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The Role of Blockchain Technology Adoption for Sustainable Supply Chain Performance: The Mediating Role of Stakeholders' Trust

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Abstract

Blockchain is a promising new technology utilized in various supply chains. It enables decentralization and secure, tamper-proof records within the supply chain system while enhancing transparency and trust. The manufacturing industry in Saudi Arabia has been compelled to adopt digital technology to mitigate security threats across all logistics aspects, particularly in light of the economic diversification aligned with the vision of 2030. However, scholars have not thoroughly investigated the issue of trust among supply chain members in relation to enhancing supply chain performance in Saudi Arabia using Blockchain Technology (BCT). Anchoring on the Resource-Based View (RBV) theory, this quantitative study investigates the effect of BCT adoption on sustainable supply chain performance and examines how trust mediates this relationship. Primary data were gathered via a questionnaire from 200 manufacturing firms in Saudi Arabia. For data analysis, the Structural equation modelling-partial least squares (SEM-PLS) approach was employed using SmartPLS software. The findings revealed that BCT adoption significantly and directly affects both stakeholders' trust and sustainable supply chain performance. Additionally, stakeholders' trust contributes to enhancing sustainable supply chain performance and mediates the relationship between BCT adoption and sustainable supply chain performance. The study offers guidance for future research in supply chain management. The findings provide

valuable insights into the manufacturing sector, emphasizing the importance of implementing BCT to foster trust, which can enhance supply chain performance.
Keywords: Blockchain Technology, Sustainable Supply Chain Performance, Stakeholders' Trust, Manufacturing Industry, Saudi Arabia

Introduction

The adoption of innovative technologies plays a crucial role in supporting organizations' sustainable development. By integrating advanced technologies, organizations can significantly enhance their supply chain performance. This comprehensive strategy for sustainability, backed by advanced technologies, ultimately helps achieve a competitive edge (Sarfraz et al., 2023). In fact, the COVID-19 pandemic triggered most businesses to enhance their organizational performance through innovative and advanced technology adoption. Furthermore, the revolution of Industry 4.0 technologies has facilitated the efficient digitalization of supply chains (AlKubaisy and Al-Somali, 2023). However, it has driven an increased demand for supply chain transparency and efficiency throughout the entire supply chain system (Melendez et al., 2024). Additionally, the modern and new supply chain system is characterized by globalization and complexity, which requires coordinating geographically dispersed partners with complete transparency (Centobelli et al., 2021).

Traditional supply chain systems often lack effective and timely connections between partners, resulting in poor performance (Melendez et al., 2024). They have faced various challenges and disruptions during and after the COVID-19 pandemic, such as decreased visibility within the supply chain network, uncertainty about demand and supply, and limited supplier capacity (Bai et al., 2022). Moreover, traditional centralized supply chain management faces significant challenges, including limited visibility and transparency due to its centralized nature. Additionally, the centralized database means that many documents and stakeholder details are only accessible to specifically authorized members (Černý et al., 2021), which, according to Kumar et al. (2020), can be viewed as a problem with the traditional system. In particular, the supply chain sector within Saudi Arabia must make major adjustments to its business practices and adopt cutting-edge technologies to build a more sophisticated and responsive supply chain system. This also requires stronger digital security measures to defend against threats across all areas of manufacturing and logistics (AlKubaisy and Al-Somali, 2023).

Most supply chain processes have been transitioning from traditional physical methods to fully automated systems by adopting advanced technologies to promote sustainable supply chain practices (Bai et al., 2022). This shift enables real-time inventory tracking, reduces uncertainty, and improves visibility and transparency (Pattanayak et al., 2024). Transforming supply chain systems involves adopting innovative technologies, such as Blockchain technology (BCT). Indeed, it is one of the most popular and promising strategic technologies capable of enabling successful digital supply chain transformation, allowing organizations to gain a competitive advantage (Hald and Kinra, 2019; Sarfraz et al., 2023). BCT serves as a decentralized, peer-to-peer database that enhances organizational transparency by changing data exchange practices (Ronaghi and Mosakhani, 2021). It can efficiently record all transactions in an immutable, secure, and shared ledger that prevents modification of the entered data (Bai et al., 2022). Further, the smart contract of the BCT allows for fewer human errors, supports the exchange of information between stakeholders, and provides complete

transparency of all supply chain activities and transactions as long as they are recorded (Nayal et al., 2021; Yousefi and Mohamadpour Tosarkani, 2022). Thus, the BCT, due to its distinctive features, is crucial for organizations to overcome challenges concerning trust and information quality (Taherdoost, 2022).

Besides, trust is considered a crucial element in the success of supply chain relationships and operational efficiency (Qian and Papadonikolaki, 2020; Rajah, 2019). In fact, since the early stages, the issue of trust within the supply chain has been regarded as a significant concern (Pryke, 2009). Notably, when trust is lacking, supply chain parties are less likely to collaborate for the sake of supply chain operations (Capaldo and Giannoccaro, 2015). The issue arises because traditional trust management faces several limitations that hinder operational efficiency. Typically, trust in the traditional supply chain system does not provide a secure platform for exchanging information, which can lead to data manipulation and misuse (Shala et al., 2020). Furthermore, it is noticeable that even the global supply chain system struggles with inefficient transactions that have resulted in weak trust (Behl et al., 2022).

Numerous academic scholars have thoroughly examined the effect of BCT adoption on supply chain management performance. For instance, Yousefi and Mohamadpour Tosarkani (2022) found that BCT is an enabler to enhance environmental sustainability, traceability, and transparency in the supply chain operations. Likewise, Dehshiri and Amiri (2024) demonstrate that BCT applications can improve social, economic, and environmental aspects of supply chain sustainability, while their capabilities can address security issues in the supply chain. Besides, the contribution of BCT to enhancing trust within the supply chain has been widely investigated by other scholars in the field. Alkhudary and Féniès (2022) suggested that BCT serves as a solution to address trust issues by verifying that the shared information aligns with the actual physical flow.

Despite the focus on BCT adoption and supply chain performance, there remains a demand for further studies exploring the BCT in the broader supply chain context (Behl et al., 2022). Wamba (2019) and Ali et al. (2023) investigated the contribution of BCT applications to trust. Ronaghi and Mosakhani (2021) and Yadav et al. (2023) examined the role of BCT adoption in sustainable supply chain performance. However, there is still a need for additional studies exploring the role of BCT in building trust for long-term supply chain relationships (Yavaprabhas et al., 2022). Additionally, Brookbanks and Parry (2022) noted that a significant gap in the existing literature regarding the influence of technologies such as BCT and their impact on trust among supply chain participants.

Given the above arguments and research gaps, this study explores the mediating role of stakeholders' trust influenced by BCT adoption in enhancing supply chain sustainability. The study's primary objective falls into three aspects: (1) to examine the role of BCT adoption in enhancing the overall sustainable supply chain performance. (2) to investigate the potential contribution of BCT adoption in improving trust among stakeholders. (3) to investigate the effect of trust among stakeholders. (4) to examine the role of trust of the supply chain stakeholders on the BCT adoption and the enhancement of sustainable supply chain performance. Further, this study offers novel findings that contribute to social science research by revealing stakeholders' trust as a key mediating mechanism through which BCT

adoption translates into sustainable supply chain performance, bridging technological and relational perspectives.

The current paper consists of five sections. The first section provides a background of the research on BCT adoption and supply chain performance. The second section reviews the literature and the development of theories and hypotheses. The third section describes the research methodology. The fourth section presents the research analysis and findings, and the last section summarizes the study's results, findings, and implications.

Literature Review

Stakeholders' Trust in Supply Chain Management

The trust was initially defined by Mayer et al. (1995) as the party's willingness to be vulnerable to another's actions, based on the expectation that the other will perform a specific action necessary to the trustor, regardless of whether the trustor can monitor or control that party. Trust can be considered a fundamental factor in all businesses (Queiroz and Wamba, 2018). In the supply chain, trust is crucial for facilitating interactions among stakeholders operating within the same network, which are often complex and require a high level of information sharing to achieve better operational performance (Anh et al., 2018). Stakeholders are individuals, groups, or organizations with an interest in an organization, who can influence or be affected by the achievement of organizational objectives (Freeman and McVea, 2001). In this regard, Queiroz and Wamba (2018) defined stakeholders' trust from a supply chain perspective as the willingness of two or more organizations in the supply chain network to trust each other and meet mutual expectations. Hence, trust between those stakeholders is essential to enhance the overall environmental and financial performance within the supply chain (Baah et al., 2021).

Evolution Of Blockchain Technology

Blockchain Technology (BCT) was first introduced by Satoshi Nakamoto in his 2008 paper, "Bitcoin: A Peer-to-Peer Electronic Cash System," which emerged after the financial crisis (Nakamoto, 2008). The rise of Bitcoin and cryptocurrency has significantly increased the popularity of BCT as a decentralized database (Kouhizadeh and Sarkis, 2018). It is typically a distributed ledger technology where various parties share data within a peer-to-peer network. BCT functions as a shared database or public ledger, enabling a predefined protocol where data must first be validated and approved by the members sharing the same database before the transaction appears on the ledger (Khanfar et al., 2021). Specifically, participants verify each transaction recorded in the ledger, and the information entered is typically secure, traceable, and permanent (Ahmed and MacCarthy, 2023). Further, transactions are stored in the form of blocks, where the blocks are sequenced using a hash. These hashes are digital signatures that secure data in the BCT (Yadav et al., 2023).

Blockchain Technology in Supply Chain Management

The supply chain has recently been facing greater pressure to become digitalized due to the external forces of uncertainty, natural disasters, and sustainability (Kopyto et al., 2020). In fact, the supply chain systems are required to increase the transparency, security, integration, and connection throughout the supply chain network. Therefore, the BCT can help facilitate integration and help the traditional supply chain systems deal with major challenges (Centobelli et al., 2021). BCT is an advanced and innovative technology that can record all

supply chain data, guaranteeing complete transparency of the supply chain's information. Since it records data into blocks, connecting each block with the other block in a timely, shared, and secure ledger (Hariyani et al., 2025), BCT encompasses a high trust rate through its transparency, immutability, and integrity features (Difrancesco et al., 2022). In this regard, all paper records, invoices, and documents related to the supply chain network will be eliminated and replaced with digitized and secure transaction stored on the BCT (Gong et al., 2022). Invoicing based on BCT is vital in fraud prevention, as it removes the risk of double-spending and manipulation of paper records (Patil and Sangeetha, 2021). BCT reduces transaction costs, optimizes cash flow, and improves coordination via real-time, peer-to-peer information sharing among supply chain members (Negi, 2024).

Sustainable Supply Chain Management

Supply chain management refers to the process of reducing costs and enhancing value by connecting supply chain members, including suppliers, manufacturers, and distributors, to produce and distribute final products and services within the supply chain network (Chopra, 2018). The SCM network includes activities such as purchasing raw materials from suppliers, production, distribution, and delivering products to customers. Hence, the current SCM system enables seamless integration of resources to meet customer demand for products and services (Boiko et al., 2019). It aims to increase the overall value and decrease the expenses. This value is calculated by subtracting the total supply chain cost from the final product value (Chopra, 2018).

Sustainable supply chain management is defined as a strategic approach that coordinates social, environmental, and economic objectives across key interorganizational activities to enhance long-term performance (Carter and Rogers, 2008). The Interest in sustainable supply chain performance has increased globally and is vital for supporting the world's economy (Park and Li, 2021). The concept of sustainable performance encompasses the three pillars of sustainability: environmental, social, and economic (Yadav et al., 2023). Moreover, scholars have developed various methods to assess supply chain sustainability (PN, 2014). Specifically, organizations should measure the sustainable performance of their supply chains to address challenges in the supply chain network. Accordingly, Chardine-Baumann and Botta-Genoulaz (2014) identified key sustainability aspects affected by supply chain practices, such as financial outcomes, quality, safety, responsiveness, consumer concerns, resource utilization, environmental management, and pollution.

Resource-Based View Theory

The resource-based view (RBV) theory posits that a firm's resources are key drivers of its capabilities, leading to desired performance. When organizations leverage valuable resources effectively, they can attain and sustain a competitive advantage (Wernerfelt, 1984; Olavarrieta and Ellinger, 1997). In light of the RBV, implementing sustainable supply chain management practices allows organizations to gain a competitive edge by effectively assessing asset efficiency (El-Garaihy et al., 2022). The RBV of a firm explains how a competitive advantage is achieved by transforming unique resources into capabilities. It helps organizations gain a competitive edge by integrating and reconfiguring their resources within processes and activities (Fawcett et al., 2011; Madhani, 2021). Further, Hoopes et al. (2003) indicated that RBV suggests a way for organizations to maintain a sustainable competitive position in highly intense competitive markets.

RBV provides a detailed framework for connecting internal resources with capabilities, helping organizations understand how to deploy BCT, which is seen as a crucial firm resource within this framework (Shahzad et al., 2023). Using BCT in the supply chain greatly improves various capabilities, resulting in enhanced overall supply chain performance (Madhani, 2021). Additionally, RBV suggests that BCT, as an intangible, innovative technology, can act as a strategic resource, allowing firms to gain and sustain a competitive advantage (Kant, 2021). Barney (1991) pointed out that intangible resources are often harder to imitate and tend to be more strategically valuable than tangible ones. Hence, BCT is classified as an intangible technological resource (Kant, 2021). Accordingly, this perspective is pertinent to the current study because organizations can enhance their supply chains by adopting BCT, which facilitates more efficient financial transactions. Using this framework, the analysis examines the connections between BCT adoption and supply chain performance, focusing on how stakeholders' trust serves as a mediating factor. It provides a conceptual approach to understanding how adopting BCT can boost trust among stakeholders, helping them gain a competitive edge through improved supply chain performance.

Conceptual Framework and Hypothesis Development

Conceptual Framework

The research developed a conceptual framework (Figure 1) based on the RBV theory. The model applies the RBV theory to analyze how BCT adoption influences stakeholders' trust and improves the organization's sustainable supply chain performance. Additionally, the framework shows how stakeholders' trust mediates the relationship between BCT adoption and sustainable supply chain performance. Specifically, the independent variable is BCT adoption, while the dependent variable is sustainable supply chain performance. Stakeholders' trust is considered a mediating variable. In the research model, H1 demonstrates the direct impact of BCT adoption on sustainable supply chain performance. Similarly, H2 highlights the effect of BCT adoption in building stakeholders' trust. H4 illustrates the mediating role of stakeholders' trust between BCT adoption and sustainable supply chain performance.

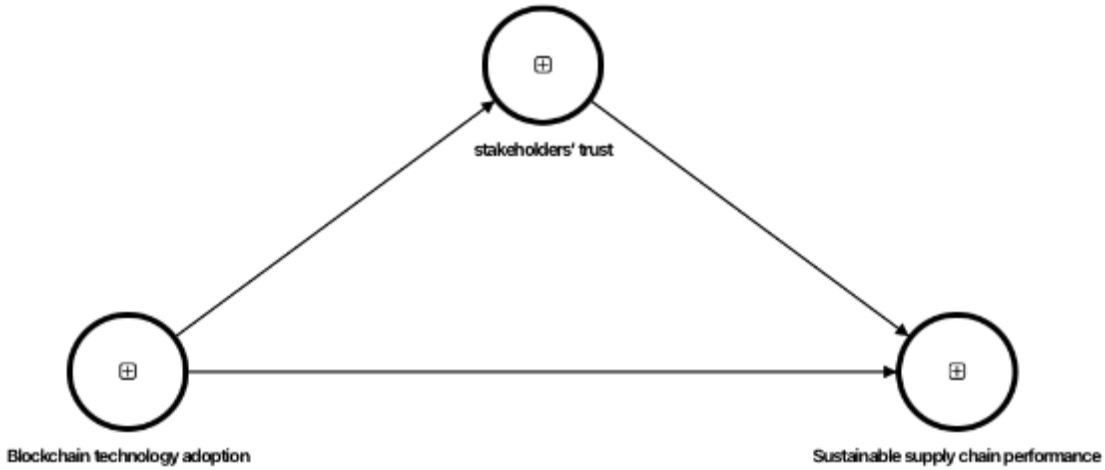

Figure 1: Conceptual Framework

Blockchain Technology Adoption and Sustainable Supply Chain Performance

BCT is gaining recognition to promote the digitalization of the traditional supply chain systems, which lack the essential supply chain requirements, such as full tracking of products. It enables organizations to enhance the transparency of all supply chain transactions and

ensures the integration of both assets and resources, thereby improving overall supply chain performance (Yadav et al., 2023). It is recognized as an innovative technology in the manufacturing industry that can enhance production efficiency and responsiveness. It was found that BCT strengthens the transparency of manufacturing operations while improving performance and sustainability (Sui et al., 2023). Additionally, BCT can improve quality and provide full visibility into the entire supply chain, including production, sales, and other processes. This can lead to better supply chain security, optimized inventory, and increased customer satisfaction (Hariyani et al., 2025). In addition, BCT enhances trust and efficiency in the supply chain while providing a distinctive, secure, and distributed digital ledger that is considered distinct from all other distributed ledger technologies (Bai et al., 2022). In this regard, Vishwakarma et al. (2022) found that BCT adoption can have a direct impact on improving the sustainable supply chain performance. This improvement can be achieved through its unique features. For example, the immutability of BCT prevents information related to the supply chain from being altered or modified, which can reduce the risk of fraud, theft, or misuse of information. Further, the BCT transparency positively influences the stakeholders' involvement. This technology can be effectively used to protect human and citizenship rights (Ronaghi and Mosakhani, 2021).

Despite the fact that a large number of research bodies have proved the significance of BCT adoption to enhance the sustainable supply chain performance (Difrancesco et al., 2022; Mubarik et al., 2023), some other empirical studies highlighted the insignificant contribution of BCT adoption to the enhancement of the supply chain performance. Scholars noted some challenges that hinder the capabilities of BCT to enhance the supply chain performance and that require further examination. For instance, Nazam et al. (2022) argue that a comprehensive understanding of social, economic, and environmental issues is needed to address the BCT barriers, such as technological, research and development, and human resources barriers. Additionally, Lohmer & Lasch (2020) identified other obstacles to BCT adoption within the manufacturing context, including regulatory and legal uncertainties, trust and transparency issues within the network, and an unclear governance system. Thus, based on the above debate and arguments, this study proposes the following hypothesis to examine the impact of BCT adoption on sustainable supply chain performance.
H1: Blockchain technology adoption directly influences sustainable supply chain performance.

Blockchain Technology Adoption and Stakeholders' Trust
BCT evolved as a revolutionary type of technology that can digitize traditional transactions using its distributed ledger system, which creates a history of public transactions (Melendez et al., 2024). The traditional supply chain system, along with traditional trust management, often lacks the necessary security for sharing information, which can lead to data manipulation (Shala et al., 2020). Meanwhile, BCT has shifted the trust model from humans to technology (Vatankhah Barenji, 2021). BCT can serve as a tool to address the lack of trust by verifying that shared information aligns with the actual physical flow (Alkhudary and Féniès, 2022). It enables full automation of supply chain transactions through smart contracts, eliminating the need for a third-party coordinator (Shala et al., 2020). Therefore, stakeholders' trust is a key factor in driving the adoption of Blockchain-based supply chain systems (Wamba, 2019). Specifically, BCT offers immutability, transparency, and traceability, which can enhance trust within the buyer-supplier relationship (Brookbanks and Parry, 2022).

In this regard, Ko et al. (2018) emphasized that the transparency and visibility features of BCT enable the stakeholders' trust within the supply chain. Hence, according to the above arguments, this study proposes the following hypothesis to study the impact of BCT adoption on stakeholders' trust.

H2: Blockchain technology adoption directly influences stakeholders' trust.

Stakeholders' Trust and Sustainable Supply Chain Performance

Trust is crucial in supply chain relationships, which are usually characterized by fragility and distraction (Yavaprabhas et al., 2022). Supply chain relationships between partners are considered complex; however, they are always seen as essential to all operations (Queiroz and Wamba, 2018). The supply chain must create a reliable communication platform to facilitate smooth interaction among suppliers, customers, and the organization (Baah et al., 2021). Therefore, trust provides a trustworthy channel for communication between supply chain partners, which is essential for enhancing supply chain efficiency (Owot et al., 2023). Once relationships are bound with trust, there is a greater likelihood of more collaborations within the supply chain parties (Yavaprabhas et al., 2022). Such collaboration is crucial for maintaining a high level of performance and achieving a competitive advantage (Barrane et al., 2020). Conversely, the lack of trust is a serious challenge that threatens the supply chain systems (Khan et al., 2018). In this regard, Capaldo and Giannoccaro (2015) stated that the absence of trust leads to disadvantages in the supply chain operations; however, high levels of trust is predictor to a better supply chain performance. Similarly, Panayides and Lun (2009) found that trust can positively impact the innovativeness of manufacturing firms, thus enhancing supply chain performance. Based on existing research, we propose the following hypothesis to examine how trust between stakeholders affects overall sustainable supply chain performance:

H3: Stakeholders' trust significantly influences sustainable supply chain performance.

The Mediation Role of Stakeholders' Trust

The supply chain system, with ongoing innovations, is often distracted, highlighting the need for trust to satisfy all stakeholders (Barrane et al., 2020). Primarily, trust should be maintained at both interpersonal and inter-organizational levels. Interpersonal trust refers to the trust between parties from different organizations, while trust within the same organization is called inter-organizational trust (Shahzad et al., 2023). When trust is established, partners are more willing to collaborate to improve performance (Capaldo and Giannoccaro, 2015). In this context, Barrane et al. (2020) suggest that trustful collaboration can be achieved by fostering transparency throughout the supply chain system. Specifically, information technology tools like BCT can play a vital role in promoting transparency and accountability, which enhances trust among involved parties (Vern et al., 2024). Past studies indicate that trust mediates the relationship between BCT adoption and supply chain performance (Pattanayak et al., 2024; Vern et al., 2024). Since trust in the supply chain acts as a bridge connecting businesses (Shahzad et al., 2023), it facilitates information and resource sharing among supply chain partners in manufacturing companies to address operational disruptions (Yang et al., 2022). Consequently, BCT improves the quality of shared information, making it fully accessible to all parties through its unique features and smart contracts (Medina et al., 2024). Notably, BCT removes the need for intermediaries within the system. As a result, trust increases because stakeholders can easily access information stored in the database. In fact, BCT creates an immutable, tamper-proof electronic record of transactions, which can motivate customers,

suppliers, regulators, and other stakeholders to adopt sustainable practices (Soori et al., 2024).

H4: Stakeholders' trust mediates the relationship between Blockchain technology adoption and sustainable supply chain performance.

Research Methodology

Data Collection

The research employed non-probability sampling because the population is well-defined, and only relevant respondents were targeted for questionnaire completion. According to the report from the Ministry of Industry and Mineral Resources in June 2024, the total number of factories operating in Saudi Arabia has reached 12,840 industrial facilities (The Ministry of Industry and Mineral Resources, 2025). A questionnaire was considered an appropriate data collection tool and was distributed via email to relevant organizations. Notably, this study only included professionals from manufacturing firms that actively use BCT for sustainable supply chain management practices.

The initial sample size consisted of 220 respondents from different manufacturing companies. However, 200 questionnaires remained for data analysis after data screening. The first step in the data collection process was to send a Google Forms link via email to the appropriate personnel within the manufacturing departments. Respondents were then asked to complete the questionnaire using a five-point Likert scale (5= strongly agree to 1= strongly disagree) for all measurement items. Additionally, a cover letter was attached to each questionnaire, stating that all responses will remain confidential and will be used solely for research purposes. Table 1 presents the demographic profile of the respondents.

Table 1
Demographic Data

Items	Description	Frequency	Percent
Company's Town/City	Madinah	107	53.5
	Makkah	68	34.0
	Riyadh	5	2.5
	Al-Kharj	3	1.5
	Yanbu	3	1.5
	Tabuk	3	1.5
	Hail	3	1.5
	Dhahran	2	1.0
	Abha	2	1.0
	Jazan	2	1.0
	Al-Khobar	1	0.5
	Dammam	1	0.5
Manufacturing Sector Types	Building Materials	38	19.0
	Petroleum	33	16.5

	Food Processing	31	15.5
	Machinery and Equipment	27	13.5
	Automotive	23	11.5
	Chemicals	15	7.5
	Pharmaceuticals	14	7.0
	Medical Devices	8	4.0
	Minerals and Metals	6	3.0
	Aerospace	3	1.5
	Renewable Cluster	2	1.0
Years in Operation	Less than 5 years	31	15.5
	5 - 10 years	63	31.5
	11 - 15 years	51	25.5
	16 – 20 years	41	20.5
	Above 20 years	23	11.5
Number of Employees	Less than 50 employees	31	15.5
	50 – 249 employees	92	46.0
	250 employees and above	77	38.5
Blockchain Technology Usage Duration (in Years)	Less than two years	63	31.5
	2 - 5 years	100	50.0
	6 - 10 years	37	18.5
Position in the Company	Manager	53	26.5
	Director	36	18.0
	CEO	26	13.0
	Officer	19	9.5
	General Director	19	9.5
	General Manager	13	6.5
	Head of Manufacturing Unit	11	5.5
	Consultant	11	5.5
	COO	9	4.5
	Senior Staff from the Supply Chain	3	1.5
The Supply Chain Unit	Warehousing	52	26.0
	Production	33	16.5
	Customer Service	30	15.0
	Transportation	31	15.5
	Procurement/Purchasing	19	9.5
	Distribution	18	9.0
	Materials Handling	13	6.5
	Inventory/Stock Management	4	2.0

Measures

This study used two constructs to evaluate the sustainable supply chain performance among manufacturing firms in Saudi Arabia, namely BCT adoption and stakeholders' trust. Eight items were adopted from Kamble et al. (2021) for measuring sustainable supply chain

performance; eight items for BCT adoption were adopted from Bag et al. (2022); and five items for measuring stakeholders' trust were adopted from Baah et al. (2021). All the items were examined.

Data Analysis

The Structural Equation Modeling (SEM) was used to analyze the data and to investigate the direct and indirect relationships between constructs. Based on Deng et al. (2018), SEM is a practical approach that allows researchers to examine the hypothetical relationship between constructs. Additionally, Saleem (2021) argued that SEM is an effective method for examining the research framework and estimating the structural coefficient paths. Hence, this study used the SEM approach with Smart-PLS software to examine the relationship between the proposed hypotheses. PLS-SEM is able to provide more accurate and reliable results and works effectively with both small and large sample sizes (Choi et al., 2020). Furthermore, it can work well with several indicators while managing complex distributions and non-normal data. In this regard, managing complex models with numerous indicators requires the flexibility offered by PLS-SEM to accurately represent underlying components, enabling it to handle a large number of indicator variables (Khan and Yu, 2020).

Research Results

Measurement Model Analysis

This study used Cronbach's Alpha and composite reliability (CR) to evaluate the reliability of the constructs. Table 1 shows the Cronbach's Alpha and CR values for all constructs, ensuring that the obtained values exceed 0.7, as suggested by Ramayah et al. (2017). Additionally, the convergent validity was evaluated using the Average Variance Extracted (AVE). The obtained AVE values were above 0.5, which confidently confirms the achievement of convergent validity (Ramayah et al., 2018). Additionally, this study tested the factor loadings for all measurement items to remove items with loadings below 0.6.

Table 2
Measurement Sources

Construct	Outer loading	Cronbach's Alpha	CR	AVE
Blockchain Technology Adoption		0.601	0.769	0.550
BCT2	0.618			
BCT3	0.642			
BCT6	0.688			
BCT7	0.744			
Sustainable Supply Chain Performance		0.901	0.931	0.772
SCP1	0.844			
SCP2	0.889			
SCP3	0.904			
SCP4	0.877			

Stakeholders' Trust		0.794	0.859	0.551
ST1	0.753			
ST2	0.810			
ST3	0.819			
ST4	0.636			
ST5	0.675			

Further, Table 2 illustrates the discriminant validity of the study constructs using Fornell and Larcker (1981). It presents the square root of AVE for each variable, which should be higher than its correlation with any other latent variable. The obtained values demonstrated satisfactory results, indicating that the constructs are suitable for examining the proposed framework.

Table 3
Discriminant Validity

	1	2	3
Blockchain Technology Adoption	0.675		
Stakeholders' Trust	0.469	0.879	
Sustainable Supply Chain Performance	0.680	0.669	0.742

Structural Model and Hypotheses Testing

For data analysis, bootstrapping with 5000 subsamples was performed to test the statistical significance of the hypothesized relationships. Table 3 and Table 4 illustrate the direct and indirect relationships among BCT adoption, stakeholders' trust, and sustainable supply chain performance. Overall, four hypotheses were developed, of which three show significant results; however, one hypothesis shows an insignificant result. Based on the obtained results, BCT directly impacts both stakeholders' trust; however, it does not significantly improve sustainable supply chain performance. Further, stakeholders' trust significantly affects sustainable supply chain performance and mediates the link between BCT adoption and sustainable supply chain performance. Therefore, H1 is not supported, while H2-H4 were supported.

Table 4
Path Coefficients and Results

	Original sample	T statistics	P values	Hypotheses Result
Blockchain Technology Adoption- > Sustainable Supply Chain Performance	0.026	0.472	0.637	Not Supported
Blockchain Technology Adoption -> Stakeholders' Trust	0.680	24.281	0.000	Supported
Stakeholders' Trust -> Sustainable Supply Chain Performance	0.651	11.630	0.000	Supported

Table 5
Indirect effect

	Original sample	T statistics	P values	Hypotheses Result
Blockchain Technology Adoption -> Stakeholders' Trust -> Sustainable Supply Chain Performance	0.443	10.272	0.000	Supported

According to Saleem (2021), the coefficient of determination (R^2) value is considered the main criterion for assessing the structural model. The R^2 values indicate the proportion of variance explained by the model for each endogenous construct. In this study, sustainable supply chain performance exhibits an R^2 value of 0.448. In other words, the proposed variables explained 44.8% of the variance in sustainable supply chain performance. Figure 2 presents the hypothesised path in the current research framework.

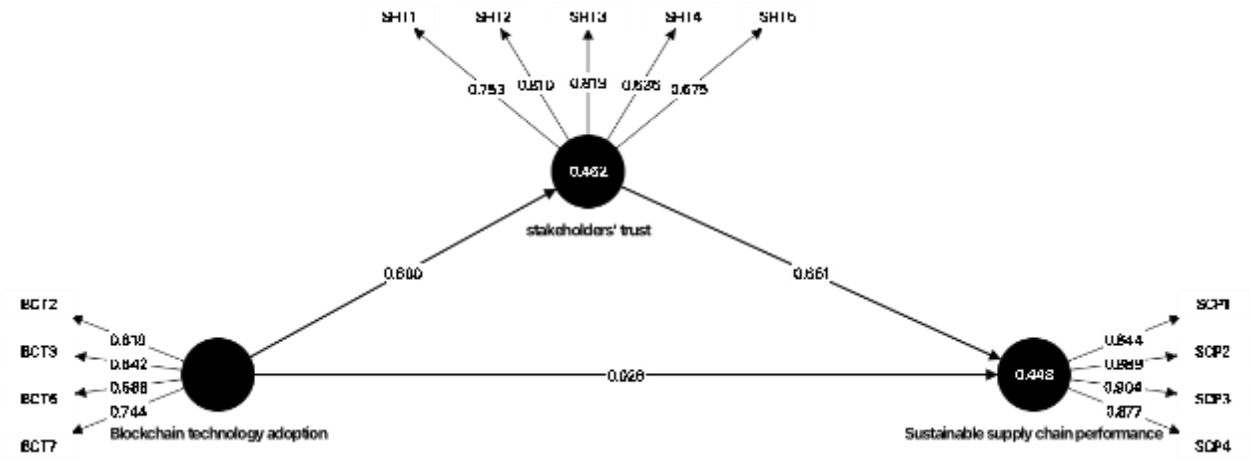

Figure 2: Structural Model

Discussion

The present study examined the impact of BCT adoption on sustainable supply chain performance within the manufacturing industry in Saudi Arabia. Additionally, it investigates the mediating role of stakeholders' trust in the relationship between BCT adoption and sustainable supply chain performance. Specifically, the current study applied the RBV theory to explore the direct and indirect relationships among BCT adoption, stakeholders' trust, and sustainable supply chain performance. The proposed research model included four hypotheses to analyze the connections between the constructs, which, in turn, demonstrate significant contributions. The results clearly demonstrate that adopting BCT directly affects stakeholders' trust; however, it does not impact the performance of sustainable supply chains. Additionally, stakeholders' trust has a direct influence on sustainable supply chain performance. The study also highlights the significant mediating role of stakeholders' trust in linking BCT adoption to improved supply chain performance.

The primary objective of the study is to educate the manufacturing sector in Saudi Arabia on the importance of BCT in supply chain operations. Although previous studies highlighted the BCT potential in improving the supply chain sustainability (Park and Li, 2021; Zayed and Yaseen, 2025), the results of this study didn't show a direct link between BCT adoption and

sustainable supply chain performance improvement. However, the findings in this study are consistent with a few other empirical studies in the field, which have emphasized the insignificant role of BCT adoption in improving sustainable supply chain performance (Khan et al., 2022; Shahzad et al., 2023). Therefore, this topic requires further investigation to analyze the critical role of BCT adoption in the supply chain context. The current study proves that BCT adoption can drive trust among stakeholders; however, it highlights that BCT adoption alone will not improve the supply chain performance. Notably, BCT has economic, social, and environmental drawbacks that organizations should not overlook, including a lack of sustainability guidelines, lack of expertise, limited storage capacity, regularity issues, and high integration costs (Mohammed et al., 2023; Wang et al., 2023).

Further, the results confirms the mediating role of trust between BCT and supply chain performance, which is aligned with the previous findings of Mahyuni et al. (2020), Pattanayak et al. (2024) and Vern et al. (2024). Thus, the result suggests that stakeholders' trust based on the RBV perspective can be considered a capability of the BCT technological resource to improve sustainable supply chain performance. Moreover, the positive impact of BCT adoption and trust between stakeholders is also supported by the findings of Mahyuni et al. (2020). This finding confirms that BCT can strengthen the relationship and integration between stakeholders, which fosters trust. Lastly, the direct positive association between trust and supply chain performance enhancement is consistent with Owot et al. (2023) Vern et al. (2024) and Kankam and Dza (2025). This result highlights the critical role of trust in optimizing the stakeholders' involvement and information sharing to sustain the supply chain operations.

Theoretical Implications

This research examines how adopting BCT affects supply chain performance and investigates how stakeholders' trust in BCT contributes to enhancing that performance. While several previous studies have analyzed and concluded the role of BCT adoption in the supply chain context, only a few have explored how BCT adoption improves supply chain performance and how this relationship relates to stakeholders' trust and its significance. Specifically, only a few studies have examined BCT's impact within the manufacturing industry in Saudi Arabia. Therefore, this study provides a comprehensive framework based on the RBV theory to assess the impact of BCT adoption on supply chain operations. It empirically investigates the relationship using SEM-PLS to contribute to the existing literature and fill current research gaps. The statistical results demonstrate that BCT adoption within the manufacturing industry positively influences stakeholders' trust, which consequently enhances the supply chain performance. Additionally, the findings reveal that stakeholders' trust positively impacts the enhancement of the supply chain performance.

Managerial Implications

This study has important managerial implications for manufacturing organizations. It emphasizes the positive effect of BCT adoption on supply chain operations. In Saudi Arabia, the manufacturing industry faces many challenges due to efforts to diversify the economy and reduce dependence on oil revenue. Therefore, organizations should consider the social, economic, and environmental issues related to adopting digital technology to leverage its impact on sustainable operations and enhance traditional supply chains. Consequently, this study can assist professionals, managers, and policymakers by providing different insights on

how to overcome trust issues within the traditional supply chain challenges through the adoption of digital tools. The research model investigates a key relationship between BCT and stakeholders' trust, and how this relationship contributes to enhancing supply chain performance, based on the RBV theory perspective that drives competitive advantage. As a result, professionals within manufacturing organizations will understand the importance of trust between stakeholders to boost supply chain productivity, which can be further improved through technology adoption. Recognizing the critical role of BCT in strengthening trust will significantly encourage the adoption of this technology to optimize supply chain operations. Additionally, BCT enhances trust among supply chain parties by enabling complete tracking of the product's origin, manufacturing process, and movement throughout the supply chain system. It also facilitates real-time information sharing that fosters trust and transparency, which in turn enables a robust supply chain. Notably, the high levels of trust established through the adoption of BCT can facilitate manufacturing organizations in enhancing their internal and external collaborations with key suppliers, distributors, service providers, and customers. Consequently, supply chain performance is likely to experience further improvements.

Conclusion and Suggestions for Future Research

The adoption of BCT has demonstrated potential in building trust among supply chain stakeholders, significantly enhancing overall supply chain performance. This study investigates the influence of BCT adoption on sustainable supply chain performance while driving stakeholders' trust. The proposed framework developed four hypotheses to examine the direct and indirect relationships between BCT adoption, stakeholders' trust, and sustainable supply chain performance based on RBV theory. A sample of 185 manufacturing organizations was considered as respondents for the research questionnaire. The proposed model was empirically examined by PLS-SEM using Smart-PLS 4.0. The research findings highlighted that BCT adoption has a positive direct impact on stakeholders' trust. However, the findings indicate that BCT adoption doesn't impact the sustainable supply chain performance. Also, the results show that stakeholders' trust mediates the relationship between adopting BCT and sustainable supply chain performance.

The paper sheds light on the current adoption of BCT in manufacturing companies. It investigates how stakeholders' trust, facilitated through BCT adoption, mediates the relationship between BCT adoption and sustainable supply chain performance, based on the RBV Theory. This paper presents new opportunities and insights to address research gaps regarding how manufacturing companies can optimize their supply chain performance through digitalization. It helps professionals, management, academics, and researchers understand the role of BCT adoption in creating a sustainable supply chain system. In particular, this paper can guide management and decision-makers in manufacturing industries on the competitive advantages that can be achieved through the digitalization of the supply chain. The overall research findings can benefit managers, decision-makers, organizations, and academic scholars by illustrating the opportunities of BCT adoption as a modern digital tool to overcome challenges in supply chain systems and make them sustainable and responsive.

Lastly, this study contributes to the supply chain literature on the importance of BCT adoption to drive trust and sustain supply chain performance within the manufacturing industry in

Saudi Arabia. This can lead organizations to maintain their competitive advantage within the market. Therefore, future research studies can examine the contribution of BCT adoption in other industries. Moreover, future investigations can explore other promising features of BCT, such as smart contracts, information security, and information integration on supply chain performance. Lastly, further studies can explore the relationship in greater detail using case studies.

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