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Understanding the Enablers of Artificial Intelligence Adoption for Supply Chain Risk Management: A Qualitative case study of Textile and Clothing industry in Pakistan

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ABSTRACT

Purpose:

Extant literature has indicated a paucity of scholarship on artificial intelligence and supply chain risk management. Considered the backbone of the nation, the Pakistani textile and clothing industry has witnessed a persistent decline recently which has increased its vulnerability to various supply chain risks. Although artificial intelligence holds significant promise to enhance resilience in supply chains, its adoption is complex particularly in the industrial sectors of emerging nations. In this context, scholars have urged the need for case studies to explore factors that could enable AI adoption for effective management of supply chain risks.

Design:

This single qualitative case study obtained data from 26 participants through semi-structured interviews and open-ended questionnaires, which were analyzed by both thematic analysis and summative content analysis.

Findings:

Participants of the research revealed that a) artificial intelligence awareness, trust, and workforce development b) digital Infrastructure, maturity, and financial enablement c) strategic leadership d) advanced artificial intelligence data governance and protection frameworks are some of the enablers which can facilitate successful adoption of artificial intelligence for supply chain risk management.

Originality and Value:

The findings of the research offer valuable insights for the academia and industry professionals.

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1. Introduction

1.1 Overview

The textile and clothing sector of Pakistan is considered the backbone of the nation. Representing 46 % percent of the total manufacturing sector, providing employment to 40 % of the total labor force and contributing 8.5 % in the nation's Gross Domestic Product (Board of Investment,2020), Pakistani textile and clothing industry develop supply networks connecting markets across the globe (Frederick & Center 2019). In 2022, it exported textile and clothing products worth USD19.30 billion (Pakistan Today,2024). While obsolete technology remains a significant challenge (Nasir et al.,2025; Khan, 2025)., currently, the Pakistani textile and clothing industry is confronted with declining business performance (The Guardian,2023; The Express Tribune, 2023; Business Recorder, 2023) which increase its vulnerability to numerous supply chain risks (Durugbo & Al-Balushi,2023).

Supply chain risk management entails, assessment and prioritization supply chain risks on certain criteria and then develop, execute and responsive strategies (Oliveira et al.,2019) It refers to devising effective strategies to manage both routine and non-routine risks originating across the supply networks by continued risk evaluation and monitoring with an objective of minimizing vulnerability and thereby maximizing business continuity (Schlegel & Trent,2014). Firms require robust supply chain management expertise to decrease the supply chain vulnerabilities. A pragmatic supply chain risk management imitative focuses on discovering both apparent and latent supply chain risks, creating a strategy to respond to these risks and then implementing it effectively (Kara et al.,2020)

Artificial intelligence has been defined as replication of human intelligence by a system or machine. The fundamental objective of artificial intelligence is to produce a machine which can think like that of people and imitate their behaviors such as perception, reasoning, planning, acquiring knowledge etc. (Xu et al.,2021) It refers to the maximal capacity of an artificial system to utilize computational algorithms to complete a standardized task with accurate and valid results (Gignac & Szodorai,2024). It is a combination of algorithms, software and hardware which facilitate the machines to execute functions which require intelligence of human beings (Blut et al., 2021) It refers to systems which replicate cognitive functions which are typically associated to human attributes, such as learning, language processing and problem solving (Stuart & Novig, 2016).Artificial intelligence holds promising potential to improve various aspects of supply chain management (Toorajipour et al.,2021; Jackson et al.,2024) Since the basic characteristics of artificial intelligence make it suitable for supply chain risk management (Mithas et al.,2022; Wong et al.,2024) Pakistani textile and clothing organizations can adopt it to enhance supply chain resilience.

1.2 Research Problem

First, globalization has led to supply networks extended around the world. An exposure to risk anywhere in the supply chains render the entire supply chain vulnerable to various risks. Consequently, contemporary supply chains are exposed to increased levels of complexities which can influence the overall continuity of a business concern (Moretto & Caniato, 2021). Supply chain risk management encompasses numerous variables and inherently intricate (Lochan et al.,2021). Second, although the

basic attributes of artificial intelligence position it as a suitable choice for managing supply chain risks (Baryannis et al.,2019; Mithas et al.,2022; Wong et al.,2024). its adoption in the context of supply chain risk management is relatively scarce (Baryannis et al.,2019; Ganesh & Kalpana 2022). Third, previous studies have demonstrated that investigations on artificial intelligence in connection with supply chain risk management are limited and largely confined to quantitative methods (Baryannis et al.,2019; Jia et al.,2024) . Fourth, although adoption of AI is instrumental for supply chain risk management, it is accompanied by a wide array of obstacles (Morgan et al.,2023; Richey Jr et al., 2023) particularly for the firms operating in the industrial sectors of emerging economies (Alshahrani, 2023). Consequently, researchers have called for studies concentrating on critical success factors which can facilitate adoption of artificial intelligence (Hasija & Esper, 2022 ; Hendriksen, 2023 ; Culot et al 2024) which is crucial for supply chain risk management (Riad et al .,2024 ; Li et al.,2025). On the basis of these insights, the study asks:

RQ: What factors enable Pakistani textile and clothing firms to adopt artificial intelligence for supply chain risk management?

2. Literature Review

2.1 Supply Chain Risks – Characteristics and Typologies

It is crucial to manage risks emanating from contemplator complex supply chains in order to enhance business continuity (Das & Perona,2025). A probabilistic construct, supply chain risk which may arise internally or externally within the supply chain disrupting product, information or funds flows across various activities ultimate influencing the overall economic, environmental or social performance of the supply chain (Wicaksana et al.,2022). Disturbing the firms' operations, these supply chain risks result into significant financial troubles (Emrouznejad et al.,2023). The extant literature has indicated diverse typology of supply chain risks. Olson & Wu (2010) and Wu et al (2006) bifurcated supply chain risks into either internal or external contexts. Juttner et al., (2003) categorized supply chain risks on the basis of three dimensions including organizational, network related or environmental Samvedi et al., (2013) presented their grouping of supply chain risks on the grounds of supply, process, demand and environment. Ravindran et al (2010) stated that the supply chain risks are either miss-the-target or value-at-risk. Wicaksana et al., (2022) proposed an innovative classification of supply chain risks on the basis of three components including the risks' characteristics (internal and external; intentional and unintentional), location of the risk (supply, demand, manufacturing, structures as well as flows of the supply chain namely products, information and funds) and the impacts of risks (economic, environment and social). Studies conducted by Giannakis and Papadopoulos (2016) identified another type of supply chain sustainability related risks.

2.2 Strategies of Supply chain risk management

Risk management is considered crucial in order to operationalize the supply chains amid pervasive uncertainties. Many scholars have concentrated on supply chain risk management with specific emphasis on definition, operationalization and mitigation of risks emanating from supply chains (Ho et al.,2015) Supply chain risk management aims at devising pragmatic strategies related to

identification, evaluation, treatment and control of various supply chain risks (Pham et al.,2023). It focuses on identifying, interpreting and controlling threats associated with the integrity, dependability and originality of goods and services across supply networks (Daneshmand-Meh & Ghane, 2021). An effective supply chain risk management agenda offers a source of competitive advantage to the organizations (Lavastre et al., 2014) The fundamental objective of supply chain risk management is to enhance supply chain resilience so that the firms can respond to unanticipated disruptive events effectively by minimizing their adverse effects and maximizing operational continuity (Nwankwo et al.,2024). Bak (2018) positions research related to supply chain risk management across four continuums including design (from theoretical to empirical), relationship (from independent organization to inter-organizational associations) process (from identification of risk-to-risk control) and economic (from micro to macroeconomic perspectives) in order to evaluate the extant body of literature and propose avenues for future research. While an effective supply chain risk management strategy offers numerous benefits to an organization, it is an intricate task (Lochan et al.,2021; Fan et al.,2017) especially for the supply chains in emerging economies.

2.3 Artificial intelligence – Transformative potential for supply chain risk management

Artificial intelligence has been described as the capability of machines to execute cognitive functions which are generally associated with human brains such as sensing, logical reasoning, learning, communicating, problem solving, decision making and creative thinking (Rai et al., 2019). The analytical methods used for supply chain risk management have changed over a period of time. Recently supply chain methods are more focused towards data resulting from digitalization of supply chains and data processing tools. Involvement of high velocity and volume of data has required decision makers to utilize the potential of artificial intelligence for an effective risk management procedure (Xia et al.,2019). The integration of artificial intelligence into the process of supply chain risk management can enhance resilience in supply chains (Jia et al.,2024). The overall process of supply chain risk management can be benefited by artificial intelligence by determining best possible line of action to mitigate supply chain risks in the current turbulent environment of supply chains (Baryannis et al., 2019). A typical artificial intelligence approach may span from traditional symbolic artificial intelligence relying on mathematically or knowledge-based models to sub-symbolic artificial intelligence such as machine learning systems (Jahin et al., 2024). As a matter of fact, artificial intelligence provides multiple applications to improve supply chain risk management process through faster speed, better accuracy levels and the capacity to process complex as well as huge data in comparison with traditional system (Lynn et al., 2019). Although effective adoption of artificial intelligence is crucial for supply chain risk management, it is surrounded by a range of intricacies (Morgan et al., 2023; Richey Jr et al., 2023).

3. Methodology

3.1 Research Methodology

An inductive research approach was used for this research because it moved from specific observations to general generalizations (Trochim, 2006; Creswell & Clark (2017) and was considered suitable to capture the perspectives of the participants. “Case Study” was selected as the research strategy of this research as it elaborates current dilemmas embedded in multiple perspectives (King et al., 2018) and it enables in-depth comprehension of the meaning and contextualization of the phenomenon (Eisenhardt, 1989; Yin, 2003). The researchers reside in Pakistan with potential industrial contacts which supported collection of data. Pakistan is the “Context” of the case study. The “Case” of

this research is textile and clothing sector of Pakistan, Case study protocol was observed as described by Yin (2003). A qualitative research type was adopted for detailed exploration of the phenomenon (Patton, 2002) utilizing multi method. The time horizon of this research is "cross-sectional". The research engaged twenty-six industry practitioners from the textile and clothing industry of Pakistan who were purposefully selected on the basis of their extensive professional experience and active involvement in core supply chain functions. All participants had between five and seventeen years of industrial experience. It ensured that the perspectives captured reflected considerable and multidimensional exposure to the supply chain risk management, adoption of artificial intelligence and supply chain resilience. Their roles encompassed key process of supply chain including orchestrate, plan, order, source, transform, fulfill, and return providing them with direct, practice-informed understanding of vulnerabilities and operational challenges associated with supply chain processes. In order to protect the privacy of the participant, their identities, roles, and organizational affiliations were kept confidential. Since this research required identification and selection of participants with adequate knowledge and experience about the phenomenon, purposive sampling was employed (Creswell & Clark, 2017). Data saturation (Glaser & Strauss, 1967) was reached after 17 responses (Q1- Q17) for open-ended questionnaires and 9 responses (N1- N9) for semi-structured interviews. Both Open ended questionnaires and semi structured interviews were used to collect the data. Thematic analysis revolves around identification of recurring patterns within the data (Mirzaei & Shokouhyar, 2023). A reflexive thematic analysis was used to interpret and analyze the qualitative data which enabled in-depth understanding of respondents' perspectives (Braun & Clarke 2006). Thematic analysis was utilized in order to identify, examine, and interpret key patterns and themes from qualitative data set. In contrast, summative content analysis begins with identification and quantification of some particular words or the content of a text or document (Wiese et al., 2012). Summative content analysis enabled us to systematically identify and examine patterns as well as meanings embedded in the data with the help of quantification and contextualization of major words and themes. Interpretive depth and empirical substantiation were attained by using both reflexive thematic analysis and summative content analysis as data analysis techniques. Trustworthiness (Lincoln & Guba,1985) was achieved in the study through a number of initiatives. Confirmability was ensured through triangulation which involved cross-checking the findings of the study from other secondary sources such as research papers and industrial reviews and reports, etc. Methodological triangulation was attained by using two analytical techniques. The researchers' connections and experiences in the textile and clothing industry enhanced dependability. Provision of detailed descriptions and interpretations facilitated transferability. Member check procedure created credibility.

3.2 Ethical considerations

Informed consent was taken from the participants which allowed them withdraw from the research any time at their discretion. Participants' identities were kept confidential for protection and privacy purposes. The data obtained in the research was utilized exclusively for this research and maintained carefully. Appropriate measures were taken to ensure that the interpretation of the data is unbiased and strictly reflects the participants perspectives. Relevant ethical approvals were taken. Honesty, integrity and transparency remained fundamental priorities of the study.

4. Result And Discussion

Participants in this exploratory research depicted some drivers which can facilitate the adoption of AI These enablers include 1) AI Awareness, Trust, and Workforce Development 2) Digital Infrastructure, Maturity, and Financial Enablement 3) Strategic Leadership for AI Adoption 4) Advanced AI Data Governance and Protection Frameworks.

4..1 Results of Summative Content Analysis

The results of summative content analysis of the theme (Enablers of AI Adoption for supply chain risk management in the Pakistani Textile and Clothing Sector) are summarized below in the form of Table 1,2 and 3. The frequency of direct words, indirect words and total words is represented by D, I and T respectively.

4.1 Summative Content Analysis Performed on the Data Collected from Open-Ended Questionnaires

Table 1:

Respondents	**(a) AI Awareness, Trust, and Workforce Development**	**(b)** ***Digital Infrastructure, Maturity, and Financial Enablement***	**(c)*Strategic Leadership for AI Adoption***	**(d)** ***Advanced AI Data Governance and Protection Frameworks***
Q 1	D=0 / I=1 / T=1	D=0 / I=0 / T=0	D=0 / I=0 / T=0	D=0 / I=2 / T=2
Q 2	D=3 / I=1 / T=4	D=0 / I=0 / T=0	D=9 / I=6 / T=15	D=0 / I=0 / T=0
Q 3	D=0 / I=0 / T=0	D=0 / I=0 / T=0	D=0 / I=0 / T=0	D=0 / I=0 / T=0
Q 4	D=3 / I=1 / T=4	D=0 / I=0 / T=0	D=1 / I=0 / T=1	D=8 / I=3 / T=11
Q 5	D=0 / I=2 / T=2	D=8 / I=4 / T=12	D=0 / I=0 / T=0	D=0 / I=0 / T=0
Q 6	D=1 / I=0 / T=1	D=0 / I=0 / T=0	D=1 / I=0 / T=1	D=4/ I=7 / T=11
Q 7	D=0 / I=0 / T=0	D=1 / I=1 / T=2	D=0 / I=0 / T=0	D=0 / I=0 / T=0
Q 8	D=2 / I=0 / T=2	D=0 / I=0 / T=0	D=0 / I=0 / T=0	D=0 / I=0 / T=0
Q 9	D=8 / I=4 / T=12	D=2 / I=1/ T=3	D=0 / I=0 / T=0	D=0 / I=0 / T=0
Q 10	D=0 / I=1 / T=1	D=0 / I=1 / T=1	D=7 / I=5 / T=12	D=0 / I=0 / T=0
Q 11	D=0 / I=3 / T=3	D=0 / I=0 / T=0	D=0 / I=1 / T=1	D=0 / I=0 / T=0
Q 12	D=2 / I=0 / T=2	D=9 / I=0 / T=9	D=0 / I=0 / T=0	D=2 / I=3 / T=5
Q 13	D=0 / I=3 / T=3	D=0 / I=0 / T=0	D=0 / I=1 / T=1	D=0 / I=0 / T=0
Q 14	D=0 / I=0 / T=0	D=7 / I=4 / T=11	D=1 / I=0 / T=1	D=0 / I=3 / T=3
Q 15	D=1 / I=2 / T=3	D=0 / I=0 / T=0	D=1 / I=0 / T=1	D=3 I=0 / T=3
Q 16	D=1 / I=0 / T=1	D=1 / I=0 / T=1	D=0 / I=1 / T=1	D=0 / I=0 / T=0
Q 17	D=0 / I=1 / T=1	D=0 / I=0 / T=0	D=0 / I=0 / T=0	D=0 / I=0 / T=0
Total Frequency	D=21 / I=19 / T=40	D=28 / I=11 / T=39	D=20 / I=14 / T=34	D=17 / I=18 / T=35

Table 1 presents the findings from open-ended questionnaires explaining the key enablers for AI adoption in the Pakistani textile and clothing industry

4.2 Summative Content Analysis Performed on the Data Collected from Semi Structured Interviews

Table 2:

Respondents	*(a) AI Awareness, Trust, and Workforce Development*	(b) *Digital Infrastructure, Maturity, and Financial Enablement*	(c)*Strategic Leadership for AI Adoption*	(d) *Advanced AI Data Governance and Protection Frameworks*
N 1	D=0 / I=1 / T=1	D=0 / I=1 / T=1	D=5 / I=4 / T=9	D=2 / I=2 / T=4
N 2	D=1 / I=0 / T=1	D=2 / I=0 / T=2	D=0 / I=1 / T=1	D=0 / I=1 / T=1
N 3	D=3 / I=0 / T=3	D=1 / I=0 / T=1	D=3 / I=0 / T=3	D=3 / I=1 / T=4
N 4	D=2 / I=0 / T=2	D=5 / I=4 / T=9	D=0 / I=0 / T=0	D=2 / I=0 / T=2
N 5	D=1 / I=0 / T=1	D=3 / I=1 / T=4	D=2 / I=0 / T=2	D=0 / I=0 / T=0
N 6	D=7 / I=4 / T=11	D=0 / I=0 / T=0	D=1 / I=1 / T=2	D=0 / I=0 / T=0
N 7	D=0 / I=2 / T=2	D=3 / I=0 / T=3	D=0 / I=1 / T=1	D=5/ I=7 / T=12
N 8	D=3 / I=0 / T=3	D=2 / I=0 / T=2	D=3 / I=0 / T=3	D=1/ I=0 / T=1
N 9	D=0 / I=0 / T=0	D=0 / I=1 / T=1	D=0 / I=0 / T=0	D=0 / I=0 / T=0
Total Frequency	D=17 / I=7 / T=24	D=16 / I=7 / T=23	D=14 / I=7 / T=21	D=13 / I=11 / T=24

Table 2 summarizes the insights from semi-structured interviews, showing participants' insights on the enablers of AI adoption.

4.3 Summative Content Analysis Performed on the Data Collected from Open-Ended Questionnaires and Semi Structured Interviews

Table 3:

Data Source	(a) *AI Awareness, Trust, and Workforce Development*	(b) *Digital Infrastructure, Maturity, and Financial Enablement*	(c) *Strategic Leadership for AI Adoption*	(d) *Advanced AI Data Governance and Protection Frameworks*	Total Frequency per Source
Open-Ended Questionnaires (Q1–Q17)	D=21 / I=19 / T=40	D=28 / I=11 / T=39	D=20 / I=14 / T=34	D=17 / I=18 / T=35	T = 148
Semi-Structured Interviews (N1–N9)	D=17 / I=7 / T=24	D=16 / I=7 / T=23	D=14 / I=7 / T=21	D=13 / I=11 / T=24	T = 92
Combined Total Frequency	D = 38 / I = 26 / T = 64	D = 44 / I = 18 / T = 62	D = 34 / I = 21 / T = 55	D = 30 / I = 29 / T = 59	T = 240

Using cumulative frequencies, Table 3 combines data from both questionnaires and interviews elucidating an integrated view of the determinants that support successful AI adoption for supply chain risk management in the Pakistani textile and clothing industry.

4.2 Results of Thematic Analysis

The findings of thematic analysis (Enablers of AI Adoption for supply chain risk management T in the Pakistani Textile and Clothing Sector) are mentioned below:

4.2.1 AI Awareness, Trust, and Workforce Development

Study participants indicated that AI familiarity, trust and workforce skill development initiatives are critical enablers for successful deployment of AI. Mentioning this determinant, Q9, and N6 said: "*A series of structured workshops, pilot projects, targeted training and continuous skill development, illustrative case studies along with effective communication of AI applications and results can definitely develop confidence towards the reliability of AI which will promote its adoption*."

Firms can arrange organized workshops comprised of interactive sessions about theoretical as well as practical application of AI in supply chain risk management. Supporting successful case studies can be used in order enhance workers' confidence. Trial implementation process including performance metrics, feedback mechanisms and active participation of the workers can be implemented on rather small level. Targeted training and development initiatives may include hands on exercise, simulations and joint assignments which enable the employees to understand, trust and subsequently apply AI tools and techniques in real industrial settings.

4.2.2 Digital Infrastructure, Maturity, and Financial Enablement

Highlighting digital infrastructure, maturity and financial enablement as core enablers of AI adoption in Pakistani textile and clothing industry, Q5 and Q14 said:

"Advanced digital infrastructure, standardized and mature organizational processes as well as strategic financial investment establish the requisite conditions for effective AI deployment."

Q12 and N4 added:

"Government grants or Industrial partnerships, internal resource optimizations may help address financial challenges. Cloud-based or hybrid systems, backup power as well as energy systems, low band width solutions, incremental upgrade and collaborative mechanism with technology providers may decrease digital deficiencies. Data integration, governance and analytical potential, automation and continuous evaluation will lead to digital maturity. As a matter of fact, digital Infrastructure, maturity, and financial enablement are enablers of AI adoption."

On the basis of the insights of the participants, it is evident that enhancement of digital infrastructure, technological maturity and financial means can trigger the adoption of AI

4.2.3 Strategic Leadership for AI Adoption

Effective strategic leadership is crucial for successful adoption of AI. Leaders are indispensable in guiding the development of the vision and strategies of investment related to AI. They assist in alignment of AI adoption initiatives with organizational goals, resource allocation, decision making and accountability. Emphasizing the importance of leadership for adoption of AI Q2, Q10 and N1 exclaimed:

"It is for sure that strategic leadership is essential for AI adoption. Formulating AI vision and direction, it fosters change management which facilitates the adoption process"

Effective corporate leadership aligns the AI vision and direction with corporate goals, capability building, allocation of resources as well as accountability and governance. The experiences of the participants of the study have explained that a high level of leadership is extremely important for the successful adoption of AI.

4.2.4 Advanced AI Data Governance and Protection Frameworks

Inadequate AI governance and protection mechanisms in Pakistan hinder textile and clothing firms to adopt AI effectively. Weak systems result in data violation, intellectual property espionage, manipulative AI interventions, and exploitation of confidential supply chain information. Absences of established guidelines, insufficient control procedures, and poor enforcement of data protection laws may deter firms from utilizing AI in supply chain risk management initiatives. Q4, Q6, N7 noted:

"Advanced AI data governance and protection frameworks are enablers of AI adoption because they ensure confidentiality and security by mitigating data breaches, intellectual property theft, and adversarial attacks through encryption, access controls, continuous monitoring, and regulatory compliance."

The perspectives of respondents delineate that well-structured AI data governance and protection systems act as critical enabler for the effective and secure adoption of AI

4. Discussion, Conclusion, Recommendations, Implications and Limitations

5.1 Discussion

AI awareness, trust, and workforce development; digital Infrastructure, maturity, and financial enablement; strategic leadership; and advanced AI data governance and protection frameworks are the potential enablers which can facilitate the adoption of AI in order to manage supply chain risks it he textile and clothing industry of Pakistan. Numerous studies have revealed the importance of top management commitment and leadership as foundational enabler of successful adoption of AI in supply chain risk management. Rahim et al (2024) stated the need of effective corporate leadership providing resources, attention and priority to AI adoption. Our results also indicate that strategic leadership is essential for successful adoption of AI. Shahzadi et al (2024) suggest that certain "human factors" are also drivers of successful adoption of AI which illustrates that firms must take appropriate actions to foster AI related trust and awareness among the workers and increase their skills and capabilities which is corroborated by this research. Some studies enumerated the significance of digital infrastructure and technological readiness in relation with AI adoption. Merhi (2024) demonstrated the importance of digital infrastructure. Brătucu et al. (2024) positioned digital maturity as a contextual readiness factor which is associated with the firms' capabilities to adopt AI. Albous et al. (2025) observed that strong technical infrastructure and availability of various financial and non-financial resources strengthen the process of AI adoption. Our study found out that Digital Infrastructure, maturity, and adequate financial resources enable effective adoption of AI. Paul et al (2021) have mentioned how integrated data management is crucial for productive adoption of AI for supply chain risk management. Their findings align with our identified enabler of Advanced AI Data Governance and Protection Frameworks which are considered fundamental aspects of integrated data management. Similarly, Culot et al (2024) highlighted data and system requirements as prerequisites of well managed adoption of AI which corresponds to our narrative that Advanced AI Data Governance and Protection Frameworks are essential enablers of AI adoption in supply chain risk management. Rajgopal & Yadav (2025) and Nikiforova et al. (2025) also underscore the importance of robust AI Data Governance and Protection Frameworks for enabling adoption of AI.

5.2 Conclusion

The findings of research have demonstrated that successful adoption of AI for supply chain risk management depends not only on technological readiness but also on socio-organizational and strategic determinants including: AI awareness, trust, and workforce development; digital infrastructure, maturity, and financial enablement; strategic leadership; and advanced AI data governance and protection frameworks. Consequently, adoption of AI can be considered a multidimensional process which may

require alignment and integration of diverse capabilities. A comprehensive understanding of these key enablers is critical for both scholars and practitioners devising strategies for effective adoption of AI for managing risks in the resource constrained supply chains.

5.3 Recommendations

On the basis of this study, it is suggested that the managers and the policy makers within the textile and clothing sector of Pakistan should establish a holistic strategy to adopt AI which should include not only the technological readiness factors but also the socio-organizational and institutional determinants. Firms must develop targeted training programs and cross learning initiatives to educate the workers about efficacy, limitations and ethical use of AI. Pilot testing or showcasing successful AI adoption case studies can enhance the confidence and acceptance level of the employees. Considerable investment in cloud-based platforms, IoT-enabled systems, and AI-compatible supply chain software, implementation of standardized workflows, performance monitoring systems, and cross-functional coordination mechanisms along with allocation of dedicated budgets and creation of financial support mechanisms will ensure enhancement of digital infrastructure, organizational maturity and financial enablement. Top level management must be engaged who will support and guide the effective adoption of AI in connection with the organizational goals. Moreover, organizations must formulate appropriate data governance models which must define data ownership, access controls and quality parameters. Robust cybersecurity protocols and compliance procedures must be developed for secure and safe use of AI.

5.4 Implications

The outcomes of the study have significant implications for both theory and practice. The research extends AI-supply chain risk management literature from a developing economy perspective. Responding to the literature gap related to scarcity of qualitative research with regard to AI adoption for supply chain risk management in an emerging economy, it offers in-depth qualitative evidence from the textile and clothing industry of Pakistan. Suggesting theoretical advancement beyond technology-driven frameworks, it illustrates that AI adoption cannot be understood solely through investigating technological readiness and is shaped by several socio-organizational dimensions such as trust and leadership. It provides a robust ground for further research in supply chain risk management and AI adoption by capturing analytical salience and interpretive depth through utilization of both summative content analysis and thematic analysis. The four enablers identified in this research can be validated quantitatively in future studies and provide a foundation for cross-country or cross-industry comparative research. From industrial perspectives, the results of the study provide pragmatic insights to facilitate successful adoption of AI for managing risks within the labor-intensive industry of textile and clothing.

5.5 Limitations

The study has various limitations. As a single qualitative case study, its outcomes have limited generalizability which many not be statistically validated in other industrial or national setups. A sample size of 26 based on purposive sampling may not have captured the diverse perspectives of the industry. The cross-sectional scope of the research limits the observations as to how the enables of AI adoption evolve over a period of time in response to changing internal and external business environment.

References

Abbasi, S., Daneshmand-Mehr, M., & Kanafi, A. G. (2023). Designing a tri-objective, sustainable, closed-loop, and multi-echelon supply chain during the COVID-19 and lockdowns. *Foundations of Computing and Decision Sciences, 48*(1), 269-312.

Albous, M. R., & Anouze, A. L. (2025). From Vision to Validation: A Theory-and Data-Driven Construction of a GCC-Specific AI Adoption Index. *arXiv* preprint arXiv:2509.05474.

Alshahrani, S. T. (2023). Industry 4.0 in "major emerging markets": A systematic literature review of benefits, use, challenges, and mitigation strategies in supply chain management. *Sustainability, 15*(20), 14811.

Bak, O. (2018). Supply chain risk management research agenda: from a literature review to a call for future research directions. *Business Process Management Journal, 24*(2), 567-588.

Baryannis, G., Dani, S., Validi, S., & Antoniou, G. (2018). Decision support systems and artificial intelligence in supply chain risk management. *In Revisiting supply chain risk* (pp. 53-71). Cham: Springer International Publishing.

Blut, M., Wang, C., Wünderlich, N. V., & Brock, C. (2021). Understanding anthropomorphism in service provision: a meta-analysis of physical robots, chatbots, and other AI. *Journal of the Academy of Marketing Science, 49,* 632-658.

Board of Investment Pakistan (2020), Textiles Accessed through: https://invest.gov.pk/textile (accessed on: August 10,2024)

Brătucu, G., Ciobanu, E., Chițu, I. B., Litră, A. V., Zamfirache, A., & Bălășescu, M. (2024). The use of technology assisted by artificial intelligence depending on the companies' digital maturity level. *Electronics, 13*(9), 1687.

Business Recorder (2023) Challenges facing the textile sector Accessed through: https://www.brecorder.com/news/40281203 accessed on: November 25,2024

Creswell, J. W., & Clark, V. L. P. (2017). Designing and conducting mixed methods research. Sage publications.

Culot, G., Podrecca, M., & Nassimbeni, G. (2024). Artificial intelligence in supply chain management: A systematic literature review of empirical studies and research directions. Computers in industry, 162, 104132.

Das, S. K., & Perona, M. (2025). Supply chain risk management automation: A literature review. *Electronic Markets, 35*(1), 104.

Durugbo, C. M., & Al-Balushi, Z. (2023). Supply chain management in times of crisis: a systematic review. *Management Review Quarterly, 73*(3), 1179-1235.

Eisenhardt, K. M. (1989). Agency theory: An assessment and review. *Academy of Management Review. 14*, 57-74.

Emrouznejad, A., Abbasi, S., & Sıcakyüz, Ç. (2023). Supply chain risk management: A content analysis-based review of existing and emerging topics. *Supply Chain Analytics*, 3, 100031.

Fan, H., Li, G., Sun, H., & Cheng, T. C. E. (2017). An information processing perspective on supply chain risk management: Antecedents, mechanism, and consequences. *International Journal of Production Economics, 185*, 63-75.

Frederick, S., Daly, J., & Center, D. G. V. C. (2019). Pakistan in the apparel global value chain. Duke Global Value Chains Center, Duke University, Durham, North Carolina, United States.

Ganesh, A. D., & Kalpana, P. (2022). Future of AI and its influence on supply chain risk management–A systematic review. Computers & Industrial Engineering, 169, 108206.

Gignac, G. E., & Szodorai, E. T. (2024). Defining intelligence: Bridging the gap between human and artificial perspectives. *Intelligence, 104,* 101832.s

Glaser, B., & Strauss, A. (1967). Discovery of grounded theory: Strategies for qualitative research. Routledge.

Hasija, A., & Esper, T. L. (2022). In AI (AI) we trust: A qualitative investigation of AI technology acceptance. *Journal of Business Logistics, 43*(3), 388-412.

Hendriksen, C. (2023). AI for supply chain management: Disruptive innovation or innovative disruption? *Journal of Supply Chain Management, 59*(3), 65-76.

Ho, W., Zheng, T., Yildiz, H., & Talluri, S. (2015). Supply chain risk management: a literature review. *International journal of production research, 53*(16), 5031-5069.

Jackson, I., Ivanov, D., Dolgui, A., & Namdar, J. (2024). Generative artificial intelligence in supply chain and operations management: a capability-based framework for analysis and implementation. International *Journal of Production Research, 62*(17), 6120-6145.

Jackson, I., Ivanov, D., Dolgui, A., & Namdar, J. (2024). Generative AI in supply chain and operations management: a capability-based framework for analysis and implementation. *International Journal of Production Research, 62*(17), 6120-6145.

Jahin, M. A., Naife, S. A., Saha, A. K., & Mridha, M. F. (2023). Ai in supply chain risk assessment: A systematic literature review and bibliometric analysis. *arXiv* preprint arXiv:2401.10895.

Jamil, K., Zhang, W., Anwar, A., & Mustafa, S. (2025). Exploring the Influence of AI Adoption and Technological Readiness on Sustainable Performance in Pakistani Export Sector Manufacturing Small and Medium-Sized Enterprises. *Sustainability, 17*(8), 3599.

Jia, F., Hu, S., He, Q., Chen, L., & Xing, X (2024) The Role of Artificial Intelligence in Supply Chain Risk Management: Towards an Integrated Conceptual Framework. Available at SSRN 4913631.

Kara, M. E., Fırat, S. Ü. O., & Ghadge, A. (2020). A data mining-based framework for supply chain risk management. Computers & Industrial Engineering, 139, 105570.

Khan, A. R. (2025). Greening the textile industry: An analysis of the policy landscape of Pakistan (UNCTAD Project Paper No. 2). United Nations Conference on Trade and Development.

King, N., Brooks, J., & Tabari, S. (2018). Template analysis in business and management research. Qualitative methodologies in Organization studies: volume II: methods and possibilities, 179-206.

Lavastre, O., Gunasekaran, A., & Spalanzani, A. (2014). Effect of firm characteristics, supplier relationships and techniques used on Supply chain risk management: an empirical investigation on French industrial firms. I*nternational Journal of Production Research, 52*(11), 3381-3403.

Li, J., Yi, M., & Sun, Q. (2025). Artificial intelligence and supply chain risk: Mediating effects of supply chain efficiency and resilience. International Review of Financial Analysis, 104700

Lincoln, YS. & Guba, EG. (1985). Naturalistic Inquiry. Newbury Park, CA: Sage Publications.

Lochan, S. A., Rozanova, T. P., Bezpalov, V. V., & Fedyunin, D. V. (2021). Supply chain management and risk management in an environment of stochastic uncertainty (Retail). Risks, 9(11), 197.

Lochan, S. A., Rozanova, T. P., Bezpalov, V. V., & Fedyunin, D. V. (2021). Supply chain management and risk management in an environment of stochastic uncertainty (Retail). *Risks, 9*(11), 197.

Lynn, T., Mooney, J. G., Rosati, P., & Cummins, M. (2019). Disrupting finance: FinTech and strategy in the 21st century (p. 175). Springer Nature.

Merhi, M. I., & Harfouche, A. (2024). Enablers of artificial intelligence adoption and implementation in production systems. International journal of production research, 62(15), 5457-5471.

Mirzaei, S., & Shokouhyar, S. (2023). Applying a thematic analysis in identifying the role of circular economy in sustainable supply chain practices. *Environment, Development and Sustainability, 25*(5), 4691-4722.

Mithas, S., Chen, Z. L., Saldanha, T. J., & De Oliveira Silveira, A. (2022). How will AI and Industry 4.0 emerging technologies transform operations management? *Production and Operations Management, 31*(12), 4475-4487.

Moretto, A., & Caniato, F. (2021). Can Supply Chain Finance help mitigate the financial disruption brought by Covid-19?. *Journal of Purchasing and Supply Management, 27*(4), 100713.

Morgan, T. R., Gabler, C. B., & Manhart, P. S. (2023). Supply chain transparency: theoretical perspectives for future research. *The International Journal of Logistics Management, 34*(5), 1422-1445.

Nasir, S., Ali, M., Irshad, M., & Wazir, S. (2025). Critical Evaluation of Textile Industry of Pakistan and Way Forward. Khyber Journal of Public Policy, 4 (1).

Nikiforova, A., Lnenicka, M., Melin, U., Valle-Cruz, D., Gill, A., Flores, C. C., ... & Tesarova, B. (2025). Responsible AI Adoption in the Public Sector: A Data-Centric Taxonomy of AI Adoption Challenges. arXiv preprint arXiv:2510.09634.

Nwankwo, T. C., Ejairu, E., Awonuga, K. F., Usman, F. O., & Nwankwo, E. E. (2024). Conceptualizing sustainable supply chain resilience: Critical materials manufacturing in Africa as a catalyst for change. International Journal of Science and Research Archive, 11(1), 2427-2437.

Oliveira, J. B., Jin, M., Lima, R. S., Kobza, J. E., & Montevechi, J. A. B. (2019). The role of simulation and optimization methods in supply chain risk management: Performance and review standpoints. Simulation Modelling Practice and Theory, 92, 17-44.

Pakistan Today (2024) Tier One Advantages: Strategic Sourcing in Pakistan's Textile Industry Accessed through: https://www.pakistantoday.com.pk/2024/11/03/tier-one-advantages-strategic-sourcing-in-pakistans-textile-industry/ accessed on December 5,2025

Patton, M. Q. (2002). Qualitative research & evaluation methods. Sage

Paul, S. K., Riaz, S., & Das, S. (2021). Adoption of artificial intelligence in supply chain risk management: an Indian perspective. Journal of global information management (JGIM), 30(8), 1-18.

Pham, T. H., Testorelli, R., & Verbano, C. (2023). Supply chain risk and its impact on performance: A structured literature review. Journal of Industrial Engineering and Management, 16(2), 236-262.

Rahim, S. A., Rahman, N. A. A., Ahmi, A., & Waheed, M. (2024). Identifying the factors influencing AI adoption in supply chain management to resolve supply chain disruptions. International Journal of Academic Research in Business and Social Sciences, 14(11), 210-231.

Rai, A., Constantinides, P., & Sarker, S. (2019). Next generation digital platforms: toward human-AI hybrids. Mis Quarterly, 43(1), iii-ix.

Rajgopal, P. R., & Yadav, S. D. (2025). The role of data governance in enabling secure AI adoption. International Journal of Sustainability and Innovation in Engineering, 3(1).

Riad, M., Naimi, M., & Okar, C. (2024). Enhancing supply chain resilience through artificial intelligence: developing a comprehensive conceptual framework for AI implementation and supply chain optimization. Logistics, 8(4), 111.

Richey Jr, R. G., Chowdhury, S., Davis-Sramek, B., Giannakis, M., & Dwivedi, Y. K. (2023). Artificial intelligence in logistics and supply chain management: A primer and roadmap for research. Journal of Business Logistics, 44(4), 532-549.

Russell, S., & Norvig, P. (2016). Artificial intelligence: A modern approach (4th US ed.). Pearson.

Schlegel, G. L., & Trent, R. J. (2014). Supply chain risk management: An emerging discipline. Crc Press.

Shahzadi, G., Jia, F., Chen, L., & John, A. (2024). AI adoption in supply chain management: A systematic literature review. Journal of Manufacturing Technology Management, 35(6), 1125-1150.

The Express Tribune (2023) Textile sector faces worrying decline Accessed through: https://tribune.com.pk/story/2450465/textile-sector-faces-worrying-decline accesed on: November 25.2024)

The Guardian (2023) Pakistan's textile industry is in crisis – and women are bearing the brunt of its decline Accessed through: https://www.theguardian.com/global-development/2023/feb/01/pakistan-textile-industry-crisis-women (accessed through: January 10,2025)

Toorajipour, R., Sohrabpour, V., Nazarpour, A., Oghazi, P., & Fischl, M. (2021). Artificial intelligence in supply chain management: A systematic literature review. Journal of Business Research, 122, 502-517.

Trochim, W. (2006). Qualitative validity. Research methods knowledge base. Web Center for Social Research Methods.

Wicaksana, A., Ho, W., Talluri, S., & Dolgui, A. (2022). A decade of progress in supply chain risk management: risk typology, emerging topics, and research collaborators. International Journal of Production Research, 60(24), 7155-7177.

Wiese, A., Kellner, J., Lietke, B., Toporowski, W., & Zielke, S. (2012). Sustainability in retailing–a summative content analysis. International Journal of Retail & Distribution Management, 40(4), 318-335.

Wong, L. W., Tan, G. W. H., Ooi, K. B., Lin, B., & Dwivedi, Y. K. (2024). AI-driven risk management for enhancing supply chain agility: A deep-learning-based dual-stage PLS-SEM-ANN analysis. International Journal of Production Research, 62(15)

Xiao, C., Petkova, B., Molleman, E., & van der Vaart, T. (2019). Technology uncertainty in supply chains and supplier involvement: the role of resource dependence. Supply Chain Management: An International Journal, 24(6), 697-709.

Xu, Y., Liu, X., Cao, X., Huang, C., Liu, E., Qian, S., ... & Zhang, J. (2021). Artificial intelligence: A powerful paradigm for scientific research. The Innovation, 2 (4), 100179.

Yin, R. K. (2003). Design and methods. Case study research, 3(9.2)