consensus mechanisms replace expensive and difficult to implement 'trust-building mechanisms and measures' used in traditional inter-personal trust scenarios. Beck et al. (2016) created a proof-of-concept prototype to replace a traditional coffee shop payment system to assess if it produced a 'trust-free' system. Although it was cost-effective, among other benefits, the study was inconclusive on whether BCT creates a trust-free environment. In this study, we also intend to add understanding to this debate, arguing that social factors beyond algorithms are essential to better understanding trust in the BCT context (Lustig and Nardi 2015).

Trust in technology can be divided into two forms, trust in platforms and trust in records (Batwa and Norrman, 2021). The sub-dimensions of 'trust in platform' include i) provision – trust that the technology can provide a service without the need to access the trustee's resources, ii) certification – trust is provided through a set of certificates to authenticate identity or membership, iii) delegation – trust to let trustee make decisions on the trustor's behalf and iv) infrastructure – trust in the related hardware and software. The sub-dimensions of 'trust in records' are: i) reliability – trust in how records are created and who created them and ii) authenticity – trust in the process that keeps the record up-to-date and maintains the identity of the records.

Trust in institutional governance refers to stakeholders' confidence in the mechanisms, systems, structures, and protocols that coordinate and regulate actors' interactions within the supply chain network. It encompasses the effectiveness of institutional arrangements that guide participation, decision-making, and rule enforcement (Griffiths and Zammuto, 2005).

Trust in partners refers to the inter-personal and inter-organisational trust that emerges from social interactions between supply chain actors. This form of trust is underpinned by relational qualities such as benevolence, credibility, and openness, as detailed above (Tejpal et al., 2013).

In line with this framing, we conceptualise 'technical trust' and 'social trust' as predominant but interrelated forms of trust that operate across socio-technical boundaries.

Technical trust refers to confidence derived from technological or some institutional mechanisms that provide assurance through formalised rules, protocols, and system reliability. It is expressed through trust in technology, such as data integrity, authentication, and system reliability, and through some aspect of trust in institutional governance, including compliance mechanisms and regulatory enforcement.

Social trust, in contrast, stems from inter-personal and inter-organisational relationships grounded in shared values, systems, credibility, and openness. While these two forms of trust are analytically distinct, they are functionally intertwined, institutional governance embeds social legitimacy within technical rules. Accordingly, in our conceptual model in Fig. 1, we refer to a 'predominantly technical trust' and a 'predominantly social trust' to emphasise that boundaries are permeable and that BCT impacts trust across both technical and social domains.

Moreover, for conceptual precision, we distinguish between 'technical trust' and 'trust in technology'. Technical trust serves as a broader category encompassing trust derived from the mechanisms, processes, and institutional rules that provide assurance within BCT-mediated supply chains. It includes both aspect of the governance and technological infrastructures that enable coordination, compliance, and reliability. Trust in technology, by contrast, refers more specifically to trust placed in the BCT itself, its records, platforms, algorithms, and system integrity. Accordingly, trust in technology is considered a subset of technical trust within our framework.

Our interpretation of the literature has led us to develop a BCT-mediated Supply Chain Trust Conceptual Framework, as illustrated in Fig. 1. It incorporates trust definitions and dimensions from various perspectives and support the exploration of the multidimensional trust concept within an innovative application of BCT as positioned in this study (MediLedger). Building on this framing, we investigate how BCT redistributes trust across socio-technical boundaries. Technical artefacts, such as cryptographic protocols, consensus mechanisms, and smart contracts, impact certain aspects of trust, particularly those related to data integrity, identity authentication, record immutability, and contract execution. Other forms of trust, such as trust in governance structures, trust in regulatory bodies, are arguably quite mechanistic, while others such as trust in institutional arrangements, and trust in partners remain predominantly rooted in the social domain, as illustrated in Fig. 1. Although BCT has attracted increasing academic attention in the supply chain literature, much of the research has concentrated on public and permissionless blockchains and cryptocurrency-driven applications (Jabbar and Dani, 2020; Casino et al., 2021). In contrast, the mechanisms through which trust is formed and developed within private BCT-mediated supply chains, especially through empirical investigation, are less commonly addressed. Our study seeks to fill this gap by focusing on a private and permissioned blockchain case in the pharmaceutical sector.

Fig. 1 illustrates the concept that BCT can function as a mediator that redistributes different forms of trust within supply chain networks. The framework integrates three interdependent dimensions of trust. Trust in institutional governance reflects confidence in the mechanisms, standards, and rule-enforcing bodies that coordinate participation and ensure compliance across the network, incorporating both social and technical aspect of trust. Trust in technology concerns the reliability, authenticity, and integrity of the records and platforms that underpin the operations. Trust in partners captures relational attributes such as partners' benevolence, credibility, and openness, which sustain collaboration among actors. BCT enables the intersection of these dimensions and forms a dynamic trust ecosystem in which technical assurances complement social and institutional mechanisms. Collectively, these layers contribute to supply chain efficiency, agility, transparency and collaboration, and they frame our enquiry into how BCT reshapes trust across socio-technical boundaries.

3. Methodology

3.1. Research approach

An abductive approach was deployed in this study, with the use of a priori and a posteriori themes, along with triangulation between primary and secondary data (Vila-Henninger et al., 2024). Van Hulst and Visser (2025) noted that an abductive approach is most suitable to study a 'puzzling' or nascent observation of a real-life phenomenon (BCT application in PSC) that cannot be fully addressed within established theories. The existing theoretical frameworks, however, play a very important role to guide us to produce a 'creative iterative process' to extend the theories and build conceptual models. We deliberately used the abductive approach, which fits our research context. Inspired by Bendoly and Oliva (2025) theoretical pathway, we developed our observations and interpretations of BCT-based trust in the PSC grounded within existing models of supply chain trust and identified insights and patterns that are explained through our data collection and analysis. The MediLedger and its PSC ecosystem are a pioneering example in utilising blockchain to manage safety concerns, transparency, and regulatory compliance. This rich case provided us with a meaningful and valid context to extend the theory. We discuss the details of our research design and present our logic in the sections below (Saunders et al., 2016).

3.2. Research design

We relied on a qualitative design using both primary and secondary data, where a case study strategy was used (Yin, 2012; Schwandt and Gates, 2018; Harrison et al., 2017; Hyett et al., 2014). We used the MediLedger network as a revelatory and theoretically relevant case (Yin, 2012). The MediLedger is a blockchain network designed to improve efficiency and transparency in the PSC, designed and operated by Chronicled, facilitating technical onboarding, providing data and transaction services and supporting compliance with the sector-specific regulations. It's a collaborative venture involving major pharmaceutical manufacturers, distributors, and healthcare providers in the USA. It was chosen for two reasons: i) the MediLedger is a well-established, developed network, which started in 2017/18, so it provides a rich context of the practical application of BCT in industry; ii) it includes actors along the entire PSC, providing us with diverse data to study the supply network. Overall, it represents a unique and innovative case to understand the dynamic of trust in the PSC environment, which makes this study timely and relevant. Additionally, there is a considerable amount of secondary data publicly available online, via Chronicled, the custodian of the MediLedger network. The triangulation between the primary and secondary data significantly strengthened the validity and depth of the research.

3.3. Participants and primary data collection

Purposive heterogeneous sampling was used to select participants representing the MediLedger network population. Its pilot project was formed by a consortium of leaders from 25 pharmaceutical companies, with the goal of evaluating blockchain as the solution to the Drug Supply Chain Security Act (DSCSA) requirements (MediLedger, 2018). Using the purposive sampling method, we were more likely to effectively explore rich information in this relatively small sample of cases, due to the infancy nature of BCT-based trust. In terms of heterogeneous sampling, the maximum variation in the sample was considered to ensure a variety of themes and patterns emerged (Patton, 2002). The company details in the 2020 MediLedger Drug Supply Chain Security Act (DSCSA) pilot project document were used for contacting the interviewees. The research team had no prior involvement in the MediLedger project or formal relationships with the participating organisations. While this outsider position supported a degree of objectivity and critical distance during data collection and analysis, it also presented some access constraints. Participants were identified through publicly available information and purposive sampling. Our academic background and interest in supply chain innovation, particularly BCT, informed our interpretation of the data and guided our focus on the socio-technical dimensions of trust. This led to seven interviews with participants in five different roles across the PSC, including two manufacturers, two distributors, a Third-Party Logistics service provider, a solution provider and a consulting firm, as detailed in Table 1. The sample size was limited to seven interviews due to the highly specialised nature of the network and the limited access we faced. Nevertheless, participants represented a cross-section of key stakeholders, providing diverse perspectives on the BCT ecosystem's dynamics. The collective strategic influence represented by these seven individuals is very significant, which allows us to invoke the concept of "information power" (Malterud et al., 2016). While the sample size of seven interviews may appear limited in numerical terms, this study draws on the concept of "information power" rather than relying solely on saturation logic to justify sample adequacy (Malterud et al., 2016). Information power suggests that the more information the sample holds relevant to the study, the fewer participants are required. In this study, participants were selected based on their strategic roles and network centrality within the pharmaceutical supply chain and the MediLedger ecosystem. The interviewees were senior executives, solution architects and providers, and decision-makers directly involved in blockchain implementation, governance, and inter-organisational coordination across the pharmaceutical network. As such, each participant represented a significant portion of the network and provided insights at the strategic and governance levels rather than operational perspectives. The combination of a narrow research aim, a highly specialised elite sample, strong theoretical framing, and rich interview data provided high information power, thereby supporting the justification of a smaller sample size for this exploratory and theory-building study. In addition, data saturation was also assessed based on the recurrence of themes across interviews and the secondary data collected and triangulated (Vila-Henninger et al., 2024).

Each semi-structured interview lasted between 45 and 60 min and was recorded. We used open-ended questions to allow deeper discussions on the rich and complex contexts of trust in the PSC. A non-standardised approach was used by preparing themes, prompts, and possible questions linked to the aims and objectives, which increased the flexibility in questions related to the participants' role, knowledge, and company's position. Further, new themes appeared as the interview process unfolded, which became more central to the later discussions. Given the limitations of semi-structured interviews, our secondary data analysis serves to triangulate our analysis and increase the rigour and trustworthiness of findings and conclusions (Denzin and Lincoln, 2011).

Table 1
Participants sample.

Participants code	Organisation types	Participant position	Interviewee roles
P1	Third-Party Logistics	Director	Represented the logistics perspective, focusing on product traceability and integration.
P2	Manufacturer	U.S. serialisation market lead	Led internal compliance and coordinated technical implementation of some MediLedger protocols.
P3	Solution provider	Co-founder	Key architect of the blockchain solution; contributed to system design, governance structure, and interoperability mechanisms.
P4	Manufacturer	Senior director	Acted as a strategic liaison between internal supply chain functions and the consortium; focused on network trust and regulatory alignment.
P5	Consulting firm	Founder and CEO	Advised members on governance, and strategic use of blockchain; provided thought leadership on decentralisation.
P6	Distributor	Vice-President	Oversaw data exchange and operational coordination across the network; key stakeholder in establishing real-time transparency.
P7	Distributor	VP Supply Chain	Managed implementation of blockchain processes in distribution operations; emphasised shared standards and interoperability.

3.4. *Secondary data collection*

In addition to the primary data collected through interviews, we supplemented our research with secondary data from annual progress reports (2017–2019), the 2020 MediLedger DSCSA (Drug Supply Chain Security Act) pilot project, government reports and publicly available sources. A large proportion of our secondary data was gathered from Chronicled's official website, the company behind the MediLedger platform. Chronicled has compiled a variety of resources, including case studies, webinars, white papers, blogs, and press releases, which provide valuable insights into the development and application of BCT in the PSC. For example, we extracted relevant data from Baptist Health System, Grifols, Premier Inc, Johnson and Johnson, FFF Entreprises and Cencora cases. These documents were systematically collected and analysed to triangulate the findings from the primary interviews. The case studies and white papers offered detailed accounts of the MediLedger platform's implementation and its impact on various stakeholders, while the webinars and blogs provided contemporaneous industry perspectives and discussions on blockchain's role in the sector. Press releases were also examined to capture significant milestones and public statements from Chronicled regarding the progress and adoption of MediLedger. By incorporating this secondary data, we were able to cross-validate our empirical findings and enrich the analysis, ensuring a more robust understanding of the trust dynamics within the BCT-based pharmaceutical network. The diverse nature of these data sources allowed for a more comprehensive triangulation of findings, providing both temporal depth and industry context.

3.5. *Data analysis*

We used a combination of thematic and template analysis to generate new understanding and knowledge grounded in human experience through interviews. Thematic analysis aids in identifying, analysing, organising, describing, and reporting themes found within a data set (Braun and Clark, 2006). We also included techniques from template analysis due to the flexibility of each method (King, 2004). We followed the six-step approach to thematic analysis suggested by Nowell et al. (2017) and Braun and Clarke (2006), ensuring robustness in analysis. The research team documented a self-critical account throughout the study by recording methodological decisions, rationale, and personal thoughts and values (Tobin and Begley, 2004).

3.5.1. *Six-Step approach to thematic analysis*

The first stage was to become familiarised with the data (both primary and secondary) to actively seek and take notes of meanings and patterns when reading through the transcripts and to become immersed in the data. Next, initial codes were extracted through '*a priori*' codes, based on the conceptual model developed in the literature review using a codebook. These codes were placed into a provisional template, representing the template analysis technique. A separate "other" code was used to accommodate emerging themes through induction. We used mind maps and journals to stay reflexive and systematically search for themes, representing the third stage. Mind maps provide a way to explore codes and themes and their relationships, which move beyond the linear template (Crabtree and Miller, 1999). The themes were refined to reflect inadequacies in the initial coding by i) creating new codes for themes not initially covered (e.g.: creating 'trust in network' as a new theme with many lower-order themes such as 'swift trust'); ii) deleting redundant codes (e.g.: the removal of the 'temporal' code); and iii) reordering the coded data into different codes (e.g.: generating the 1st and 2nd order codes and moving 'standards' into 'trust in network'). Thematic analysis is an organic and iterative process (Braun and Clarke, 2006), so reviewing and modifying the codes and themes was an important step. Defining and naming codes and themes was a critical component of step five. Once each code and theme could be clearly defined and the entire text was read through three times, the research team stopped modifying and refining them.

3.5.2. Thematic analysis

Our methodological approach follows a similar logic to that of Dehe et al. (2026), Olaniyan et al. (2024), Dehe et al. (2024), and Minshull et al. (2022), and tabulated a summary of the analysis process in Table 2, showing the four themes and 11 sub-themes that emerged from the thematic analysis and the numerous 1st and 2nd order codes. Each theme contains individual sub-themes that were developed from the abductive coding processes and support the final themes. 'Barriers to trust formation and development' shows the traditional supply chain configuration in the pharmaceutical sector with two major challenges of trust formation. 'Trust in BCT and its governance' demonstrates the impact BCT has in protecting against opportunistic behaviours and the efficiencies it brings to reduce redundancies. 'Trust in partners' illustrates the BCT's technical and social functionality to support trust development between actors. 'Trust in network' is a key and emerging finding from our data, illustrating the extensive applications of BCT to establish trust in a broader scope, via new industry standards, new aspects of governance, and new integrations with consumers. Moreover, we found a conceptual association of these themes, showing a hierarchical trust development from a low to a high socio-technical system perspective (trust in technology and trust in institutional governance to trust in partners to trust in network).

4. Findings

4.1. Barriers to supply chain trust formation and development in the PSC

Complexity in PSC structure – Our data showed that the involvement of group purchasing organisations (GPOs) and the pricing strategies of manufacturers increases the complexity in the PSC and therefore challenges supply chain trust formation and development. The high R&D investment and the dominant market powered by pharmaceutical manufacturers commonly impose high purchasing prices on individual customers (e.g.: hospitals). Hence, GPOs have emerged as intermediary actors in the PSC. The GPO consolidates a large purchasing volume across member customers by standardising product specifications, quality requirements, and delivery time. The manufacturer, in turn, is willing to provide more favourable prices to the GPO member customers. Two different prices, namely 'GPO price to member customers' and 'market price to non-GPO member customers (by a distributor)', are set by manufacturers. Our findings suggest this differentiated pricing strategy is commonly used by drug manufacturers. To implement pricing strategies, manufacturers share the GPO prices and request the distributors' deliveries to GPO member customers at a lower price. However, a distributor may find the GPO prices are lower than their own purchasing prices and thus sells at loss. A manufacturer voluntarily allows the distributor to claim 'chargeback' to resolve the conflicting prices. We found that disputes and transaction risks are a result of this complexity in the supply chain structure, which does not favour trust formation and development. Price changes are not quickly updated to the distributor, and chargeback is unlikely to be immediately processed by the manufacturer. These 'reverse financing' flows increase unnecessary trade credits. More importantly, unnecessary trade credits create the opportunistic risk. The dispute on chargeback significantly discourages the trust formation between distributor and manufacturer and increases transaction costs. As stated by the solution provider, '*friction and issues sit between trading partners,*' and '*these chargebacks are disputed [...] Creating a business problem of about 4% revenue leakage for the entire industry, or about $35 billion*', showing the financial costs and '*labour required to resolve the disputes*'. A distributor indicated that '*in pharma, there was no trust whatsoever*'. A manufacturer pointed out, '*trust has always been an issue because of the nature of pharmaceuticals products, which are highly controlled, and very valuable*'. Many of the interview participants stated that this complexity and trust issues were due to the lack of long-term vision in the supply chain design and its integration. The consulting firm participant suggested that '*in the U.S. pharmaceutical industry, rather than get to root causes, we tend to build more middlemen and... build more layers of complexity on top, because sometimes that's an easier way to fix the short-term problem*'. Two separate information flows indicate that the supply chain members are unlikely to establish an incentive in trust development but rather protect their interests.

Lack of data and technology governance – We found that the lack of reliable and secure data and technology governance hinders supply chain trust formation in the pharmaceutical sector. First, given the nature of the high product values and sensitive business information, pharmaceutical companies commonly keep all their data within their '*four walls and do not give access*' to others, as stated by a manufacturer participant. However, '*leveraging a trusted source of information is paramount to securing our supply chain,*' added another manufacturer interviewee. But there are no central system and governance, where supply chain partners may share their information, such as serial numbers. It is difficult to verify and authenticate data in the supply chain. In turn, it hampers the development of trust in supply chain partners. Second, we found that a lack of data and technology governance significantly hinders trust formation. In a manufacturer's GPO price, a distributor may choose to quickly deliver the drugs to the GPO member customers and then initiate a chargeback through '*overnight and batched Electronic Data Interchange (EDI) transactions*.' It requires a certain level of trust between distributors and manufacturers, to achieve efficiency and effectiveness in the supply chain operations. However, many distributors found EDIs are batched, so often do not have the '*latest information on the price changes.*' There is a lack of real-time updates on the prices while GPO deals are constantly transferred to distributors. The overlaid delays on chargeback information make distributors increasingly cautious in delivery before the price confirmation by manufacturers. Such trust issues between manufacturers and distributors are extended to the wider supply chain partners and significantly influence effectiveness and efficiency. However, we found that BCT can overcome some of these issues.

4.2. Trust in BCT and governance – evidence of the MediLedger

BCT improves data management and reduces redundant transactions – The participants widely agreed with the technical contributions of BCT to enhancing trust by providing an effective and reliable data management mechanism and reducing redundant transactions. We found multiple dimensions in 'trust in record and technology' in our data, where interview participants related them to the technical and technology trust development. First, the recording reliability was acknowledged widely by the interviewees. When considering contracts and chargebacks, Participant 7 argued that the data they receive, as a distributor, is now more reliable because the data is shared first between manufacturers and GPOs before being sent to the distributor and they '*consider that data with more confidence than [they] have had before*'. For instance, proofs and consensus are used '*on the private network*' for peer-to-peer messaging, so there is a certain level of trust and accuracy about who created and sent messages and data. However, initial data entry was not discussed, which is considered a key element of reliable data in BCT, and distributed ledgers more generally. Second, BCT improves

Table 2
Sample of the data analysis and coding.

Exploration points	Emerged from Literature	Prompts	Sample from interviews and documentation	1st order codes (descriptive)	2nd order codes (conceptual)	Final themes and sub-themes
The current, specific PSC context	PSC issues Lack of trust Legal requirements and traditional governance mechanisms BCT and the MediLedger	A. What are the current PSC issues? how would you describe the level of trust? B. What are the current key innovations in PSCs? C. Before MediLedger and BCT how did you share product information with other supply chain actors? D. What are the main blockchain innovations you have been involved in in the last few years? E. What do you think is going to be the future of BCT in the sector?	*(P4) The PSC is very complex and dynamic and involved many different stakeholders and has been under an increased scrutiny this past decadeP6) In pharma, there was no trust whatsoever.* *(P5) In the industry rather than getting to the root causes, in the U.S., we tend to build more middlemen and build more layers of complexity on top of things, because sometimes that's an easier way to fix the short-term problem.* *(3) All parties in the PSC have their own sources of truth with respect to prices, chargebacks and contracts that do not match, and any efforts that we all try to connect the pieces are disjointed at best; systems are not connected.* *(5) Using a platform that provides transparency to all parties is a different way of working than we have ever had.* *(6) Update notifications and mismatches of customer master data between trading partners would happen.* *(6) The industry struggles with administrative burden and revenue leakage within the industry.* *(1) Baptist Health explored options to address contract alignment, but those options were unilateral and not collaborative.* *(P2) Traditionally the pharma companies tend to keep all their data within their four walls and not give access to others.* *(P4) Trust has always been an issue because of the nature of pharmaceuticals products, which are highly controlled, and very valuable.* *(P3) BCT has the potential to resolve the many frictions and issues sitting between trading partners, for example, the chargebacks are often disputed. Creating a business problem of about 4% revenue leakage for the entire industry, or about $35 billion U.S.* *(P3) Many distributors found EDIs are batched, so often do not have the latest information of the price changes, BCT and the MediLedger overcome this problem.* *(P4) BCT enable leveraging a trusted source of information, which is paramount to securing our supply chain.* *(4) Most other solutions tackle the problem using the historical process and electronic data exchanges. The blockchain is real time, accurate and private*	Complexity and dynamic SC Layers of middlemen Disjointed information systems Administrative burden Data hoarding High value and tightly regulated products Disputed chargebacks and revenue leakage Limitation of traditional EDIs Trusted source of information Real-time, accurate and private data Real-time and accurate communication Timely and accurate updates	Systemic complexity Operational fragmentation Data silo and fragmentation Inefficient coordination Lack of data transparency Intrinsic trust challenges in pharma BCT-supported data integrity Improved data reliability Strengthened information transparency Data synchronisation across partners	**PSC trust formation and development barriers** – Complexity in the PSC structure –Lack of data and technology governance

(*continued on next page*)

Table 2 (*continued*)

Exploration points	Emerged from Literature	Prompts	Sample from interviews and documentation	1st order codes (descriptive)	2nd order codes (conceptual)	Final themes and sub-themes
			which is a strong foundation for the future. *(1) MediLedger – it automates processes and workflow and closes the gap on contract misalignment. … the data should exist on a distributed network for all parties to access data elements necessary to the business relationship.* *(1) Our work with MediLedger has stirred thoughts of other avenues where we transact data with vendor partners, and the need to work more collaboratively.* *(1) The wholesaler can fix it instantly because they can see the very same communication from the manufacturer. The opportunity to work collaboratively with industry partners to improve our process was too good to pass up.* *(5) With blockchain technology, I foresee processes speeding up and error resolution being managed better.* *(6) Real-time communication, data accuracy, and improved efficiency in managing trading partner relationships.* *(6) We have been able to eliminate manual work, improve communication with trading partners, and ensure timely and accurate updates.* *(4) The technology is only as good as the process that's built around it. Also, the internal and external customers need to work together to make the process solve the challenge.*			
Technical and Institutional trust	BCT features and advantages Trust in record −reliability −authenticity Trust in platform −provision −certification −delegation −infrastructure Trust in institutional arrangement and governing bodies	F. How is BCT reducing complexity and facilitating transactions between different businesses and entities? G. What sort of sensitive data is kept and recorded on the blockchain and is this data secure? H. Are there any security issues, for example can you manipulate the hash on the network? I. How well do you think the proof of authority consensus mechanism works and has this built trust in the ecosystem?	*(P7) Now the data we receive, as a distributor, is more reliable because the data is shared first between manufacturers and GPOs before being sent to the distributor and we consider this data more reliable than did before, also there are less redundancies and inaccuracies.* *(1) Transactions are instant and transparent to all parties. …. All parties see the same data, so there is no dispute about the communication.* *(7) Blockchain allows for more immediate visibility than EDI or email notification while still providing flexibility to collaborate on a single source of truth.* *(5) Contract administration is a complex process with multiple parties trying to align to a single set of data. The network should provide transparency to a complex process.* *(5) Seeing a single source of truth allows all parties to be on the same page to ensure the best outcome for our shared customers.* *(3) The MediLedger network*	Improved data reliability and reduce redundancy Instant and transparent transactions reduce disputes Real-time data sharing enables collaboration Contract visibility simplifies complex coordination Replaces outdated systems and reduces manual tasks Trusted, shared information platform Human trust gaps addressed through technological design Consensus mechanisms establish trust in data origin Verifiability fosters confidence in records Live verification enhances trust Automated rule	Enhanced data quality and management Elimination of redundant communication Real-time unified data access Improved multi-party process integration Data synchronisation across partners BCT as infrastructure for trustworthy data Automation and simplification of workflows Institutionalising trustworthy data practices Technology as a mediator of interfirm trust Instant validation	**Trust in BCT and governance** −BCT improves data management and reduces redundant transactions −BCT acts as a 'Symbiosis' for opportunism safeguarding and long-term commitment → BCT contributes to a new type of swift trust formation

(*continued on next page*)

Table 2 (*continued*)

Exploration points	Emerged from Literature	Prompts	Sample from interviews and documentation	1st order codes (descriptive)	2nd order codes (conceptual)	Final themes and sub-themes
			has provided a secure way for all participants to agree on a shared source of information that everyone trusts… At the end of the day, our collective roadblock is human – a lack of trust – and not technological in nature. *(3) We think it will solve real business problems such as aligning pricing across life sciences manufacturers, wholesalers, GPOs and mutual provider customers. We saw MediLedger as having the potential to be a unified source of truth for many of the core pieces of information that drive today's supply chain.* *(P5) Proofs and consensus are used on the private network for peer-to-peer messaging, so there is a certain level of trust in who created and sent messages/data.* *(P6) The ability to audit and verify in real-time builds confidence that the records are correct and maintained.* *(P2) The decentralised nature means the data is very accessible to all participants, allowing constant monitoring, and when issues occur, they can be flagged almost in real-time.* *(P7) Verification in real-time builds confidence that the records are correct and maintained.* *(P4) Secure data distribution increases business confidence in supply chain information sharing.* *(P4) MediLedger uses two separate blockchains which talk together and with one another.* *(P3) Zero-knowledge proofs enforce the business rules without anybody knowing what the actual drug identifiers are.* *(P3) Smart contracts enforce business rules about the chargeback transaction.* *(P4) It removes batch EDI transactions that happen overnight, which are known to cause issues, and eliminates a whole host of individuals who were doing contract management.* *(P7) Transparency is ready, we're just starting with how to do it.* *(P5) There needs to be better master data sharing and transparency. Transparency is supported by 'trust certification' in BCT.* *(P2) Mutual benefits have been at the heart of the BCT implementation, we would agree when making big calls that we do not do something that favours one sector over the*	enforcement limits opportunism Transparency infrastructure exists, adoption is ongoing	fosters trust acceleration Rule-based governance ensures fairness Emerging culture of digital trust readiness	

(*continued on next page*)

Table 2 (*continued*)

Exploration points	Emerged from Literature	Prompts	Sample from interviews and documentation	1st order codes (descriptive)	2nd order codes (conceptual)	Final themes and sub-themes
			other. So everything we design works for everybody.			
Social trust	Openness Credibility −predictability −confidence Benevolence −goodwill	J. How would you define trust within the MediLedger and how important is this initiative? K. How does the relationships with the members inside the MediLedger differ to the relationships with actors outside the network and ecosystem? L. Is the lack of trust in BCT stopping people joining the network? M. What are the issues with overpayment, contract misalignment, cach back within the network?	*(P5) At the beginning of the project, there was lots of mutual sharing of ideas and plans during the 'first year or two, which helped create a [new] trusting environment.* *(9) MediLedger was formed through unprecedented industry collaboration looking to tackle common problems together. As Corey put it, "We need to collectively work together to make the industry better."* *(P2) The industry was coming together every week to discuss how can we meet the saleable returns.* *(P6) In these meetings, trading partners saw massive value by aligning the different requirements of quality, transparency and traceability.* *(P1) With the deployment of the blockchain, we were able to solve other pain points in the SC to produce win-wins.* *(9) MediLedger is not just internal alignment, it's external alignment.* *(1) MediLedger transform the way we communicate data with members of the network.* *(4) They have brought together Manufacturers, Wholesalers and GPOs in a way that I have not experienced in the past.* *(P5) One of the biggest problems with all this is definitely that the ramp up is slow due to some partners wanting to stay more kind of point to point or more old school.* *(P4) We felt that the technology was not yet well developed and there was not 100% use case behind, so it was a bit of a leap of faith.* *(P4) I think we're still relatively early. And that's why more people aren't jumping on board, because the S curve has not had that 10-year mark to get that 10% adoption.* *(P1) MediLedger is a private blockchain so only authorised members… have standing to participate….. [There is a] onboarding process to check [new member companies'] identity and to check they are a legitimate pharmaceutical company… [new members and existing members] take that data with trust that [they] didn't have before.* *(8) Despite best efforts to settle disputes, many companies continue to lose millions due to unapproved chargebacks, write-offs, pricing mistakes, and unauthorized 340B access. It is estimated that these disputes contribute to an industry-wide*	Initial openness facilitated rapid trust-building Shared purpose strengthened trust across actors Collaborative forums improved alignment on transparency and traceability Trust enabled solutions that benefitted multiple parties Improved communication across the network Early adoption required trust in potential, not proof Verification process ensures data credibility and partner legitimacy Lack of transparency creates costly disputes Inefficient reconciliation reveals need for better information traceability	Early collaboration enabled swift trust formation Collective intent supports trust-based practices BCT fosters shared expectations for transparency BCT fosters reciprocal trust through shared gains BCT enhances transparent and traceable data exchange Adoption built on anticipatory (swift) trust Blockchain creates verifiable and traceable trust boundaries Transparency deficits undermine trust and performance Inefficiencies highlight the demand for traceable financial data	**Trust in partners** −BCT supports transparency and traceability between partners −BCT enables direct information flows between partners −BCT enables new working protocols based on this newly established 'swift trust'

(*continued on next page*)

Table 2 (*continued*)

Exploration points	Emerged from Literature	Prompts	Sample from interviews and documentation	1st order codes (descriptive)	2nd order codes (conceptual)	Final themes and sub-themes
			revenue loss of $4B-$10B. *(1) Credit and rebills are cumbersome and expensive. There is a finite amount of time to determine overcharges. …. Even a timely catch of an overpayment typically takes weeks or months to resolve, as the manufacturer determines the correct price and the back and forth is not a quick process.*			
Socio-technical Trust	Governance Public v Private blockchain Consumer perspective Process change Standard	N. Over the last four years how has the trust between different stakeholders developed in this ecosystem? O. Have you seen the element of swift trust? *Swift trust refers to a type of trust that develops quickly within temporary teams or groups. It contrasts with the traditional view of trust building slowly over time through experience and interaction.* P. How has the relationship between members of the ecosystem changed? Q. In this Medileder ecosystem, is peer-to-peer trust still important or do we have trustless trust in the machine? R. Is there anything else you would like to discuss regarding trust in MediLedger?	*(P1) I think people are going to use it to extend trust into areas that they have not been able to trust in before.* *(P3) When I speak about the other solutions, the transaction speed becomes more a factor about how many consensus nodes are used.* *(P2) The biggest thing was the speed of interoperability in enabling supply chain improvements.* *(3) In summary, the largest learning is things don't change overnight – it takes time…. Time to build trust with those who have been business partners for years.* *(P2) In terms of the blockchain, we didn't find any security risk.* *(4) Working with the MediLedger team has been very positive. They have brought together Manufacturers, Wholesalers and GPOs in a way that I have not experienced in the past. They are committed to building a better process with breakthrough technology.* *(P4) BCT has led to create more trust and increased security in our processes.* *(1) The MediLedger project is the initiative I am most passionate about because of the marked improvement it offers to all parties involved. This is the most collaborative I have seen the industry and I'm excited to see all the use cases we are able to build within the MediLedger network.* *(P4) The decentralised nature of it, again, from my perspective does increase the level of trust.* *(P5) There are some messaging standards that are meant more for sort of peer to peer.* *(6) MediLedger gives us a real-time view of trading partner updates, shared customer identification/matching, and clean and timely roster updates.* *(P6) Industry started joining like GS1, the standards group.* *(P5) We're just not there yet with standards but hopefully soon.* *(P7) It's interesting because I don't look at a GTIN as being private. But believe it or not, there are a number of pharma manufacturers, particularly*	Time is needed to rebuild trust among partners Expansion of use cases under a shared governance framework Use of peer-to-peer communication protocols Access to shared partner and customer data Involvement of industry standards bodies Lack of industry willingness to own governance Sector-based voting promotes balanced governance Transparency and communication drive trust	Governance requires social trust evolution Innovation emerging from shared governance infrastructure BCT encourages standardised communication frameworks Standardised real-time data exchange Movement toward industry-wide standardisation Challenges in decentralised governance adoption Structured participatory governance mechanisms Foundations for consumer trust and integration Transparency as a trust-building strategy for consumer adoption	**Trust in network** –BCT supports industry standardisation –BCT leads to business process innovation –BCT provides network governance mechanisms –BCT supports consumers integrations

(*continued on next page*)

Table 2 (*continued*)

Exploration points	Emerged from Literature	Prompts	Sample from interviews and documentation	1st order codes (descriptive)	2nd order codes (conceptual)	Final themes and sub-themes
			those with brand product, who felt that that is private information that the GTIN with the URL you would send a request to get approval on is very private. *(P7) Trust was built because there's also a business process change related to using that blockchain environment.* *(P7) So, there's business processes that need to take place that are changed to reflect the trust in the community, if you don't have the trust in the environment to do that, you shouldn't be in it.* *(P3) We struggled with getting a good governance model that was owned by the industry, and the industry and players within it did not want to have that ownership.* *(P4) The governance still resides with the company Chronicled.* *(P2) There are voting rights per sector, so for each manufacturer, wholesalers and dispensers, when working on designs we vote for what's going to work for each to keep neutrality.* *(P2) I don't know how much they know about it in terms of education to say we as an industry are taking steps to provide an authentication model.* *(P2) The more we can promote the steps that we have done and the issues that come out it will help promote consumer confidence and integration.*			

Secondary Data Sources:
(1) Thomas Matanich, Director, Pharmacy Contract Management Baptist Health System.
(2) David Moss, Director of Operations, Grifols.
(3) Chad Connelly, VP Supply Chain Technology, Premier Inc.
(4) Ray Pellicciotti, Director Enterprise Operations, Johnson & Johnson
(5) Michael Connelly, VP Contracts and Pricing, Cencora.
(6) FFF Enterprises.
(7) Susan Lowe, Senior Vice President Supply Chain Operations, FFF Enterprises.
(8) Fortune 500 Pharma Case Study.
(9) https://www.chronicled.com/content-resources/from-reactive-to-proactive-data-management-armas-transformation-with-mediledger.

authenticity in the MediLedger network. The ability to audit and '*verify in real-time*' builds confidence that the records are correct and maintained, as stated by a distributor. The decentralised nature means the data is '*very accessible*' to all participants, allowing constant monitoring, and when issues occur, *'they can be flagged almost in real-time'*, added a manufacturer participant. Third, secure data distribution increases business' confidence in supply chain information sharing. The MediLedger uses two separate blockchains which '*talk together and with one another*' as explained by a manufacturer's participants. The private nodes that carry proprietary data are kept within company firewalls, while the MediLedger blockchain maintains the public data, such as Global Trade Item Numbers (GTIN's). In the Product Verification System (PVS), '*zero knowledge proofs…enforce the business rules without anybody knowing what the actual drug identifiers are*' (P3). This is a form of provision as transactions occur inside the consensus nodes (lookup directory) without accessing private ledgers/nodes. Fourth, the use of smart contracts in MediLedger increases delegation trust. The solution provider noted, '*smart contracts enforce business rules about the chargeback transaction*', meaning BCT makes decisions based on predefined contract rules and resources. Automating the contracting process increases trust and significantly improves contract processes, as it '*removes batch EDI transactions that happen overnight*', which are known to cause issues, and '*it eliminates a whole host of individuals who were doing contract management*', another participant added. Therefore, BCT reduces redundant transactions and improves supply chain trust, especially regarding the chargeback issue between the distributors and manufacturers. We also found that a new BCT-enabled swift trust was emerging from the implementation.

BCT acts as a symbiosis for opportunism safeguarding and long-term commitment – Our data showed that BCT is an effective solution to reduce opportunistic behaviours in the PSC. Many participants highlighted the social perspective of BCT and viewed it as a virtual 'industry symbiosis' that reconciles the disparate PSC. The multiple supply chain trust dimensions are effectively developed by the BCT-based symbiosis safeguarding the opportunism in the complex PSC environment, and stimulating the long-run commitment, especially via the conversion of the newly established BCT-enabled swift trust. Six out of seven participants mentioned that BCT significantly increases the social trust dimension of openness. There have been more significant open and mutual collaborations, ideas sharing and plans during the '*first year or two of launching the MediLedger project*' (P5). For example, '*the industry was coming together every week to say how do we meet the saleable returns*' (P2). In these meetings, trading partners saw significant value in '*align[ing]with the requirements*' (P6) of the DSCSA (Drug Supply Chain Security Act) and overcoming other pain points to produce win–win and mutual benefits. Further, mutual benefits were at the heart of the discussions, as Participant 2 said, we would '*agree when making big calls that we do something that doesn't favour one sector over the other… so everything we have to design works for everybody*'. Trust was being built through these open forums and mutually beneficial discussions during the implementation of BCT.

4.3. Trust in partners – evidence of the MediLedger

BCT supports transparency and traceability – Although BCT is designed to enhance transparency and traceability, our findings indicated that these capabilities were still emerging rather than fully realised in the MediLedger network. As one distributor stated, *'[full] transparency [was not] ready'* or achieved yet, *'we're just starting'*. Similarly, the consulting firm participant noted that '*there needs to be better master data sharing and transparency*' to enhance collaboration, suggesting that BCT is seen more as a potential enabler.

Another participant referred to the '*trust certification*' concept, meaning the ability of BCT to provide verifiable proof of product origins and transactions. However, the solution provider participant acknowledged that the '*full track and trace system*' had not yet been fully implemented. We found that this gap is not primarily technological but social and relational. It goes beyond the technical perspective of BCT. Effective traceability depends on firms being willing to input accurate and complete data into the system. This, in turn, requires confidence that partners will not misuse shared information. As a result, many firms remain cautious about data sharing, despite blockchain's assurances of immutability and security. This illustrates an aspect of the distribution across the socio-technical boundaries to achieve greater collaboration. BCT can provide the technical foundations for visibility, but the realisation of transparency requires trust in partners and willingness to cooperate. Only when trust begins to flow across social and technological boundaries can transparency become embedded. As one participant observed, *"once transparency is ready, it's going to be disruptive"* (P5), signalling that BCT has the potential not only to increase visibility but to transform partner trust and collaboration at the network level.

BCT improves information flows between partners – The MediLedger is a private and permissioned blockchain, which requires the consensus of member companies to authorise new membership. The records of new member companies are centrally managed by the solution provider, Chronicled, which also uses the designed cryptography system to trace and record the follow-up transactions. Based on the decentralised data distribution in the network, specific transactions between peers can also be placed in consensus. As discussed earlier, a distributor may be concerned with opportunism risks of a chargeback by the manufacturer and postpone the product delivery to GPO member customers. Using the consensus mechanism, the transitions with chargeback can be quickly endorsed in the supply network. Supported by smart contracts, chargebacks can be triggered along with delivery by the distributor to specific customers. The consensus mechanism in the MediLedger significantly improves the information flow and increases the credibility of partners within the network. In a discussion with Accenture, Chronicled predicted that '*the MediLedger project can save $9 million in labour costs and increase revenue by $300 million (estimated total cost of manual processing of roster reconciliation eligibility determination and chargeback dispute resolution) through reduction on transactions/WIP line by 60–80%, errors, roster management and time reduction of a chargeback by 50%-60%*'.

BCT-enabled swift trust leads to new working protocols – BCT supports the development of swift trust, where an 'agile-term' vision and commitment are possible. The data interestingly showed that with BCT, a swift trust is quickly established when transacting with new partners. In the MediLedger network, we found that member companies were developing new working protocols based on a BCT-enabled swift trust to deal with various challenges. A distributor stated that '*everybody's motivation is the same,*' and committed to collaboratively developing a solution, for example, regarding *'the FDA and their compliance legislation*' within the DSCSA (Drug Supply Chain Security Act), added by a manufacturer. The FDA used this DSCSA legislation to *'build an electronic, interoperable system to identify and trace certain prescription drugs as they are distributed in the United States'* (Food and Drug Administration, 2021) and to *'verify and authenticate'* products. The DSCSA's compliance requires strong supply chain collaborations, including sensitive information sharing, while it is essential for every supply chain actor to legally run pharmaceutical businesses. The decentralised data sharing, cryptography system and consensus mechanisms of BCT reduce the risks of information sharing and motivate a swift trust to manage the new compliance by a wider range of collaborations. When member firms extensively use the MediLedger to develop and follow new working protocols, the collaboration on compliance with the DSCSA is considered more genuine and trustworthy. Such cooperation is beyond establishing a central repository from a technical perspective but extended to operations strategies and agility design in the supply chains. The emergence of a BCT-enabled swift trust is a novel finding. However, rather than being sustained over time, this form of trust appears to act as an initial mechanism that enables and accelerates the development of more stable forms of trust across the network. In supply chains, swift trust is often conditional and contingent (e.g.: for quick adaptation to regulations or market changes). In this BCT-based trust development, we found that this swift trust act as mechanisms to support trust in technology, trust in institutional governance and trust in partners. The coordinated and integrated use of these dimensions of trust, enabled by advanced blockchain adoption, leads to increased efficiency and effectiveness in the supply network. Finally, we observed a higher order of trust hierarchy in the 'trust in network'.

4.4. Trust in network – evidence of the MediLedger

One key emerging finding was that BCT supports an encompassing new level of trust, which goes beyond the firms' immediate supply chains and is established at the wider network level. We discuss the associated sub-themes below enabling this new level of trust: 'BCT supports industry standardisation', 'BCT leads to business process innovation', 'BCT provides network governance mechanisms', and 'BCT supports consumers integration'.

BCT supports industry standardisation – We found that a mature stage of supply chain trust emerged by implementing BCT, as industry standards are developed and rolled out, which enables new collaborations between the network's partners. The messaging standard is simple evidence but can be quickly extrapolated and developed to incorporate wider industry factors. The consulting firm participant noted, '*there are some messaging standards that are meant more for effective peer-to-peer communication.*' Another distributor added, '*the industry started joining GS1, the standards group*', (*note*: *GS1 develops and licenses globally unique barcode numbers for products*), contributing to this newly perceived swift trust and network credibility. The emergence of industry standardisation demonstrates the BCT's efficiency and effectiveness in developing supply chain trust.

BCT leads to business process innovation – The participants widely agreed that the greatest value of increased supply chain trust is to support innovative business models and process changes. A distributor noted,

> '*Trust was built because there's also a business process change related to using that blockchain environment,*'… '*So, there are business processes that need to take place that are changed to reflect the trust in the community, if you don't have the trust in the environment to do that, you shouldn't be in it.*'

With BCT, processes and business model changes are made more secure, visible, transparent, and predictable. The intensive data and established social control are more likely to allow industry partners to develop mutually beneficial innovations, such as solving the issues of complexity in PSC configuration.

BCT provides network governance mechanisms – We explored that the trusted collaborations supported by BCT are extended from immediate supply chains to a wider network, where firms are expected to develop new buyer–supplier relationships or technologies/production alliances in the ecosystem. Relationship governance is a common issue in extended supply chains, especially in an unfamiliar and large industry network. However, we found that in the MediLedger, issues can be resolved more quickly. The consensus nodes in BCT allow partners to effectively manage the relationships, '*there are voting rights per sector, so for each manufacturer wholesalers and dispensers, when working on designs we vote for what's going to work for each to keep neutrality,*' as explained by a manufacturer. The decentralised data distribution of BCT ensures transaction visibility and real data to every relevant party in the network. Meanwhile, the solution provider takes the role of a 'custodian' of the network. Such centralised governance integrated with decentralised data evidence ensures effectiveness in dealing with any issues/conflicts and efficiency in maintaining daily routine transactions.

BCT supports consumer integration – There is a notorious lack of consumer trust in the pharmaceutical industry since the opioid overdose crisis (CDC, 2022). However, we found that BCT can effectively support the integration of the pharmaceutical industry with consumers. First, the trust development by BCT between industrial partners at the point of production (e.g.: manufacturers and distributors) improves the industry integrity and strengthens their confidence in communication with consumers. A manufacturer noted, *"the more we can promote the steps that we have taken, and the issues resolved, the more consumer confidence will improve"*. Second, the wider adoption of BCT technology in society provides the pharmaceutical industry with an opportunity to develop a more transparent image toward consumers. Another manufacturer added '*I don't know how much [consumers] know about [BCT] in terms of education to say we, as an industry, are taking steps to provide an authentication model*'. We found our sample firms illustrate strong willingness and confidence in integration with consumers, especially the upstream manufacturers. Finally, we found both technical and social feasibility of converting the current private to the public blockchain in the future, which could make the integration with consumers. From the technical perspective, the MediLedger maintains both public data (e.g.: GTIN: Global Trade Item Numbers) and private data (e.g.: proprietary data). Data integration, for example, for the purpose of Product Verification System (PVS), is not challenging, while data security mechanisms need to be carefully developed. From the social perspective, distributors strongly support this conversion, because of their proximity to the end markets and thus urgency to improve consumers' trust. However, the potential resistance by manufacturers is also acknowledged (Dwivedi et al., 2023). A distributor commented that, '*it's interesting because I don't look at a GTIN as being private… but believe it or not, there are a number of pharma manufacturers, particularly those with brand product, who felt that is private information*'. The potential reason is the manufacturers' concern with sensitive proprietary information. Given the solid development of data security mechanisms by BCT, this concern can be relieved in the future.

Trust in network emerged as a distinct dimension of trust, enabled by the shared technological infrastructure and collaborative governance. Participants referred to the transparency of the system, the immutability of records, and the collective validation of transactions as central to their confidence in the network. For example, one Director described how *'Transactions are instant and transparent to all parties. All parties see the same data, so there is no dispute about the communication',* and other evidence suggested that the actors have been able to ***'eliminate manual work, improve communication with trading partners, and ensure timely and accurate updates.'*** Consequently, they felt that the system itself becomes more reliable and trusting. This sentiment was reinforced through practices such as standardisation of data fields, which ensured interoperability across organisational boundaries, and the use of mechanisms to collectively approve updates. Rather than trusting any single firm or individual, participants expressed trust in the functioning and fairness of the network as a whole. We believe while our interviewees might not know everyone in the network, they trust the rules that keep it running. These mechanisms, decentralised validation, transparent access to records, and shared governance processes, contribute to what we term 'trust in network': a higher form of supply chain trust that is embedded in socio-technical fabric rather than in specific dyadic relationships.

Although BCT is often associated with fully decentralised systems, the MediLedger network operates as a permissioned blockchain with a defined governance structure and a network custodian, Chronicled. This means that trust in the network is not purely decentralised but reflects a hybrid governance structure combining trust in the protocol, trust in the governance mechanisms, and trust in the network architect and facilitator. In this context, trust in network emerges as a socio-technical construct distributed across technological infrastructure, governance rules, and institutional actors responsible for maintaining and coordinating the network. Rather than eliminating institutional trust, enterprise blockchain systems such as MediLedger reconfigure trust by embedding it within federated governance structures, shared standards, and protocol-level rules. This hybrid structure further reinforces the view that BCT-enabled trust is not purely technical nor purely social, but socio-technical and network-based in nature.

5. Discussion

5.1. The impact of BCT and the MediLedger on supply chain trust and the effect of swift trust

Our investigation into the PSC powered by BCT focuses on how the MediLedger fosters supply chain trust within this network. We used a socio-technical system (STS) lens and developed a BCT-based hierarchical supply chain trust framework (Fig. 2), revealing that BCT attributes positively influence supply chain trust.

First, the technological trust mechanisms (trust in records and trust in platforms) increase confidence in shared data, governance, alleviating long-standing concerns among trading partners. For instance, automated smart contracts create reliability through predefined business rules, enhancing process efficiency and reducing operational costs. Second, trust in institutional governance refers to the trust that supply chain actors (e.g.: manufacturers, distributors, group purchasing organisations (GPOs), regulators) place in the formal rules, standard-setting bodies, and governance structures that enable the functioning of this pharmaceutical ecosystem. In this configuration, institutional trust is crucial because it underpins actors' willingness to rely on the system's outputs (e.g.: contract enforcement, data accuracy) without requiring full inter-personal or organisational trust. It acts as a stabilising layer, enabling actors to operate within the ecosystem with reduced need for direct inter-personal assurances, because they trust the institutional arrangements that govern interactions and exchanges. Third, beyond this predominantly technical trust, our findings highlight improvements in predominantly social trust dimensions too, particularly openness and credibility. The deployment of the MediLedger has fostered increased collaboration and data transparency, creating an environment where

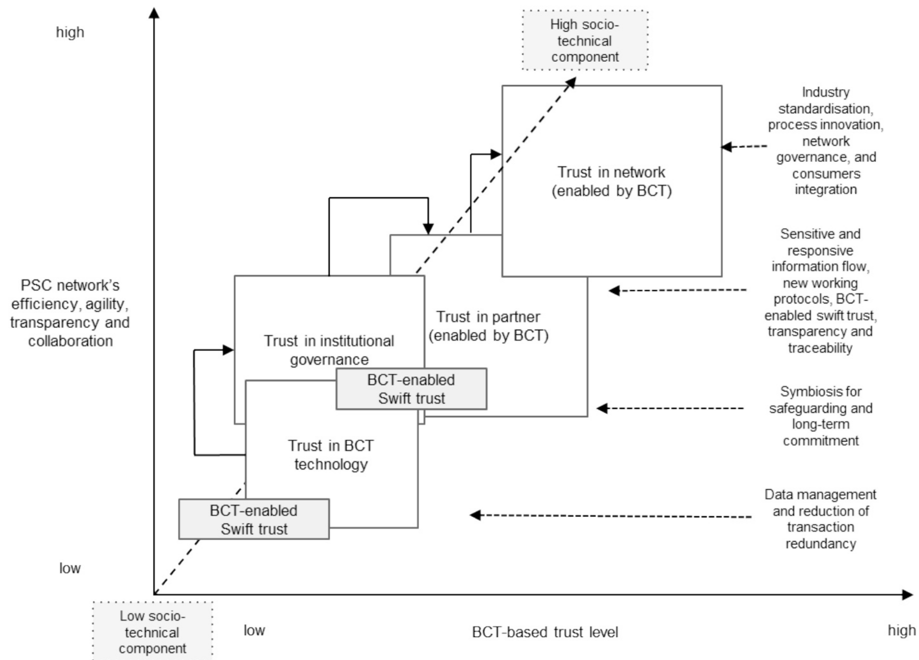

Fig. 2. BCT-based hierarchical supply chain trust framework.

partners are more willing to share and engage (Zaheer and Zaheer, 2006). This suggests a significant spillover effect, where trust in BCT technology and the associated trust in institutional governance propagate to trust in partners, even if these types of trust are not simultaneously established. Effectively managed BCT thus becomes a catalyst for supply chain trust-building, encouraging long-term commitment and new collaborative protocols. This important finding shows that 'trust in BCT technology', 'trust in institutional governance' and 'trust in partners' may not necessarily be simultaneously invested; rather well-designed and operated BCT solution and usage can be an efficient instrument to incubate 'trust in partners'. For example, we argue that the effectiveness of BCT on data and transaction management motivates supply chain partners to innovatively use the MediLedger as an industry symbiosis, which safeguards and develops long-term commitments, new working protocols, and efficient information flows. Fourth, one of the most significant findings of our study is the emergence of 'trust in network', a concept newly developed and enabled by BCT that extends beyond dyadic buyer–supplier relationships and includes a broader socio-technical component. It is operationalised through three core mechanisms: standardisation, process innovation, and governance. Standardisation, such as the adoption of common data formats and verification protocols, helps reduce ambiguity and align expectations across actors. BCT-enabled process innovation by shifting traditional exchanges to more integrated, real-time interactions, reduce frictions and enabling faster resolution. Governance mechanisms embedded in the network, such as decision rights or rule-based access control, ensure procedural fairness and accountability, thus reinforcing a network trust. These mechanisms make trust in the network a tangible and actionable construct. It becomes less dependent on individual or organisational reputation and more reliant on the transparency, consistency, and auditability afforded by the BCT infrastructure. While prior research has largely conceptualised trust at the inter-personal (between individuals), inter-organisational (between firms), and institutional levels (trust in regulations or third parties) (Zaheer et al., 1998; McEvily et al., 2003; Gefen et al., 2003), we argue that the decentralised and protocol-based nature of BCT reshapes the locus of trust. In a permissioned BCT ecosystem, we believe that actors will place trust in the integrity of the networked system as a whole, including its governance rules, consensus mechanisms, smart contracts, and shared data protocols. As such, we propose this construct as a conceptual extension of existing trust categories, responding to the structural affordances of BCT and their influence on inter-organisational dynamics.

Lastly, we found that BCT enables a swift trust mechanism that is critical within the trust hierarchy (De Giovanni, 2022) and in fostering broader trust in network. In the case of the MediLedger, BCT appears to transform traditional trust formation by materialising institutional dimensions of trust and reshape the social trust component. We observed that consensus around the credibility of new member firms enhanced the confidence of established members, enabling the formation of swift trust to manage demand variability. Importantly, this BCT-enabled swift trust is not only instrumental in short-term but also supported the emergence of long-term commitment and strategic relationships. While swift trust is often contingent and fragile, we found that the strong credibility offered by BCT can act as a mechanism for its evolution into more stable form of trust. Notably, this mechanism was strategically deployed to foster supply chain agility. BCT-enabled swift trust allows firms to respond sensitively and flexibly to market disruptions through rapid rerouting, alternative sourcing, and collaborative compliance with regulations. Traditionally, these agility responses have a high transaction costs and exposed firms to opportunistic risks. In contrast, within the BCT ecosystem, the reliability and integrity of data motivated firms to enter into trust-based relationships more confidently. As such, BCT not only reduces barriers to swift trust but also promotes its strategic use to enhance agility.

Our conceptualisation of trust redistribution can be further clarified through the notion of boundary spanning (Levina & Vaast, 2005), which refers to the processes that enable collaboration across organisational, institutional, and technological divides. In BCT-enabled ecosystems, boundary-spanning mechanisms allow actors to share information, coordinate activities, and build confidence in collective action despite differing structures, interests, and capabilities (Benitez et al., 2023). In the context of MediLedger, we interpret that technologies such as shared ledgers, consensus protocols, and smart contracts mediate interactions across firms and regulatory bodies. These artefacts embed verification, traceability, and rule enforcement directly into the network infrastructure, reducing dependence on inter-personal familiarity, historical relationships, or third-party intermediaries.

In doing so, BCT does not replace trust but reconfigures it, by embedding boundary-spanning capabilities into the socio-technical system. Trust is thus redistributed, rather than being located solely in partners, institutions, or technologies; it takes shape at the network level, supported by shared visibility, codified governance, and decentralised accountability. We theorise this as a boundary-spanning mechanism of trust reconfiguration, which explains how BCT enables emergent network-level trust, rather than merely where trust resides. This contribution extends the information systems (IS) literature by linking socio-technical trust redistribution to digital boundary-spanning and shows how BCT supports new forms of inter-organisational collaboration across previously more rigid boundaries.

Although we argue that the MediLedger enhances supply chain trust, there are noticeable issues that have been raised. For instance, scalability was a concern for several participants and is well documented in the literature (Chen et al., 2018). Moreover, the gradual ramping up of MediLedger due to a relatively slow adoption rate could potentially decrease the level of trust and other solutions could then be prioritised and developed. In contrast to the literature debate about BCT as a trust-free technology (Zhu et al., 2022), we note that our sample data do not show strong evidence that BCT 'replaces' trust or creates a trust-free environment, at least in the short run. The effectiveness of BCT lies in its automation or incentive of trust formation and development by untangling complex social factors through advanced technological interference. Moreover, it should be noted that we did not find evidence regarding the impact on benevolence. This is in line with Fawcett et al. (2017) explaining that we should be sceptical of the existence of benevolence in commercial supply chain relationships. In a fiercely competitive market, it is unlikely to assume benevolence behaviours. This adds insight to the debate on benevolence in supply chain management.

5.2. The BCT-based hierarchical supply chain trust framework

We propose the BCT-based hierarchical supply chain trust framework that links the different trust levels and orders and their impact on the PSC network's efficiency, agility, transparency and collaboration, as per Fig. 2. The conceptual model represents the associations of different levels of BCT-based trust on the X-axis (low to high), the impact on the PSC network's objectives on the Y-axis (low to high), and the socio-technical nature of trust on the Z-axis (low to high). At the foundational level, trust in BCT technology, stemming from the technological features (e.g.: cryptography and smart contracts) can substantially enhance PSC's efficiency through secure and integrated data management and the reduction of redundant transactions. Trust in institutional governance develops as supply chain partners increasingly rely on shared rules, auditability and compliance mechanism embedded in the BCT network. Together, these trust forms create the conditions for inter-firm alignment, which is an essential instrument of moving toward trust in partners. The PSC network is further improved by the trust in partners, where sensitive and responsive information flow and new working protocols supported by BCT enhance the agility, efficiency, transparency and collaboration (Motamedi et al., 2021). At this stage, BCT acts less as a replacement for relational trust and more as an enabler that supports long-term commitment, reduced opportunism, and shared monitoring capabilities. The highest order in our BCT-based supply chain trust hierarchy is trust in network, it represents a comprehensive integration of social and technological trust features.

We suggest that trust in network represents an emergent, higher-order form of trust that extends beyond traditional formulations such as inter-personal trust, institution-based trust or platform trust. While institution-based and system or platform trust rely on formal governance structures, regulatory compliance and technological reliability, trust in network reflects a more holistic confidence in the functioning of the BCT-enabled ecosystem as a self-regulating system with a high level of socio-technical component. It is not trust in a specific actor, institution, or technological artefact, but in the collective capability of the network to coordinate actions, ensure fairness, and maintain integrity across organisational boundaries. This form of trust emerges when technological assurances (immutability, traceability), institutional mechanisms (shared governance, consensus rules), and social expectations (reciprocity, non-opportunism) become interlinked and mutually reinforcing. In this sense, trust in network is qualitatively different. It is distributed rather than centralised, systemic rather than dyadic, and sustained through shared visibility and boundary-spanning mechanisms embedded in BCT infrastructures. By articulating this distinction, we move beyond adding another trust category and instead explain how BCT reconfigures trust into a network-level phenomenon that cannot be reduced to institutional or technological trust alone.

Importantly, this hierarchical model shows that BCT does not eliminate trust but restructures and redistributes it. Early adoption of MediLedger was largely driven by regulatory pressure, but our findings indicate that ongoing participation is now sustained by shared operational gains such as reduced revenue leakage, aligned contracts, and real-time visibility. As these benefits materialise, firms move from compliance-driven participation to co-created norms and emergent network-level trust.

Ultimately, our BCT-based hierarchical supply chain trust framework offers a blueprint for organisations to achieve greater efficiency, agility, transparency and collaboration, addressing long-standing issues in PSC network governance and design. As such, in trust in network, BCT reshapes trust by codifying certain functions traditionally reliant on interpersonal or institutional guarantees, while preserving the need for human coordination and negotiated norms in areas not easily programmable. This layered view of trust reinforces our argument that trust is not eliminated but restructured and redistributed within a socio-technical system.

While the literature conceptualises swift trust as fragile, temporary, and contingent upon limited prior interaction (Meyerson et al., 1996), our findings suggest that BCT does not sustain swift trust indefinitely but rather alters the dynamics of trust development over time. Specifically, BCT appears to accelerate the transition from initial swift trust toward more stable forms of trust such as structural assurance, system trust, and network-level trust. The immutable verification mechanisms, shared visibility, automated validation processes, and rule-based governance embedded in blockchain systems reduce uncertainty and opportunistic behaviour, allowing actors to move more rapidly from provisional trust to institutionalised reliance. In this sense, BCT does not eliminate the need for trust nor simply create permanent swift trust; rather, it compresses the traditional trust-building process and enables what can be described as accelerated trust evolution within inter-organisational supply chain networks.

This suggests that blockchain functions not only as a technical infrastructure but also as a socio-technical mechanism that accelerates trust formation and stabilisation across organisational boundaries.

6. Conclusion

6.1. Contributions and practical implications

This study examined the MediLedger network to understand how BCT can transform the principles and mechanisms of trust formation and development within the PSC network. Our analysis showed that the integration of BCT introduced new dynamics of collaboration and integration amongst the actors, addressing growing complexities of supply chain operations. We developed a BCT-based hierarchical supply chain trust model comprising four levels of trust: trust in technology, trust in institutional governance, trust in partners, and trust in network. These trust orders are operationalised through a newly identified mechanism, BCT-enabled swift trust, which helps explain how initial confidence can accelerate the transition toward more stable inter-organisational trust relationships. We contribute to the discourse on BCT-mediated supply chain trust by offering empirical evidence of how, within the

MediLedger network, trust is redistributed and reconfigured across the social and technical boundaries. Our findings demonstrate that BCT-based trust in technology enables accurate analysis and planning, which in turn enhances trust in institutional governance and then trust in partners. This recursive relationship between trusts fosters collaboration and joint decision-making, leading to significant advancements in supply chain design, planning, and operations, such as industry standardisation and compliance with regulatory requirements. While BCT's role in establishing technological and institutional trust is critical, extending trust to partners is essential for overcoming long-standing relational supply chain challenges. Our findings suggest that achieving further improvements in efficiency and effectiveness require a higher order level of trust, trust in network, which is developed from innovative BCT applications that support shared visibility, decentralised verification and collective accountability.

Overall, our research provides evidence of a meaningful evolution and redistribution of trust mediated by BCT, demonstrated through the emergence of BCT-enabled swift trust and the development of network-level trust. Together, these forms of trust illustrate how BCT spans and integrates social and technical boundaries within the supply network, enabling the PSC to enhance openness, credibility, commitment, and cooperation among stakeholders. This enhanced trust contributes directly to improvements in efficiency, agility, transparency, and collaboration across the network.

The study contributes theoretically by offering a nuanced and empirically grounded account of how BCT reshapes and redistributes trust within supply chains. By situating our analysis within the PSC, a highly regulated and complex context, we provide insights into how private, permissioned blockchain solutions can facilitate trust through decentralised data sharing, automated consensus, and embedded governance mechanisms. Moreover, by theorising the socio-technical mechanisms underpinning BCT-enabled trust, including dimensions such as trust in technology, institutional governance, partners, and network, this study advances a foundation for future research aimed at refining and validating trust configurations in diverse supply chain environments.

We believe these findings carry important implications for cross-disciplinary research in IS and SCM. Our socio-technical framing bridges the two domains by offering a unified perspective on how trust forms, evolves, and is redistributed in BCT-enabled networks. By demonstrating how BCT reconfigures trust across organisational, institutional, and technological boundaries, we highlight a shared research space in which IS and SCM scholars can jointly examine the mechanisms underpinning trust development. This cross-boundary framing opens a promising avenue for future inter-disciplinary work on technology-mediated supply chain trust and network design.

Practically, the study offers a strategic framework for supply chain executives, policymakers, and technologists. We identify key features through which BCT can support trust-building efforts in response to growing regulatory pressures, such as requirements for product traceability, authenticity, secure data sharing and collaboration. While our findings are rooted in the pharmaceutical sector, the conceptual framework developed here can inform trust-building strategies in other industries facing similar demands for resilience, compliance, and inter-organisational coordination.

6.2. *Limitations and future research directions*

This study presents some limitations that offer valuable avenues for future research. First, the generalisability of our findings beyond the PSC requires careful consideration. While the study provides rich, context-specific insights into the dynamics of trust and BCT, it is based on a single case, the MediLedger, within a highly regulated and technologically mature industry. The pharmaceutical sector's distinctive characteristics, including regulatory stringency, product criticality, and sensitivity to data integrity, may shape trust mechanisms differently. Consequently, our findings may not apply to supply chains with different stakeholder configurations, risk profiles, or institutional logics. Future research could explore whether and how the socio-technical trust dynamics identified here manifest in other sectors with varying levels of complexity, digital maturity, and governance arrangements.

Second, this is a qualitative study based on a relatively small number of expert interviews, which limits the breadth of empirical generalisation. Nonetheless, the depth offered by this approach enabled a detailed, context-rich examination of trust in a BCT-enabled environment. The proposed trust hierarchy, while grounded in empirical insight, remains exploratory and provisional. Future research should seek to validate and refine this hierarchy through larger-scale studies, possibly using mixed methods or quantitative approaches. Such work could test the robustness of the identified trust dimensions across industries, blockchain platforms, and regulatory contexts, thereby advancing a more generalisable understanding of BCT-enabled trust.

Third, a longitudinal research design would be valuable for assessing the evolving role of BCT in shaping and redistributing trust over time. As technologies such as AI, and IoT become more integrated into blockchain solutions, new trust dynamics are likely to emerge. Longitudinal studies could capture how trust develops, stabilises, or transforms in response to these shifts, providing a more comprehensive understanding of the sustained impact of BCT in the PSC.

Finally, while this study primarily focuses on B2B trust dynamics among manufacturers, distributors, and GPOs, we acknowledge the potential for "trust in network" to extend to end-users such as pharmacists, healthcare providers, and patients. Although their integration with the platform is currently limited, the foundational trust established among core actors may eventually support broader public-facing applications. Future research could explore how BCT-enabled trust mechanisms might trickle down to these stakeholders and assess the societal impact on issues such as medication authenticity and patient confidence.

CRediT authorship contribution statement

Benjamin Dehe: Writing – review & editing, Writing – original draft, Validation, Supervision, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Jason X. Wang:** Writing – review & editing, Writing – original draft, Validation, Methodology, Investigation, Formal analysis, Data curation. **Samuel Heath:** Writing – original draft, Formal analysis, Data curation, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgements

The authors would like to acknowledge all the participants for their time and insight into the MediLedger network and sincerely thank the reviewers for their thoughtful, constructive, and thorough feedback, which has significantly strengthened the clarity, depth, and rigour of our manuscript.

Data availability

The data that has been used is confidential.

References

Ahmed, W. A., MacCarthy, B. L., & Treiblmaier, H. (2022). Why, where and how are organizations using blockchain in their supply chains? Motivations, application areas and contingency factors. *International Journal of Operations & Production Management, 42*(12), 1995–2028. https://doi.org/10.1108/IJOPM-12-2021-0805

Alkalha, Z., Dehe, B., & Reid, I. (2025b). How absorptive capacity mediates supply chain effectiveness: A quality integration approach to boosting operational performance. *Operations Management Research, 18*(3), 870–890. https://doi.org/10.1007/s12063-025-00559-8

Alkalha, Z., Dehe, B., Reid, I., & Al-Zu'bi, Z. B. M. (2025a). Investigating the mediating impact of supplier quality integration in pharmaceutical supply chains. *International Journal of Quality & Reliability Management, 42*(6), 1596–1624. https://doi.org/10.1108/IJQRM-04-2023-0135

Anand, G., Ball, G. P., Gray, J. V., & Mukherjee, U. K. (2025). Operations management in the pharmaceutical industry. *Journal of Operations Management, 71*(3), 302–313. https://doi.org/10.1002/joom.1365

Andersen, P. H., & Kragh, H. (2010). Sense and sensibility: Two approaches for using existing theory in theory-building qualitative research. *Industrial marketing management, 39*(1), 49–55. https://doi.org/10.1016/j.indmarman.2009.02.008

Awasthy, P., Gopakumar, K. V., Gouda, S. K., & Haldar, T. (2019). Trust in humanitarian operations: A content analytic approach for an Indian NGO. *International Journal of Production Research, 57*(9), 2626–2641. https://doi.org/10.1080/00207543.2019.1566652

Baharmand, H., Maghsoudi, A., & Coppi, G. (2021). Exploring the application of blockchain to humanitarian supply chains: Insights from Humanitarian Supply Blockchain pilot project. *International Journal of Operations & Production Management, 41*(9), 1522–1543. https://doi.org/10.1108/IJOPM-12-2020-0884

Bai, C., & Sarkis, J. (2020). A supply chain transparency and sustainability technology appraisal model for blockchain technology. *International Journal of Production Research, 58*(7), 2142–2162. https://doi.org/10.1080/00207543.2019.1708989

Batwa, A., & Norrman, A. (2021). Blockchain technology and trust in supply chain management: A literature review and research agenda. *Operations and Supply Chain Management, 14*(2), 203–220.

Batwa, A., Norrman, A., & Arvidsson, A. (2021). How Blockchain interrelates with trust in the supply chain context: Insights from tracing sustainability in the metal industry. In *Adapting to the Future: How Digitalization Shapes Sustainable Logistics and Resilient Supply Chain Management. Proceedings of the Hamburg International Conference of Logistics (HICL), Vol. 31* (pp. 329-351). Berlin: epubli GmbH.

Baxter, G., & Sommerville, I. (2011). Socio-technical systems: From design methods to systems engineering. *Interacting with Computers., 23*(1), 4–17. https://doi.org/10.1016/j.intcom.2010.07.003

Beck, R., Czepluch, J., Lollike, N. and Malone, S. (2016). 'Blockchain - The Gateway to Trust-Free Cryptographic Transactions', *Proceeding of the 24th European Conference on Information Systems (ECIS)*. Istanbul, Turkey. 12th-15th June 2016. AIS eLibrary, pp. 1-14. Available at: file:///Users/samiheath/Downloads/ECIS_Format_Blockchain_paper160330.pdf (Accessed: 1 August 2021).

Beck, R., Müller-Bloch, C., & King, J. L. (2018). Governance in the blockchain economy: A framework and research agenda. *Journal of the Association for Information Systems, 19*(10), 1.

Benbasat, I., Gefen, D., & Pavlou, P. A. (2008). Trust in online environments. *Journal of Management Information Systems, 24*(4), 5–11. https://doi.org/10.2753/MIS0742-1222240400

Bendoly, E., & Oliva, R. (2025). Meaningful theoretical pathways for research contributions. *Journal of Operations Management, 71*(1), 4–10. https://doi.org/10.1002/joom.1348

Benitez, G. B., Ghezzi, A., & Frank, A. G. (2023). When technologies become Industry 4.0 platforms: Defining the role of digital technologies through a boundary-spanning perspective. *International Journal of Production Economics, 260*, Article 108858. https://doi.org/10.1016/j.ijpe.2023.108858

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology., 3*, 77–101.

Casino, F., Kanakaris, V., Dasaklis, T. K., Moschuris, S., Stachtiaris, S., Pagoni, M., & Rachaniotis, N. P. (2021). Blockchain-based food supply chain traceability: A case study in the dairy sector. *International Journal of Production Research, 59*(19), 5758–5770. https://doi.org/10.1080/00207543.2020.1789238

Cao, Y., & Shen, B. (2022). Adopting blockchain technology to block less sustainable products' entry in global trade. *Transportation Research Part E: Logistics and Transportation Review, 161*, Article 102695. https://doi.org/10.1016/j.tre.2022.102695

CDC. (2022). Understanding Drug Overdoses and Deaths | Drug Overdose | CDC Injury Center. Centers for Disease Control and Prevention. https://www.cdc.gov/drugoverdose/epidemic/index.html.

Chang, Y., Iakovou, E., & Shi, W. (2020). Blockchain in global supply chains and cross border trade: A critical synthesis of the state-of-the-art, challenges and opportunities. *International Journal of Production Research, 58*(7), 2082–2099. https://doi.org/10.1080/00207543.2019.1651946

Chen, P., Zhiqiang, L., Zhen, L., & Yu, L. (2018). Research on scalability of blockchain technology: Problems and methods. *Journal of Computer Research and Development, 55*(10), 20–50.

Choi, T.-M., Wen, X., Sun, X., & Chung, S.-H. (2019). The mean-variance approach for global supply chain risk analysis with air logistics in the blockchain technology era. *Transportation Research Part E: Logistics and Transportation Review, 127*, 178–191. https://doi.org/10.1016/j.tre.2019.05.007

Collomb, A., & Sok, K. (2016). Blockchain/Distributed ledger technology (DLT): What impact on the financial sector? *Communications and Strategies, 103*(103), 93–111.

Crabtree, B., & Miller, W. (1999). Using codes and code manuals: A template for organizing style of interpretation. In B. Crabtree, & W. Miller (Eds.), *Doing qualitative research* (pp. 163–178). Newbury Park, CA: Sage.

Danese, P., Mocellin, R., & Romano, P. (2021). Designing blockchain systems to prevent counterfeiting in wine supply chains: A multiple-case study. *International Journal of Operations & Production Management, 41*(13), 1–33. https://doi.org/10.1108/IJOPM-12-2019-0781

De Giovanni, P. (2022). Leveraging the circular economy with a closed-loop supply chain and a reverse omnichannel using blockchain technology and incentives. *International Journal of Operations & Production Management, 42*(7), 959–994. https://doi.org/10.1108/IJOPM-07-2021-0445

Dehe, B., Bamford, D., & Kotcharin, S. (2024). Bespoke benchmarking framework employed as vehicle and platform for open innovation–a healthcare infrastructure case. *Production Planning & Control, 35*(7), 725–743. https://doi.org/10.1080/09537287.2022.2126952

Dehe, B., Subasinghage, M., & Mirzaei, M. (2026). Orchestrating resources for big data analytics implementation in manufacturing SMEs: Insights into managerial role and engagement. *Production Planning & Control, 37*(6), 521–553. https://doi.org/10.1080/09537287.2025.2561966

Dehghani, M., Kennedy, R. W., Mashatan, A., Rese, A., & Karavidas, D. (2022). High interest, low adoption. a mixed-method investigation into the factors influencing organisational adoption of blockchain technology. *Journal of Business Research, 149*, 393–411. https://doi.org/10.1016/j.jbusres.2022.05.015

Denzin, N., & Lincoln, Y. (2011). Introduction: The discipline and practice of qualitative research. In N. Denzin, & Y. Lincoln (Eds.), *The sage handbook of qualitative research* (4th ed., pp. 1–19). London: Sage.

Dwivedi, Y. K., Balakrishnan, J., Das, R., & Dutot, V. (2023). Resistance to innovation: A dynamic capability model based enquiry into retailers' resistance to blockchain adaptation. *Journal of Business Research, 157*, Article 113632.

Fawcett, S., Jin, H., Fawcett, A., & Magnan, G. (2017). I know it when I see it: The nature of trust, trustworthiness signals, and strategic trust construction. *The International Journal of Logistics Management., 28*(4), 914–938. https://doi.org/10.1108/IJLM-11-2016-0268

Food and Drug Administration. (2021). *Drug Supply Chain Security Act (DSCSA)*. Available at: https://www.fda.gov/drugs/drug-supply-chain-integrity/drug-supply-chain-security-act-dscsa (Accessed: 23 August 2021).

Gefen, D., Karahanna, E., & Straub, D. W. (2003). Trust and TAM in online shopping: An integrated model. *MIS quarterly, 27*(1), 51–90. https://doi.org/10.2307/30036519

Gligor, D. M., Pillai, K. G., & Golgeci, I. (2021). Theorizing the dark side of business-to-business relationships in the era of AI, big data, and blockchain. *Journal of Business Research, 133*, 79–88. https://doi.org/10.1016/j.jbusres.2021.04.043

Griffith, T. L., & Dougherty, D. J. (2001). Beyond socio-technical systems: Introduction to the special issue. *Journal of Engineering and Technology Management, 18*(3–4), 207–218. https://doi.org/10.1016/S0923-4748(01)00034-0

Griffiths, A., & Zammuto, R. F. (2005). Institutional governance systems and variations in national competitive advantage: An integrative framework. *Academy of Management Review, 30*(4), 823–842. https://doi.org/10.5465/amr.2005.18378880

Harrison, H., Birks, M., Franklin, R., & Mills, J. (2017). Case study research: Foundations and methodological orientations. In *Forum Qualitative Sozialforschung* (Vol. 18, pp. 1-17). Freie Universitaet Berlin.

Heim, G. R., & Peng, X. (2022). Introduction to the special issue on "Technology management in a global context: From enterprise systems to technology disrupting operations and supply chains". *Journal of Operations Management, 68*(6–7), 536–559. https://doi.org/10.1002/joom.1216

Hou, Y., Wang, X., Wu, Y. J., & He, P. (2018). How does the trust affect the topology of supply chain network and its resilience? an agent-based approach. *Transportation Research Part E: Logistics and Transportation Review, 116*, 229–241. https://doi.org/10.1016/j.tre.2018.07.001

Hu, Q., & Schwarz, L. B. (2011). Controversial role of GPOs in healthcare-product supply chains. *Production and Operations Management, 20*(1), 1–15. https://doi.org/10.1111/j.1937-5956.2010.01121.x

Hyett, N., Kenny, A., & Dickson-Swift, V. (2014). Methodology or method? a critical review of qualitative case study reports. *International journal of qualitative studies on health and well-being, 9*(1), 23606. https://doi.org/10.3402/qhw.v9.23606

Ireland, R. D., & Webb, J. W. (2007). A multi-theoretic perspective on trust and power in strategic supply chains. *Journal of Operations management, 25*(2), 482–497. https://doi.org/10.1016/j.jom.2006.05.004

Jabbar, A., & Dani, S. (2020). Investigating the link between transaction and computational costs in a blockchain environment. *International Journal of Production Research, 58*(11), 3423–3436. https://doi.org/10.1080/00207543.2020.1754487

Jain, G., Kamble, S. S., Ndubisi, N. O., Shrivastava, A., Belhadi, A., & Venkatesh, M. (2022). Antecedents of Blockchain-Enabled E-commerce Platforms (BEEP) adoption by customers–A study of second-hand small and medium apparel retailers. *Journal of Business Research, 149*, 576–588. https://doi.org/10.1016/j.jbusres.2022.05.041

Jarvenpaa, S. L., & Leidner, D. E. (1999). Communication and Trust in Global Virtual Teams. *Organization Science, 10*(6), 791–815. https://doi.org/10.1287/orsc.10.6.791

King, N. (2004). Using Templates in the Thematic Analysis of Text. In C. Cassell, & G. Symon (Eds.), *Essential guid to qualitative methods in organisational research* (pp. 256–270). London: Sage.

Klöckner, M., Schmidt, C. G., Fink, A., Flückiger, L., & Wagner, S. M. (2023). Exploring the physical–digital interface in blockchain applications: Insights from the luxury watch industry. *Transportation Research Part E: Logistics and Transportation Review, 179*, Article 103300. https://doi.org/10.1016/j.tre.2023.103300

Kotcharin, S., Dehe, B., & Boonchoo, P. (2024). 'All you need is trust': Examining trust, information sharing, and supplier performance perception in SMEs from a social exchange perspective. *Cogent Business & Management, 11*(1), Article 2415523. https://doi.org/10.1080/23311975.2024.2415523

Kwon, I. W. G., & Suh, T. (2004). Factors affecting the level of trust and commitment in supply chain relationships. *Journal of Supply Chain Management, 40*(1), 4–14. https://doi.org/10.1111/j.1745-493X.2004.tb00165.x

Levina, N., & Vaast, E. (2005). The emergence of boundary spanning competence in practice: Implications for implementation and use of information systems. *MIS Quarterly, 335–363*. https://doi.org/10.2307/25148682

Lustig, C. and Nardi, B. (2015). Algorithmic authority: The case of Bitcoin. *Proceeding of the 48th Hawaii International Conference on System Sciences (HICSS)*, Hawaii. 5th- 8th January 2015. IEEE, 743-752. Available at: https://ieeexplore.ieee.org/document/7069744 (Accessed: 26 July 2021).

Malterud, K., Siersma, V. D., & Guassora, A. D. (2016). Sample size in qualitative interview studies: Guided by information power. *Qualitative Health Research, 26*(13), 1753–1760.

Martinez, V., Zhao, M., Blujdea, C., Han, X., Neely, A., & Albores, P. (2019). Blockchain-driven customer order management. *International Journal of Operations & Production Management, 39*(6/7/8), 993–1022. https://doi.org/10.1108/IJOPM-01-2019-0100

Mathivathanan, D., Mathiyazhagan, K., Rana, N. P., Khorana, S., & Dwivedi, Y. K. (2021). Barriers to the adoption of blockchain technology in business supply chains: A total interpretive structural modelling (TISM) approach. *International Journal of Production Research, 59*(11), 3338–3359. https://doi.org/10.1080/00207543.2020.1868597

McEvily, B., Perrone, V., & Zaheer, A. (2003). Introduction to the special issue on trust in an organizational context. *Organization Science, 14*(1), 1–4. https://doi.org/10.1287/orsc.14.1.1.12812

McEvily, B., Zaheer, A., & Kamal, D. K. F. (2017). Mutual and exclusive: Dyadic sources of trust in interorganizational exchange. *Organization Science, 28*(1), 74–92. https://doi.org/10.1287/orsc.2016.1102

McKnight, D. H., Choudhury, V., & Kacmar, C. (2002). Developing and Validating Trust measures for e-Commerce: An Integrative Typology. *Information Systems Research, 13* (3), 334–359. https://doi.org/10.1287/isre.13.3.334.81

MediLedger. (2018). *MediLedger 2018 Progress Report*. Available at: https://assets.chronicled.com/hubfs/2018%20MediLedger%20Progress%20Report.pdf (Accessed: 2 August 2022).

Meyerson, D., Weick, K. E., & Kramer, R. M. (1996). Swift trust and temporary groups. *Trust in Organizations: Frontiers of theory and Research, 166*(195), 1–18.

Minshull, L. K., Dehe, B., & Kotcharin, S. (2022). Exploring the impact of a sequential lean implementation within a micro-firm–a socio-technical perspective. *Journal of Business Research, 151*, 156–169. https://doi.org/10.1016/j.jbusres.2022.06.052

Mirzaei, M., Dehe, B., Weerasinghe, K., & Srivastava, H. (2025). Enhancing supply chain visibility in the fishing industry: The role of emerging technologies and their affordances. *Operations and Supply Chain Management, 18*(2), 146–160.

Motamedi, M., Darvish Motevalli, M. H., & Norouzzadeh, A. (2021). The impact of dynamic supply chain on the performance of pharmaceutical companies. *Journal of Operations Management, 1*(2), 95–119.

Nollet, J., & Beaulieu, M. (2005). Should an organisation join a purchasing group? *Supply Chain Management: An International Journal, 10*(1), 11–17. https://doi.org/10.1108/13598540510578333

Nowell, L., Norris, J., White, D., & Moules, N. (2017). Thematic analysis: Striving to meet the trustworthiness criteria. *International Journal of Qualitative Methods, 16*(1), 1–13. https://doi.org/10.1177/1609406917733847

Olaniyan, O., Dehe, B., Bamford, D., & Ward, S. (2024). Enhancing on-pitch learning capabilities with data analytics and technologies in elite sports. *European Sport Management Quarterly, 24*(6), 1195–1214. https://doi.org/10.1080/16184742.2023.2270565

Papalexi, M., Vafadarnikjoo, A., Bamford, D., & Dehe, B. (2026). Developing pharmaceutical supply chain resilient capabilities: The role of Industry 4.0 technologies. *Supply Chain Management: An International Journal, 31*(7), 1–20. https://doi.org/10.1108/SCM-03-2025-0180

Patton, M. (2002). *Qualitative research and evaluation methods* (3rd ed.). Thousand Oak, CA: Sage.

Pelt, R. V., Jansen, S., Baars, D., & Overbeek, S. (2021). Defining blockchain governance: A framework for analysis and comparison. *Information Systems Management, 38*(1), 21–41. https://doi.org/10.1080/10580530.2020.1720046

Reijers, W., & Coeckelbergh, M. (2018). The blockchain as a narrative technology: Investigating the social ontology and normative configurations of cryptocurrencies. *Philosophy & Technology, 31*(1), 103–130. https://doi.org/10.1007/s13347-016-0239-x

Ruesch, L., Tarakci, M., Besiou, M., & Van Quaquebeke, N. (2022). Orchestrating coordination among humanitarian organizations. *Production and Operations Management, 31*(5), 1977–1996. https://doi.org/10.1111/poms.13660

Saunders, M., Lewis, P., & Thornhill, A. (2016). *Research methods for business students* (7th ed.). Harlow, Essex: Pearson.

Schotanus, F., Telgen, J., & de Boer, L. (2010). Critical success factors for managing purchasing groups. *Journal of Purchasing and Supply Management, 16*(1), 51–60. https://doi.org/10.1016/j.pursup.2009.10.002

Schwandt, T. A., & Gates, E. F. (2018). Case study methodology. *The SAGE handbook of qualitative research, 5*, 600-630.

Schiffling, S., Hannibal, C., Fan, Y., & Tickle, M. (2020). Coopetition in temporary contexts: Examining swift trust and swift distrust in humanitarian operations. *International Journal of Operations & Production Management, 40*(9), 1449–1473. https://doi.org/10.1108/IJOPM-12-2019-0800

Tan, T. M., Salo, J., Alejandro, T. G. B., Tan, G. W. H., Ooi, K. B., & Dwivedi, Y. K. (2024). Guest editorial: A blockchain-based approach to marketing in the sharing economy. *Journal of Business Research, 177*, Article 114639. https://doi.org/10.1016/j.jbusres.2024.114639

Tandon, A., Dhir, A., Islam, A. N., & Mäntymäki, M. (2020). Blockchain in healthcare: A systematic literature review, synthesizing framework and future research agenda. *Computers in Industry, 122*, Article 103290.

Tatham, P., & Kovács, G. (2010). The application of "swift trust" to humanitarian logistics. *International Journal of Production Economics, 126*(1), 35–45. https://doi.org/10.1016/j.ijpe.2009.10.006

Tejpal, G., Garg, R. K., & Sachdeva, A. (2013). Trust among supply chain partners: A review. *Measuring Business Excellence, 17*(1), 51–71. https://doi.org/10.1108/13683041311311365

Tobin, G. A., & Begley, C. M. (2004). Methodological rigour within a qualitative framework. *Journal of Advanced Nursing, 48*(4), 388–396. https://doi.org/10.1111/j.1365-2648.2004.03207.x

Van Hoek, R. (2019). Exploring blockchain implementation in the supply chain: Learning from pioneers and RFID research. *International Journal of Operations & Production Management, 39*(6–7-8), 829–859. https://doi.org/10.1108/IJOPM-01-2019-0022

Van Hulst, M., & Visser, E. L. (2025). Abductive analysis in qualitative research. *Public Administration Review, 85*(2), 567–580. https://doi.org/10.1111/puar.13856

Vila-Henninger, L., Dupuy, C., Van Ingelgom, V., Caprioli, M., Teuber, F., Pennetreau, D., & Le Gall, C. (2024). Abductive coding: Theory building and qualitative (re) analysis. *Sociological Methods & Research, 53*(2), 968–1001. https://doi.org/10.1177/004912412110675

Wang, S., Ouyang, L., Yuan, Y., Ni, X., Han, X., & Wang, F. Y. (2019). Blockchain-enabled smart contracts: Architecture, applications, and future trends. *IEEE Transactions on Systems, Man, and Cybernetics: Systems, 49*(11), 2266–2277. https://doi.org/10.1109/TSMC.2019.2895123

Wang, Y., Chen, C. H., & Zghari-Sales, A. (2021). Designing a blockchain enabled supply chain. *International Journal of Production Research, 59*(5), 1450–1475. https://doi.org/10.1080/00207543.2020.1824086

Weisz, E., Herold, D. M., Ostern, N. K., Payne, R., & Kummer, S. (2024). Artificial intelligence (AI) for supply chain collaboration: Implications on information sharing and trust. *Online Information Review, 49*(1), 164–181. https://doi.org/10.1108/OIR-02-2024-0083

Werbach, K. (2018). Trust, but verify: Why the blockchain needs the law. *Berkeley Technology Law Journal, 33*(2), 487–550.

Wong, L. W., Tan, G. W. H., Lee, V. H., Ooi, K. B., & Sohal, A. (2020). Unearthing the determinants of Blockchain adoption in supply chain management. *International Journal of Production Research, 58*(7), 2100–2123. https://doi.org/10.1080/00207543.2020.1730463

Xiong, Y., Lam, H. K., Kumar, A., Ngai, E. W., Xiu, C., & Wang, X. (2021). The mitigating role of blockchain-enabled supply chains during the COVID-19 pandemic. *International Journal of Operations & Production Management, 41*(9), 1495–1521. https://doi.org/10.1108/IJOPM-12-2020-0901

Yaroson, E. V., Breen, L., Hou, J., & Sowter, J. (2021). Advancing the understanding of pharmaceutical supply chain resilience using complex adaptive system (CAS) theory. *Supply Chain Management: An International Journal, 26*(3), 323–340. https://doi.org/10.1108/SCM-05-2019-0184

Yavaprabhas, K., Pournader, M., & Seuring, S. (2023). Blockchain as the "trust-building machine" for supply chain management. *Annals of Operations Research, 327*(1), 49–88.

Yin, R. K. (2012). *Applications of case study research* (3rd ed.). Thousand Oaks; London: Sage Publications.

Yuan, Y., & Wang, F. Y. (2016, November). Towards blockchain-based intelligent transportation systems. In *2016 IEEE 19th international conference on intelligent transportation systems (ITSC)* (2663-2668). IEEE.

Zaheer, A., McEvily, B., & Perrone, V. (1998). Does trust matter? Exploring the effects of interorganizational and interpersonal trust on performance. *Organization Science, 9* (2), 141–159. https://doi.org/10.1287/orsc.9.2.141

Zaheer, S., & Zaheer, A. (2006). Trust across borders. *Journal of International Business Studies, 37*, 21–29.

Zhao, X., Ai, P., Lai, F., Luo, X., & Benitez, J. (2022). Task management in decentralized autonomous organization. *Journal of Operations Management, 68*(6–7), 649–674. https://doi.org/10.1002/joom.1179

Zhu, Q., Bai, C., & Sarkis, J. (2022). Blockchain technology and supply chains: The paradox of the atheoretical research discourse. *Transportation Research Part E: Logistics and Transportation Review, 164*, Article 102824. https://doi.org/10.1016/j.tre.2022.102824

Dr Benjamin Dehe is an Associate Professor of Supply Chain Management at Auckland University of Technology (AUT). His research focuses on operational excellence, supply chain innovation, and the exploration of digital transformation and Industry 4.0 technologies, with a particular emphasis on decision-making processes. Benjamin's work has been published in leading national and international journals, including *International Journal of Operations and Production Management*, *Expert Systems with Applications*, *Production Planning and Control*, and *Journal of Business Research*.

Dr Jason X. Wang is a Lecturer of Sustainable Supply Chain Management at Sheffield University Management School. Previously, he worked at University of Huddersfield as MBA programme leader and Senior Lecturer of Operations and Supply Chain Management. Focusing on sustainable/circular supply chain management applied with carbon neutrality and blockchain, Jason's work has been published in leading international journals, including the *International Journal of Operations and Production Management, Transportation Research Part E: Logistics and Transportation Review, and International Journal of Production Economics*.

Samuel Heath is a Procurement and Contracts Specialist at EDF (UK) with expertise in technology, sustainability and supply chain management. He is passionate about leveraging technology to drive sustainable solutions. His key interests lie in blockchain and other emerging technologies, exploring their transformative potential in supply chains and beyond. Samuel combines analytical skills with strategic insight to support organisations in achieving their goals.