

Sustainable Supply Chain Value Creation through Digital Transformation: The Mediating Role of Supply Chain Effectiveness in the Relationship between AI Capabilities, Visibility, Resilience, and Firm Performance in Pakistan's Apparel Industry

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Received: 05-02-2026

Revised: 20-02-2026

Accepted: 08-03-2026

Published: 24-03-2026

ABSTRACT

The current research study exploring the complex the association with the three significance factors the supply chain capabilities, the supply chain visibilities, the supply chain residence, with the supply chain effectiveness to significance productivity in the industry of the Apparel Industry, Pakistan. Therefore, the research conceptual model developed with the help of extensive literature based on the performance of the supply chain effectiveness associated with the firm productivity and the current research study based on the quantitative research approach with administrative developed questionnaire and the data collected from the experts of the Apparel Industry, and the greater experience in the field of Apparel Industry. The author collects the data through the non-probability convenience sampling technique to collect the data. Actually, the better process of supply chain effectiveness always developed good strategic decision making in terms of inventory management, in terms of optimization of resource allocation with significant integration increased organization performance and profitability. The data related to the manufacturing industry of Apparel Industry to analysis the data through the Smart PLS, and the measurement model and the structural equation modeling approach, to analysis the conceptual research model among the relationship of the variables, supply chain capabilities, supply chain resilience, supply chan visibility with the mediating effects of the supply chain effectiveness and with the firm performance. The results indicate that the supply chain resilience, the supply chain visibility, and the supply chain capabilities, the positive and the significant association with the supply chain effectiveness and the positive impact on the firm performance.

Keywords: *supply chain capabilities, supply chain resilience, supply chan visibility, supply chain effectiveness, firm performance*

OVERVIEW

The apparel industries the significance part of the economy of Pakistan, and more than 80% of the GDP of the country of Pakistan (Sayedur et al., 2026). The concept of the supply chain management essential factors such as the supply chain transparency, supply chain traceability, supply chain visibility regarding the firm productivity in the industry of textile, has the significance importance to increase firm productivity (Leal et al., 2022). In the era of globalization, the concept of supply chain management

was most significant and most valuable in the organizational productivity and the streamless process of supply chain management. Because approaches of supply chain management always play an important role in various industries such as manufacturing, pharmaceutical, automobiles, the sector of services and Apparel Industry provides good integration with suppliers, management, distributions and retailers (Ali, 2024). But in traditional way, the functions of supply chain management or approach of supply chain management have greater challenges faces in term of data process, lack of information in term of transparency (Basu, 2023). The methodology of supply chain management contributes the success factors in term of organizations performance, organization profitability such as Apparel Industry sector and the sector of Apparel Industry have utilized the more complex system of networks in term of manufacturers, suppliers, distributors and retailers (Labanava et al., 2022). Due to these complex distribution networks supply chain management strong face challenges (Medhi, 2020). The prior research study suggested that the functionality of the efficiency of supply chain, the multinational companies set objectives effectively in term of provides products according to the customer demands, delivered products at right time and maximum objective of the efficiency supply chain at the minimum possible cost and to increase organizational productivity (Kim & Schoenherr, 2018). In the past research study explained that in the complex supply chain management, security functionality has the significance importance in terms of risk management integrated with supplier relationships, logistics management (Kouhizadeh & Sarkis, 2018). Actually, in the manufacturing process and product delivery the factor of product safety and as well as security features are considered always in the supply chain management significance importance and have more attention. The prior research study suggested that security in the supply chain management refers to reducing the risk during production and increasing productivity (Ali, Nasir, & Haider, 2025). Most of the multinational companies such as pharmaceuticals, automobiles, textiles industries focused on the security features and methods to increase customer satisfaction and reduced error and increase profits (Khan et al., 2022)

In the past research study explained that information technology provides innovative support in the field of supply chain management in terms of transparency, in form of traceability and in terms of efficiency entire supply chain management effectiveness (Ali, Khan, Khan, & Ali, 2024). So that the basic core concept of supply chain effectiveness significant role of digital distribution, good transaction records to control data in this process and control fraud or lack of records or information (Centobelli et al., 2022). So that the factors of transparency and the factor of traceability integrate with technology of information provide visibility all process activities (Badhwar et al., 2023). Actually, the functions of information technology are provenance and authentication in form of recording valuable information such as batch numbers, quality tests of product, certificates introduced in the process of supply chain (Ali, Siddiqui, Ali, & Lutufullah, 2025). So that through this technique increases customer trust, satisfaction and reduces risk and increases organization profitability (Anjum & Dutta, 2022). In the past research study suggested that in the supply chain management the visibility of the real time of the products and also inventory management efficient manner through the technology of information in the industry of Apparel Industry such as order delivering, order placement, order replenishment and optimization productions with cost saving with minimization defects or errors and increase organization performance (Park, 2017). The information technology and the approach of supply chain financing support the supply chain financing in terms of creating transparent operations and accurate transaction records to increase production productivity and reduced production cost (Raj et al., 2022). The prior research study suggested that the definition of transparency in the context of supply chain management the function of sharing information as well as data in terms of purchasing raw materials from the suppliers, inventory management, finished products delivered to customers and developed strong relationships among the suppliers, manufacturing, distributors, retailers and as well as the customers (Jana, 2022). The past research study explained that the transparency positive associated with supply chain management regarding the supply chain efficiency, reduce risk, increase customer satisfaction (Hasan & Habib, 2022). The findings reveal that supply chain transparency positively affects dynamic performance, which includes factors like responsiveness, flexibility, and adaptability and suggests that increased transparency enhances the ability of supply chain participants to respond effectively to changes and disruptions (Ali, Khan, Khan, & Ali, 2024)

The functionality of the information technology based on decentralized characteristics with consensus qualities developed secured and due to this could not breakdown the secured process and transactions with increased protections (Bergers et al., 2021). In the complex supply chain process, information technology supported the factions of sustainability and the supply chain management ethical practices in terms of data saving, fair trade and labor conditions impact on environmental and also facilitates businesses, consumers to take better decisions making (Agyabeng-Mensah et al., 2023). Thus, information technology has significance importance in the field of supply chain management in terms of traceability, transparency, efficiency and the important factor of security. So that the current research study examines innovative technology and the concept of this new innovative in the Apparel Industry process of supply chain management contributes the better opportunities and increased profitability in productions and decreased minimize total cost (Ali, Khan, Iqbal, Bukhari, & Boumal, 2025). The economy of any country, the Apparel Industry has strategic importance and in the field of supply chain management the Apparel Industry faces various challenges in terms of strong supplier relationship, inventory management, sharing, trace the production level and productivity performance (Ali, Ahmed, Nasir, & Ahmed, 2025)

The Problem Statement

The current research study explored and focus on the three significance determinants, the supply chain capabilities, the supply chain visibilities, and the supply chain resilience on the supply chain effectiveness to increase the firm productivity, related to the Apparel Industry, in the city of Karachi. Because of the complex process of supply chain management in the Apparel Industry, faces the challengers regarding the supply chain effectiveness, with relate to the firm's performance.

Through the prior research study suggested that in the field of supply chain management information technology has extensive applications and found that limited research in the area of its applications, thus research study investigates the factors of resilience, capability and the visibility to increase organizational productivity (Zheng & Brintrup, 2025). Actually, in the competitive and dynamics environments, supplier relationships, supply chain resilience, capability and the supply chain visibility to increase the production efficiency and security of the data, becomes the most significance approach to better firm performance and organizational productivity (Ali, Nasir, & Haider, 2025)

The Objectives of the Research Study

The current research study objective explores the concept of the supply chain resilience, capability, and the supply chain visibility, in the productivity of the Apparel Industry to better performance of the organization. Therefore, the following objectives are:

RO1: To investigates the current challenges in the Apparel Industry of Pakistan to increase productivity in the production in the context of Pakistan.

RO2: Analysis the theoretical approach with the concept of the supply chain resilience, with the supply chain effectiveness on organizational performance

RO3: To explore the concept of the supply chain capabilities on the supply chain effectiveness to increase firm performance.

RO4: Examine the factor of the supply chain visibility with the supply chain effectiveness to increase firm performance

Research Questions of the Study

RQ1: What is the key challenges face in the Apparel Industry through the effects of supply chain effectiveness with organizational performance

RQ2: What is the supply chain capabilities with the supply chain effectiveness with the firm productivity

RQ3: What is the impact of the supply chain resilience with the supply chain effectiveness on the firm's performance

RQ4: What is the impact of the supply chain visibility with the supply chain effectiveness on the firm's performance

Research Study Significance

The current research study has significance contributions of the factors of the supply chain resilience, and the capability associated, and the visibility with the supply chain effectiveness with the firm Productivity in terms of theoretical and as well as practical. As the theoretical contribution expensive knowledge, information technology integrates the Apparel Industry in Karachi, through the effects of supply chain visibility, resilience, and the capability with the mediating effects of supply chain effectiveness and the organizational productivity (Ali & Ahmed, 2023). Whereas the contribution of the practically, the research study results give better decision making in the experts of Apparel Industry in Karachi. Thus, the Apparel Industry sector can enhance the supply chain effectiveness, resilience and the capability functionality and better strategic decision and to better productivity

Scope of the Research Study

In the industry of Apparel Industry in Pakistan, the research study has significance importance to better decision making and enhanced productivity with integrated the supply chain resilience, capability, and the supply chain visibility in the information technology and the complex supply chain effectiveness. Thus, the current research study was focusing the significance important characteristics, supply chain management challenges and opportunities of information technology to enhance the productivity in the Apparel Industry.

Gap of the Research Study

The research gap in exploring the impact of supply chain resilience, visibility, and the capability regarding the supply chain effectiveness and the firm productivity, in the Apparel Industry of Pakistan, Thus, the gap of the current research study with the mediating effects of supply chain effectiveness with between the supply chain resilience, the capability, and the visibility with the firm performance. The prior research more investigated regarding the information technology influence on the process of supply chain in terms of supplier relationship, production capacity, data efficiency, transactions, inventory management, thus the propose research study was examines the information technology impact on the process of supply chain management with different factors of supply chain management such as traceability, transparency, and the supply chain visibility to increase productivity and also focus to the better understanding of the potential benefits of the technology (Ali, Khan, Khan, & Ali, 2024). Thus, the research study explained the concept of the practices of the supply chain management on the productivity of the textile industry, the data collection process of the sampling technique of convenience sampling and multiple regression analysis and results indicates that strategic supplier relationship, customer relationship, and information sharing positive associated with productivity (Chen, 2024)

The Supply Chain Capability and the Apparel Industry

The prior study explains that the relationship with the supply chain capability and the supply chain resilience and through this association develops the supply chain effectiveness to better productivity. The supply chain capability integrated with the different elements and the parties to achieve the sharing, and the resources and the shared goals collective achievement (Nikookar et al., 2024). The study suggested that the supply chain capacity explains effective methods to reduce disruptions, and to monitor, recover, and to develop competitive advantages, and control the production process, and the

productivity (Joshi & Luong, 2024). Actually, through the better understanding of supply chain flow of goods, materials, with the technology, automation and streamlines process of supply chain management, to better understanding of organizational performance and increase efficiency in term of goods availability, and decrease cost of the products, thus improve the functionality of the organizational performance (Connor, 2024). With the correct authenticity approach in the supply chain management and protects the data of supply chain management, to decrease the risk in supply chain management process and improve the functionality of supply chain management performance and increase organizational performance (Nursyamsiah et al., 2024)

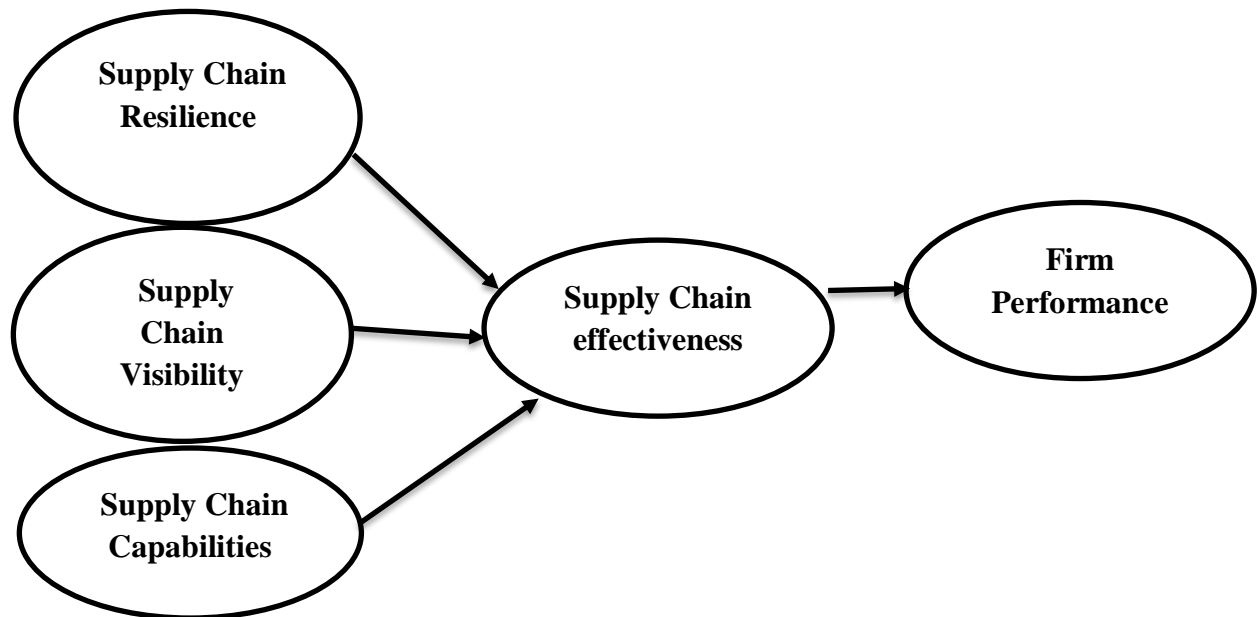
The Apparel Industry Associated with the Supply Chain Visibility

The prior research study suggested that the factor of the supply chain visibility has significance of importance with the firm productivity and has the positive associated with the productivity and as well as the increase the efficiency of the supply chain operations (Huang et al., 2023). Through the factor of transparency, accuracy of the data in the field of supply chain management, to improve the functionality of the customer satisfactions, trust, with shareholders. Thus, increase the importance of customer satisfaction in terms of product availability, and reduced search cost and increase organizational productivity (Asha et al., 2023). Another factor of the supply chain management, the traceability in the supply chain management, through this factor, the searching goods, track the materials in the supply chain management. Through this approach to increase the profitability of the organizational and better performance of the organizational performance (Munawaroh et al., 2024). Furthermore, enhancing Supply Chain Efficiency and the factor of Traceability enables companies to improve supply chain efficiency by providing real-time visibility into the movement of goods and materials. This helps in optimizing inventory levels, reducing lead times, and enhancing overall operational performance. Mitigating Risks and Improving Resilience and Traceability allows for the identification and tracking of products throughout the supply chain, which helps in mitigating risks associated with product recalls, counterfeiting, and food safety issues. It also enables companies to respond quickly to disruptions, enhancing supply chain resilience (Khan et al., 2022).

Apparel Industry Associated Supply Chain Resilience

The concept of the supply chain resilience is associated with the ability of the supply chain to remove the disruptions on time and more effectively during the process of supply chain (Agrawal & Alikhani, 2025). The prior study suggested that the supply chain resilience investigates and measured the flexibility, the collaboration of supply chain, the supply chain agility to measure the supply chain effectiveness with the using of google form collection data, the different companies in Jordan, and results suggested that the supply chain resilience has the significance impact on the supply chain effectiveness, and the firm productivity (Sari et al., 2023). The study explains that the functionality of the supply chain resilience refers to the disruption of the supply chain, with the significance factors integrated, the innovation technology, supply chain globalization, the outsourcing, considered the development of the supply chain resilience, and the literature suggested that the supply chain resilience, and the capability to reduce the disruption regarding the fast response to achieve the effectiveness process of the supply chain, and the uncertainty environment (Shahzad & Irfan, 2024). Through the strategies of the supply chain, the supply chain flexibility, the collaboration of supply chain, the redundancy, the ability to achieve the effective resilience of supply chain effectiveness (Susitha et al., 2024). The factors of the supply chain resilience, through the flexibility, the ability of the firm to accept the changes and also the uncertainty in the competitive business environment, in term of changes customer requirements, and with the collaboration associated with the capability firm to develop significance mutual relationships associated with the reward strategies, and the sharing risk in the effective process of supply chain, and redundancy associated with the strategies of the changes of the suppliers relationships, and the ability of the firm to accumulate the process of the productivity, and these factors significance impact on the supply chain effectiveness and the firm productivity (Duan et al., 2025).

Conceptual Research Model



Hypotheses Development

H1: Supply Chain Resilience has significantly and the positively associated with the Supply Chain effectiveness

H2: Supply Chain Visibility has the significantly and the positively associated with the Supply Chain effectiveness

H3: Supply Chain Capabilities the significantly and the positively associated with the Supply Chain effectiveness

H4: Supply Chain effectiveness Mediates the relationship between the Supply Chain Resilience and the effectiveness

H5: Supply Chain effectiveness Mediates the relationship between the Supply Chain Visibility and the effectiveness

H6: Supply Chain effectiveness Mediates the relationship between the Supply Chain Capabilities and the Firm Performance

H7: Supply Chain effectiveness has the significantly and the positively associates with the Firm Performance

Research Design

The current research study was based on the quantitative research approach to explore the concept of enhancing supply chain management, and organization profitability in the apparel industry in Karachi. The quantitative research allows for an in-depth understanding of participants' experiences, perspectives, and perceptions (Creswell, 2014). The study utilizes interviews and surveys as data collection methods to gather rich and comprehensive data from relevant stakeholders. The research approach defined as two types of research approach such as qualitative research and quantitative research, the qualitative research is based on subjective, opinion based and whereas the quantitative

research is based on quantitative and includes numbers for analysis data. There are two main types of research types, the type of explanatory research type has greater importance and helps to provide the accept or reject the hypotheses with detailed results. Through the explanatory research to includes the variables which explained the people behavior, actions and impact of the phenomenon (Kumar & Phrommathed, 2005)

Sampling Technique for Research Study

The current research study was taken the technique of sampling, the non-probability sampling technique, the convenience sampling technique to collect the data from the respondent through the closed ended questionnaires, the respondents of the research study was considered have the greater experience in the field of supply chain management and the students of the supply chain management of the different universities of the Karachi.

Measurement Model

The measurement model, analysis, through the results of the convergent validity and the discriminant validity with the help of the cross lodgings in the following table. Thus, the results show that the discriminant validity and the values of the factor loading greater than 0.7. The values of the Cronbach's alpha show the consistency of the constructs, which are more than 0.7. and composite reliability greater than 0.7. the threshold values of the average variance more than 0.6, acceptable (Hair et al. 2019; Khan et al. 2019)

Standardized factor loadings

Constructs	Out-loading	Cronbach's alpha	AVE	Composite Reliability
Supply chain capabilities (SCC)	0.825	0.788	0.678	0.778
	0.714			
	0.814			
	0.738			
Supply chain visibility (SCV)	0.774	0.838	0.652	0.752
	0.730			
	0.834			
	0.799			
	0.782			
Supply chain resilience (SCR)	0.777	0.783	0.547	0.783
	0.714			
	0.872			

Supply chain effectiveness (SCP)	0.810			
	0.814	0.740	0.686	0.778
	0.830			
	0.778			
Firm performance (FP)	0.814			
	0.737	0.737	0.658	0.834
	0.725			
	0.708			

The results show that the inter correlations matrix, through the discriminant validity and thus the results of the Fornell Larcker criteria method suggested that good evidence regarding the discriminant validity of the constructs.

Fornell–Larcker criteria.

Constructs	FP	SCP	SCPF	SCR	SCV
FP	0.822				
SCP	0.671	0.823			
SCE	0.690	0.664	0.852		
SCR	0.484	0.540	0.532	0.770	
SCV	0.586	0.644	0.578	0.477	0.730

Summary of Hypothesis Results

Hypotheses	Relationships	P values	Decisions
H1: Supply Chain Resilience has significantly and the positively associated with the Supply Chain Effectiveness	SCR -> SCE	0.000	Accepted
H2: Supply Chain Visibility has the significantly and the positively associated	SCV -> SCE	0.000	

with the Supply Chain Effectiveness

Accepted

H3: Supply Chian
 Capabilities have the significantly and the positively associated with the Supply Chain Effectiveness

SCP -> SCE

0.000

Accepted

H7: Supply Chain
 Effectiveness has the significantly and the positively associates with the Firm Performance

SCE -> FP

0.000

Accepted

The results indicate that the probability value less than 0.05, which is suggested that the Supply Chian Resilience has significantly and the positively associated with the Supply Chain effectiveness, is supported, thus, concludes that the supply chain resilience has the positive and the significantly impact on the supply chain effectiveness and the Supply Chain Visibility has the significantly and the positively associated with the Supply Chain effectiveness the results indicates that the value of the sig-value which is less than 0.05, thus, suggested that supply chan visibility has the positive impact on the supply chain effectiveness hence the hypothesis H2 is supported. Furthermore, the Supply Chian Capabilities has the significantly and the positively associated with the Supply Chain effectiveness is also supported based on the results of the probability values less than 0.05, thus, concludes that supply chain capabilities have the positive and the significantly. Based on the results, suggested that the supply chain resilience, supply chain visibility and the supply chain capabilities have important factors considered to increase supply chain effectiveness. Further results indicates, the hypothesis, H7, the supply chain performance has the significantly impact on the firm performance, based on the results, the value of the P-Value=0.000, which is less than 0.05, thus, concludes that the variable supply chain effectiveness has the positive impact with the firm performance, thus, in any industry, the supply chain effectiveness has the significance importance to increase the firm productivity and enhanced the firm performance. Thus, the hypothesis has been supported. **H7: Supply Chain effectiveness has the significantly and the positively associates with the Firm Performance**

Mediating Effects of the Hypotheses

Hypotheses	Relationships	P values	Decisions
<p>H4: Supply Chain effectiveness mediates the relationship between the Supply Chian Resilience and the Firm Performance</p>	<p>SCR -> SCE -> FP</p>	<p style="text-align: center;">0.000</p>	<p style="text-align: right;">Accepted</p>

LIMITATIONS AND FUTURE RESEARCH

The current research study has some limitations and further shared the significance suggestions for future research. The current research study includes the factors with the associated the mediating effects of the supply chain effectiveness with the independent variables of the supply chain capabilities, the supply chain visibility and the supply chain resilience with the firm productivity. The current research study has some limitations regarding the geographic area, the city of Karachi, and includes the variables such as supply chain resilience, the supply capabilities, and the supply chain visibility, thus the more factors may include, the moderating effects of supply chain transparency, the supply chain

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