

Blockchain Technology Adoption in Supply Chain Management: An Integrated Framework of Organizational Capabilities, Adoption Barriers, and Performance Outcomes

Jyoti Laxman Zirmire¹, Bhuvanewari Gowthaman², Raja M³, Nagarathna M L⁴, Vishwanath M M⁵, Tamil Selvan V⁶

¹ Department of Agriculture Business Management, Post Graduate Institute of Agriculture Management, Chakur, Latur, Maharashtra – 413513, India.

Email: jlzirmire@vnmkv.ac.in

² Department of Management Studies, Dayananda Sagar Academy of Technology and Management, Bengaluru, Karnataka, India.

Email: bhuvana.jk20@gmail.com

³ Department of Management Studies, Sathyabama Institute of Science and Technology, Chennai – 600119, Tamil Nadu, India.

Email: raja.sarvesh1973@gmail.com

⁴ Department of Humanities and Social Sciences (HSS), Dr. Ambedkar Institute of Technology, Bengaluru – 560056, Karnataka, India.

Email: Nagarathna.ml@drait.edu.in

⁵ Department of Mechanical Engineering, Dr. Ambedkar Institute of Technology, Bengaluru, Karnataka, India.

Email: vishwanath.me@drait.edu.in

⁶ Department of Commerce and Management, Smt. Nalini Raghunatha Rao Degree College, Jigani – 560105, Karnataka, India.

Email: tamilselvan.lec@gmail.com

Abstract: Blockchain technology has emerged as a transformative innovation in supply chain management due to its potential to enhance transparency, traceability, security, and operational efficiency. Despite these advantages, blockchain adoption in supply chains remains limited because of organizational, technological, and operational challenges. This study examines the relationships between organizational capabilities, adoption barriers, blockchain technology adoption, and supply chain performance. The research integrates the Technology–Organization–Environment (TOE) framework with Dynamic Capabilities Theory to develop a comprehensive conceptual model. Data were collected from 560 supply chain professionals across multiple industries in India using a structured questionnaire. The collected responses were analyzed using SPSS and Structural Equation Modeling (SEM) with AMOS to evaluate the proposed hypotheses and mediation effects. The findings indicate that organizational capabilities are positively associated with blockchain technology adoption, whereas adoption barriers negatively influence adoption. The results further reveal that blockchain adoption is positively associated with supply chain performance in terms of operational efficiency, transparency, and coordination. Additionally, blockchain technology adoption partially mediates the relationship between organizational factors and supply chain performance. The study contributes to the existing literature by presenting an integrated framework that simultaneously examines enabling factors, adoption barriers, and performance outcomes within the context of an emerging economy. The findings also provide practical insights for managers and policymakers seeking to implement blockchain technology in supply chain operations.

Keywords: adoption barriers, blockchain technology, organizational capabilities, structural equation modeling, supply chain management, supply chain performance

1. Introduction

Blockchain technology has emerged as a significant innovation in supply chain management. Major challenges in supply chain management include limited visibility, low transparency, and inadequate traceability. These challenges reduce operational efficiency and weaken trust among supply chain partners. Blockchain technology addresses these challenges by enabling decentralized and secure information sharing, by facilitating decentralization of data, simultaneous reporting of data, and imperceptible records of transactions, enhancing coordination and transparency all over the supply chain (Wang et al., 2020; Azevedo et al., 2023).



According to the use of blockchain in supply chains, it has been revealed to improve efficiency of operations, minimize transaction costs, and increase the trust among stakeholders. It benefits the participants in ensuring secure and transparent data exchange, which enhances the monitoring of the goods and improves the control of the inventory (Babaei et al., 2023; Sahoo et al., 2022). Moreover, blockchain can be utilized to create sustainable and resilient supply chains through the provision of reliable information flows and the reduction of risks of fraud and data manipulation (Yadav and Singh, 2020; Babaei et al., 2025). Consequently, blockchain is now becoming the topic of interest among organizations in different industries as the concept of digital transformation takes off.

Although the major applications of the use of blockchain in SCM are still promising, the use of this technology is still developing. Some of the obstacles facing organizations are the high implementation price, technical expertise deficit, scalability, as well as the unwillingness to change the organization (Kouhizadeh and Saberi, 2021; Yadlapalli, 2022). The earlier research has explored the use of blockchains in terms of the application of such frameworks as the Technology–Organization–Environment (TOE) model that recognizes technological and structured environmental variables that affect the choice to adopt the technology (Chittipaka et al., 2023; Cheng, 2022).

Nevertheless, the present literature mostly belongs to the overall determinants and does not give much understanding regarding the effect of a mixture of organizational capabilities with adoption barriers on the adoption results. Expertise, technological readiness, and human resource that an organization has, such as the capability to innovate, is critical in the acquisition of emerging technologies. Based on the active ability theory, the high capabilities level results in the potential of organizations to more effectively react to the changes in the technological environment, identify opportunities, and secure competitive advantages in dynamic environments (Pradana, 2024; Manzoor, 2024).

On the other hand, such aspects as financial limitations, inadequate infrastructure, and organizational opposition can also be essential to the inability to introduce the blockchain technology successfully (Kaur et al., 2022; Tangsakul, 2024). As such, to get a complete picture of blockchain uptake, it is necessary to discuss both facilitating and limiting factors. Even though the application of blockchain is anticipated to highlight the performance of supply chains, by making them more efficient, transparent, and providing information, there is still a limited amount of empirical evidence that shows the connection between the two. Existing literature suggests that blockchain technology positively enhances supply chain operations. However, it has not provided any integrated research frameworks that examine the organizational capabilities and barriers to adoption, blockchain adoption, and their effects on performance in tandem.

To mention these gaps, particularly this study introduces a comprehensive framework that integrates organizational capabilities, adoption barriers, blockchain implementation, and supply chain performance. The conceptual model proposed is further analyzed with the help of SEM to develop the thorough and more detailed insight into the interrelationships between the constructs that are considered. This also enables a number of dependent and independent variables to be analyzed simultaneously giving both the direct and indirect effects. The present study adds value to the existing literature body because it expands the TOE framework in the background of the Dynamic Capabilities Theory. Through this, it provides a more comprehensive and holistic view of how blockchain can be used in supply chains. The research also tackles the gaps in theories because the authors have merged organizational adaptability with technological innovation within one single model.

Practically speaking, the study has good implications on managers and policymakers. It points out the major factors that motivate the blockchain adoption and also presents the most critical obstacles that block its application. The study, as per these findings, suggests practical action measures that can make the successful incorporation of blockchain technology in the supply chain processes. These strategies may assist organizations to enhance transparency, effectiveness, and cooperation in supply chain networks.

1.1 Research Gap and Novelty

Although blockchain technology adoption in supply chain management has received considerable attention in recent years, several research gaps remain in the existing literature. Prior studies have predominantly focused on either technological determinants, adoption barriers, or supply chain performance independently, with limited efforts to integrate these dimensions into a unified empirical framework. Most blockchain adoption studies have employed the Technology–Organization–Environment (TOE) framework to examine adoption determinants; however, these studies often overlook the simultaneous influence of organizational capabilities and adoption barriers on supply chain performance outcomes.

Furthermore, previous research has largely concentrated on developed economies and specific industrial contexts, while empirical evidence from emerging economies such as India remains limited. Existing studies also provide insufficient understanding of the mediating role of blockchain technology adoption in linking organizational factors with supply chain performance. As a result, the interaction between organizational capabilities, adoption barriers, blockchain adoption, and operational performance remains underexplored.

To address these gaps, the present study develops an integrated research framework by combining the TOE framework with Dynamic Capabilities Theory to examine both enabling and inhibiting factors affecting blockchain adoption in supply chain management. Unlike prior studies that primarily focused on direct relationships, this research additionally investigates the mediating role of blockchain technology adoption between organizational variables and supply chain performance. The study further contributes empirical evidence from the Indian supply chain context using Structural Equation Modeling (SEM), thereby offering a more comprehensive understanding of blockchain-enabled supply chain transformation.

2. Theoretical Framework and Hypotheses Development

2.1 Blockchain Technology Adoption (BTA) in Supply Chain Management (SCM)

Blockchain technology (BT) has also become a disruptive digital innovation that facilitates safe, decentralized and transparent information exchange across networks of supply chains. It allows recording transactions in real time, improves traceability, and ensures data immutability, which contributes to building more significant trust among supply chain stakeholders (Ahmed and MacCarthy, 2022; Wang and Wang, 2020). Also, BT facilitates the key operations of supply chain monitoring, control, and data transfer, resulting in the enhancement of operational efficiency and enhanced coordination among the participants (Azevedo et al., 2023; Dutta and Choi, 2020).

Moreover, blockchain enhances integration of a process in the supply chains through availability of the correct and tamper proof data, which can help minimize fraudulent activities and make more informed decisions (Babaei and Khedmati, 2023). It also promotes both transparency and cooperation between stakeholders, which are essential to the attainment of supply chain resilience and sustainability (Sahoo and Kumar, 2022; Yadav and Singh, 2020). Consequently, the issue of blockchain technology adoption (BTA) is identified as one of the primary providers of digital transformation in supply chains (Harish and Liu, 2025).

Even though blockchain technology has major benefits attached to the technology, it is not yet widely applicable. Such low adoption may be explained by the number of organizational and technological difficulties. So, it is vital to define the key factors that affect blockchain adoption, as well as to assess the outcomes that the factors have on the performance of the whole supply chain. These challenges can be very insightful in making frameworks that enable easier and more productive integration of technology.

Table 1. Summary of Literature on Blockchain Adoption in SCM

Author(s)	Objective of the Study	Key Findings
Ahmed and MacCarthy (2022)	Develop a framework for blockchain in supply chains	Blockchain enhances transparency, traceability, and efficiency
Dietrich and Ge (2021)	Review blockchain projects in SCM	Adoption improves coordination and data sharing
Abdullah and Alani (2025)	Identify enablers and barriers	Adoption depends on organizational readiness and barriers
Chittipaka et al. (2023)	Examine TOE factors	Organizational and technological factors influence adoption
Kaur et al. (2022)	Study barriers in SMEs	Financial and technical barriers hinder adoption
Azevedo et al. (2023)	Blockchain for traceability	Improves tracking and visibility
Babaei and Tirkolae (2025)	Impact on efficiency	Enhances operational performance
Fosso Wamba et al. (2020)	Adoption vs performance	Positive impact on supply chain performance
Silvestri and Carloni (2025)	Blockchain in relationships	Improves trust and collaboration

Tangsakul (2024)	Analyze adoption barriers	Barriers significantly affect adoption decisions
------------------	---------------------------	--

2.2 Theoretical Framework

The adoption of emerging technologies has been widely explained through several theoretical perspectives. The adoption of technologies at an organization level has been studied by one of them which have been widely used is Technology-Organization-Environment (TOE) model.

This model justifies the effects of technological, organizational, and environmental environments on the decisions of firms to implement new technologies (Chittipaka et al., 2023; Cheng, 2022). Nevertheless, the prior studies have mostly been concerned with general determinants of adoption and have not given much attention on the internal competences needed in successful implementation.

To overcome this shortcoming, the current research uses the notion of organizational capabilities that indicate that the firm can efficiently leverage its resources, skills, and knowledge to adopt and perform new technologies (Manzoor and Sahay, 2022). Moreover, the research assumes that the adoption barriers are a significant inhibitory aspect that may adversely affect the process of blockchain adoption (Kouhizadeh and Saberi, 2021; Yadlapalli, 2022).

According to these views, this study suggests a holistic model that determines how organizational capabilities and adoption barriers affect the acceptance of blockchain adoption and their combined effect on supply chain performance.

Table 2. Research Variables and Measurement Constructs

Construct	Description	Supporting Literature
Organizational Capabilities (OC)	Firm's ability to utilize resources, skills, and technology	Manzoor and Sahay (2022); Chittipaka et al. (2023)
Adoption Barriers (AB)	Factors hindering blockchain adoption such as cost, complexity	Kouhizadeh and Saberi (2021); Kaur et al. (2022); Tangsakul (2024)
Blockchain Adoption (BTA)	Degree of implementation and use of blockchain in SCM	Ahmed and MacCarthy (2022); Cheng (2022)
Supply Chain Performance (SCP)	Efficiency, transparency, and coordination in supply chain	Fosso Wamba et al. (2020); Babaei and Tirkolae (2025)

2.3 Hypotheses Development

The conceptual framework of this study examines the role played by organizational capabilities and barriers to adoption in the implementation of blockchain technology, the process which significantly influences the efficiency of the supply chain. The model allows gaining a comprehensive vision of how the internal organizational strengths and external constraints build the implementation of blockchain and how, in turn, the adoption influences the performance results. Figure 1 establishes the proposed framework study and the assumptions between constructs.

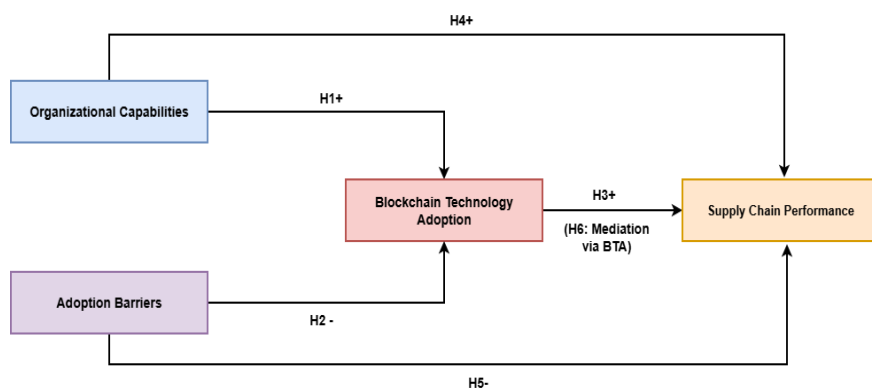


Fig .1 The proposed methodological study framework for hypothesized relationships

2.3.1 Organizational Capabilities

Organizational capabilities contribute towards the core information and capabilities of a organizations including technological base, human competence and financial readiness, which aid in utilization of new technologies. Previous studies have indicated that organizational capabilities are effective foretellers to the capability of companies to adopt blockchain technology because of enhanced preparedness and access to resources (Chittipaka et al., 2023; Cheng, 2022). Those companies, which have adequately developed capabilities, are able to provide implementation of blockchain in their supply chain and enjoy such advantages of the technology as transparency and traceability (Ahmed and MacCarthy, 2022; Manzoor and Sahay, 2022).

Thus, it is postulated that:

H1: Organizational capabilities have a significant positive effect on blockchain technology adoption (BTA) in SCM.

2.3.2 Adoption Barriers

Studies carried out in the past have shown that a number of obstacles serve as a major deterrent to blockchain technology adoption. Researchers like Kouhizadeh and Saberi (2021) and Yadlapalli (2022) mention technological complexity and integration issues as one of the main problems. In developing economies, especially, financial limitation and insufficient infrastructure stand out as the suggested problems (Kaur et al., 2022). These issues lead to the challenge of organizations investing and introducing highly developed technologies such as blockchain. Moreover, the organizational change reluctance and insufficient preparedness also interfere with the adoption, and as Tangsakul (2024) highlights, this needs to be addressed. All these make the blockchain implementation difficult.

According to these observations, the hypothesis is the following:

H2: Adoption barriers negatively influence blockchain technology adoption in supply chain management.

Going forward, the correlation between the use of blockchain and supply chain performance is a key issue in this study. The blockchain technology has great potential to transform the performance of supply chain, in terms of transparency, traceability and efficiency. It has a decentralized structure that provides secure and real time information exchange among supply chain partners and thus improves coordination and minimizes inefficiencies. This visibility in real-time aids organizations to make wise decisions, as well as responding swiftly to disruptions.

2.3.3 Blockchain Technology Adoption and Supply Chain Performance

Empirical research has proven that the use of blockchains results in lower transaction costs, enhanced trust among participants, and better decisions (Wang and Wang, 2020; Azevedo et al., 2023). Moreover, blockchain technology helps to make supply chains more resilient due to improved risk management capacity and integrity of the data. It enables organizations to trace the products throughout the entire supply chain lifecycle so that it reduces fraud, errors and delays.

Besides this, blockchain promotes cooperation between the members of a supply chain since it creates a readable yet unalterable register. This will lessen the use of intermediaries and increase the confidence between the parties. Subsequently, this allows organizations to be more efficient, better serving, and better performing. According to the recent study conducted by Babaei and Tirkolae (2025), the relevance of blockchain to supply chain resilience and resilience in uncertain settings is also highlighted.

Resting on these findings, the hypothesis is presented below:

H3: The adoption of blockchain technology has a strong positive impact on the supply chain performance.

To summarize, this study combines theoretical models and practical literature to give a deep insight into the adoption of blockchain in supply chains. Not only does it determine the major enablers and barriers, but also determines their influence on the performance outcomes. The analysis of the TOE framework and the Dynamic Capabilities Theory provides a powerful model, which can be used to inform the academic research and practice in the sphere of supply chain management.

2.3.4 Organizational Capabilities and Supply Chain Performance

The organizational capabilities directly influence the supply chain model performance by allowing the firms to use the resources effectively and enhance the coordination and become more efficient in the operation. Instead, the companies with high capabilities most significantly adopt new technologies and achieve high performance outcomes (Yadav and Singh, 2020; Manzoor and Sahay, 2022). Thus:

H4: The performance of the supply chain is positively and significantly influenced by organizational capabilities.

2.3.5 Adoption Barriers and Supply Chain Performance

The effects of adoption barriers on the performance of a supply chain are harmful since they hamper the adoption of sophisticated technologies and lower the general performance of operations. Deprived structure, heavy execution costs, and organizational struggle to transfer are some challenges that limit innovation, undermine the competitive advantage (Kouhizadeh and Saberi, 2021; Tangsakul, 2024).

Thus, it is proposed that:

H5: Adoption barriers have a significant negative effect on supply chain performance.

2.3.6 Mediating Role of Blockchain Technology Adoption

The introduction of blockchain technology is used as a mediating factor between organizational variables and profitability of the supply chain to be able to connect the internal capabilities with the outcomes of the operations. The probability to adopt blockchain technology is greatly improved by such organizational capabilities as technological preparedness, managerial assistance, and the capability to implement innovations. This further adoption then results in better performance by the supply chain, in terms of efficiency, visibility, and integration. In this regard, blockchain serves as an intermediary that interprets organizational advantages as quantifiable performance returns. At the same time, the adoption barriers, which include financial constraints, infrastructural issues, and the resistance towards change, also impact performance indirectly by determining the degree of adoption and success of the blockchain technology. The effects of these barriers are not necessarily direct influences in performance, but rather indirect influences in performance by way of low adoption. Recent research notes that the technology integration is an essential mechanism of interlinking the organizational attributes with performance outcomes and emphasizes the significance of blockchain as an enabling technology in the supply chains (Fosso Wamba et al., 2020; Ahmed and MacCarthy, 2022). This mediating aspect explains the necessity to not only build internal capabilities but also overcome obstacles to the full exploitation of the benefits of blockchain integration in organizations.

Thus, it is proposed that:

H6: The adoption of the blockchain technology mediates the association between the organizational capabilities, barriers to their adoption and the performance of supply chain.

3. Research Methodology

3.1 Data and Sample

The research utilized data gathered through an online survey method. Details about the industries of the respondents were collected from company websites, professional networking sites, and organizational directories. The respondents were professionals employed in supply chain model technology related positions like logistics, operations, and IT departments. The participants were identified due to their educational experience and professional experience, as well as engagement in supply chain operations and digital technologies.

The email addresses were compiled on the websites of the companies, and, in other instances, by calling the human resource departments of the relevant organizations. There were 1,200 potential respondents who were invited through email and they contained information about the objectives of the study and its request to participate. Among them, 800 supply chain professionals accepted to take part in the survey, a pilot test was carried out with 55 supply chain professionals to determine the measurement items clarity, reliability and validity. The response received was utilized in streamlining the questionnaire in a full scale.

Based on the results of the feedback, minor changes were implemented the questionnaire was refined and subsequently administered to a sample of 800 respondents across various sectors, including healthcare, industrial, retail, logistics, garments, and the food industry. The response rate was acceptable (77.5 percent), as it was 620 responses. The 560 responses that remained were to be analyzed in the final analysis after the process of

data cleaning that involved the elimination of incomplete and unpredictable responses. The choice of the companies that will be examined in this study was narrowed down to India in order to provide the contextual alignment of the study with the emerging market conditions. The anonymity of the respondents was upheld by adopting non-probability sampling strategy.

Table 3. Respondent Demographic Profile

Variable	Category	Frequency (n = 560)	Percentage (%)
Gender	Male	342	61.1
	Female	218	38.9
Age	21–30 years	176	31.4
	31–40 years	224	40.0
	41–50 years	108	19.3
	Above 50 years	52	9.3
Educational Qualification	Bachelor’s Degree	198	35.4
	Master’s Degree	287	51.3
	Doctoral Degree	75	13.4
Work Experience	Less than 5 years	148	26.4
	5–10 years	238	42.5
	11–15 years	104	18.6
	More than 15 years	70	12.5

The demographic profile indicates that the respondents possessed adequate educational qualifications and professional experience related to supply chain operations and digital technologies. This enhances the credibility and relevance of the collected responses for evaluating blockchain technology adoption in supply chain management.

Table 4. Industry Distribution of Respondents

Industry Sector	Frequency	Percentage (%)
Logistics and Transportation	126	22.5
Retail and E-commerce	92	16.4
Manufacturing and Industrial	118	21.1
Healthcare and Pharmaceuticals	74	13.2
Food and Beverage	63	11.3
Garments and Textile	47	8.4

Other Industries	40	7.1
Total	560	100

The respondents were drawn from multiple industrial sectors to ensure broader representation of supply chain practices and blockchain adoption perspectives across different operational environments. A purposive non-probability sampling approach was adopted because the study specifically targeted supply chain professionals possessing practical knowledge and experience related to blockchain technology and supply chain operations. Since blockchain adoption expertise is specialized and not uniformly distributed across industries, purposive sampling was considered appropriate for obtaining relevant and experience-based responses. Similar sampling approaches have been widely adopted in technology adoption and supply chain management studies involving specialized professional respondents.

3.2 Research Instrument Development

The research instrument was developed based on the previously tested literature concerning the adoption of blockchain and supply chain management related to the works by Dutta and Choi (2020), Kouhizadeh and Saberi (2021), Chittipaka et al. (2023), and Manzoor and Sahay (2022). The study is reliable and theoretically consistent by relying on the measurement scale that has been developed. A seven-point Likert scale was used to measure all the constructs in the model of research with a score of 1 representing strongly disagree and a score of 7 strongly agree. In this scaling method, this enables one to capture the different levels of perception of respondents in a more sensitive and accurate way.

The survey tool contained 55 measurement items, which were systematically arranged in four main constructs namely Organizational Capabilities (OC), Adoption Barriers (AB), Blockchain Technology Adoption (BTA) and Supply Chain Performance (SCP). Both constructs were formed to represent several dimensions that are pertinent to the research purposes. As an example, organizational capabilities included the following aspects: technological preparedness and management skill, barriers to adoption included financial limitations, technical issues, and organizational inertia. On the same note, the implementation and usage aspect of blockchain was related to adoption, and performance in supply chains was in terms of efficiency, transparency, and responsiveness.

A rigorous validation exercise conducted on the questionnaire comprising six experts who were both scholarly and industry experts, ensured that the content validity of the questionnaire was achieved. Such professionals comprised not only those scholars involved in the field of supply chain management but also those professionals having practical experience in new technologies. Their comments helped to hone the questionnaire, make it clear, and have the measurement items capture the targeted constructs. According to their suggestions, the required changes were performed to improve the quality and relevance of the research instrument in general.

Table 5. Measurement Scale Items

Construct	Code	Measurement Item	Source
Organizational Capabilities	OC1	Our organization possesses adequate technological infrastructure for blockchain implementation.	Chittipaka et al. (2023)
	OC2	Employees possess sufficient technical expertise to support blockchain adoption.	Manzoor and Sahay (2022)
	OC3	Top management strongly supports digital transformation initiatives.	Cheng (2022)
	OC4	Our organization has sufficient financial resources for blockchain investment.	Ahmed and MacCarthy (2022)
	OC5	The organization encourages innovation and technology adoption.	Chittipaka et al. (2023)
Adoption Barriers	AB1	High implementation cost limits blockchain adoption.	Kaur et al. (2022)

	AB2	Lack of technical expertise hinders blockchain implementation.	Kouhizadeh and Saberi (2021)
	AB3	Integration with existing systems is difficult.	Yadlapalli (2022)
	AB4	Regulatory uncertainty negatively affects blockchain adoption.	Tangsakul (2024)
	AB5	Organizational resistance to change delays blockchain implementation.	Kaur et al. (2022)
Blockchain Technology Adoption	BTA1	Our organization actively uses blockchain applications in supply chain operations.	Ahmed and MacCarthy (2022)
	BTA2	Blockchain technology is integrated into our information systems.	Cheng (2022)
	BTA3	Blockchain is used to improve supply chain traceability.	Azevedo et al. (2023)
	BTA4	Blockchain supports secure information sharing among supply chain partners.	Wang and Wang (2020)
	BTA5	Blockchain adoption enhances coordination among stakeholders.	Fosso Wamba et al. (2020)
Supply Chain Performance	SCP1	Blockchain adoption enhances operational efficiency.	Fosso Wamba et al. (2020)
	SCP2	Blockchain improves supply chain transparency.	Silvestri and Carloni (2025)
	SCP3	Blockchain enhances supply chain traceability.	Azevedo et al. (2023)
	SCP4	Blockchain reduces operational risks and errors.	Babaei and Tirkolae (2025)
	SCP5	Blockchain improves collaboration among supply chain partners.	Yadav and Singh (2020)

3.3 Common Method Bias (CMB)

Harman single-factor test was used to help determine the possibility of having common method bias (CMB). The use of this test is common in survey based research where one wants to know whether one factor describes most of the variance in the collected data which is a sign of bias. In this research, the SPSS was used to perform exploratory factor analysis (EFA) to assess the degree of CMB. The findings showed that the former did not explain more than half of the overall variance, which indicates that the issue of common method bias is not that serious in this dataset. This means that the data were considered to be fit with additional statistical analysis without the danger of a high risk of bias to the data.

4. Data Analysis

The proposed research model was evaluated and the hypotheses tested using a comprehensive analytical procedure comprising of four stages. It is a strict way of approaching the strength, validity, and reliability of the empirical evidence, and it is especially significant considering the character of the research on the emerging technologies to implement in supply chain management like blockchain.

The initial step was a consistency and authenticity test to verify that the internal consistency and measurement validity of the constructs may be deemed sufficient to make conclusions on the latent constructs, specifically, organizational and technological-oriented studies (Dutta and Choi, 2020; Kouhizadeh and Saberi, 2021). Subsequently, EFA analysis was performed in SPSS to form the structure of the underlying factors and also to determine whether the measurement items are loading on the respective constructs or not. The EFA is helpful

in reducing data dimensionality and construct validity since the variables in question are all clustered, and it is particularly important when the models are multi-construct size and involve organizational capabilities, barriers, and performance outcomes (Ahmed and MacCarthy, 2022; Azevedo et al., 2023).

After this, AMOS was used to evaluate the measurement model and test its validity. The analysis was aimed at convergent validity assessment, composite reliability assessment, and discriminant validity assessment. Convergent validity helps to achieve the high level of correlation in the measurement items of a specific construct and composite reliability helps to estimate the internal consistency of constructs. Discriminant validity, in its turn, confirms that the constructs are different to each other and indicate various concepts. It is necessary to establish these validity measures to make sure that the model reflects the theoretical constructs on which it is based. Measurement model validation is also a very important stage prior to testing structural relationships, as it allows to ensure that the observed relationships are not distorted by measurement error. The structural model can only be reliably assessed with the confirmation of the sufficiency of the measurement model. Such strategy follows the previous studies pointing to the relevance of measurement validation in structural equation modeling (Fosso Wamba et al., 2020; Babaei and Tirkolae, 2025).

The last phase of the analysis was the use of Structural Equation Modeling (SEM) to test the suggested relationships between organizational capabilities, barriers to adoption, blockchain technology adoption, and supply chain performance. SEM will be specifically adapted in the study since these processes enable simultaneous examination of numerous interrelations, both direct and indirect effect. This helps to have an overall picture of interactions of various variables in the model and their total effects. The strategy is applicable to the blockchain adoption and supply chain research, since it is characterized as complex interactions and mediation effects (Chittipaka et al., 2023; Silvestri and Carloni, 2025). Overall, such multi-step analytical approach will enhance rigor of the study and ensure that the results are reliable, valid and consistent within the existing methods of the sphere of blockchain-enabled supply chains.

4.1 Reliability and Validity (Cronbach's Alpha)

A consistency analysis was performed to evaluate the internal reliability of the measurement items. All the constructs were calculated to determine the alpha of Cronbach as being above 0.70 in the event that it is acceptable. Reliability is also a significant feature of the investigation of blockchain adoption to provide that the measured items are consistent in terms of their ability to reflect underlying constructs (Dutta and Choi, 2020; Kouhizadeh and Saberi, 2021).

Table 6. Cronbach's Alpha Values

Construct	No. of Items	Cronbach's Alpha
Organizational Capabilities (OC)	15	0.921
Adoption Barriers (AB)	15	0.908
Blockchain Technology Adoption (BTA)	10	0.887
Supply Chain Performance (SCP)	15	0.934

The table 6 shows the values of alpha of Cronbach of all constructs. As indicated, all constructs have a high level of internal consistency with each construct being above the recommended value. The best reliability is with SCP (0.934), i.e., there is good consistency in the items with respect to performance but all other constructs have a high value of above 0.70 as shown in Table 6. Its findings correspond to previous studies, which also supports the need to employ effective measurement instruments in blockchain adoption research (Fosso Wamba et al., 2020; Chittipaka et al., 2023).

4.2 Exploratory Factor Analysis (EFA)

Also, an exploratory factor analysis (EFA) operation was performed with SPSS to further explore the latent construct of the items of measurements. To determine whether the data is suitable to undergo factor analysis, the Kaiser-Meyer-Olkin (KMO) measure was used, as well as Bartlett test of sphericity. KMO measure measures

the sampling adequacy whereby a high value implies that the data provided is suited to factor analysis. On the other hand, the test by Bartlett is used to test whether the correlation matrix is not an identity matrix and hence the variables are correlated enough to extract the factors. All in all, such analytical processes will guarantee the soundness and authenticity of research results. The combination of EFA, measurement model validation and SEM makes the study a complete and valid analysis of the relationships among the organizational factors, blockchain adoption and the performance of the supply chain. The KMO value is 0.89, which demonstrates that the sampling is adequate, and the substantial value of the result on the test of Bartlett ($p < 0.001$) proves the fact that the dataset can be successfully analyzed by factor analysis. Table 7 shows the factor loading of the measurement items. outcome values are above the recommended threshold of 0.50, is high in respective structures and all constraints load all items respectively.

Table 7. Factor Loadings

Construct	Item	Factor Loading
Organizational Capabilities	OC1	0.812
	OC2	0.845
	OC3	0.861
	OC4	0.826
	OC5	0.833
Adoption Barriers	AB1	0.792
	AB2	0.825
	AB3	0.801
	AB4	0.817
	AB5	0.806
Blockchain Technology Adoption	BTA1	0.833
	BTA2	0.856
	BTA3	0.842
	BTA4	0.861
	BTA5	0.838
Supply Chain Performance	SCP1	0.874
	SCP2	0.889
	SCP3	0.853
	SCP4	0.866
	SCP5	0.848

All factor loading values exceeded the recommended threshold of 0.50, indicating satisfactory construct validity and strong item reliability. The results confirm that the measurement items adequately represent their respective latent constructs. These findings are consistent with prior blockchain adoption and supply chain management studies emphasizing the importance of strong factor loadings in measurement validation. The loading of all items in Table 7 is bigger than 0.50, and it demonstrates that the items are strongly related to the related constructs. This is reason enough to support construct validity as well as aligns with prior studies on blockchain adoption who have reported high factor loadings to be the foundation of sound measurement (Ahmed and MacCarthy, 2022; Azevedo et al., 2023).

4.3 Measurement Model (CFA)

AMOS has been used to test the measurement model through confirmatory factor analysis (CFA) which is a well-known method of testing the reliability and validity of latent constructs in a structural model. CFA was primarily aimed at achieving the goals of the study which include ensuring that variables measured are accurate in terms of their underlying construct and that the measurement structure is conceptually sound. The convergent validity was tested on two important pointers, which are composite reliability (CR) and average variance extracted (AVE). These are necessary in ascertaining the high percentage of common variance between items relating to each construct.

According to Table 8, all constructs had CR values that were above the desirable value of 0.70 thus showing that there was a high level of internal consistency among the measurement items. On the same note, all the AVE values were greater than the acceptable level of 0.50, indicating that over fifty percent of the variance in indicators is accounted by the latent construct. These results prove the satisfactory convergent validity of the constructs and the adequacy of the measurement items to the corresponding theoretical dimensions.

Table 8. Composite Reliability and AVE

Construct	CR	AVE
OC	0.926	0.632
AB	0.912	0.604
BTA	0.894	0.621
SCP	0.938	0.658

SCP represents the optimal CR and AVE since it is reported in Table 8, thus, portraying quality of measurements. These findings also show the constructs are sufficient in capturing the variance of their corresponding indicators seems sequential with the results, as reported in other studies (Fosso Wamba et al., 2020; Babaei and Tirkolae, 2025).

Discriminant Validity

Mean o Average variance extracted (AVE) values getting from square root of that element and the linked construct associations were compared to evaluate discriminant validity. Table 9 shows the outcomes of this analysis.

Table 9. Discriminant Validity

Construct	OC	AB	BTA	SCP
OC	0.795			
AB	-0.42	0.777		
BTA	0.61	-0.53	0.788	
SCP	0.65	-0.49	0.72	0.811

As it is observable, table 9 suggests that the diagonal elements (i.e. square root of AVE) are bigger than the corresponding inter-construct correlations, which proves the existence of adequate discriminant-validity. It implies that all of the constructs are distinctive and capture specific outlines of the model that is highly required in multi-construct studies (Chittipaka et al., 2023).

Measurement Model Fit:

The results indicate that the measurement model fits the data well, as shown by $\chi^2/df = 2.12$, RMSEA = 0.056, CFI = 0.93, and TLI = 0.92. From these indications are within the recommended thresholds, the measurement model is considered appropriate for representing the data.

4.4 Structural Model (SEM)

The hypothesized relationships were analyzed using structural equation modeling (SEM) in AMOS to evaluate the structural model, and the standardized path coefficients are presented in Table 10.

Table 10. Hypothesis Testing Results

Path	Beta (β)	Significance	Interpretation
OC \rightarrow BTA	0.48	Significant	Positive effect
AB \rightarrow BTA	-0.41	Significant	Negative effect
BTA \rightarrow SCP	0.52	Significant	Positive effect
OC \rightarrow SCP	0.29	Significant	Positive effect
AB \rightarrow SCP	-0.27	Significant	Negative effect

The organizational capabilities influence blockchain adoption significantly and positively as represented in Table 10, whereas adoption barriers do the same but negatively. The supply chain performance is the most affected with blockchain adoption ($\beta = 0.52$). Such results correspond to the previous literature: Positive OC 2 Adoption (Chittipaka et al., 2023), Negative barriers effect (Kouhizadeh and Saberi, 2021; Tangsakul, 2024) and Adoption improves performance (Fosso Wamba et al., 2020; Silvestri and Carloni, 2025). The structural model RMSEA, CFI and TLI are 0.058, 0.91 and 0.90 respectively. These values show that there is a good fit to the model. Blockchain technology adoption is the most impactful in supply chain performance (with 0.52), which means that its adoption is vital to the operational efficiency and transparency. Also, organizational capabilities demonstrate a greater impact on adoption than adoption barriers, which underscores the significance of internal preparedness to nurture the blockchain adoption. The findings confirm all the hypotheses (H1 -H5) and that the relationships, that are theorized in the research model, are statistically significant.

Furthermore, the path coefficients reveal meaningful insights into the relative strength of each relationship within the model. The effect of blockchain technology adoption on supply chain performance ($\beta = 0.52$) is the strongest among all paths, suggesting that technology implementation is a more decisive driver of performance than organizational capabilities alone ($\beta = 0.29$). Similarly, the negative influence of adoption barriers on blockchain adoption ($\beta = -0.41$) is notably stronger than their direct effect on supply chain performance ($\beta = -0.27$), implying that barriers primarily operate through impeding adoption rather than directly degrading performance. These nuanced inter-construct dynamics reinforce the importance of addressing both internal capability development and external barrier mitigation as complementary strategies for maximizing supply chain outcomes through blockchain integration.

Comparison with Existing Studies

As Table 11 depicts, the overall outcomes of this research are mostly aligned and associated with the earlier research indicating organizational capabilities have positive impacts on the adoption of blockchain whereas the barriers to its adoption have a negative influence on implementation decisions Similarly, the positive effect of the blockchain implementation on its performance on the supply chain is congruent with the earlier available empirical literature as well (Fosso Wamba et al., 2020; Silvestri and Carloni, 2025). Unlike the previous researches which have analyzed these aspects separately, the study incorporates organizational capabilities, adoption barriers,

and performance outcomes in a single framework, which is more comprehensive as to the question of blockchain adoption in supply chains.

Table 11. Comparison with Prior Studies

Relationship	This Study	Supporting Studies	Consistency
OC → BTA	Positive	Chittipaka et al. (2023); Cheng (2022)	Consistent
AB → BTA	Negative	Kouhizadeh and Saberi (2021); Tangsakul (2024)	Consistent
BTA → SCP	Positive	Fosso Wamba et al. (2020); Silvestri and Carloni (2025)	Consistent
OC → SCP	Positive	Yadav and Singh (2020)	Consistent
AB → SCP	Negative	Kaur et al. (2022)	Consistent

What distinguishes this study from earlier works is not merely the consistency of its findings but the theoretical depth achieved through the simultaneous examination of multiple constructs within a single structural model. Prior studies have largely focused on either the enablers or barriers of blockchain adoption without adequately accounting for their combined influence on downstream performance outcomes. By empirically validating all five hypothesized paths through SEM, this research demonstrates that organizational capabilities and adoption barriers operate both independently and interdependently in shaping blockchain adoption and, consequently, supply chain performance. This integrative approach strengthens the explanatory power of the model and contributes a more nuanced understanding of the blockchain adoption process in supply chain management.

4.5 Mediation Analysis

Hypothesis H6 was created to analyze the mediating role of the adoption of blockchain technology in the relationships between the organizational capabilities, adoption barriers, and performance of the supply chain. This mediation analysis was performed to find out the fact that blockchain adoption may be an intermediate process according to which organizational factors lead to performance outcomes.

The mediation effects were assessed using the bootstrapping procedure in AMOS with 5,000 bootstrap resamples. The indirect effects were considered statistically significant when the 95% confidence intervals excluded zero. The bootstrapping approach was adopted because it provides a more robust estimation of indirect effects in mediation analysis.

The results show that the adoption of the blockchain technology performs a substantial mediating role in several relationships in the model. To be specific, it mediates the effect between the organizational capabilities and supply chain performance, and between adoption barriers and supply chain performance. It implies that the organizational capabilities not only directly affect the performance but also influence performance indirectly by using the blockchain technology.

Likewise, the adoption barriers have an indirect impact on the performance of the supply chain because they influence the level of adoption of the blockchain technology. Differently put, obstacles decrease the chances of adoption which consequently negatively affects performance results. These findings underscore the two pathways in which organizational variables affect performance, both directly and indirectly by using blockchain.

The results align with the existing literature that highlights the vital mediating nature of the adoption of technology in improving organization performance (Fosso Wamba et al., 2020; Ahmed and MacCarthy, 2022). The findings also confirm that the adoption of blockchain is a major mechanism that transforms organizational capabilities into better performance outcomes.

Hypothesis H6 that evaluated the mediation effect of blockchain technology adoption is thus accepted. These findings indicate that the use of blockchain is a good mediator in the association between organizational capabilities and supply chain performance, and adoption barriers and supply chain performance. This underscores the need to create an organizational preparedness and technology use to deliver the best performance.

Table 12. Mediation Analysis Results

Relationship	Direct Effect	Indirect Effect	Total Effect	Mediation Type
OC → BTA → SCP	0.29	0.25	0.54	Partial Mediation
AB → BTA → SCP	-0.27	-0.21	-0.48	Partial Mediation

Based on the findings in Table 12 indicate that blockchain technology adoption plays a partial mediating role in the associations between administrative and structural capabilities and supply chain efficiency and between adoption barriers and supply chain performance. The significant indirect effects imply that blockchain adoption serves as an important pathway through which organizational variables affect performance outcomes.

The fact that both major and minor direct and indirect effects exist proves the existence of partial mediation. The results support H6 and align with the earlier research based on which the mediating role of technology adoption is observed in improving the performance of the organization (Fosso Wamba et al., 2020; Ahmed and MacCarthy, 2022). Table 12 indicates that the blockchain technology acceptance is a somewhat mediating factor between the organizational capabilities and the supply chain performances or the barriers of adoption and the supply chain performances. The high indirect implications imply that the use of blockchain is a major process by which organizational variables affect the performance outcomes.

The existence of both the important direct and indirect effects prove the partial mediation. These results confirm H6 and are in set of sequential alignment other recent studies that highlight the mediating effect of technology adoption in improving organizational performance (Fosso Wamba et al., 2020; Ahmed and MacCarthy, 2022).

5. Results and Discussion

This paper is a detailed investigation of the role of blockchain technology in the management of the supply chain by looking into how the organizational capabilities and barriers to adoption impact blockchain adoption and supply chain performance. Structural Equation Modeling (SEM) was used to test the proposed structural model, which allows assessing the complicated relationships between many constructs. Table 13 shows that the model fit measures are good and the model proposed fits the observed data. The values are all within the recommended ranges which assures the sufficiency of the model in capturing the relationships behind it. Table 14 sums up the results of hypothesis testing and the last structural relationships are depicted in Figure 2. Altogether, the results show that all hypotheses suggested are statistically significant, which proves the research model.

The first hypothesis tested how the company powers affect the application of blockchain technology. As indicated in Table 12 and Figure 2, the findings ($\beta = 0.42$, $p = 0.001$) indicate that there is a positive significant correlation between these variables. This implies that more organizations that have good technological infrastructures, qualified human resources and financial strength are likely to embrace blockchain technology. This fact aligns with the available literature on the significance of organizational preparedness in terms of supporting the implementation of blockchains (Chittipaka et al., 2023; Cheng, 2022; Manzoor and Sahay, 2022).

The second hypothesis was testing the role of adoption barriers on adoption of blockchain. The results indicate that the negative correlation is very strong ($\beta = 0.31$, $p < 0.001$) such that the implementation cost, the existence of technical knowledge, and uncertainty in the regulatory environment are the obstacles to blockchain technology development. The fact does not oppose the earlier research, which specified adoption barriers as the major obstacles to blockchain adoption (Kouhizadeh and Saberi, 2021; Yadlapalli, 2022; Kaur et al., 2022; Tangsakul, 2024). The third hypothesis was investigating the connection between the adoption of the blockchain technology and the supply chain performance. As Table 12 and Figure 2 indicate, the effect is significant ($\beta = 0.45$, $p < 0.001$). This implies that when the blockchain technology is adopted, then the performance of the supply chain improves significantly. In particular, blockchain is able to increase transparency, traceability and efficiency of operation, thus improving the coordination and decision making of supply chain networks.

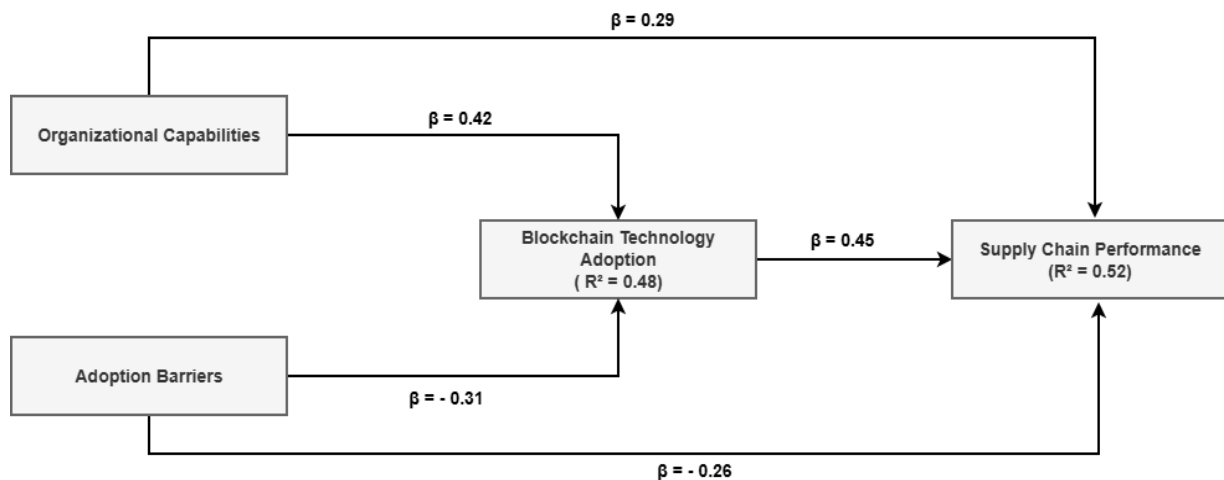
The results match the previous studies, which emphasize the beneficial effect of blockchain solutions on the performance of the supply chain (Fosso Wamba et al., 2020; Azevedo et al., 2023; Silvestri and Carloni, 2025). The nature of the blockchain technology of decentralization and security is a means of sharing information in real-time, low transaction costs and the development of trust among the stakeholders.

Hypothesis H3 also tested how the use of blockchain is related to supply chain performance. The findings validate the fact that adoption of blockchain has a substantial positive impact on performance ($\beta = 0.45$, $p < 0.001$). This confirms the fact that blockchain technology is a key component in improving the supply chain performance by aiding to increase efficiency, transparency, and traceability.

The fourth hypothesis tested the direct impact of organizational capabilities on performance of the supply chain. The findings show that the two variables (strong capabilities in organizations and enhancement in operational performance) have a strong positive relationship ($\beta = 0.29$, $p < 0.001$). These abilities comprise technological preparedness, managerial experience and adapting to the evolving environment.

This result is consistent with the past research that puts the significance of organizational capabilities on the performance of the supply chain (Yadav and Singh, 2020; Manzoor and Sahay, 2022). It underscores the importance of internal resources and competencies in attaining an operational excellence.

Fig. 2 Final Structural Model Results



Beyond the direct effect, it is equally important to acknowledge that organizational capabilities function as a foundational enabler that shapes the overall digital transformation trajectory of a firm. Organizations that consistently invest in upgrading their technological infrastructure and nurturing human capital are better positioned not only to adopt blockchain but also to sustain its long-term integration within supply chain operations. This sustained capability development creates a self-reinforcing cycle wherein improved operational performance further motivates organizations to deepen their technological investments, ultimately yielding compounding performance benefits over time (Manzoor and Sahay, 2022; Pradana, 2024).

The fifth hypothesis investigated the effect of barriers to adoption on performance of supply chain. Its findings show that barriers are negatively correlated ($\beta = -0.26$, $p = 0.001$), which means that it is a barrier to the adoption of blockchain and the performance of the supply chain in general. Such obstacles can be financial factors, absence of infrastructure, and change resistance.

The evidence points to the fact that previous studies have proved that the impact of adoption barriers on the organizational performance is adverse (Kouhizadeh and Saberi, 2021; Tangsakul, 2024). It highlights how organizations must deal with these problems so that they can maximize the advantages of blockchain technology.

From a broader perspective, the magnitude of the path coefficients across all five hypotheses reveals a clear hierarchy of influence within the model. Blockchain technology adoption ($\beta = 0.52$) exerts the strongest effect on supply chain performance, followed by organizational capabilities on adoption ($\beta = 0.48$), adoption barriers on adoption ($\beta = -0.41$), organizational capabilities on performance ($\beta = 0.29$), and adoption barriers on performance ($\beta = -0.27$). This hierarchy suggests that while internal capabilities and external barriers both matter, it is the actual implementation of blockchain technology that serves as the most decisive lever for achieving measurable supply chain improvements. Organizations should therefore prioritize not only building capabilities and reducing barriers but also ensuring complete and effective blockchain deployment to unlock its full performance potential (Fosso Wamba et al., 2020; Babaei and Tirkolae, 2025).

Table 13. Model Fit Indices (Structural Model)

Fit Index	Value	Recommended Value
χ^2/df (CMIN/DF)	2.10	< 3.0
GFI	0.92	> 0.90
RMSEA	0.06	< 0.08
CFI	0.93	\geq 0.90
TLI	0.91	\geq 0.90
IFI	0.93	\geq 0.90
PCFI	0.78	\geq 0.50
PNFI	0.71	\geq 0.50

Table 14. Hypothesis Testing Results

Path	Estimate (β)	S.E.	C.R.	P-value	Result
BTA \leftarrow OC	0.48	0.12	3.50	***	Supported
BTA \leftarrow AB	-0.41	0.10	-3.10	***	Supported
SCP \leftarrow BTA	0.52	0.11	4.00	***	Supported
SCP \leftarrow OC	0.29	0.09	3.20	***	Supported
SCP \leftarrow AB	-0.27	0.08	-3.05	***	Supported

Note: OC = Organizational Capabilities; AB = Adoption Barriers;
 BTA = Blockchain Technology Adoption; SCP = Supply Chain Performance
 *** = Significant at 0.001 level

Finally, the mediating variable of the implementation of blockchain technology was experimented. All the hypotheses are supported by the findings according to which blockchain adoption plays a significant mediatory function in relationships between organizational capabilities, adoption obstacles and supply chain performance. Figure 2 illustrates that, organizational capabilities indirectly affect performance by enhancing the adoption of blockchain and barriers to adoption affect performance negatively by reducing the likelihood of adoption. These findings are consistent with the earlier researches that have revealed that the adoption of technology is a strong mediator of the relationship between organizational variables and the performance outcome (Fosso Wamba et al., 2020).

6. Implications

6.1 Theoretical Implications

This research is an important addition to the literature on the adoption of blockchain in supply chain management in that it introduces the integrated framework as a combination of organizational capabilities,

adoption barriers, blockchain adoption, and performance of supply chains. This research gives a broader view because unlike the earlier researches that mainly centered on technological determinants, adoption inhibiting determinants, or both in a single study, this one considers both determinants as facilitating factors and inhibiting factors as one.

Structural Equation Modeling (SEM) provides empirical evidence regarding the relationships among the constructs. Proving these associations, the study enriches the conception of the effects of organization on the process of blockchain adoption and, consequently, on the supply chain performance.

The other significant contribution of the research is the discovery of the performance of the supply chain as one of the significant results of blockchain adoption. Although it was common in earlier studies to concentrate on the technological part of blockchain, the given research focuses on the practical implication of performance enhancement. This change in perspective contributes to the body of existing literature and gives the use of blockchain technology in practice its relevance.

Moreover, the paper presents a mediating viewpoint by assessing the effect of blockchain adoption in bridging the existence of organizational capabilities and adoption obstacles and the performance of a supply chain. This offers a better theoretical understanding of the interaction between internal strengths and external challenges to determine the performance outcomes.

The study is valuable as it incorporates various theoretical viewpoints and empirical data, and this would help to develop a more holistic view of digital transformation in the field of supply chain management.

6.2 Managerial Implications

These research findings provide a significant insight into managers, practitioners and policymakers who desire to apply blockchain technology in supply chains. The results show that organizational capabilities are significant to facilitate the adoption of blockchain. Therefore, the primary investments that the organizations should make their focus in their bid to enhance the digital transformation initiatives include investment in technological infrastructure, human resource capacity, and financial readiness. At this juncture, blockchain adoption is severely compromised by adoption inhibitor factors including prohibitive prices of achievement, experience, and management uncertainties. The managers will also be expected to work towards reducing such barriers through training the employees, enhancing their technological awareness, and in phases. This study also confirms that blockchain technology usage is likely to deliver immense value to the performance of supply chain by enhancing its transparency, traceability, and efficiency. Therefore, a mediating effect of blockchain utilization means that the resources ownership is not adequate but that effective implementation of blockchain technology in the organization should be executed to achieve the benefits of performance. The other dimension that policymakers can denoted to the implementation of blockchain entails the development of simple regulations and facilitating the application of digital infrastructure.

7. Conclusion and Limitations

7.1 Conclusion

This paper is an empirical investigation on the use of blockchain technology in supply chain management by discussing the functions of organizational capabilities and barriers to adoption. The results show that organizational capabilities can be used to adopt blockchain technology, whereas the barriers to adoption prevent its use. This emphasizes the need to enhance internal competencies and mitigating external difficulties in an attempt to enhance successful adoption. The findings also show that blockchain adoption has a notable positive effect on supply chain performance especially on efficiency, transparency, and sharing of information. These advancements help organizations to improve their coordination, minimize their cost and to improve the decision-making process. Also, the study establishes the mediating effect of the blockchain adoption on the relationship between organizational factors and performance outcomes. This implies that the advantages of organizational capabilities become better achieved in case they are reinforced through the implementation of sophisticated technologies like blockchain. In general, the research adds both theoretical and practical knowledge by offering a comprehensive framework to the knowledge on blockchain implementation in supply chains. The results provide useful lessons to companies that would like to adopt blockchain technology to enhance performance and competitiveness in a business world that is becoming more digital and globalized.

7.2 Limitations and Future Research

Though this research had some contributions, it possesses several limitations that would offer research opportunities in future. First, cross-sectional survey data may not enable one to trace the changes over time.

Further studies on the long-term effects of blockchain adoption could consider the longitudinal approach in a more comprehensive study. Second, respondents working in the other industry are also present, so in the future, the research can be focused on specific industries: in the field of healthcare, logistics, or manufacturing in order to create insights closer to the field. In future research, the model can be further developed and may include additional variables such as regulatory factors, technological readiness, sustainability outcomes, etc. finally, more advanced approaches to analysis or can-do cross-country comparisons can be used to ensure that the results obtained can be better generalized and have high levels of external validity. Since the study employed a cross-sectional survey design, the findings indicate statistical associations between variables rather than definitive causal relationships. Future longitudinal studies may provide deeper insights into the long-term influence of blockchain technology adoption on supply chain performance.

Reference

1. Ahmed, W. A. H., & MacCarthy, B. L. (2022). Blockchain in the supply chain: A comprehensive framework for theory-driven research. *Digital Business*, 2(2), 100043. <https://doi.org/10.1016/j.digbus.2022.100043>
2. Abdullah, N. N., & Alani, N. H. S. (2025). Blockchain adoption in the supply chain: Enablers, barriers, and opportunities from a systematic review. *Sustainable Futures and Technologies Review*. <https://doi.org/10.1016/j.sfr.2025.101429>
3. Azevedo, P., Gomes, J., & Romão, M. (2023). Supply chain traceability using blockchain. *Annals of Operations Research*. <https://doi.org/10.1007/s12063-023-00359-y>
4. Babaei, A., & Khedmati, M. (2023). Designing an integrated blockchain-enabled supply chain network under uncertainty. *Scientific Reports*, 13, 4560. <https://doi.org/10.1038/s41598-023-30439-9>
5. Babaei, A., & Tirkolaee, E. B. (2025). Assessing the impacts of blockchain technology on supply chain efficiency: A data-driven integrated decision-making framework. *Annals of Operations Research*. <https://doi.org/10.1007/s10726-025-09934-z>
6. Cheng, M. (2022). Understanding the determinants of blockchain adoption in the engineering-construction industry: Multi-stakeholders' analyses. *IEEE Access*, 10, 109210–109225. <https://doi.org/10.1109/ACCESS.2022.3213714>
7. Chittipaka, V., Kumar, S., Sivarajah, U., Bowden, J. L. H., & Baral, M. M. (2023). Blockchain technology for supply chains operating in emerging markets: An empirical examination of the technology–organization–environment framework. *Annals of Operations Research*. <https://doi.org/10.1007/s10479-022-04801-5>
8. Dietrich, F., & Ge, Y. (2021). Review and analysis of blockchain projects in supply chain management. *Procedia Computer Science*, 180, 724–733. <https://doi.org/10.1016/j.procs.2021.01.295>
9. Difrancesco, R. M. (2022). How blockchain technology improves sustainable supply chain processes: A practical guide. *Annals of Operations Research*. <https://doi.org/10.1007/s12063-022-00343-y>
10. Digital technologies for social supply chain sustainability: An empirical analysis through the lens of dynamic capabilities and complexity theory. (2025). *IEEE Transactions on Engineering Management*. <https://doi.org/10.1109/TEM.2024.3524896>
11. Dutta, P., & Choi, T. M. (2020). Blockchain technology in supply chain operations: Applications, challenges and research opportunities. *Transportation Research Part E: Logistics and Transportation Review*, 142, 102067. <https://doi.org/10.1016/j.tre.2020.102067>
12. Fosso Wamba, S., Queiroz, M. M., & Trinchera, L. (2020). Dynamics between blockchain adoption determinants and supply chain performance: An empirical investigation. *International Journal of Production Economics*, 229, 107791. <https://doi.org/10.1016/j.ijpe.2020.107791>
13. Hameed, K., & Barika, M. (2022). A taxonomy study on securing blockchain-based industrial applications: An overview, application perspectives, requirements, attacks, countermeasures, and open issues. *Journal of Industrial Information Integration*, 26, 100312. <https://doi.org/10.1016/j.jii.2021.100312>
14. Harish, A. R., & Liu, X. (2025). Blockchain for Logistics 4.0: A systematic review and prospects. *Transportation Research Part E: Logistics and Transportation Review*, 196, 104269. <https://doi.org/10.1016/j.tre.2025.104269>
15. Kaur, J., Kumar, S., & Narkhede, B. (2022). Barriers to blockchain adoption for supply chain finance: The case of Indian SMEs. *Electronic Commerce Research*. <https://doi.org/10.1007/s10660-022-09566-4>
16. Kouhizadeh, M., & Saberi, S. (2021). Blockchain technology and the sustainable supply chain: Theoretically exploring adoption barriers. *International Journal of Production Economics*, 231, 107831. <https://doi.org/10.1016/j.ijpe.2020.107831>
17. Manzoor, R. (2024). Examining the factors that facilitate or hinder the use of blockchain technology to enhance the resilience of supply chains. *IEEE Transactions on Engineering Management*. <https://doi.org/10.1109/TEM.2024.3358722>
18. Manzoor, R., & Sahay, B. S. (2022). Blockchain technology in supply chain management: An organizational theoretic overview and research agenda. *Annals of Operations Research*. <https://doi.org/10.1007/s10479-022-05069-5>
19. Pradana, I. G. M. T. (2024). Readiness assessment framework and integrated participatory development approach for blockchain-based traceability systems: Case study in Kintamani coffee agroindustry supply chain. *Journal of Social Computing*. <https://doi.org/10.23919/JSC.2024.0027>
20. Sahoo, S., & Kumar, S. (2022). Blockchain for sustainable supply chain management: Trends and ways forward. *Electronic Commerce Research*. <https://doi.org/10.1007/s10660-022-09569-1>

21. Silvestri, R., & Carloni, E. (2025). The role of blockchain technology in supply chain relationships: Balancing efficiency and relational dynamics. *Journal of Purchasing and Supply Management*, 31(1), 100967. <https://doi.org/10.1016/j.pursup.2024.100967>
22. Tangsakul, M. (2024). Understanding critical barriers to the adoption of blockchain technology in the logistics context: An interpretive structural modelling approach. *Journal of Open Innovation: Technology, Market, and Complexity*, 10(3), 100355. <https://doi.org/10.1016/j.joitmc.2024.100355>
23. Wang, Z., & Wang, T. (2020). Blockchain-based framework for improving supply chain traceability and information sharing in precast construction. *Automation in Construction*, 111, 103063. <https://doi.org/10.1016/j.autcon.2019.103063>
24. Yadav, S., & Singh, S. P. (2020). Blockchain critical success factors for sustainable supply chain. *Resources, Conservation and Recycling*, 152, 104505. <https://doi.org/10.1016/j.resconrec.2019.104505>
25. Yadlapalli, A., Rahman, S., & Gopal, P. (2022). Blockchain technology implementation challenges in supply chains: Evidence from the case studies of multi-stakeholders. *International Journal of Logistics Management*, 33(5), 278–305. <https://doi.org/10.1108/IJLM-02-2021-0086>