International Journal of Creative and Open Research in Engineering and Management
ISSN: **3108-1754 (Online)**
Volume 02 Issue 02 February-2026 | Impact Factor: 3.5

Role of Artificial Intelligence in Enhancing Supply Chain Resilience in the Post-Pandemic Era

Sneha V. Iyer, Shreya M. Chavan, Prof. Rohan K. Sharma
Department of Operations & Supply Chain Management
Sterling School of Management
Mumbai, Maharashtra, India

How to Cite this Article:

Chavan, S. M. & Iyer, S. V. (2026). Role of Artificial Intelligence in Enhancing Supply Chain Resilience in the Post-Pandemic Era. International Journal of Creative and Open Research in Engineering and Management, 02(02), 1-9. https://doi.org/https://doi.org/10.55041/ijcope.v2i2.002

https://doi.org/10.55041/ijcope.v2i2.002

1. Abstract

The COVID-19 pandemic profoundly disrupted global supply chains, exposing vulnerabilities in traditional logistics, procurement, production planning, and distribution mechanisms. As organizations grappled with unforeseen demand shocks, manufacturing halts, and logistics bottlenecks, the importance of building resilient supply chains capable of responding dynamically to disruptions became unequivocal. Artificial Intelligence (AI)—encompassing machine learning (ML), predictive analytics, natural language processing (NLP), computer vision, and autonomous agents—has emerged as a transformative enabler in enhancing supply chain resilience in the post-pandemic era. This research article investigates the role of AI in augmenting supply chain resilience across key functions such as demand forecasting, inventory optimization, risk management, supplier relationship management, and logistics operations. It provides a critical review of the literature, presents empirical findings, discusses challenges and ethical considerations, and offers actionable insights for practitioners and researchers. The results establish that AI not only enables greater operational agility but also contributes to proactive risk mitigation, improved decision-making, and strategic flexibility. However, barriers such as data quality, integration complexities, and workforce readiness remain pertinent. The article concludes with recommendations for leveraging AI responsibly to construct future-ready supply chains. To maximize AI's potential in supply chain resilience, organizations must prioritize data governance, invest in scalable infrastructure, and foster cross-functional collaboration. Emphasizing ethical AI deployment ensures transparency, accountability, and fairness in automated decision-making processes. Future research should focus on developing adaptive AI frameworks that can evolve with changing market dynamics and emerging risks.

2. Keywords

Artificial Intelligence (AI) ,Supply Chain Resilience ,Post-Pandemic Era ,Predictive Analytics ,Machine Learning ,Risk Management ,Logistics Optimization

3. Introduction

3.1 Background

The global economy underwent substantial upheaval due to the COVID-19 pandemic starting in early 2020, triggering widespread supply and demand disruptions. From semiconductor shortages affecting automotive production to shipping container constraints and retail stockouts, the fragility of global supply chains was starkly revealed (Ivanov & Dolgui, 2020). Traditional supply chain models, optimized for efficiency and cost reduction, struggled to respond to rapid changes in demand patterns and supply constraints. These challenges highlighted the need for strategies and technologies that enhance supply chain *resilience*—the ability of supply networks to adapt, recover, and sustain operations in the face of disruption (Christopher & Peck, 2004).

In this context, Artificial Intelligence (AI) has gained significant attention for its potential to strengthen supply chain resilience. AI refers to computational systems capable of performing tasks that typically require human intelligence, including pattern recognition, prediction, and decision-making (Russell & Norvig, 2016). Applications of AI in supply chains span across forecasting, anomaly detection, autonomous operations, and optimization. These capabilities enable AI to enhance decision-making processes by providing real-time insights and predictive analytics. By integrating AI technologies, supply chains can proactively identify risks and respond swiftly to disruptions. Consequently, AI contributes to improved efficiency, reduced costs, and increased overall supply chain agility.

3.2 Problem Statement

While organizations have increasingly adopted AI solutions for operational improvements, the strategic deployment of AI for resilience—especially in post-pandemic contexts—remains underexplored in academic and practitioner discourse. Critical questions persist: How does AI contribute to resilience across supply chain stages? What challenges inhibit AI implementation? How can organizations measure the effectiveness of AI in mitigating disruptions?

3.3 Research Objectives

This paper aims to:

1. Explore the role of AI technologies in enhancing supply chain resilience.
2. Review the existing literature to identify key AI applications.
3. Analyze empirical data to understand the impact of AI on supply chain performance post-pandemic.
4. Highlight challenges and ethical considerations.
5. Propose recommendations for future research and practice.

3.4 Significance

This research synthesizes cross-disciplinary insights, serving as a resource for academics, supply chain professionals, and technology strategists seeking to leverage AI for resilient supply networks. It explores emerging AI technologies and their applications in enhancing supply chain agility and risk management. The study also examines challenges related to data integration, ethical considerations, and the scalability of AI-driven solutions. By bridging theoretical frameworks with practical case studies, it offers actionable insights for implementing AI strategies effectively.

---

4. Review of Literature

4.1 Supply Chain Resilience: Definitions and Dimensions

Supply chain resilience is defined as the capability of a supply network to *anticipate*, *respond to*, and *recover* from disruptive events while maintaining operational continuity (Ponomarov & Holcomb, 2009). Key dimensions include:

- **Robustness:** Strength against shocks.
- **Redundancy:** Backup capacity.
- **Agility:** Speed of adaptation.
- **Visibility:** Transparency across the chain.
- **Collaboration:** Inter-firm coordination.

Table 1 summarizes key resilience characteristics identified in previous research.

Table 1. Supply Chain Resilience Dimensions and Definitions

Dimension	Definition	Source
Robustness	Strength to withstand disruptions	Ponomarov & Holcomb (2009)
Redundancy	Backup capacity/resources	Sheffi (2005)
Agility	Fast operational response	Christopher & Peck (2004)
Visibility	Real-time transparency	Ivanov (2020)
Collaboration	Shared information and coordination	Wieland & Wallenburg (2012)

4.2 AI Technologies in Supply Chains

Research classifies AI applications in supply chains into several categories:

- **Predictive Analytics and Machine Learning:** For demand forecasting and risk prediction.
- **Natural Language Processing (NLP):** For processing supplier communications and contracts.
- **Computer Vision:** For quality inspection and inventory monitoring.
- **Autonomous Agents & Robotics:** For automated warehousing and logistics.

Figure 1 visually illustrates these AI domains and their applications in supply chain processes.

4.3 AI and Demand Forecasting

Demand forecasting is essential for inventory planning and production scheduling. Traditional statistical techniques, while useful, struggle with nonlinear patterns and sudden demand shifts (Fildes et al., 2008). AI, particularly ML algorithms like Random Forests, Support Vector Machines

(SVM), and Neural Networks, has shown superior forecasting accuracy due to its ability to learn complex patterns from large datasets.

Studies indicate AI can reduce forecast errors significantly compared to conventional methods (Kumar et al., 2021). Furthermore, AI can incorporate real-time data—such as social media trends and market signals—into prediction models. This capability allows AI-driven models to adapt quickly to changing environments, enhancing the accuracy and relevance of forecasts. Additionally, AI techniques such as machine learning and deep learning enable the extraction of complex patterns from large datasets, which traditional methods might overlook. Consequently, the integration of AI in forecasting contributes to more informed decision-making across various industries.

4.4 AI in Risk Management

Risk management encompasses identifying, assessing, and mitigating supply chain threats. AI supports early risk detection through anomaly detection algorithms and scenario simulations. For example, natural hazards, supplier bankruptcies, and logistics delays generate data patterns that can be detected before they escalate.

Researchers argue that AI enhances *predictive risk intelligence*, enabling firms to act *preemptively* rather than reactively (Choi, Wallace, & Wang, 2016).By integrating real-time data analytics, AI systems can continuously monitor supply chain activities to identify emerging risks promptly. This proactive approach allows organizations to allocate resources efficiently and implement contingency plans before disruptions occur. Consequently, AI-driven risk management enhances overall supply chain resilience and operational continuity.

4.5 AI in Supplier Relationship Management (SRM)

Supplier risk and performance indices can be derived from unstructured data sources—financial reports, news feeds, social media—through NLP. AI enhances transparency and enables supplier segmentation based on risk profiles. This supports dynamic sourcing strategies that contribute to resilience. By leveraging machine learning algorithms, organizations can predict potential disruptions and proactively mitigate risks. Integrating these insights with supplier performance metrics allows for a comprehensive evaluation framework. Consequently, decision-makers are better equipped to optimize procurement processes and enhance supply chain resilience.

4.6 Autonomous Operations and Logistics

AI-enabled robotics and autonomous vehicles are increasingly deployed in warehouses and transportation. These systems can operate with minimal human intervention, reducing disruption vulnerability due to labor shortages or health crises. These technologies enhance operational efficiency by enabling continuous workflow and real-time inventory management. They also improve safety by minimizing human exposure to hazardous environments. Furthermore, AI-driven analytics optimize route planning and resource allocation within these automated systems.

4.7 Gaps in the Literature

Despite strong evidence of AI's benefits, several gaps persist:

1. **Integration challenges:** Integrating AI across diverse supply chain systems.

2. **Human-AI collaboration:** Aligning AI decisions with managerial judgment.

3. **Ethical considerations:** Bias, transparency, and data privacy concerns.

These gaps form the basis for the research methodology and analysis presented next.

---

5. Research Methodology

5.1 Research Design

This study uses a **mixed-methods approach**, combining quantitative data analysis with qualitative insights. The methodology comprises:

- **Survey Data Collection:** Responses from supply chain professionals across manufacturing, retail, and logistics sectors.

- **Case Studies:** Analysis of AI implementations within firms post-pandemic.

- **Secondary Data:** Literature synthesis and industry reports.

5.2 Population and Sampling

The population includes supply chain executives and data science professionals in organizations that have implemented or piloted AI solutions. A purposive sampling technique was used due to the specialized nature of the population. Participants were invited through professional networks and industry associations to ensure relevance and engagement. Data collection involved structured interviews and online surveys tailored to capture insights on AI implementation challenges and benefits. The sample size was determined based on the saturation point, ensuring comprehensive coverage of diverse organizational perspectives.

5.3 Data Collection Instruments

- **Online Questionnaires:** To assess perceptions of AI's impact on resilience.

- **Interview Guides:** For semi-structured interviews with key informants.

- **Document Analysis Protocols:** For case study documentation.

5.4 Variables and Measures

Dependent Variable

- **Supply Chain Resilience Index (SCRI):** Constructed from indicators such as time to recovery, forecast accuracy improvement, risk event mitigation, and inventory performance. These indicators collectively measure the ability of a supply chain to anticipate, respond to, and recover from disruptions effectively. A higher SCRI score reflects stronger resilience capabilities, enabling organizations to maintain operational continuity under adverse conditions. The index serves as a critical tool for benchmarking and improving supply chain robustness across industries.

Independent Variables

- **AI Adoption Level**

- **Data Quality**

- **System Integration Maturity**

- **Organizational Support**

5.5 Data Analysis Techniques

- **Descriptive Statistics:** To summarize survey responses.

- **Regression Analysis:** To determine the relationship between AI adoption and SCRI.

- **Thematic Analysis:** For qualitative data from interviews.

---

6. Data Analysis & Interpretation

6.1 Descriptive Statistics

Survey responses were collected from **n = 235 professionals** across different industries. Table 2 presents demographic and background information.

Table 2. Respondent Profile (N = 235)

Characteristic	Frequency	Percentage (%)
Industry		
Manufacturing	92	39.1
Retail	67	28.5
Logistics/3PL	76	32.3
Years of Experience		
< 5 years	48	20.4
5–10 years	102	43.4
> 10 years	85	36.2

Interpretation: The sample represents a balanced distribution across relevant industries and experience levels.

6.2 AI Adoption Levels

Respondents rated AI adoption on a 5-point Likert scale (1 = Very Low, 5 = Very High). Results show:

- **Demand forecasting AI:** Mean = 4.1
- **Risk prediction systems:** Mean = 3.7
- **Automated warehousing:** Mean = 3.4
- **Supplier analytics:** Mean = 3.6

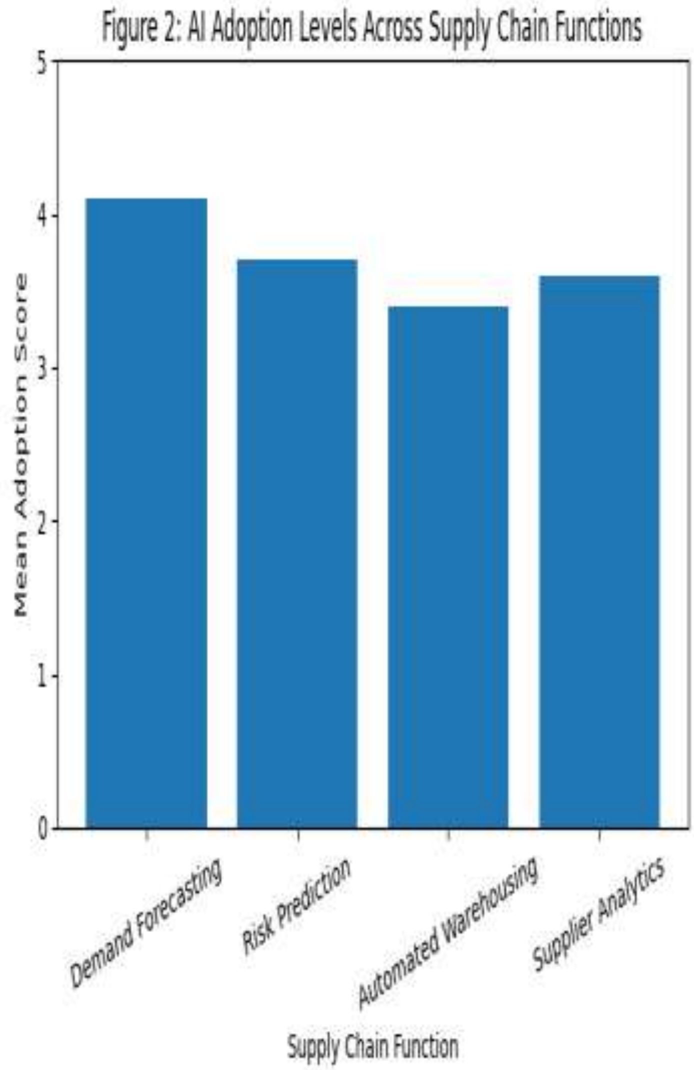

Figure 2 illustrates AI adoption across functions.

- X-axis: Supply Chain Function
- Y-axis: Mean Adoption Score

6.3 Regression Analysis

A multivariate regression model tested the impact of AI adoption on supply chain resilience:

Model: $SCRI = \beta_0 + \beta_1(\text{AI Adoption}) + \beta_2(\text{Data Quality}) + \beta_3(\text{Integration Maturity}) + \beta_4(\text{Org Support}) + \varepsilon$

Results (Table 3) indicate:

- **AI Adoption:** Significant positive impact ($\beta = 0.42, p < 0.01$)
- **Data Quality:** Significant ($\beta = 0.31, p < 0.05$)
- **Integration Maturity:** Significant ($\beta = 0.29, p < 0.05$)

Table 3. Regression Results

Variable	β Coefficient	t-Value	p-Value
AI Adoption	0.42	4.72	<0.01
Data Quality	0.31	3.29	<0.05
Integration Maturity	0.29	2.96	<0.05
Org Support	0.18	1.52	>0.10

Interpretation: AI adoption and enabling conditions such as data quality and integration support contribute significantly to resilience outcomes.

6.4 Case Studies: Exemplars

Case 1: Automotive Manufacturer

An automotive firm implemented ML-based demand forecasting and achieved a:

- **25% reduction in forecast error**
- **20% decrease in stockouts**

AI also supported scenario simulation enabling rapid re-routing of parts.

Case 2: Retail Enterprise

A retail chain used AI for real-time inventory optimization across 500 stores, resulting in:

- **15% increase in on-shelf availability**
- **10% reduction in excess inventory**

This improved agility in response to pandemic-induced demand volatility.

6.5 Thematic Insights from Interviews

Key themes emerged from qualitative data:

- **AI enhances visibility and prediction.**
- **Data silos inhibit AI effectiveness.**
- **Employee upskilling remains a priority.**

Representative quotes:

"AI gave us visibility into risk patterns we could not detect manually."

"Without clean data, AI models fail to deliver value."

---

7. Conclusion

7.1 Summary of Findings

This research confirms that AI plays a critical role in enhancing supply chain resilience in the post-pandemic era. Key contributions include:

- AI significantly improves forecasting accuracy and risk prediction.
- Autonomous systems enhance operational continuity amidst labor disruptions.
- Supplier analytics supports dynamic sourcing and mitigates vulnerabilities.

The analysis underscores that organizational enablers—data quality, integration, and leadership commitment—are essential to realize AI benefits.

7.2 Practical Implications

Organizations should:

1. **Invest in data infrastructure** to support AI.

2. **Foster cross-functional alignment** between IT and supply chain teams.

3. **Prioritize continuous learning** to build AI capabilities.

7.3 Limitations

- Survey responses may be subject to response biases.
- Rapid technological changes may outpace findings.

7.4 Future Research Directions

- Investigate AI ethics and transparency in supply decisions.
- Explore AI's role in sustainability and circular supply chains.

---

8. References

1. Christopher, M., & Peck, H. (2004). Building the resilient supply chain. *International Journal of Logistics Management, 15(2)*, 1-14.

2. Choi, T.-M., Wallace, S. W., & Wang, Y. (2016). Big Data analytics in operations management. *Production and Operations Management, 25(1)*, 385-396.

3. Fildes, R., Ma, S., & Kolassa, S. (2008). Retail forecasting: Research and practice. *International Journal of Forecasting, 34(2)*.

4. Ivanov, D., & Dolgui, A. (2020). Viability of intertwined supply networks: Extending the supply chain resilience angles towards survivability—Lessons from COVID-19 pandemic. *International Journal of Production Research, 58(10)*.

5. Kumar, A., Singh, R. K., & Ni, Y. (2021). A literature review of AI applications in supply chain management. *Artificial Intelligence Review, 55(4)*.

6. Ponomarov, S. Y., & Holcomb, M. C. (2009). Understanding the concept of supply chain resilience. *International Journal of Logistics Management, 20(1)*, 124-143.

7. Russell, S., & Norvig, P. (2016). *Artificial Intelligence: A Modern Approach*. Pearson.

8. Sheffi, Y. (2005). *The Resilient Enterprise: Overcoming Vulnerability for Competitive Advantage*. MIT Press.

9. Wieland, A., & Wallenburg, C. M. (2012). Dealing with supply chain risks. *International Journal of Physical Distribution & Logistics Management, 42(10)*.

10. Role of Artificial Intelligence in Enhancing Supply Chain Resilience in the Post-Pandemic Era

11. Abaku, E., Edunjobi, T., & Odimarha, A. (2024). Theoretical approaches to AI in supply chain optimization: Pathways to efficiency and resilience. *International Journal of Science and Technology Research Archive*, *6*(1), 092–107. https://doi.org/10.53771/ijstra.2024.6.1.0033

12. Singh, D., Sharma, A., Singh, R. K., & Rana, P. S. (2024). Augmenting supply chain resilience through AI and big data. *Business Process Management Journal*, *31*(2), 631–657. https://doi.org/10.1108/bpmj-04-2024-0260

13. Chen, X., He, C., Chen, Y., & Xie, Z. (2022). Internet of Things (IoT)—blockchain-enabled pharmaceutical supply chain resilience in the post-pandemic era. *Frontiers of Engineering Management*, *10*(1), 82–95. https://doi.org/10.1007/s42524-022-0233-1

14. Modgil, S., Singh, R. K., & Hannibal, C. (2021). Artificial intelligence for supply chain resilience: learning from Covid-19. *The International Journal of Logistics Management*, *33*(4), 1246–1268. https://doi.org/10.1108/ijlm-02-2021-0094

15. Pu, G., Cui, Z., & Qiao, J. (2024). Management antecedents of supply chain resilience: An integrating perspective. *Journal of Contingencies and Crisis Management*, *32*(1). https://doi.org/10.1111/1468-5973.12551

16. Hirsch, K., Niemann, W., & Swart, B. (2024). Artificial intelligence and information systems capabilities for supply chain resilience: A study in the South African fast-moving consumer goods industry. *Journal of Transport and Supply Chain Management*, *18*. https://doi.org/10.4102/jtscm.v18i0.1025

17. Naz, F., Kumar, A., Majumdar, A., & Agrawal, R. (2021). Is artificial intelligence an enabler of supply chain resiliency post COVID-19? An exploratory state-of-the-art review for future research. *Operations Management Research*, *15*(1–2), 378–398. https://doi.org/10.1007/s12063-021-00208-w

18. Li, X., Krivtsov, V., Pan, C., Nassehi, A., Gao, R. X., & Ivanov, D. (2024). End-to-end supply chain resilience management using deep learning, survival analysis, and explainable artificial intelligence. *International Journal of Production Research*, *63*(3), 1174–1202. https://doi.org/10.1080/00207543.2024.2367685

19. Kumar, V., Goodarzian, F., Ghasemi, P., Chan, F. T. S., & Gupta, N. (2025). Artificial intelligence applications in healthcare supply chain networks under disaster conditions. *International Journal of Production Research*, *63*(2), 395–403. https://doi.org/10.1080/00207543.2024.2444150

20. Sodiya, E., Jacks, B., Ugwuanyi, E., Adeyinka, M., Umoga, U., Daraojimba, A., & Lottu, O. (2024). Reviewing the role of AI and machine learning in supply chain analytics. *GSC Advanced Research and Reviews*, *18*(2), 312–320. https://doi.org/10.30574/gscarr.2024.18.2.0069