Journal of Contemporary Business and Islamic Finance
Volume 3, Issue 1, 2023 C.E./1444H, Pages 250-263

Available Online
https://journals.iub.edu.pk/index.php/jcbif
ISSN: 2790-2986

Nexus of Block Chain Alignment, Supply Chain Agility, Supply Chain Performance and their Impact on Firm's Environmental Performance: A Developing Country Perspective

Muhammad Shahid Yaqub*[1], Noor Ul Ain[2], Hassan Mujtaba Nawaz Saleem[3], Muhammad Junaid Akbar[4]

[1] Assistant Professor, Department of Marketing and International Business, Institute of Business Management and Administrative Sciences, The Islamia University of Bahawalpur, Pakistan
[2] M.Phil Scholar, Department of Marketing and International Business Institute of Business and Administrative Sciences. The Islamia University of Bahawalpur.Email: ghaurinoor@gmail.com
[3] Assistant Professor, Department of Finance, Institute of Business Management and Administrative Sciences, The Islamia University of Bahawalpur, Pakistan.Email: hassan.mujtaba@iub.edu.pk
[4] M.Phil Scholar, Department of Marketing and International Business Institute of Business and Administrative Sciences. The Islamia University of Bahawalpur.Email: junaidakbarmalik88@gmail.com
* Correspondence: Email:shahid.yaqub@iub.edu.pk

Received: January 2023
Accepted: June 2023
Published: June 2023

Publisher's Note: JCBIF stays neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Abstract: Blockchain technology has significant potential for improving the environmental performance of businesses and supply chains. One of the key benefits of blockchain is its ability to provide greater transparency and traceability in supply chains. This can enable companies to better monitor and manage their environmental impacts, such as carbon emissions and waste production, throughout their supply chain. Therefore, the purpose of this study was to investigate the use of blockchain technology in improving supply chain alignment (SCA), supply chain agility (SCAG), and supply chain performance (SCP), and their influence on the environmental performance (EP) of firms. Additionally, the study aimed to identify the moderating effect of innovative climate (IC) on the relationship between SCA, SCAG, SCP, and EP. The researchers employed a quantitative research paradigm and collected data through a survey questionnaire. The sample was collected using the probability cluster sampling method and consisted of 350 personnel in executive and middle management positions. The results indicated that SCA, SCAG, and SCP positively impact the EP of businesses, and this relationship is moderated by IC. The study's findings have several theoretical and practical implications, including the potential for blockchain technology to improve supply chain sustainability and the importance of fostering an innovative climate to enhance the positive effects of SCA, SCAG, and SCP on EP.

Keywords: *Blockchain technology, supply chain alignment, supply chain agility, supply chain performance, innovative climate, environmental performance.*

1. Introduction

Blockchain technology (BCT) originated from the electronic cash system described by Satoshi Nakamoto, which introduced the 'bit coin' digital currency in 2008. BCT has the potential to enhance transparency and effectively manage and store critical product information throughout the product life cycle. In manufacturing supply chains, distributed data blocks can create a secure and shared record of transaction data and product information. The impact of blockchain technology, which encompasses technological objects and human interactions, is expected to extend beyond supply chains to the environment and society as a whole (Reijers et al., 2018). Innovative businesses that experiment with blockchain technology in supply chain infrastructure and expertise capabilities are expected to be unique. Numerous researchers have contributed to this field, such as Fawcett et al. (2011) and Turkman et al. (2007). However, studies have shown that technical skills and understanding alone are insufficient (Kim et al., 2018). Likewise, firms do not automatically possess modern blockchain technology assets that can enhance supply chain performance (Zhang et al., 2011). The sentence structure and English are correct.

Block Chain Technologies is regarded as a modern technology(Megat et al.,2023), particularly in the field of SCM, because it possesses multiple advantageous characteristics that can solve a variety of SCM problems (Casey & Wong, 2017; Korpela, Hallikas, & Dahlberg, 2017; Kshetri, 2018). The nature of the supply chain issues being addressed, as well as the BCT application in its early development or implementation stages. Increasing efforts to implement supply chains enabled by Block Chain Technologies are being observed. Capabilities of the operational supply chain that enabled significantly Information sharing and coordination capabilities. There are two ways that IT can be utilized to aid in environmental management and stability. First, information technology can be "greened" by incorporating environmental stability principles into an organization's IT strategy and usage, thereby reducing IT's negative environmental impacts (Elliot et al., 2008). Numerous businesses participate in environmental sustainability and implement procedures for environmental management (energy efficiency, waste reduction) that contribute to reputation enhancement and environmental impact reduction (Montabon et al., 2007)

Technology plays a significant role in environmental sustainability because it increases the effectiveness of firm resources and business processes, thereby making the environment sustainable (Watson et al., 2010). However, industrialization played a crucial role in increasing carbon production; consequently, the supply chain and electrical grid are used to mitigate these negative effects (Mithas et al., 2010). The natural resource base theory is an extension of the resource-based theory that incorporates the natural environment into the relationship between resources, environmental performance (EP), and firm performance (Hart, 1995). Firms can develop organizational capacities to increase their performance outcomes while mitigating their impact on the natural environment, leading to environmental sustainability (Benitez-Amado et al., 2013).

Environmental Performance refers to a company's compliance with environmental regulations, as well as its efforts to mitigate the impact of environmental crises and educate its employees on environmental issues (Nishant et al., 2012). There is a positive correlation between technology, environmental management, and EP. By enabling more effective and adaptable environmentally sustainable processes, technology can enhance a company's EP. EP involves not only meeting regulatory requirements but also preventing and mitigating environmental crises and minimizing the impact of business processes on the natural environment. Integrating information technology with environmental management can further enhance a company's EP.

A supply chain process involves the continuous flow of money, materials, and information among its members (Ammous, 2016). To create efficiency and effectiveness, all members of the supply chain must work together, especially given the financial excess and trust issues that have affected previous supply chain performance and the difficulty of tracking purchases. Blockchain technology (BCT) has proven useful in improving demand forecasts, inventory management, and backup plans for demand disruptions (Dolgui et al., 2018). By creating a decentralized structure with transparent and distributed data, BCT enables diverse groups and network actors to share data in real-time across the globe, thus enhancing the sustainability of the supply chain environment. Alignment and agility are crucial elements that give an organization a competitive advantage, and BCT-based business process execution improves speed, accuracy, and dependability (Kim, 2018). BCT eliminates trust issues between trading partners and facilitates record-sharing, allowing the entire supply chain to focus on a common objective and enhancing supply chain alignment (SCA) and business competitiveness. SCA involves a strategy that includes tracking data, reporting, and reviewing quality-improvement information systems, which can result in a shift in organizational priorities and the deployment of Total Quality Management (TQM)-related tools and resources (Sharifi et al., 1999). This, in turn, has a positive impact on EP.

Blockchain technology (BCT) has the inherent capability to integrate with all supply chain processes, as it generates a digital ledger that can be accessed and shared with high reliability by all parties involved. Previously, tracking all purchases made by members of the supply chain was challenging, but digital ledgers in blockchain make tracking easy. Moreover, this study aims to contribute to the body of knowledge by introducing an innovative climate (IC) that may increase employee motivation and creativity, thereby enhancing work performance. By shedding new light on the relationship between supply chain alignment (SCA), supply chain agility, supply chain performance (SCP), and their impact on environmental performance (EP), this study adds to the existing knowledge base. The scope of this study is empirical, as it examines the use of blockchain in supply chain alignment (SCA), supply chain agility, and supply chain performance (SCP), and how they enhance environmental performance (EP). The current model provides valuable insights for researchers and serves as a foundation for future research. This study contributes to the literature on blockchain technology (BCT) by incorporating it into other supply chain parameters and analyzing its impact on EP. As many emerging technologies are expected to be utilized in supply chains in the future, this study is a valuable resource that reveals the impact of other technologies on the supply chain.

2.Theoretical Underpinning and Literature Review

2.1The theory of resource-based view (RBV)

Penrose's (2009) resource-based view (RBV) theory describes a company's competitive advantages for improving environmental performance (EP) by deploying its assets to maintain three strategic competencies: product management, pollution mitigation, and sustainable development. RBV focuses on the concepts of resources, their performance, and power (Hart, 1995), specifically managing resources that are a source of competitive advantage for businesses and gaining access to these resources to maximize their potential.

Moreover, there is a significant emphasis on researching the relationship between company performance and sustainability, particularly in identifying sources of competitive advantage by integrating environmental and social concerns into corporate capabilities (Hart, 2003). The RBV perspective of sustainable supply chain management suggests that companies in a supply chain can gain a competitive edge by developing unique sustainability-related skills and applying power, which is consistent with the conventional view of corporate performance. This perspective reveals how this development fits into overall business performance objectives. Sustainable supply chain management is defined as an extension of conventional purchasing and supply activities and is integrated into the realm of strategic management (Pullman, 2009). The authors of the study also investigate how businesses handle variability by determining whether to internalize or outsource environmental operations (Vachon & Klassen, 2008). In this regard, it is essential to comprehend the governance system that is most appropriate for guiding environmental and social performance between suppliers and customers. Resource-based theory plays a critical role in enhancing environmental sustainability in supply chains by improving resource efficiency. The alignment, agility, and performance of the supply chain have a significant impact on EP.

2.2 Supply chain alignment, environmental performance, blockchain technology

Alignment has been a key concept in evaluating the performance effects of environmental and strategic alignment, as recognized by organizational scholars (Venkatraman & Prescott, 1990). A manufacturing enterprise must recognize that the correct supply chain (SC) strategy necessitates alignment with varying levels of environmental risk to maintain a competitive advantage. Previous studies have discussed and empirically studied ideal alignments on various issues, including business strategy and information technology programs, SCM structure and business projects, and business projects and the environment, which have a remarkable impact on business success (Bergeron et al., 2004; Sabherwal & Chan, 2001; Sanders, 2005; Stock et al., 2000; Venkatraman & Prescott, 1990). Recent studies show a significant positive relationship between supply chain agility (SCA) and business performance, which can be utilized to design, construct, and enhance SCA to enhance business performance. The concept of SCA was used to expand the conceptual framework, incorporating the influence of alignment on business success and clarifying the shareholder competitive advantage relationship. The researcher developed hypotheses and surveyed British manufacturers to assess them, resulting in an experimentally strengthened conceptual framework that clarifies how SCA, when implemented effectively, leads to improved business performance (Wong et al., 2012).Blockchain technology accelerates the execution of business processes and enhances their precision and reliability (Kim, 2018). It enables users to share records with trading partners, reducing trust issues (Davidson et al., 2016). Based on previous studies, the researcher hypothesized that SCA aids in sustainable production and manufacturing, which contributes to recycling and reusing products, improving EP, and that blockchain aids in enhancing SCA, which contributes to positive EP.

H1. There is a significant positive relationship between SCA and EP.

2.3 Supply chain agility, environmental performance, Blockchain technology

Agility, as defined by A. Kumar & Motwani (1995), is an organization's ability to rapidly increase activities on a difficult path, which is essential for competing based on sensitivity to change (Mason-Jones, Naylor, & Towill, 2000). "Going green" is now a requirement, as stated by Margaretha & Saragih (2013). On the other hand, a green business is socially responsible, environmentally conscious, and resource-efficient (Sathyapriya et al., 2013). By using BCT, trading partners can share documents, designs, quality documentation, and transaction data more quickly, accurately, and reliably. Sharing information in this manner aids in demand forecasting, inventory management, and data backup (Ivanov et al., 2019). Previous research has shown that the adoption of agility within an organization is positively correlated with organizational strategy and eco-friendly product development, and BCT is used to enhance the performance of supply chain agility.

H2. There is a significant positive relationship between SCAG and EP.

2.4 Supply chain performance, environmental performance, Blockchain technology

In previous research, it has been stated that supply chain performance (SCP) outcomes include cost reduction, which involves reducing material, processing, information, and management fees, as well as reducing overhead, risk, price per operation hour, and other intangible expenses (D. W. Cho et al., 2012; Lee, 2012; Gunasekaran et al., 2004; Shepherd & Günter, 2010; Zhang et al., 2011). Quality compliance and improvement imply that service expectations and customer products are met, process and product errors are reduced, quality is differentiated, and data errors are decreased. Product and service delivery times, supplier lead times, pre-and post-sale service periods, supply chain processes and their cycle times, product development cycle times, and transaction times have all been shortened. Process improvement includes increased capacity, inventory consumption, resource consumption, and flexibility in process time reduction. Response to shifting consumer expectations and environmental constraints, delivery flexibility, risk-sharing activities, service system agility, and SCAG with suppliers are also included. With BCT and supply chain system capabilities, it is more likely that process improvements, product, and service quality improvements, cost reductions, flexibility, and process time reductions will occur. This helps SCP improve the effectiveness and efficiency of resources, which aids in waste reduction and has a positive impact on EP. Blockchain helps in tracing and monitoring SCP, demonstrating a connection between SCP and EP (Lee, 2012; Gunasekaran et al., 2004; Shepherd & Günter, 2010).

H3. There is a significant direct relationship between SCP and EP.

2.5 Innovative climate and environmental performance

Innovative climate has been identified as a crucial factor in achieving better environmental performance. According to Chang, Jang, & Lu (2014), an innovative climate "encourages employees to engage in activities that promote creativity and innovation, which can lead to the development of new products and services that are more sustainable and eco-friendlier" (p. 308). Furthermore, an innovative climate fosters a culture of environmental responsibility within an organization, which leads to more environmentally conscious practices.

Research by kraus et al., 2020 indicates that organizations with an innovative climate tend to have better environmental performance than those without. They found that an innovative climate promotes the adoption of environmental management practices, such as reducing energy consumption and waste generation, which in turn leads to improved environmental performance.

Similarly, Abu Seman et al., 2019 found that an innovative climate positively affects a firm's environmental performance through the adoption of eco-friendly technologies and the development of new eco-friendly products.

H4. There is a direct relationship between Innovative Climate and Environmental Performance.

2.6 Moderating role of innovative climate in relationship between supply chain parameters (SCA, SCAG, SCP, and EP)

In recent decades, there has been a significant effort to determine the most important elements for a company's competitiveness, and previous research suggests that IC is the most influential variable in a company's profitability and competitiveness (Ren, 2015). Scholars have studied the impact of an innovative organizational climate on a company's overall performance, which includes encouraging training, brainstorming, and skill development. An innovative environment fosters individual to think freely and take calculated risks, improving procedures, developing new products, and advancing the design of a business model (Mathisen et al., 2004). The innovation climate is defined as the extent to which a company fosters and creates an environment that encourages innovation (H. J. Cho, 2005; Van de Ven, 1986), while product innovation strategy refers to the use of new components, added resources, technology, and product features for product development (Manual, 2005). To enhance access to supply chain partners' innovativeness, companies must develop innovation-supportive skills and foster an environment conducive to innovation advancement (Amabile, 1998). The innovation climate moderates the relationship between supply chain members' innovation and product innovation strategy positively.

Wagner (2005) has demonstrated that information sharing is influenced by the commitment of organizational resources to strategic relationships with supply chain partners (suppliers and customers). The relationship between the organizational climate for innovation and the organizational innovation of supply chain partners regarding the firm's innovation strategy is also discussed. Rosenbusch et al. (2011) found that to develop agility, an organization must respond quickly and creatively to change, and innovation is crucial to increasing agility (Van Oosterhout et al., 2006). Effective SCM abilities are necessary for institutional sustainability and innovation, resulting in enhanced EP (Esterhuizen et al., 2012; Nidumolu et al., 2013). Sheykhi's (2016) previous study found that SCM is an effective tool for enhancing firm performance, sustainability, and innovation-driven practices leading to enhanced firm performance. Moreover, enhanced EP is associated with commitment and collaboration (Ali & Haseeb, 2019). Therefore, an innovative environment is essential for the supply chain and the enhancement of EP. This study evaluated the hypothesis that an IC moderates the association between supply chain parameters and EP.

H5. IC moderates the relationship between SCA and EP.

H6. IC moderates the relationship between SCAG and EP.

H7. IC moderates the relationship between SCP and EP.

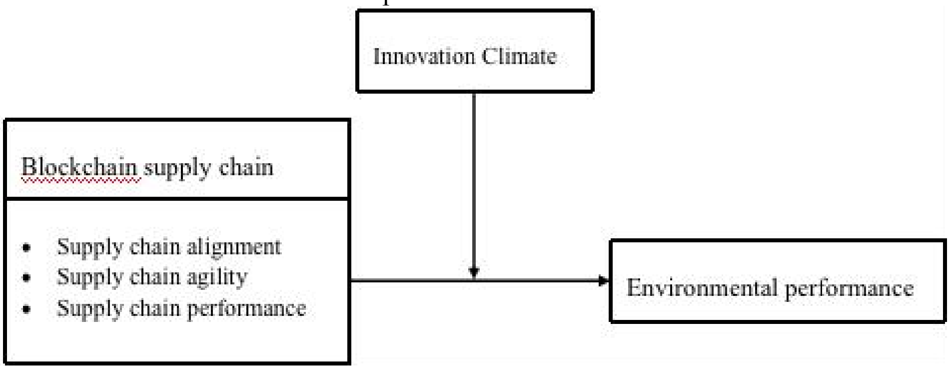

Figure 1. Theoretical framework

3. Research Method

This is a quantitative research study that utilized a structured survey questionnaire to gather data. The questionnaire was divided into two parts, with the first part containing demographic information and the second part consisting of construct items. The study's population consisted of manufacturing industries registered in the stock exchange and located in Pakistan. Cluster probability sampling was used to collect data from senior and mid-level managers from the three largest manufacturing industries in the province who possessed the necessary knowledge of BCT in SCA, supply chain agility, SCP, and EP within their organization. To increase the response rate, questionnaires were administered via personal visits, resulting in a 75% response rate, with 350 out of 400 questionnaires returned. However, only 300 of the 350 responses were used for further analysis, resulting in a 70% valid response rate. The demographic information is presented in Table 1.

Table 1. Respondent demographic profile

Item	Frequency (*n*=300)	(%)
Gender		
Male	216	72
Female	84	28
Age		
20-30	127	42
31-40	149	49
41-50	21	7
51-60	3	1
Management level		

Top-level management	50	16.7
Middle-level management	250	83.3
Department		
Management	210	70
Production	90	30
Experience		
1 year or less	58	19.3
Over 1 to 3 years	138	46
Over 3 to 5 years	70	23.7
Ove 5 to 10 years	24	8.3
Over 10 years	8	2.7

4.Data Analysis and Results

The results were analyzed using PLS-SEM. In this study, all variables were exhaustively measured, and the latent variables and indicator variables were more reflective than formative variables. The study followed a two-step approach to analyze the data. Firstly, the measurement model was used to assess the reliability and validity of the constructs. Secondly, the structural model was used to determine the proposed relationships between variables.

4.1 The measurement model

The reliability and validity of the constructs were estimated using two primary criteria, namely reliability and validity, in PLS-SEM. Cronbach's Alpha and composite reliability were used to examine the reliability of the constructs, and Table 2 displays the results. A value of Cronbach's Alpha and CR exceeding 0.7 indicates average internal consistency (Hair et al., 2016). Convergent validity was assessed by calculating AVE values, which range from 0.562 to 0.572 in this study, indicating that the convergent validity is evident as the values are above 0.5.

Table 2. Scale's reliability and convergent validity.

Full Construct	Item	Loading	Cronbach's Alpha	CR	AVE
Supply chain alignment	SCA1	0.722	0.756	0.845	0.576
	SCA2	0.778			
	SCA3	0.767			
	SCA4	0.769			
Supply chain agility	SCAG1	0.775	0.721	0.827	0.545
	SCAG2	0.693			
	SCAG3	0.763			
	SCAG4	0.718			
Supply chain performance	SCP1	0.78	0.751	0.842	0.572
	SCP2	0.79			
	SCP3	0.696			
	SCP4	0.755			
Innovative climate	IC1	0.698	0.729	0.831	0.552

	IC2	0.795				
	IC3	0.765				
	IC4	0.712				
Environmental performance	EP1	0.709	0.738		0.836	0.562
	EP2	0.833				
	EP3	0.696				
	EP4	0.752				

The discriminant validity was assessed by applying the ratio of correlation (Foren and lacker criterion).The numbers on the diagonals of the table shown above are higher than their preceding values , which demonstrates the discriminant validity of the constructs (see Table 3).

Table 3. Discriminant validity

	EP	IC	SCA	SCAG	SCP
Environmental performance (EP)	0.749				
Innovative climate (IC)	0.669	0.743			
Supply chain alignment (SCA)	0.69	0.724	0.759		
Supply chain agility (SCAG)	0.682	0.691	0.768	0.738	
Supply chain performance (SCP)	0.663	0.708	0.704	0.76	0.756

4.2 The structural model

The PLS-SEM bootstrapping approach was used to evaluate the significance of the hypothesized relationships. The B value, P-value, and t criterion were used to test the hypotheses ($p < 0.05$ and $t > 1.645$). The results of the direct hypotheses are summarized in the table 4.0. The analysis found that H1, which proposed that Supply Chain Alignment (SCA) would have a significant impact on Environmental Performance (EP), was supported ($\beta = 0.248$, $t = 4.108$, $p = 0.000$). Similarly, H2, which suggested that Supply Chain Agility (SCAG) would have a significant impact on EP, was also supported ($\beta = 0.202$, $t = 3.324$, $p = 0.001$). H3, which proposed that Supply Chain Performance (SCP) would have a significant impact on EP, was also supported ($\beta = 0.185$, $t = 2.785$, $p = 0.004$). Finally, H4, which proposed that Innovation Climate (IC) would have a significant impact on EP, was also supported ($\beta = 0.225$, $t = 3.802$, $p = 0.000$). Moreover, the results show that SCA, SCAG, SCP, and IC have a significant and positive influence on EP (refer to Fig. 2 and Table 4). IC moderates the relationship between SCP and EP but does not moderate the relationship between SCA and EP or SCAG and EP (refer to Table 4 and Fig. 3). In short, All the hypotheses were accepted except for H5 and H6 (refer to Table 4).

Table 4. Hypotheses Testing

	B value	SD	*T*-value	*P*-value	Significance (p≤ 0.05?)	Decision
H1. SCA-> EP	0.248	0.06	4.108	0.000	Yes	Supported
H2. SCAG-> EP	0.202	0.061	3.324	0.001	Yes	Supported
H3. SCP -> EP	0.15	0.063	2.785	0.004	Yes	Supported
H4. IC -> EP	0.225	0.059	3.802	0.000	Yes	Supported
H5. SCA->IC->EP	0.056	0.054	1.035	0.301	No	Not supported

H6. SCAG->IC->EP	0.028	0.054	0.506	0.613	No	Not supported
H7. SCP->IC->EP	-0.147	0.053	2.807	0.005	Yes	Supported

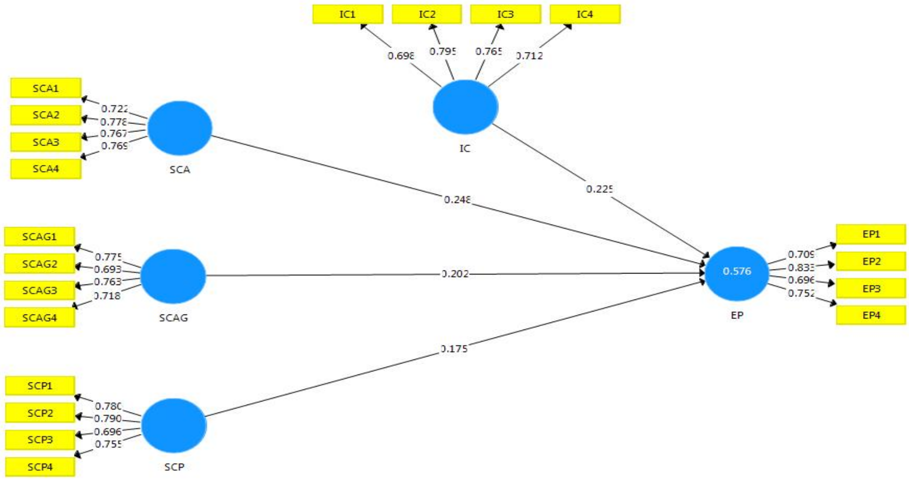

Figure 2. Structural model

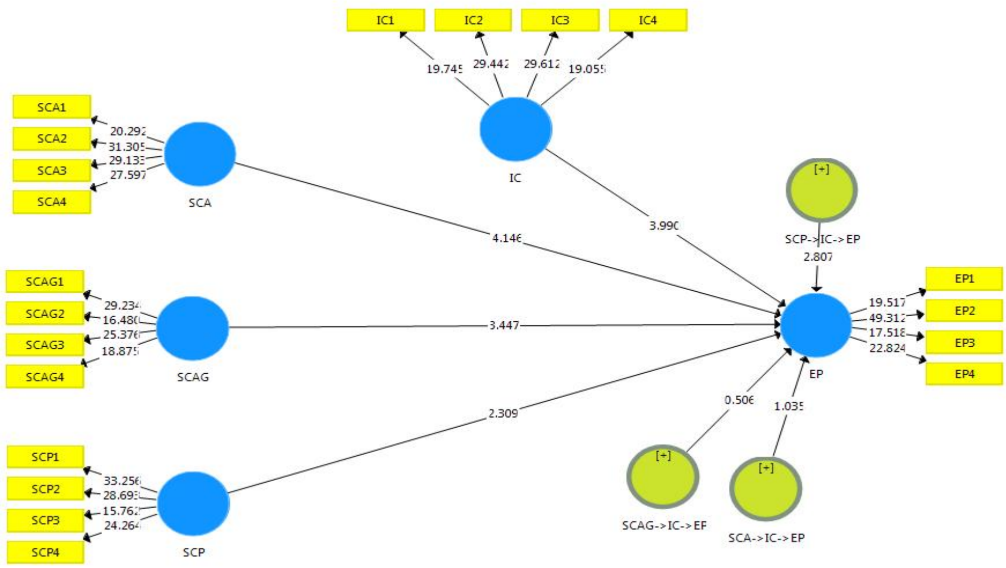

Figure 3. Moderation effect

5.Discussion and Implications

5.1 Discussion

The purpose of this study was to investigate the impact of BCT adoption on supply chain metrics such as SCA, SCAG, and SCP, and their influence on EP. Additionally, the study examined the moderating role of IC in the relationship between BCT use in supply chain metrics and EP. The research was conducted at three major manufacturing mills in the province. The study's findings support H1, H2, H3, and H4, which postulate a positive relationship between SCA, SCAG, SCP, and IC with EP, respectively. The agility concept has been adopted by several organizations in response to changing competitive scenarios and growing environmental complexity, which explains the positive association between SCA and EP. Similarly, SCAG and SCP were found to have a significant positive relationship with EP. The SCP measurement system comprises resource, output, and flexibility, which all contribute to performance metrics. Inventive climates, which foster creative ideas and innovative activities to improve business performance, product processes, and quality, were found to have a positive association with EP. The study's results also indicate that IC moderates the relationship between SCA, SCAG, and SCP with EP, as postulated in H7. However, H5 and H6, which suggest that IC moderates the relationship between SCA and EP, and SCAG and EP, respectively, were not supported.

5.2 Research Implications

The findings of this study suggest that companies should not only raise awareness about BCT but also actively collaborate with IT companies that develop blockchain-based supply chain solutions to ensure that supply chain managers have accurate expectations and assumptions about BCT's benefits for supply chain management. Supply chain managers, manufacturers, and IT companies should conduct training sessions to better understand BCT and how it can improve production efficiency and reduce waste, ultimately improving EP. To foster an environment conducive to creativity and innovation among personnel, companies should incentivize managers who encourage and support creativity. Improving quality and boosting the efficiency of the production department should be a priority for companies.

Industrial enterprises that use chemicals in their production processes, such as manufacturing mills, should provide their personnel with training on the use of BCT to monitor potentially hazardous chemicals. This could help in reducing harmful environmental effects. As blockchain is a type of meta-technology, it requires additional technologies to improve its performance in supply chains. Other applications such as IoT, Big Data, etc. are more effective technologies that can be utilized to improve Blockchain's performance in supply chains.

Finally, supply chain managers and IT companies interested in implementing and developing blockchain-based IT solutions for the supply chain should collaborate with regular actors to develop a regulatory framework to govern BCT. The adoption of technologies remains exceedingly hazardous in the absence of a legal framework. Currently, there is no solid legislative framework in the country that addresses BCT. Those chemical manufacturing firms that utilize BCT in their supply chain should provide training to all production supply chain managers to be aware of which chemicals are hazardous if used excessively. They should also provide training on measuring the impact of waste gas disposal on the environment and mitigating its adverse impacts through the use of BCT. IT businesses, managers, and academics should collaborate to explore and develop a regulatory framework for BCT, which they can subsequently consider advocating policymakers to adopt.

5.3 Study Limitations

This study has several limitations, similar to other studies. The sample size is limited because the research was conducted exclusively at the three largest manufacturing mills in the Province. Additionally, only manufacturing mills were examined, while other industries also utilize chemicals. It is important to note that different supply networks necessitate distinct strategic decisions and information needs. However, this study assumes that all supply chain requirements are the same, and it is necessary to develop different applications for different supply chains based on their unique requirements, as well as examine different adoption models. Another limitation is that the successful deployment of BCT is highly dependent on the quality of the data collection systems, such as the Internet of Things and Big Data, which can be costly. Finally, the study's target population is upper and middle management, who may have busy schedules and provide brief responses, limiting the depth of the study's insights.

5.4 Future Directions

Further investigation is necessary to better understand the impact of Blockchain technologies on supply chain characteristics and EP. It is essential to investigate how blockchains interact with other technologies and their combined effect on EP. In addition, BCT's impact on other supply chain metrics, such as supply chain flexibility and operational performance, and their relationship with EP should also be examined. Further research is also needed to investigate the moderating influence of trust and competitive environment on the relationship between supply chain parameters and EP. To increase the generalizability of the findings, future studies should be conducted in various locations outside of the Province. A longitudinal study could be conducted to assess the effectiveness of BCT in enhancing supply chain management over time. Another potential area for research could be exploring the impact of combining blockchain with other technologies such as IoT, artificial intelligence, and big data on supply chain management and their effect on EP.

Author Contributions: Conceptualization, writing—review and editing,Muhammad Shahid Yaqub,Noor Ul Ain ,Hassan Mujtaba Nawaz Saleem,Muhammad Junaid Akbar.
Funding: Not Applicable
Institutional Review Board Statement: Not applicable.
Informed Consent Statement: Not applicable.
Conflicts of Interest: "The authors declare no conflict of interest."

References

1. Aina Megat, P., Bin Ngah, B., Mahmoud Alzubi, M., & Al-Shaghdari, F. (2023). Can blockchain technology moderates corporate waqf perceived behaviour? In search of underpinning theories. *Journal of Contemporary Business and Islamic Finance (JCBIF)*, 3(Special Issue), 18–30. Retrieved from https://journals.iub.edu.pk/index.php/jcbif/article/view/1319
2. Ali, A., & Haseeb, M. (2019). Radiofrequency identification (RFID) technology as a strategic tool towards higher performance of supply chain operations in textile and apparel industry of Malaysia. *Uncertain Supply Chain Management, 7*(2), 215-226
3. Amabile, T. M. (1998). *How to kill creativity* (Vol. 87): Harvard Business School Publishing Boston, MA.
4. Ammous, S. (2016). Blockchain Technology: What is it good for? *Available at SSRN 2832751*.
5. Baker, W. E., & Sinkula, J. M. (2002). Market orientation, learning orientation and product innovation: delving into the organization's black box. *Journal of market-focused management, 5*(1), 5-23.
6. Balkin, D. B., Markman, G. D., & Gomez-Mejia, L. R. (2000). Is CEO pay in high-technology firms related to innovation? *Academy of Management Journal, 43*(6), 1118-1129.
7. Benitez-Amado, J., Llorens-Montes, F. J., & Fernandez-Perez, V. (2013). The relationship between IT infrastructure leveraging, talent management and operational sustainability, and their effects on the business value of the operations strategy.
8. Bergeron, F., Raymond, L., & Rivard, S. (2004). Ideal patterns of strategic alignment and business performance. *Information & Management, 41*(8), 1003-1020.

9. Casey, M. J., & Wong, P. (2017). Global supply chains are about to get better, thanks to blockchain. *Harvard business review, 13*, 1-6.
10. Cho, D. W., Lee, Y. H., Ahn, S. H., & Hwang, M. K. (2012). A framework for measuring the performance of service supply chain management. *Computers & Industrial Engineering, 62*(3), 801-818.
11. Cho, H. J., & Pucik, V. (2005). Relationship between innovativeness, quality, growth, profitability, and market value. *Strategic management journal, 26*(6), 555-575.
12. Dolgui, A., Ivanov, D., & Sokolov, B. (2018). Ripple effect in the supply chain: an analysis and recent literature. *International journal of production research, 56*(1-2), 414-430.
13. Elliot, S., & Binney, D. (2008). Environmentally sustainable ICT: Developing corporate capabilities and an industry-relevant IS research agenda. *PACIS 2008 Proceedings*, 209.
14. Fawcett, S. E., Wallin, C., Allred, C., Fawcett, A. M., & Magnan, G. M. (2011). Information technology as an enabler of supply chain collaboration: a dynamic-capabilities perspective. *Journal of supply chain management, 47*(1), 38-59.
15. Ivanov, D., Dolgui, A., & Sokolov, B. (2019). The impact of digital technology and Industry 4.0 on the ripple effect and supply chain risk analytics. *International journal of production research, 57*(3), 829-846.
16. Kim, H. M., & Laskowski, M. (2018). Toward an ontology-driven blockchain design for supply-chain provenance. *Intelligent Systems in Accounting, Finance and Management, 25*(1), 18-27.
17. Kraus, S., Rehman, S. U., & García, F. J. S. (2020). Corporate social responsibility and environmental performance: The mediating role of environmental strategy and green innovation. Technological Forecasting and Social Change, 160, 120262.
18. Manual, O. (2005). The measurement of scientific and technological activities. *Proposed Guidelines for Collecting an Interpreting Technological Innovation Data, 30*.
19. Margaretha, M., & Saragih, S. (2013). *Developing new corporate culture through green human resource practice.* Paper presented at the International Conference on Business, Economics, and Accounting.
20. Mason-Jones, R., Naylor, B., & Towill, D. R. (2000). Engineering the leagile supply chain. *International journal of agile management systems*.
21. Mathisen, G. E., Einarsen, S., Jørstad, K., & Brønnick, K. S. (2004). Climate for work group creativity and innovation: Norwegian validation of the team climate inventory (TCI). *Scandinavian journal of psychology, 45*(5), 383-392.
22. Mithas, S., Khuntia, J., & Roy, P. K. (2010). Green information technology, energy efficiency, and profits: Evidence from an emerging economy.
23. Montabon, F., Sroufe, R., & Narasimhan, R. (2007). An examination of corporate reporting, environmental management practices and firm performance. *Journal of operations management, 25*(5), 998-1014.
24. Nakamoto, S. (2008). Bitcoin: A peer-to-peer electronic cash system. *Decentralized Business Review*, 21260.
25. Newman, A., Round, H., Wang, S., & Mount, M. (2020). Innovation climate: A systematic review of the literature and agenda for future research. *Journal of Occupational and organizational psychology, 93*(1), 73-109.
26. Nidumolu, R., Prahalad, C., & Rangaswami, M. (2013). Why sustainability is now the key driver of innovation. *IEEE Engineering Management Review, 2*(41).
27. Nishant, R., Teo, T., Goh, M., & Krishnan, S. (2012). Does environmental performance affect organizational performance? Evidence from green IT organizations.
28. Oltra, V., & Saint Jean, M. (2009). Variety of technological trajectories in low emission vehicles (LEVs): a patent data analysis. *Journal of Cleaner Production, 17*(2), 201-213.

29. Sanders, N. R. (2005). IT alignment in supply chain relationships: A study of supplier benefits. *Journal of supply chain management, 41*(2), 4-13.
30. Sathyapriya, J., Kanimozhi, R., & Adhilakshmi, V. (2013). Green HRM-Delivering high performance HR systems. *International Journal of Marketing and Human Resource Management, 4*(2), 19-25.
31. Scherer, F. M. (1998). Schumpeter and plausible capitalism. *J. Reprints Antitrust L. & Econ., 28*, 759.
32. Seman, N. A. A., Govindan, K., Mardani, A., Zakuan, N., Saman, M. Z. M., Hooker, R. E., & Ozkul, S. (2019). The mediating effect of green innovation on the relationship between green supply chain management and environmental performance. Journal of cleaner production, 229, 115-127.
33. Sharifi, H., & Zhang, Z. (1999). A methodology for achieving agility in manufacturing organisations: An introduction. *International journal of production economics, 62*(1-2), 7-22.
34. Shepherd, C., & Günter, H. (2010). Measuring supply chain performance: current research and future directions. *Behavioral operations in planning and scheduling*, 105-121.
35. Sheykhi, M. T. (2016). Rural–urban balance as a measure of socio-economic development with special reference to Iran. *Journal of Social Economics Research, 3*(1), 1-12.
36. Siegel, S. M., & Kaemmerer, W. F. (1978). Measuring the perceived support for innovation in organizations. *Journal of Applied Psychology, 63*(5), 553.
37. Stock, G. N., Greis, N. P., & Kasarda, J. D. (2000). Enterprise logistics and supply chain structure: the role of fit. *Journal of operations management, 18*(5), 531-547.
38. Um, J. (2017). Improving supply chain flexibility and agility through variety management. *The International Journal of Logistics Management*.
39. Utterback, J. M. (1994). How Companies Can Seize Opportunities in the Face of Technological Change. *Mastering the Dynamics of Innovation*.
40. Vachon, S., & Klassen, R. D. (2008). Environmental management and manufacturing performance: The role of collaboration in the supply chain. *International journal of production economics, 111*(2), 299-315.
41. Van de Ven, A. H. (1986). Central problems in the management of innovation. *Management Science, 32*(5), 590-607.
42. Van Oosterhout, M., Waarts, E., & van Hillegersberg, J. (2006). Change factors requiring agility and implications for IT. *European journal of information systems, 15*(2), 132-145.
43. Venkatraman, N., & Prescott, J. E. (1990). Environment-strategy coalignment: An empirical test of its performance implications. *Strategic management journal, 11*(1), 1-23.
44. Vrakking, W. J. (1990). The innovative organization. *Long Range Planning, 23*(2), 94-102.
45. Wagner, S. M., & Buko, C. (2005). An empirical investigation of knowledge-sharing in networks. *Journal of supply chain management, 41*(4), 17-31.
46. Watson, R. T., Boudreau, M.-C., & Chen, A. J. (2010). Information systems and environmentally sustainable development: energy informatics and new directions for the IS community. *MIS Quarterly*, 23-38.
47. Wong, C., Skipworth, H., Godsell, J., & Achimugu, N. (2012). Towards a theory of supply chain alignment enablers: a systematic literature review. *Supply Chain Management: An International Journal*.
48. Zhang, X., van Donk, D. P., & van Der Vaart, T. (2011). Does ICT influence supply chain management and performance? A review of survey-based research. *International Journal of Operations & Production Management*.