The Effect of Blockchain on Supply Chain Performance on Organization

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Abstract

This article analyzes the effect of blockchain on supply chain performance, emphasizing the intermediary functions of trust supplier, SC traceability, & transparency. Using the amended questionnaire, pre-recruited enumerators collected data from leading supply chain experts and students. 425 of the 415 completed surveys were disseminated. The Partial Least Square-Structure Equation Modeling (PLS-SEM) method was used to analyze the study's data. The information this study provides will benefit the industry supply chain by encouraging the used of BC technology & advancing use to increase supply chain efficiency. It allows for the replication of the paradigm in cross-cultural research across different industries by academics in the future.

Keyboard: blockchain, supply chain, performance

Introduction

The blockchain's popularity has suddenly skyrocketed. Blockchain is increasingly recognized as a potentially valuable technology for the effective management of supply chains Maersk, for example, used blockchain technology from IBM to monitor its containers across the world in an efficient way. (Popper and Lohr, 2017).

New technologies throughout the supply chain are opening up good chances to make things improve. Using blockchain in the SC might minimize administrative value while making the SC more transparent and easier to track. through of a BC, people in a SC may keep track of price, certification, date, quality, location, and other important information. This makes the supply chain easier to manage.

Blockchain technology has seen tremendous growth, making it one of the commercial technologies that is now growing at the fastest rate. (DiNizo, 2018), which spurred creativity and produced a fresh approach to international trade by giving participants access to an ongoing database account (Masudin et al., 2021). Because this data is stored on the blockchain, it can also decrease losses resulting from fraudulent and gray transactions, improves transparency concerning outsourcing contract, make it easier to track traceability of the material supply chain and might even help a company set a new standard for ethical production. Saberi et al. (2019) stated that, blockchain technology (BT) is a emerging and powerful technological development that has the potential to radically change supply networks and enterprises (Jalees et al., 2024). Blockchain technology enhances supply chain visibility, integration, and sustainability, claim Saberi et al. (2019). (2017) "Korpela et al." Accord to Casado-Vara et al. (2018) and Saberi et al. (2018), integrating supply chain (SC) and improving its visibility and traceability may be crucial.

Participating in a blockchain ecosystem has apparent advantages for all stakeholders, however traditional industries face difficulties when implementing such a technology. The necessity to overcome the learning curve associated with blockchain adoption and the financial ramifications of integrating the blockchain into current systems are the main causes of these difficulties. Additionally, it takes time to negotiate the specifics of a corporate deal. When creating intelligent contracts, it is crucial to take into account qualities like adaptability. 2017 (Qinghua and Xu).

The study's goals were as follows:

1. to examine the connections between supply chain integration, transparency, traceability, and transparency's predecessors.

2. to look into how the antecedents of supply chain integration, trust in supplier, supply chain transparency, and SC traceability affect SC performance.

Theoretical Background and Literature Review

According to the Network Perspective theory (NP theory), there is exciting potential to understand and identify significant links across the many networks that enable seamless integration across multiple supply chain management levels. This paper's methodology presents an interesting perspective by viewing the network as a unique and powerful type of connection that brings together a predetermined group of individuals, objects, or events. stated Harland (1996). The concept greatly increases the influence of managers and other leaders by helping them identify key members of various groups. They can gather and share crucial knowledge and information the outcome (Jamil et al., 2024).The intricate nature of the SC network is attributed to the amazing interactions among its various components, which establish its special circumstances. Chang and associates (2012). The concept clarifies how the blockchain perceives relationships between people and organizational structures that either facilitate or impede the sharing of information. 2014 Chinese et al. The Network Perspective (NP) hypothesis helps businesses understand the complex web of interdependencies and interactions across several processes, organizations, and resources, making it easier to identify the most accurate information (Rashid et al., 2024). In this approach, blockchain makes it possible for each link in a chain to instantly give all end consumers the most accurate information. Managers can find structural gaps by applying blockchain technology and network theory. Frankfurt and others (2016). The research model illustrates how cost and innovation capabilities affect BCT & BCT on SCP, with supplier trust, traceability, and transparency acting as mediating factors. It draws from the previously described literature analysis and theoretical framework.

Construction of a conceptual framework and hypotheses.

Taking into account the aforementioned concepts and the theoretical explanation presented in the next sections, we have proposed a model with 16 hypotheses. Conceptual framework depicted in Figure 1 contains the developed hypotheses.

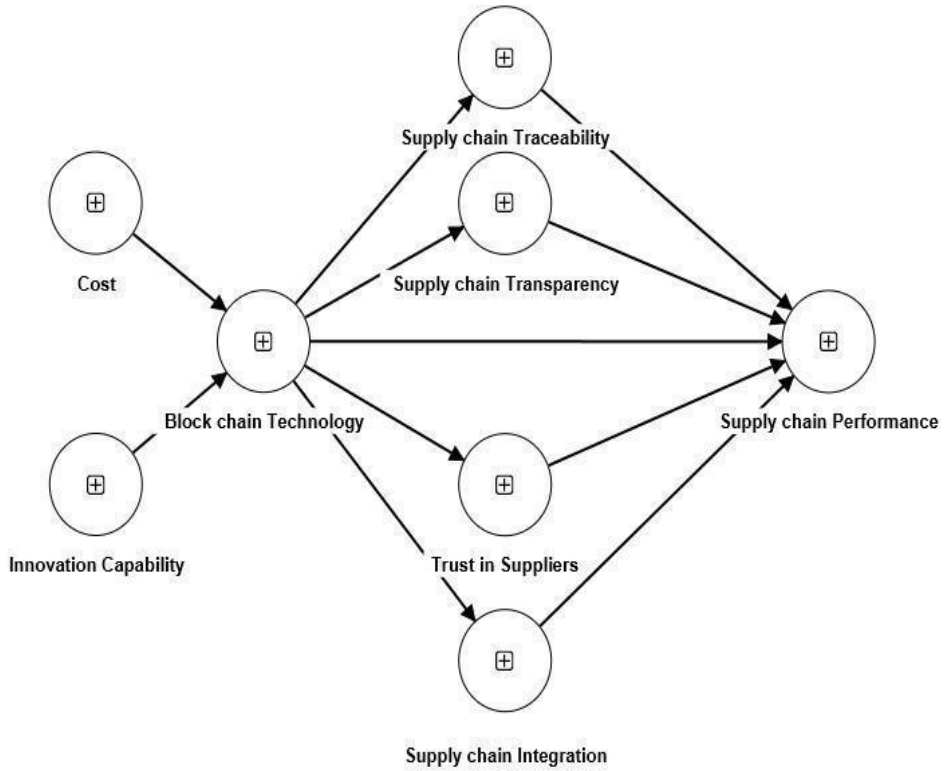
1. BC and SC Transparency

As mentioned Chang et al. (2020), the Hash cash method of adding blocks to a chain has already established the concept of blockchain. Blockchain's features (Chang et al., 2020) make it possible building a decentralized system for a long security chain possibleng transactions without the need for third parties and cutting down on trading time & cost (Abubakar and Hassan, 2018). As explained by Zelbst et al. (2019) and Rashid and Rasheed (2022), RFID technology has a positive effect on Blockchain Technology (BT), which has a good and direct impact on SC Transparency. Availability of information continue to increase, stakeholders urge enterprises for more knowledge about the inputs, processes, and products used as well as the sources of their supply (Khan, Zaman, et al., 2023). According to Kashmanian (2017), improving supply chain transparency has a positive impact on business resilience, share value, credibility, sustainable and security**.**

H1. BC have a positive influence on SC Transparency.

Figure 1

Conceptual Framework



1. **BC and SC-Traceability**

Trust is necessary for relationship development and intelligent supply chain decision-making. Corazzini (1977) asserts that the concept of trust transcends disciplines. The belief that other individuals will keep their half of the contract is known as trust in psychology. Partners must be able to build long-lasting relationships for supply chain partnerships to succeed (Fawcett et al., 2011). Other crucial factors include trustworthiness and confidence (Kujala et al., 2016). The ability of blockchain technology to convey transactional and decentralized data to nefarious players is improving with time.

BTC satisfies fundamental trust norms & needs at each stage in SC. Centobellie et al. (2021) did a research to integrate 3 supply chain reverse operations—re-manufacturing, redistribution, and recycling—with three elements that have an impact on blockchain technology—transparency, traceability, and trust. The analyses of the research show how BTC significantly improves product returns and garbage transportation (Khan, Imran Zaman, et al., 2023).

H2. BTC has a positive influence on SC-Traceability.

2. Transparency in SCP and SC

As a result of revolution in Industry 4.0, the majority businesses are currently preparing to digitize their operations. Industry 4.0 promotes real-time transparency among all players in the SC, from small to big producers or consumers. Manufacturing alone won't guarantee Industry 4.0's success; logistics are also crucial. Khan et al. (2019) also investigated how supply chain transparency may enhance functionality, efficacy, and capacity to minimize the negative effects of disasters on product distribution (Cottrill, 2018). Put money in SC transparency pays off financially for firm. (Handfield and Linton) 2017. According to Francisco and Swanson (2018), companies are under increased pressure to make sure that their SC department is open. Numerous studies have emphasized the consequence of SCn transparency for an enterprise's sustainability. Gardner et al., 2019; Jestratijevic et al., 2020).

H3. SC-Transparency has a positive affact on SCP.

H4: SC-Transparency positively affects and mediates the relationship between BC and SCP.

3. **BC and supplier trust**

Trust is necessary for relationship development and intelligent supply chain decision-making.

Corazzini (1977) asserts that the concept of trust transcends disciplines. The belief that other individuals will keep their half of the contract is known as trust in psychology. Partners must be able to build long-lasting relationships in order for supply chain partnerships to succeed (Fawcett et al., 2011). Other crucial factors include trustworthiness and confidence (Kujala et al., 2016). The ability of blockchain technology to convey transactional and decentralized data to nefarious players is improving with time (ul Haque et al., 2024).

BC technology satisfies fundamental trust requirements and standards at each stage of the SC. With this in mind, Centobellie et al. (2021) conducted a study to link 3 supply chain reverse operations—re-manufacturing, redistribution, and recycling—with three variables that have an impact on blockchain technology—transparency, traceability, and trust. The end of the research show how blockchain (BTC) significantly improves garbage transportation and product returns.

H5. BTC has a positive influence on Supplier Trust.

4. SC-traceability and SCP

How well a nation's economy does depends on its capacity to provide its citizens with secure, high-quality products. One of the biggest issues that emerging nations face in this area is frequently the problem in logistics sector (Aziz et al., 2024). In an effort to identify a solution, organizations typically monitor the out flow of material along the whole supply chain until they are consumed by end users. In this case, a traceability mechanism must be implemented. Additionally, a technique for constructing a logistics system based on traceability was proposed by Ravie et al. (2018). Performance traceability's effects on quality information systems. The study's findings show that logistical traceability significantly and favorably affects the SCP as a whole. The effectiveness of the SC is impacted by the lack of details exchange and tracking (Gonzalez-Feliu et al., 2018). To avoid this traceability, SC digitization may be highly beneficial (Rueda-Velasco et al., 2019). In today's modern industries, a traceability is necessary to ensure consumer trust in product quality (Kittipanya-Ngam and Tan, 2020).

H6. SC-Traceability has a positive impact on SCP.
H7. BTC have a positive affact on SC-Traceability.
H8. SC-Traceability both influences and mediates the relationship between BC and SCP in a good way.

5. **Supplier trust and SCP**

Mutual trust enhances just-in-time capabilities of the supply chain participants. According to the study, to fully benefit from supply chain integration, supply chain participants must collaborate in a trustworthy way (Li et al., 2007). Trust is defined by Morrow et al. (2004) as "the point to which one believes that others will not act in a way that exploits one's vulnerabilities." It is essential for encouraging collaboration between those involved in the SP (Johnston et al.,2004). The objective of Amer et al. (2017) was to provide suggestions enhancing Supply chain performance timely delivery and economical use of resources. According to Olah et al. (2017), among the organizational improvement factors that are favorably impacted by stakeholder trust and its levels is supply chain performance.

H9. Supplier Trust has a positive influence on SCP.
H10. BTC have a positive influence on Supplier Trust.
H11. Supplier Trust positively influences and mediates between BC and SCP.

6. SCP and BC

The contributors are happy with enjoyment they received from the blockchain technology in terms of enhancing their operation, according to Hackius and Petersen (2017). In a similar vein, Perboliet al. (2018) said that BT has had great success cutting logistics costs and enhancing overall logistics operations. The report also highlights how, by streamlining incoming operations, blockchain improves supply chain dependability, efficiency, and transparency (Rashid et al., 2023).

H12. BC has a positive influence on SCP.

7. **Innovation capability (INC)**

Yang (2012) defines INNC as the ability of the administration to turn ideas and information into brand-new frameworks, practices, services, and products that are advantageous to the business. People think that lowering risks, improving operations, and enhancing effectiveness all depend more on a supply chain's capacity for innovation. (2000) Teece and co. According to our research, utilizing innovative talents may improve supply chain performance. by providing SC process that is simple and uniform, changing a dynamic SC environment, and offering creative and technical solutions to a problem.

H13. Innovation capability positively influences the blockchain.

H14. BTC positively influences and mediates the relationship between SCP and Innovation Capability

8. **Cost**

Cost was defined by Hanif et al. (2010) as the sum of money needed to be raised and spent in order to use BC in SC. The price of innovation that needs to purchase for installation is a crucial factor. when deciding whether to adopt blockchain and whether upper management will find it beneficial (Dwivedi et al., 2016). High adoption costs are frequently a roadblock to the execution of technology and associated processes (Shi & Yan, 2016).

Since more consumers require specialist training to feel comfortable using sophisticated technology like blockchain, the cost of introducing a new technology is often higher(2018); Museli & Jafari Navimipour (2018); Gallardo et al. (2018). It is challenging and complex to estimate the cost of using a blockchain. In blockchain-enabled SCM, the costs of transactions, operations, and maintenance must also be calculated (Wong et al., 2020a).

H15. COST positively influences blockchain.

H16. BT positively influences the relationship between SCP and Cost.

Research Methodology

Data collection and techniques

Top corporate managers and employees connected to the supply chain business have been carefully sought because of their prior experience with supply chain management across a range of industries. After sending out the survey through email, the authors received a notable 415 completed questionnaires.

Typical bias in methods

Method bias is often caused by variations in survey resulting from the research instrument (Podsakoff et al., 2003). The study minimized the possibility of biases related to the traditional approach by following the procedure. It is necessary to construct a conceptual framework with a theoretical basis in addition to modifying regularly used scales and metrics. The most recent data set was then used to confirm continued reliability & validity of the questionnaire (Podsakoff et al., 2003).

Questionnaire

Effect of integrating blockchain technology in supply networks was examined through the use of a questionnaire. We want to look into how blockchain used in various supply chain contexts.

Sizes & proportions

Every construct used in the investigation was derived from past research. Table 1 provides information regarding the construct's item count and sources. There is also an appendix with the whole poll.

Table 1
Summary of Questionnaire

	References	Items
SC Performance	(Rashid et al., 2022)	3
SC Traceability	(Rashid et al., 2022)	3
SC Transparency	(Rashid et al., 2022)	3
Trust in Supplier	(Rashid et al., 2022)	3
Blockchain technology	(Kamble et al., 2021)	3
SCIntegration	(Kamble et al., 2021)	3
Innovation Capability	(Nayal et al., 2021)	3
Cost	(Nayal et al., 2021))	3

Discriminant Validity

The study has used Fornell and Larcker (1981) a discriminating criterion for evaluating validity. There is a visual summary of the findings in Table 3. Since the square root of AVE values are greater than the Pearson Correlation values, the results show that the constructs used in the study are unique and different.. (Fornell and Larcker, 1981).

From the study, eleven direct theories and eleven indirect hypotheses have been made. Bootstrapping was used to test the theories. Table 4 shows the results of the theories, and Figures 2 and 3 show the measurement and structural models.

Our results proved that all direct hypotheses except the following two (1) Supply chain Transparency affects Supply chain Performance (β 0.009, t 0.253 0.800, $p > 0.05$) and (2) Trust in Suppliers affects SC Performance (β -0.063, t 1.343 0.179, $p > 0.05$).

Discussion

Our study found SC sustainability positively influences SC performance (H1), which is necessary for the enhancement of firms and better management. Therefore successful industries focus on supply chain performance with a sustainable environment.

Table 2.
Descriptive analysis

	Cronbach's alpha	Composite reliability (rho_c)	Average variance extracted (AVE)
Blockchain Technology	0.780	0.872	0.696
Cost	0.875	0.922	0.798
Innovation Capability	0.810	0.888	0.726
SC Integration	0.759	0.863	0.677
SC Performance	0.801	0.882	0.715
SC Traceability	0.854	0.911	0.774
SC Transparency	0.760	0.862	0.676
Trust in Suppliers	0.881	0.927	0.809

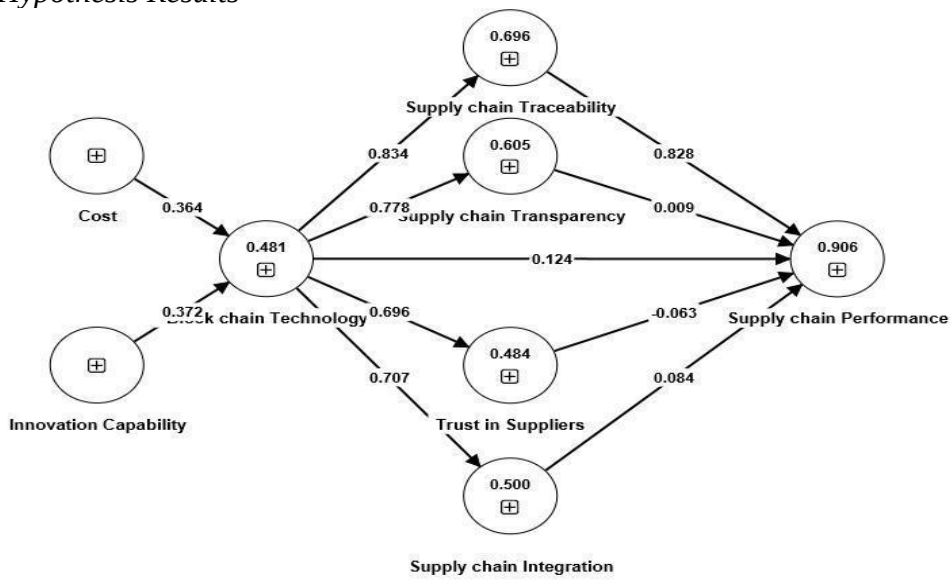
Table 3

	Blockchain Technology	Cost	Innovation Capability	Supply chain Integration	Supply chain Performance	Supply chain Traceab	Supply chain Transparency	Trust in Suppliers
Blockchain Technology								
Cost	0.766							
Innovation Capability	0.821	0.922						
Supply chain Integration	0.915	0.725	0.752					
Supply chain Performance	1.044	0.738	0.761	0.844				
Supply chain Traceability	1.019	0.728	0.738	0.801	1.098			
Supply chain Transparency	1.007	0.841	0.808	0.938	0.898	0.885		
Trust in Suppliers	0.840	0.634	0.679	1.078	0.810	0.813	0.911	

Table 4
Discriminant Validity

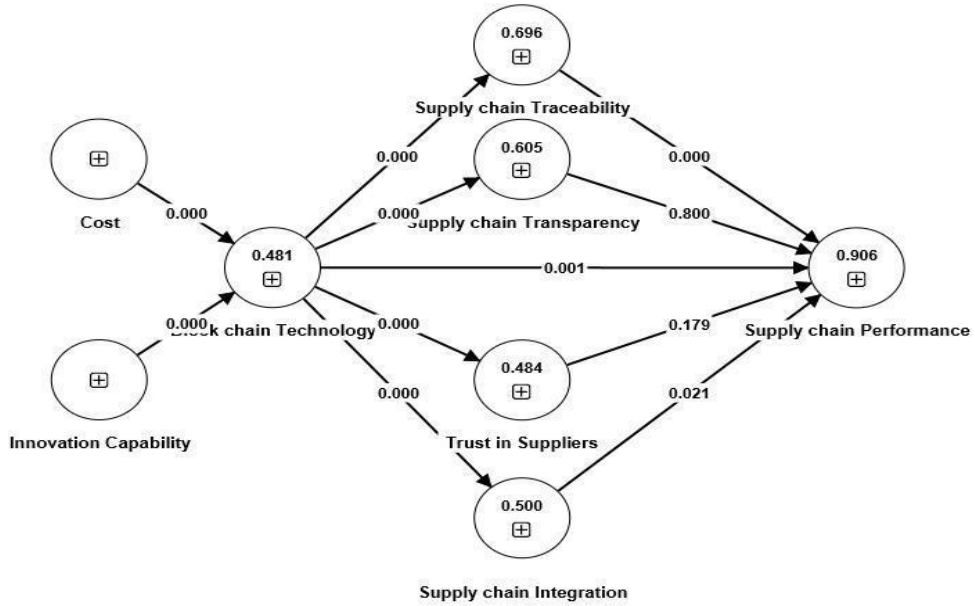
	Beta (B)	(STDEV)	T value	P values	Result
Blockchain Technology -> SC Integration	0.707	0.027	26.059	0.000	Accepted
Blockchain Technology -> SC Performance	0.124	0.037	3.332	0.001	Accepted
Blockchain Technology -> SC Traceability	0.834	0.021	39.914	0.000	Accepted
Blockchain Technology -> SC Transparency	0.778	0.026	29.950	0.000	Accepted
Blockchain Technology -> Trust in Suppliers	0.696	0.032	21.983	0.000	Accepted
Cost -> Blockchain Technology	0.364	0.075	4.862	0.000	Accepted
Innovation Capability -> Blockchain Technology	0.372	0.070	5.330	0.000	Accepted
SC Integration -> SCP	0.084	0.036	2.301	0.021	Accepted
SC Traceability -> SC Performance	0.828	0.025	32.759	0.000	Accepted
SC Transparency -> SC Performance	0.009	0.034	0.253	0.800	rejected
Trust in Suppliers -> SC Performance	-0.063	0.047	1.343	0.179	rejected
Blockchain Technology -> SC Performance	0.713	0.035	20.292	0.000	Accepted
Cost -> SC Integration	0.258	0.055	4.726	0.000	Accepted
Cost -> Supply chain Performance	0.305	0.064	4.760	0.000	Accepted
Cost -> SC Traceability	0.304	0.063	4.789	0.000	Accepted
Cost -> SC Transparency	0.283	0.061	4.657	0.000	Accepted
Cost -> Trust in Suppliers	0.254	0.053	4.750	0.000	Accepted
Innovation Capability -> SC Integration	0.263	0.052	5.047	0.000	Accepted
Innovation Capability -> SC Performance	0.311	0.058	5.327	0.000	Accepted
Innovation Capability -> SC Traceability	0.310	0.059	5.285	0.000	Accepted
Innovation Capability -> SC Transparency	0.289	0.055	5.287	0.000	Accepted
Innovation Capability -> Trust in Suppliers	0.259	0.051	5.056	0.000	Accepted

Figure 2
Hypothesis Results



We found that Cost and innovation capability affect blockchain technology (H1, H2).
We also found that blockchain also effects SC traceability, SC transparency, trust in suppliers, and supply chain integration. (H3, H4, H5, H6). And blockchain directly effects Supply chain performance (H7). Blockchain is the certain point for the betterment of SC performance in the organization

Figure 3



We found that SC traceability (H3) mediates the blockchain and SC performance. SC transparency (H4) mediates the blockchain and SC performance. Trust in suppliers (H5) mediates the blockchain (BC) and SCP. SCI (H6) mediates blockchain & supply chain performance.

Conclusion

The framework model NP theory, and theoretical support for the development of a model which helps to examine SC Performance. The adapted model has 22 relationships, which include Four mediating effects. The study has conducted the impact of factors cost, innovation capability, and blockchain. The research investigation has also looked at the effect of mediators.of blockchain, SupplyChain (SC) transparency & traceability, trust in suppliers, and supply chain integration. The outcome shows that SC performance significantly effect all factors. Trust in Suppliers and Supply Chain Transparency does not effect significantly SC Performance.

Theoretical implications

Our Research aims to expand the current understanding of block chain (BT) by organize a practical analysis on the elements that influence its affecting and the role it plays a ensuring long-term viability. Consequently, it is recommended that practitioners employ this business tool to enhance internal organizational collaboration, thereby fostering sustained growth for the corporation (Si et al., 2023). Research additionally revealed businesses have the potential to enhance their efficiency through the utilization of Business Technology (BT) in critical decision-making processes driven by the objective of minimizing organizational complexity. enterprises have the opportunity to enhance this blockchain technology (BT) by strategically leveraging effective collaboration, data visibility, and traceability. This optimization extends beyond internal operations and encompasses external stakeholders, including enterprises and other relevant entities. The transparency of BT's supply chain enables participants to cultivate trust by establishing protocols for data management, specifying permissible data collection practices, and defining the scope of data/information accessibility within the system. Firms have the potential to achieve cost savings by eliminating conventional processing methods, such as middlemen, vendors, and third parties, through the utilization of blockchain technology (BT) (Zaman et al., 2023). This technology not only facilitates the execution of these operations but also streamlines the processes of reporting and also in auditing.

Future recommendations and limitations

Future research may explore additional variables that act as mediators in figuring out how much of an impact blockchain technology has on efficiency in supply chains. Study findings could serve as an important reference for policymakers, despite the limited sample size in Pakistan. In addition, it is good to consider the potential benefits of replicating the same research in multiple countries as they transition their supply chains from traditional to digitalized systems (Khan, Imran Zaman, et al., 2023). This would contribute to the advancement of scholarly research in the future.

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