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The influence of blockchain technology and high-involvement human resource practices on supply chain resilience and organizational performance

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Abstract: The rising global competition and turbulent business environment have enabled organizations to develop resilient and crisis induced supply chain strategies. Therefore, current study strives to understand how blockchain technology, artificial intelligence and high involvement HR practices impact supply chain resilience and organizational performance. Moreover, moderating effect of environmental dynamism is examined between the relationship of supply chain resilience and organizational performance. The research model is empirically tested with 293 responses collected from managers working in manufacturing firms. Research framework is developed following positivist research paradigm. Data are computed through structural equation modeling approach. Results of the empirical analysis have revealed that blockchain novelty, blockchain efficiency, artificial intelligence, employee skills, employee incentives and employee participation explained R^2 51.1% variance in supply chain resilience. Therefore, environmental dynamism and resilience have explained R^2 48.8% variance in organizational performance. The findings of this research have suggested that policy makers could enhance supply chain resilience through blockchain novelty, blockchain efficiency, artificial intelligence, employee skills and employee incentives. Moreover, this study has suggested that if logistics firms comprise characteristics of environmental dynamism they would have better ability to work in uncertain environment. This research is pioneering as it has examined the impact of blockchain novelty and blockchain efficiency towards supply chain resilience. Similarly, developing an integrative resilient logistic research model with blockchain technology, artificial intelligence, high involvement HR practices and environmental dynamism makes this research more unique and valuable.

Keywords: Blockchain novelty; Blockchain efficiency; Artificial intelligence; High involvement HR practices; Supply chain resilience; Environmental dynamism.

1 INTRODUCTION

In this era of complexity and uncertainty organizations are facing multiple challenges including resilience in business operations. More recently pandemic wave has motivated policy makers and academic researchers to find out new ways to deal with disasters instead of just focusing on market competition (Jellason et al., 2024; Liu et al., 2024). The term resilience in logistic setting is identified as firm's ability to resist and recover rapidly against environmental disruption. It is established that resilient firms have more competency to deal with uncertainty, shortage of raw material and production constraints (Pandey et al., 2024). Nevertheless, for supply chain resilience the logistic firms need visibility of elements and information that could be retrieved through blockchain technology. Author like Khan et al. (2021) have asserted that blockchain technology is the core element of logistics firm resilience. Blockchain technology is basically kind of distributed ledger that has ability to streamline supply chain process through record keeping and synchronization of data that remained untapped and immutable. The blockchain technology has improved transparency in supply chain operations and creates long term association among supply chain members. More specifically block chain technology assist firms to achieve elements visibility, digitalization and automation in supply chain operations (Khan et al., 2021). Although Blockchain technology has emerged one of the most reliable technology to monitor supply chain information however, advantages of this technology has yet to be explored in the context of supply chain resilience (Li, 2023).

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Therefore, current study fills research gap and has developed an integrated research framework to investigate factors which enhance supply chain resilience. The integrated framework comprises two core dimensions of blockchain technology namely blockchain novelty and blockchain efficiency. In addition to that factors like artificial intelligence and high involvement HR practices are conceptualized to measure supply chain resilience. Moreover, moderating effect of environmental dynamism is tested between supply chain resilience and organizational performance. Therefore, this study has disclosed findings in threefold. To examine how blockchain novelty, efficiency, artificial intelligence, employee skills, incentives and participation impact supply chain resilience? To understand how supply chain resilience influences organizational performance? How moderating effect of environmental dynamism moderates the relationship between supply chain resilience and organizational performance? The integration of these factors provides best possible solutions to logistic firm to continue operations during crisis time period. In terms of scope this research has large scope as it collects data from multiple logistics firms. Similarly, the outcome of this research assists managers and policy makers to design resilient kind of supply chain strategies to confront unprecedented situation. In following section literature review highlights importance of these factors in measuring supply chain resilience and organizational performance.

2 LITERATURE REVIEW

2.1 Blockchain enabled logistics novelty and efficiency

The blockchain technology can streamline logistics operations through synchronization and record keeping and increase efficiency in logistics operation (Hosseini et al., 2019; Li et al., 2022). In literature authors like Pattanayak et al. (2023) have stressed to investigate the relationship between blockchain technology and supply chain resilience. Nevertheless, in this study blockchain novelty and efficiency are identified as two main enablers of blockchain technology. The term blockchain novelty is refereed to situation wherein logistic firm uses external and internal resources and integrates different emerging technologies to obtain valuable outcome (Li et al., 2022; Rozas et al., 2021). Authors like Ivanov and Dolgui (2022) have postulated that blockchain novelty assist policy makers to predict accurate market situation through latest emerging technologies. Moreover blockchain novelty enable a firm to respond quickly and boost resilience (Ivanov & Dolgui, 2021; Yamin, 2025). Therefore, blockchain efficiency is the degree wherein logistic firms integrate demand information and reduce information asymmetry to take proactive decision (Carrasco & Romi, 2022; Dolgui & Ivanov, 2022; Hosseini et al., 2019). It is argued that blockchain technology enabled firms are capable to share information instantly among stakeholder reduce transaction time and improve transaction speed. Accordingly, blockchain technology provide platform to manage real time logistics operations including inventory management, production, transportation and information sharing. Moreover prior studies have established that blockchain enabled efficiency and novelty boost supply chain resilience (Hosseini et al., 2019; Ivanov & Dolgui, 2021; Li et al., 2022; Pattanayak et al., 2023).Therefore, following hypotheses are proposed:

H1: Blockchain novelty is positively related to supply chain resilience.
H2: Blockchain efficiency is positively related to supply chain resilience.

2.2 Artificial Intelligence and SC resilience

Although blockchain technology has been found attractive in improving supply chain resilience however, importance of the artificial intelligence cannot be ignored in measuring supply chain resilience during turbulent environment (Charles et al., 2023; Sweiss & Yamin, 2024). Artificial intelligence enabled supply chain is defined as the extent wherein firm has ability to recognize business pattern, capture information using different tools and interpret that information for best possible outcomes (Charles et al., 2023; Zamani et al., 2023). In turbulent environment firms need maximum information to find crisis solution. Nevertheless, artificial intelligence acts like human being and assist managers to take reactive decision. Aside of quick information artificial intelligence can find fake transactions in supply chain and enhance transparency in supply chain operations. Moreover, studies have confirmed that artificial intelligence unveil multiple alternatives to deal with crises and increases supply chain resilience (Choi et al., 2022; Dalain et al., 2025; Hussain & Papastathopoulos, 2022). According to Yu et al. (2021) integrating artificial intelligence with block chain increases supply chain efficiency due to its ability to compute huge data. Similarly, prior studies have confirmed that altogether artificial intelligence and blockchain boost supply chain resilience (Hussain & Papastathopoulos, 2022; Wang et al., 2020). Therefore, artificial intelligence enabled supply chain is hypothesized as:

H3: Artificial intelligence is positively related to supply chain resilience.

2.3 High-involvement HR practices and resilience

The continuity of supply chain operations is largely dependent on employee abilities and skills. Although literature has discussed the role of HR practices in connection to supply chain performance however, less discussion is found about the relationship of high involvement HR practices and supply chain performance. Therefore, and with the help of prior literature this study has summarized high involvement HR practices into three core dimensions namely employee skills, employee incentive and employee participation (Amamou & Yamin, 2024; Awan et al., 2020; Das et al., 2022; Gu et al.,

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2023; Hohenstein et al., 2015). According to Gu et al. (2023) high involvement HR practices such as employee skills, incentives and participation have shown positive impact logistics firm resilience. The term employee skill is referred to firm ability to select competent employee at workplace and improve their skills through HR activities. In the context of high involvement HR practices logistic firm recruit high quality work force and further improve their skills through trainings. Consequently, high skilled employees have better ability to forecast disruption through prior experience and respond quickly. Concerning with employee incentives it indicates to firm reward system through employees get motivation and utilize knowledge and skills effectively during crisis (Abdalatif & Yamin, 2022; Dalain & Yamin, 2025). Therefore, employee participation is referred to opportunity and engagement of employee in supply chain operations. When employee participates in logistic operations they use knowledge and skills to manage disruption and enhance their ability to take better decision. Moreover, literature has revealed that employee participation empowers employees to use their knowledge and skills and makes supply chain operations more resilient. Prior studies have refined that logistics firms could enhance supply chain resilience if employees have adequate skills, get motivation through incentive and training and equally participate in decision making process (Das et al., 2022; Gu et al., 2023; Hohenstein et al., 2015; Lu et al., 2023). Therefore, high involvement HR practices are hypothesized as:

H4: Employee skill is positively related to supply chain resilience.

H5: Employee incentive is positively related to supply chain resilience.

H6: Employee participation is positively related to supply chain resilience.

2.4 Environmental dynamism

The role of environmental dynamism is found essential in measuring firm resilience (Gupta et al., 2023). Therefore, in supply chain setting environmental dynamism is explained as a situation wherein logistic firm deal with frequent disasters, socio and political changes, intensity of the disaster, sustain pressure to deliver quality services during disruption and design new services to achieve customer satisfaction in turbulent environment (Schilke, 2014; Wamba et al., 2020). Environmental dynamism has comprised characteristics of unpredictability and volatility. For instance volatility characteristics indicate to rate and amount of change in environment. Therefore, unpredictability is referred to uncertainty in environment. It is said that firm with environmental dynamism characteristics have shown more resilience during disruption (Gupta et al., 2023; Kiziloglu & Yamin, 2024; Wamba et al., 2020; Yamin & Al Aqra, 2025). Although literature has established that environmental dynamism significantly impact supply chain resilience however little has been discussed about the moderating effect of environmental dynamism between supply chain resilience and organizational performance. Author like Wamba et al. (2020) have postulated that unpredictable nature of environmental dynamism offer greater opportunities to logistic firms to explore employee ability knowledge and skills. Similarly, prior studies have argued that in high volatile environment employees get empowerment to take bold decision and confidently deal with disruption (Chen et al., 2015; Schilke, 2014; Teng et al., 2022; Wamba et al., 2020). Following above arguments and consistent with Wamba et al. (2020) this study is conceptualized that environmental dynamism moderates the relationship between supply chain resilience and organizational performance. Thus, following hypotheses are assumed:

H7: Supply chain resilience is positively related to organization performance.

H8: The relationship between supply chain resilience and organizational performance is moderated by environmental dynamism.

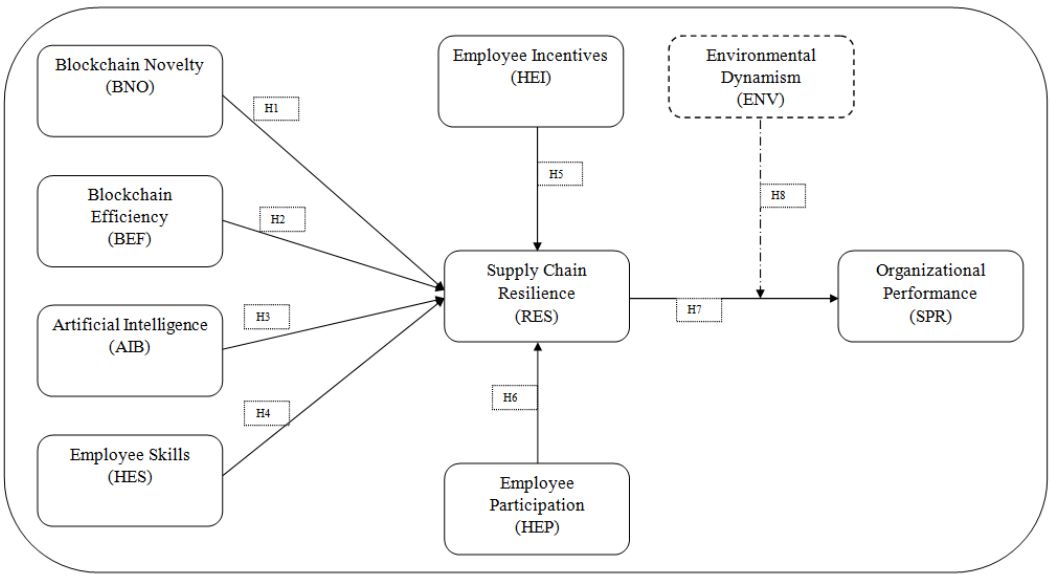

Figure 1 Research model

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3 RESEARCH METHODS

3.1 Research design

This research has followed positive research paradigm and hence research model is tested through empirical data. Overall research model comprises seven direct hypotheses and one moderating hypotheses. These hypotheses are conceptualized to test causal relationship among latent factors. According to Khan et al. (2021) managers can provide better information regarding use of blockchain technology to manage supply chain operations and overall impact of this technology on supply chain sustainability. Therefore, and consistent with Khan et al. (2021) the population of this study are senior and middle level managers working in manufacturing sector. Moving further sample size is selected with guidelines provided by Samar Rahi (2017). According to Samar Rahi (2017) data must be five time or 10 time grater when multiplying with indicators. This study has nine variables comprises 30 indicators. Therefore, in current research if indicators are multiplied with five and ten then minimum sample of 150 and maximum 300 is required. In addition to that priori power analysis has indicated that sample size of 160 respondents is satisfactory. Data were collected through purposive sampling approach. Overall, 398 respondents were approached though survey questionnaire. In return 293 respondents accepted invitation and voluntarily participated in research survey. Data were collected at one point in time with a response rate of 85%. After data collection missing value analysis was conducted. Nevertheless, missing value analysis results indicate that data were missing completely at random (MCAR) and valid for inferential analysis (Samar Rahi, 2017; Rahi, 2018). Finally, data set of 293 responses is computed through measurement and structural model approach.

The study was designed to minimize risks by adhering to ethical research practices. Data were collected through a structured survey targeting manufacturing managers, focusing on professional insights while ensuring anonymity and confidentiality. Participation was voluntary, with the right to withdraw at any time. The study offers significant benefits by enhancing the understanding of blockchain technology, artificial intelligence, and high-involvement HR practices in supply chain resilience and organizational performance. Findings provide valuable insights for policymakers and business leaders in managing supply chain challenges. Given the minimal risk, the time required to complete the survey, the benefits outweigh any drawbacks. Informed consent was obtained through a detailed information sheet outlining the study's purpose, procedures, potential risks, and confidentiality assurances, with participants providing verbal agreement before participation.

3.2 Scale measurement

In order to collect numerical responses a survey questionnaire was developed. The survey questionnaire comprised scale items of nine constructs. These items are adopted from logistics literature and then slightly amended. For instance scale items for the factor blockchain novelty are adapted from prior study conducted by Li et al. (2022). Scale items for the factor blockchain efficiency are adapted from Li et al. (2022) and Schlecht et al. (2021). Similarly, artificial intelligence is measured with scale items adapted from Davenport and Ronanki (2018). Factor like employee skill factor is measured with scale items adapted from prior literature (Gu et al., 2023; Huo et al., 2015). Employee incentive is measured with scale items adapted from prior studies (Gu et al., 2023; Huo et al., 2015). Scale items for the factor employee participation are adapted from (Gu et al., 2023). Similarly, items for factor supply chain resilience are adapted from prior study conducted by Gu et al. (2023). Scale items for the factor organizational performance are adapted from Li et al. (2022). Moreover, scale items for the factor environmental dynamism are adapted from Schilke (2014). Concerning with scale measurement all scale items were enumerated on 7 point Likert scale indicating participant's agreement and disagreement towards given statements (Rahi et al., 2024; Yamin et al., 2024).

4 STATISTICAL ANALYSIS

4.1 Analyzing data bias issue

The first step in data analysis is to ensure that data is free from common method bias. Data bias issue could reveal false and misleading results and therefore testing common method bias is essential (Abdalatif & Yamin, 2025; Samar Rahi, 2017; Rahi et al., 2023). In this study data bias issue is addressed through Harman's single factor solution. (Fornell, 1992; Rahi & Abd.Ghani, 2019; Rahi et al., 2018). According to Rahi (2022) asserted that for data validity variance explained by first factor on un-rotated extraction should be less than 40%. Data were calculated through un-rotated extraction method. Results revealed that variance explained by first factor was only 19% and significantly less than single factor threshold value 40%. These results have established that data is free from common method bias and hence can be used for inferential analysis.

4.2 Structural equation modeling

The research model is of this study tested with partial least based structural equation modeling approach (S. Rahi, 2017). At first factors reliability, convergent validity and discriminant validity of the factors is tested. In next stage hypotheses are tested through structural model analysis. Indicator reliability is established following criterion that loadings of the indicator must be higher than .70 (S. Rahi, 2017). Therefore, factors reliability is achieved through cronbach α and composite reliability following threshold value .70 as recommended by prior researchers (Hair et al., 2016; Rahi, 2018;

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Rahi et al., 2019). Similarly, convergent validity is confirmed through average variance extracted following threshold value of .50 (Rahi, 2018). Results have shown satisfactory values of AVE to establish convergent validity of the factors. Additionally, values of composite reliability and cronbach alpha are found satisfactory and hence ensure factors reliability. Similarly, loading of the indicators are higher than .70 and hence confirmed indicator reliability. Results are shown in Table 1.

Table1 Measurement model

Indicators	Λ	α	CR	AVE
AIB1: Artificial intelligence assist firm to optimize logistic operations.	0.805	0.763	0.863	0.678
AIB2: The use of artificial intelligence reduces headcount through automation.	0.827			
AIB3: Artificial intelligence enables firm to capture rare knowledge.	0.839			
BEF1: Blockchain makes transaction transparent and simple from stakeholder perspective.	0.858	0.833	0.900	0.749
BEF2: Blockchain empowered firm has capability to manage any kind of transactions.	0.873			
BEF3: Blockchain reduces asymmetric information and makes flow traceable.	0.867			
BNO1: Firms empowered by blockchain offers new combination of products and services.	0.851	0.810	0.887	0.723
BNO2: The use of blockchain technology enables firm's promotion and distribution channel novel.	0.889			
BNO3: Blockchain technology assist firm to generate revenue through novel ways.	0.809			
ENV1: This firm operates business in high volatile environment.	0.778	0.800	0.868	0.623
ENV2: Product and services are constantly changing in our industry.	0.859			
ENV3: Supplier capabilities change constantly in our industry.	0.754			
ENV4: New business model evolve frequently in our industry.	0.763			
HEI1: This firm has fair reward system and recognize employee who contributes to firm.	0.855	0.838	0.891	0.672
HEI2: Employee in this logistic firm gets encouragement through incentives and rewards.	0.810			
HEI3: In this firm reward systems motivate employee to achieve firm objectives.	0.795			
HEI4: In this firm incentives encourage employee to vigorously accomplish firm objectives.	0.819			
HEP1: This firm gives equal opportunity to employee to participate in decision making process.	0.895	0.859	0.914	0.779
HEP2: This firm update employee through adequate knowledge and solve problems though team work.	0.901			
HEP3: I believe solving problem through team improve firm logistic operations.	0.851			
HES1: This firm offer different training programs to enhance employee skills.	0.762	0.843	0.895	0.681
HES2: Employee receives relevant training to perform variety of tasks.	0.865			
HES3: Employees in this logistic firm are highly skilled and capable.	0.846			
HES4: In this firm employees learn how to perform multiple tasks.	0.824			
RES1: Our firm has ability to quickly respond to supply chain disruption.	0.833	0.765	0.864	0.680
RES2: Our firm has ability to adapt during disruption and turbulent environment.	0.853			
RES3: Our firm is able to recover quickly after disruption.	0.787			
SPR1: This logistic firm has strong competitive advantage to deal with logistic operations.	0.889	0.869	0.920	0.793
SPR2: This firm has ability to develop and introduce new products and services successfully.	0.905			
SPR3: This firm has broad market prospect and respond to market changes quickly.	0.877			

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Establishing discriminant validity is critical issue. Therefore, discriminant validity is assessed through multiple discriminant analysis such as Heterotrait monotrait ratio analysis, cross loading analysis and Fornell and Larcker analysis. At first stage discriminant validity is tested through Heterotrait monotrait ratio analysis. The HTMT analysis has recommended that values of the HTMT must not be higher than .85 or .90 representing factors are discriminant and measure distinct concepts (Hair et al., 2015; Rahi & Ghani, 2018). Nevertheless results have demonstrated that none of the HTMT value is higher than .85 and hence establishing discriminant validity of the factors. Results of the HTMT analysis are shown in Table 2.

Table 2 Heterotrait monotrait ratio analysis

	AIB	BEF	BNO	ENV	HEI	HEP	HES	RES	SPR
AIB									
BEF	0.747								
BNO	0.686	0.725							
ENV	0.763	0.770	0.692						
HEI	0.602	0.741	0.619	0.792					
HEP	0.611	0.683	0.622	0.815	0.727				
HES	0.739	0.717	0.697	0.704	0.573	0.596			
RES	0.716	0.753	0.699	0.803	0.704	0.657	0.730		
SPR	0.633	0.697	0.593	0.795	0.631	0.801	0.668	0.663	

Aside of HTMT ratio analysis discriminant validity of the factors is tested with cross loading analysis. According to Samar Rahi (2017) loadings of the indicator actually differentiate indicators and endorse that indicator measure distinct concepts. The cross loading analysis has suggested that loadings of the factor must be higher than other factors loadings (Fornell, 1992; S. Rahi, 2017). Nevertheless, results have revealed that loading of the factors are higher in correlation table and hence establishing discriminate validity of the factors. Table 3 comprises results of the cross loading analysis and established that factors are discriminant and measure distinct concepts.

Table 3 Factors cross loadings

	AIB	BEF	BNO	ENV	HEI	HEP	HES	RES	SPR
AIB1	0.805	0.475	0.434	0.438	0.389	0.337	0.456	0.433	0.390
AIB2	0.827	0.467	0.464	0.517	0.364	0.412	0.486	0.446	0.395
AIB3	0.839	0.527	0.449	0.538	0.441	0.470	0.518	0.473	0.495
BEF1	0.523	0.858	0.471	0.524	0.544	0.475	0.502	0.525	0.497
BEF2	0.546	0.873	0.548	0.561	0.547	0.494	0.512	0.497	0.484
BEF3	0.479	0.867	0.548	0.576	0.527	0.546	0.548	0.536	0.560
BNO1	0.460	0.474	0.851	0.429	0.431	0.429	0.509	0.448	0.339
BNO2	0.519	0.593	0.889	0.580	0.485	0.505	0.528	0.556	0.542
BNO3	0.399	0.453	0.809	0.443	0.392	0.397	0.433	0.401	0.389
ENV1	0.462	0.551	0.553	0.778	0.607	0.576	0.451	0.504	0.572
ENV2	0.581	0.592	0.507	0.859	0.579	0.606	0.538	0.531	0.634
ENV3	0.437	0.441	0.406	0.754	0.416	0.456	0.429	0.467	0.416
ENV4	0.409	0.404	0.325	0.763	0.465	0.509	0.408	0.484	0.480
HEI1	0.428	0.527	0.449	0.552	0.855	0.541	0.419	0.489	0.460
HEI2	0.367	0.452	0.381	0.468	0.810	0.439	0.299	0.387	0.409
HEI3	0.392	0.522	0.456	0.531	0.795	0.491	0.440	0.485	0.454
HEI4	0.395	0.530	0.401	0.618	0.819	0.550	0.420	0.477	0.447
HEP1	0.393	0.504	0.496	0.609	0.497	0.895	0.428	0.492	0.607
HEP2	0.475	0.588	0.466	0.647	0.593	0.901	0.509	0.520	0.639

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HEP3	0.447	0.441	0.428	0.558	0.555	0.851	0.404	0.400	0.591
HES1	0.520	0.445	0.474	0.526	0.387	0.439	0.762	0.448	0.476
HES2	0.482	0.522	0.554	0.566	0.431	0.476	0.865	0.509	0.460
HES3	0.488	0.498	0.433	0.397	0.401	0.398	0.846	0.482	0.450
HES4	0.468	0.518	0.451	0.437	0.388	0.370	0.824	0.501	0.502
RES1	0.438	0.537	0.471	0.530	0.455	0.470	0.537	0.833	0.470
RES2	0.489	0.442	0.472	0.517	0.434	0.437	0.484	0.853	0.504
RES3	0.427	0.509	0.439	0.511	0.515	0.424	0.431	0.787	0.366
SPR1	0.500	0.543	0.484	0.612	0.501	0.581	0.532	0.510	0.889
SPR2	0.410	0.521	0.456	0.567	0.460	0.606	0.497	0.456	0.905
SPR3	0.473	0.523	0.417	0.629	0.483	0.664	0.497	0.486	0.877

Another renowned analysis to ensure discriminate validity is Fornell and Larcker analysis (Fornell, 1992; Rahi, 2022). This analysis has suggested that square root of AVE must be higher than other factors (Fornell, 1992). Nevertheless, results have shown than square root of average variance extracted at diagonal is higher than other factors correlation. These results have established that factors are discriminant and measure distinct concepts. Thus, cross loading, HTMT ration analysis and Fornell and Larcker analysis altogether have confirmed that factors are discriminate and measure distinct concepts. Results of the Fornell and Larcker criterion are shown in Table 4.

Table 4 Fornell-Larcker criterion

AIB	0.824								
BEF	0.595	0.866							
BNO	0.545	0.603	0.850						
ENV	0.606	0.640	0.577	0.789					
HEI	0.484	0.623	0.517	0.665	0.820				
HEP	0.496	0.584	0.526	0.688	0.620	0.883			
HES	0.592	0.602	0.580	0.583	0.487	0.510	0.825		
RES	0.548	0.600	0.559	0.630	0.565	0.538	0.589	0.825	
SPR	0.520	0.595	0.508	0.679	0.542	0.694	0.572	0.545	0.890

After establishing factors discriminant validity the next step is to ensure data multi-collinearity issue. The multi-collinearity issue is tested with variance inflation factor following criterion that values of VIF must not be higher than 3.3 as recommend by prior researcher (F. Hair Jr et al., 2014; Samar Rahi, 2017). Nonetheless results have shown that VIF values are less than 3.3. and hence established that multi- collinearity is not likely issue in this study. Therefore, hypotheses are tested through bootstrapping procedure. According to S. Rahi (2017) bootstrapping method yield robust results and therefore must be considered in hypotheses testing. Thus, hypotheses are tested with beta values β, t-statistics and p-values. Table 5 demonstrates results of the hypotheses analysis.

Table 5 Hypotheses analysis

Hypothesis	Path	β	STDEV	t-Statistics	Significance	Decision
H1	BNO -> RES	0.134	0.071	1.891	0.029	Supported
H2	BEF -> RES	0.149	0.083	1.789	0.037	Supported
H3	AIB -> RES	0.127	0.066	1.914	0.028	Supported
H4	HES -> RES	0.208	0.067	3.108	0.001	Supported
H5	HEI -> RES	0.177	0.075	2.370	0.009	Supported
H6	HEP -> RES	0.102	0.068	1.502	0.067	Not-Supported
H7	RES -> SPR	0.168	0.059	2.832	0.002	Supported

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Data are bootstrapped and disclosed significant impact of Blockchain novelty in measuring supply chain resilience supported by β = .134, t-statistics 1.891 significant at .02 and confirmed H1. Another direct relationship between Blockchain efficiency and SC resilience is found significant and supported by β = 0.149, t-statistics 1.789 significant at .03 and hence confirmed H2. Next to this artificial intelligence has shown positive impact in measuring supply chain resilience and supported by β = 0.127, t-statistics 1.914 significant at .028 and hence H3 is established. The relationship between employee skill and SC resilience was found significant and supported by β = 0.208, t-statistics 3.108 significant at 0.001 and hence H4 is established. Similarly, employee incentive has shown positive impact supply chain resilience and supported by β = 0.177, t-statistics 2.370 significant at .009 and hence H5 is confirmed. However, employee participation has shown insignificant impact towards supply chain resilience and statistically not supported by β = 0.102, t-statistics 1.502 significant at 0.067 and hence rejected H6. Finally, supply chain resilience has shown positive impact towards organizational performance and supported by β = 0.168, t-statistics 2.832 significant at 0.002 and thus H7 is established. These results have also shown in Appendix 1 with path coefficient and significance level of the hypotheses.

4.3 Testing factors importance level

The research model has revealed that majority of factors positively impact supply chain resilience. Therefore, with amalgamated research model importance of the factors is yet to be confirmed. Therefore, importance performance index analysis is incorporated to check the importance and performance of the factors. Before computing factors importance and performance it is mandatory to select a single outcome variable. Nevertheless, organizational performance of the logistic firm is selected as outcome factor. Results revealed that within amalgamated research framework environmental dynamism is found most important and impactful factor in measuring organizational performance. Therefore, supply chain resilience is considered as second important factor. Concerning with performance level result has shown that employee skills and artificial intelligence have highest performance. Nevertheless for policy makers this analysis has suggested that environmental dynamism is most influential factor that boosts firm supply chain resilience and organizational performance.

Table 6 Factors importance analysis

Organizational performance		
Factors	Importance index	Performance index
Artificial intelligence	0.021	66.635
Blockchain efficiency	0.025	62.415
Blockchain novelty	0.023	63.126
Environmental dynamism	0.550	62.745
Employee incentives	0.030	61.020
Employee participation	0.017	59.654
Employee skills	0.035	68.158
Supply chain resilience	0.168	65.409

4.4 Coefficient of determination and effect size

The hypotheses analysis has revealed significance of the relationship. Therefore, impact of these relationships is collectively measured with coefficient of determination R^2 . Results revealed that altogether blockchain novelty, blockchain efficiency, artificial intelligence, employee skills, employee incentives and employee participation explained R^2 51.1% variance in supply chain resilience. Therefore, environmental dynamism and resilience have explained R^2 48.8% variance in organizational performance. Moreover effect size analysis f^2 is conducted to see actual impact of a single factor. Results of the effect size analysis have shown small effect of all factors in measuring supply chain resilience. Therefore, in measuring organizational performance environmental dynamism has shown substantial effect size. Results of the effect size analysis and coefficient of determination are shown in Table 7.

Table 7 Coefficient of determination and effect size

Coefficient of determination R^2		
Factors	Variance explained	Size/impact
Supply chain resilience	0.511	Substantial
Organizational performance	0.488	Substantial
Factors	Supply chain resilience	Size

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Artificial intelligence	0.017	Small effect
Blockchain efficiency	0.019	Small effect
Blockchain novelty	0.019	Small effect
Incentives	0.032	Small effect
Participation	0.011	Small effect
Skills	0.045	Small effect
Organizational performance		
Environmental dynamism	0.354	Substantial effect
Supply chain resilience	0.031	Small effect

4.3 Moderating analysis

The impact of environmental dynamism is studied as moderating factor between the relationship of supply chain resilience and organizational performance. Although literature has suggested different methods for moderating analysis nevertheless product indicator approach is adopted (Rahi, 2022; Yamin, 2022). Data are computed and results have disclosed satisfactory values of β = -0.049, t-statistics 1.772 significant at p 0.038. These results have established that environmental dynamism moderates and strengthen the relationship between supply chain resilience and organizational performance. Figure 2 highlights path values and t-statistics of the moderating analysis.

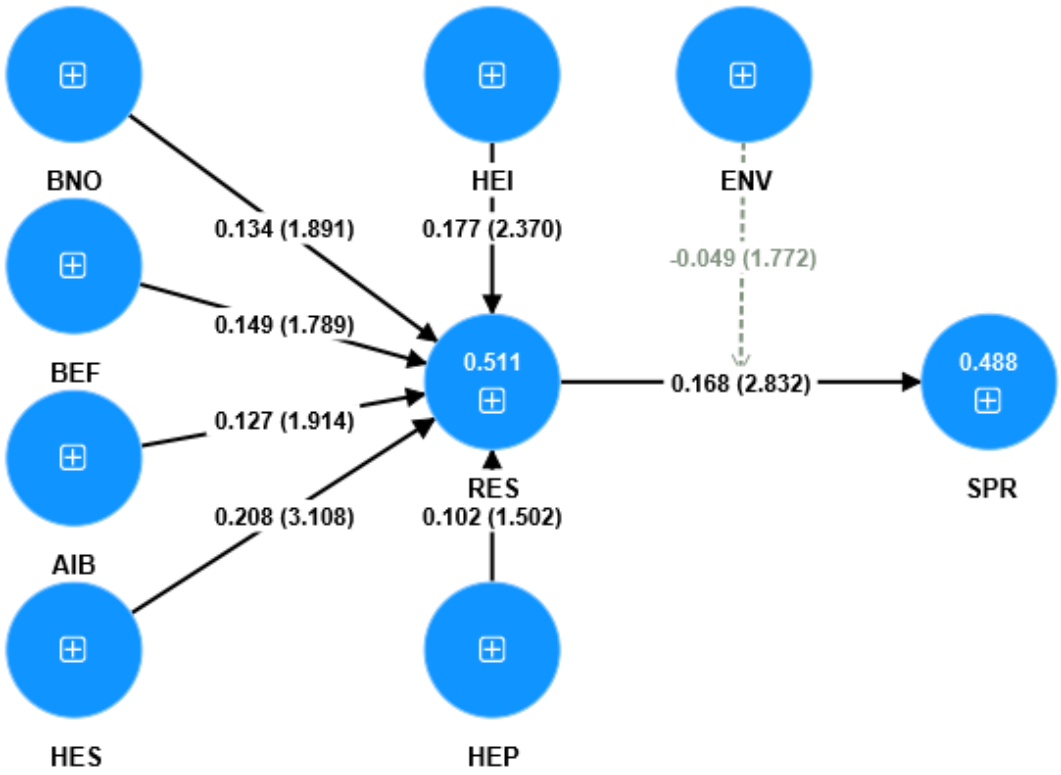

Figure 2 Path coefficient and t-values

5 DISCUSSION

The recent pandemic wave has created curiosity among academic researchers and policy makers to find out factors which increase logistics firm resilience and performance during disruptive environment. Therefore, research framework is developed that comprises factors such as blockchain technology, artificial intelligence, high involvement HR practices and environmental dynamism to predict supply chain resilience and organizational performance. Factors like blockchain novelty and blockchain efficiency have shown positive impact towards supply chain resilience and consistent with prior studies (Hosseini et al., 2019; Li et al., 2022; Pattanayak et al., 2023). Moving further artificial intelligence has shown positive impact in measuring supply chain resilience and consistent with prior researcher findings (Choi et al., 2022; Hussain & Papastathopoulos, 2022). Moreover the relationship between employee skill and supply chain resilience is

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found significant and consistent with prior study (Gu et al., 2023). Employee incentive has shown positive impact supply chain resilience and consistent with prior researcher findings (Gu et al., 2023; Hohenstein et al., 2015). Nevertheless, employee participation has shown insignificant impact towards supply chain resilience and hence inconsistent with prior researcher findings (Gu et al., 2023; Hohenstein et al., 2015). Supply chain resilience has shown positive impact towards organizational performance and in line with prior researchers findings (Gu et al., 2023; Hohenstein et al., 2015; Khan et al., 2021; Li, 2023). Overall research model has confirmed validity as it reveals substantial variance. For instance blockchain novelty, blockchain efficiency, artificial intelligence, employee skills, employee incentives and employee participation explained R^2 51.1% variance in supply chain resilience. Thus, substantial variance indicates that research framework has theoretically and statistically valid to measure supply chain resilience and organizational performance. Moreover, environmental dynamism and resilience have explained R^2 48.8% variance in organizational performance and hence confirmed validity of the research framework to measure organizational performance. In terms of research contribution following sub-section demonstrates research contributions in threefold including theoretical, methodological and practical contributions of the research.

5.1 Research contribution to theory and method

The blockchain technology has potential to track orders throughout the supply chain process and therefore being considered essential factor in logistic operations. Prior to this research blockchain technology has been studied as single factor nevertheless this research has contributed to literature by revealing two dimensions of blockchain technology namely novelty and efficiency. In addition to that developing conceptual linkage between blockchain novelty and resilience adds a new dimension into logistic literature. Moreover, confirming significant relationship between supply chain efficiency and resilience also contributes to logistic literature. As the incline of this logistic research framework is to examine relationship between advance technology factors and supply chain resilience. Therefore, the role of artificial intelligence is studied towards supply chain resilience. Thus, integration of artificial intelligence and blockchain technology altogether in supply chain resilience context contributes to logistic literature. Another theoretical contribution of this research is to investigate the role of high involvement HR practices towards supply chain resilience. This research has disclosed that among high involvement HR practices impact of employee skills and employee incentive is found positive in measuring supply chain resilience and hence enrich literature. Aside of direct effect this study has confirmed moderating effect of environmental dynamism between supply chain resilience and organizational performance and hence adds new dimension into logistic literature. In term of methodological contribution this study has used latest statistical approach like SEM for data estimation. In addition to that sample size is selected through priori power analysis and hence contributes to research methods.

5.2 Research contribution to practice

This study has several useful findings that could assist policy makers to develop resilient and crisis induced based supply chain strategies. For instance this research has revealed that collectively blocks chain novelty, blockchain efficiency, artificial intelligence, employee skills, employee incentives explained substantial variance in supply chain resilience and therefore need managerial attention. Moreover findings of this study have also recommended that environmental dynamism and supply chain resilience positively influence organizational performance and hence need managerial consideration. More precisely results of the importance performance index analysis has indicated that within amalgamated research framework environmental dynamism is found most important and impactful factor in measuring organizational performance. Therefore, supply chain resilience is considered as second important factor. Overall, this research has suggested that blockchain technology should be the part of supply chain process which in turn boosts operational efficiency of the logistic firm. In addition to that this has disclosed high involvement HR practices could help managers to understand what characteristics motivate employee to continue working during crisis or nay other natural disaster. Another useful aspect of this research is to test moderating effect of environmental dynamism between resilience and organizational performance. Findings suggest that if logistics firm consider environmental dynamism in supply chain strategies they would have better ability to deal with resilience and organizational performance. In logistics continuity of logistic operation is the core challenge during natural disaster. Nevertheless, the current research framework directs that managers can develop resilient kind of supply chain design with the help of blockchain technology, high involvement HR practices, artificial intelligence and environmental dynamism which in turn increase supply chain resilience and organizational performance.

6 CONCLUSION

This study has developed an integrated research framework to investigate supply chain resilience and organization performance in turbulent environment. To investigate supply chain resilience this study has schematized that blockchain novelty and block efficiency are two main dimensions of blockchain technology and positively impact supply chain resilience. Similarly, this research has established that artificial intelligence is important determinant of supply chain resilience that brings relevant information and pattern in supply chain process. The research model is further strengthened

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with high-involvement HR practices. Within high involvement HR practices this study has confirmed that factors such as employee skills and employee incentives assist employee in decision making process and motivate to continue work even in disruption. In term of theoretical validity of the research model results have revealed that blockchain novelty, blockchain efficiency, artificial intelligence, employee skills, employee incentives and employee participation explained R^2 51.1% variance in supply chain resilience. Therefore, environmental dynamism and resilience have explained R^2 48.8% variance in organizational performance. This study is unique as it tests the moderating effect of environment dynamism between supply chain resilience and organizational performance. In terms of scope this research has large scope as it collects data from multiple logistics firms located in Saudi Arabia. Moreover, this research is first to test the impact of blockchain novelty and blockchain efficiency towards supply chain resilience. Practically this research has suggested that policy makers could enhance supply chain resilience through blockchain novelty, blockchain efficiency, artificial intelligence, employee skills and employee incentives. Furthermore, this study has suggested that if logistics firms comprise characteristics of environmental dynamism they would have better ability to work in turbulent environment.

6.1 Research limitations and future directions

Although this study has developed valid research framework that enhance supply chain resilience and organizational performance during crisis however it is important to acknowledge study limitations for future studies. First, this research does not claim to include all technology factors that enhance supply chain resilience and organizational performance. Therefore, future researchers are suggested to extend current research model with technology theories such as diffusion of innovation theory and task technology fit model to get more insight on logistics firm resilience in turbulent environment. Second, this study has conceptualized high involvement HR practices to examine supply chain resilience. Nevertheless, future researchers are suggested to add more human resource dimensions. Similarly, in this study artificial intelligence is studied as single factor. However, examining the role of artificial intelligence with multiple dimensions could reveal interesting results. , Moreover, the design of this research is based on cross sectional however, it is expected that if researcher has no time constraints then longitudinal kind of research design could reveal more interesting findings.

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Appendix 1: Path coefficient and significance