Proceedings of the International Conference on Industrial Engineering and Operations Management

Publisher: IEOM Society International, USA DOI: 10.46254/BA08.20250046
Published: December 20, 2025

Artificial Intelligence and Machine Learning: Revolutionizing Supply Chain Decision-Making and Operations

Afshar Uddin Jubayer
Industrial and Production Engineering Department
American International University-Bangladesh
Dhaka, Bangladesh
24-58405-2@student.aiub.edu

Md. Ehasanul Haque
Industrial and Production Engineering Department
American International University-Bangladesh
Dhaka, Bangladesh
ehasanul@aiub.edu

Abstract

We review how artificial intelligence (AI) and machine learning (ML) reshape supply-chain decision-making with direct implications for Bangladesh's ready-made-garment (RMG) sector. Based on a secondary synthesis of 24 peer-reviewed studies spanning manufacturing, logistics, pharmaceuticals, procurement, and sustainability, we map AI/ML use cases in demand forecasting, procurement analytics, inventory control, routing and scheduling, production planning, digital twins, and green SCM. Reported outcomes include higher forecast fidelity, shorter decision latency, and improved disruption recovery; several studies attribute gains to predictive analytics, reinforcement learning policies, and simulation-backed digital twins. Using an MIT-style systems perspective, we identify adoption frictions salient to Bangladeshi fragmented data, infrastructure gaps, organizational resistance, and manual processes with governance concerns around explainability and data stewardship. We propose a sector-specific adoption path for RMG suppliers that prioritizes (i) data architecture and interoperability, (ii) workforce upskilling for analytics and operations, and (iii) regulatory alignment on data access and accountability. The contribution is a contextualised framework that translates global AI/ML evidence to an emerging-economy garment supply chain, clarifying where near-term value is most likely (forecasting, inventory, and production sequencing) and what prerequisites must be met for resilient and sustainable scale-up.

Keywords

Artificial Intelligence (AI), Machine Learning (ML), Supply Chain Management (SCM), Predictive Analytics, Resilience, Sustainability, Bangladesh RMG Sector.

1. Introduction

Bangladesh has been listed globally as a fast-growing economic country due to its global trade, business, industrial economic zone, and many other factors. But all these factors are highly dependent on the supply chain. The worldwide supply chain has been reshaped by artificial intelligence (AI) and machine learning (ML), such as predictive, data-driven, and automated decision-making across logistics, procurement, and production systems (Jones, 2025). Moreover, using these AI/ML tools in supply chain management makes it more effective, such as in demand forecasting, inventory planning, logistics optimization, and sustainability initiatives sting, inventory planning,

logistics optimization, and sustainability initiatives, by uncovering hidden patterns in large datasets and improving responsiveness to market changes (Abualigah et al., 2023). The MIT SCM framework suggests a modern supply chain function as dynamic, interconnected systems requiring end-to-end visibility, analytical integration, resilience to disruptions, and sustainability-driven operations (Priyadarshini, 2024). As a result, these global supply chains have the potential to be transformative by using AI/ML to improve efficiency, strengthen supplier coordination, and enhance real-time decision-support mechanisms across manufacturing, logistics, and distribution networks (Balasubramanian et al., 2023).

Supply chain is very common in different sectors in Bangladesh, such as RMG, pharmaceuticals, logistics, and manufacturing; in that case, AI/ML adoption can have a significantly measurable impact on forecasting accuracy, cost reduction, and decision quality (Apeh et al., 2024). A study shows how ML-driven analytics improves growing economic countries' logistic performance, optimises inventory decisions, and strengthens supply chain agility under critical conditions (Mwangi, 2024). Bangladesh needs to improve its supply chain through the adoption of AI/ML. Compared to global evidence, Bangladesh lacks systematic assessments of technologies and inefficiencies and needs to improve resilience in critical sectors such as RMG and logistics (Han et al., 2023). Bangladesh is becoming one of the world's largest exporters of ready-made garments (RMG). But the problem is that the Bangladeshi SCM sector is slow in adopting AI/ML for supply-chain decisions, resulting in persistent inefficiencies and weak resilience (Khadem et al., 2023). For example, Bangladeshi RMG factories often rely on manual spreadsheets for demand planning, leading to inaccurate production forecasts and excess inventory during peak export seasons (Islam, 2024). Chattogram Port, which handles over 90% of Bangladesh's trade, continues to experience congestion and long vessel turnaround times due to limited digital integration and outdated logistics-planning tools (Miah, 2023). During COVID-19, supply chain shocks caused severe disruptions in raw material imports and delivery schedules, exposing the vulnerability of Bangladesh's manual, non-digitalised systems (Abualigah et al., 2023). But the problem is existing studies do not integrate MIT SCM principles or antifragility concepts to evaluate how AI/ML can strengthen Bangladesh's supply-chain systems under disruption (Raziee, 2023). These real-life cases demonstrate why AI-enabled forecasting, logistics optimization, and decision-support systems could have reduced delays, improved visibility, and strengthened operational continuity. There is also limited translation of global AI/ML practices into context-specific strategies suitable for Bangladesh's operational, infrastructural, and institutional environment (Khan et al., 2022).

The objective of this research is to conduct a critical analysis of the global secondary literature regarding the impact of AI and ML technologies on supply chain decision-making in areas such as forecasting, logistics, procurement, inventory management, resilience engineering, and sustainability practices utilising empirical evidence from various resilience engineering and sustainability practices and drawing on empirical findings from diverse international contexts (Jones, 2025). And follow the MIT SCM principles of how AI/ML adoption could reduce inefficiencies, enhance resilience, and support sustainability within Bangladesh's supply chain ecosystem, particularly in export-driven industries such as RMG and in critical logistics nodes such as Chattogram Port (Han et al., 2023). Moreover, Bangladesh needs to improve the strategies of globally promoted AI/ML applications to identify which predictive analytics tools, decision support systems, and digital transformation approaches can effectively strengthen local supply chain performance given existing infrastructural, organisational, and capacity constraints (Mwangi, 2024) (Figure 1).

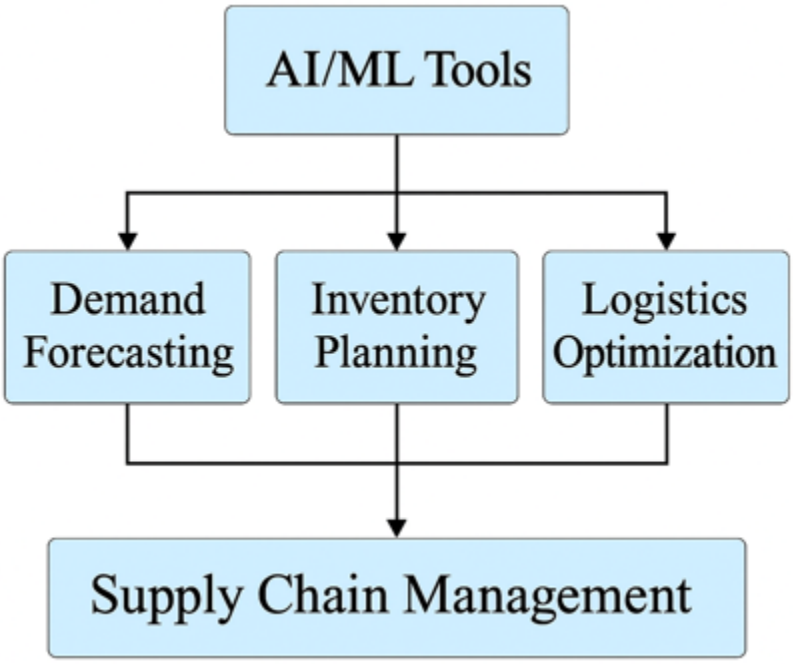

Figure 1. Integration of AI/ML tools into supply chain management

2. Literature Review

Supply chain management (SCM) thinking has shifted—from linear, efficiency-only models to integrated systems that also value resilience, adaptability, and sustainability (Han et al., 2023; Raziee, 2023). In the MIT SCM view, supply chains behave like complex adaptive systems, so procurement, logistics, production, and sustainability need to work as a whole, not in silos (Khan et al., 2022; Barua et al., 2023). Recent shocks have also highlighted antifragility: systems that learn and improve through crises rather than merely survive them (Raziee, 2023; Khan et al., 2022). AI/ML builds on this foundation by adding predictive analytics and data-driven optimisations 3). Studies in pharmaceuticals and workforce analytics show that AI helps organisations make better staffing decisions and use skills more effectively (Apeh et al., 2024; Balasubramanian et al., 2023). On the operations side, optimisation, especially metaheuristics, links cost and efficiency goals with sustainability targets (Abualigah et al., 2023; Barua et al., 2023; Farazi, 2025). For Bangladesh's RMG industry, where rigid processes raise risk, AI-enabled, adaptive approaches can make operations more resilient and more sustainable (Khadem et al., 2023; Muthu, 2024; Jones, 2025).

Decision frameworks have shifted from fixed, deterministic models to adaptive, AI-enabled systems that let managers react in real time (Mwangi, 2024; Nwangwu, 2025). Evidence from Africa shows that AI-supported procurement cuts inefficiency and improves transparency—insights that fit Bangladesh's fragmented sourcing networks (Mwangi, 2024; Nwangwu, 2025). Multi-agent frameworks help organisations adjust when disruptions hit (Khan et al., 2022; Raziee, 2023), and the idea of antifragility emphasises learning from crises to build long-term resilience (Raziee, 2023; Han et al., 2023).

In practice, predictive bid analysis strengthens supplier evaluation (Rahman, 2023; Islam, 2024; WCjhWVE et al., 2023). AI-integrated ERP systems give managers real-time visibility into what's happening across the operation (Islam, 2024; Balasubramanian et al., 2023; REVOLUTIONIZING ERP, 2023). Sales and operations planning also gains from predictive models that help match supply with demand (Miah, 2023; Jones, 2025; Revolutionizing S&OP, 2023). Sales and operations planning also benefits from predictive models that align supply with demand (Miah, 2023; Jones, 2025; Revolutionizing S&OP, 2023) (Table 1). For Bangladesh, these tools are vital for dealing with port bottlenecks, weak forecasting, and supply variability in the RMG sector (Khadem et al., 2023; Nwangwu, 2025; Rahman, 2023).

Table 1. Supply chain function

Supply Chain Function	AI/ML Technique Used	Impact/Benefit	Key References
Demand Forecasting	Supervised Learning, Predictive Analytics	Higher forecast accuracy, reduced stockouts	Jones (2025); Mwangi (2024)
Inventory Management	Reinforcement Learning, Optimization Algorithms	Dynamic stock control, reduced holding costs	Khadem et al. (2023); Kilari (2024)
Procurement	Predictive Bid Analysis, AI Risk Models	Improved supplier selection, transparency, risk reduction	Rahman (2023); Islam (2024)
Logistics & Transportation	Route Optimization, Predictive Maintenance	Fuel efficiency, reduced delays, adaptive delivery schedules	Barua et al. (2023); Han et al. (2023)
Production Scheduling	AI-Integrated ERP, Digital Twins, RL	Real-time adjustment, reduced downtime, improved throughput	Priyadarshini (2024); Kilari (2024)
Risk Management	Simulation, Multi-agent Systems	Forecasting disruptions, proactive mitigation	Raziee (2023); Khan et al. (2022)
Sustainability & Green SCM	AI Optimization, Carbon Analytics	Emission reduction, compliance with ESG goals	Abualigah et al. (2023); Miah (2023)

Digital tools like AI/ML, IoT, blockchain, and digital twins are making SCM more data-driven, with clearer visibility and tighter control (Han et al., 2023; Miah, 2023). In Industry 4.0 settings, robotics and automation boost production efficiency and cut downtime (Kilari, 2024; Priyadarshini, 2024; Intelligent Engines, 2023). By drawing on large datasets, AI-powered forecasting sharpens accuracy so firms can adjust quickly as conditions shift (Jones, 2025; Mwangi, 2024; Demand Forecasting, 2025). Pairing blockchain with AI increases transparency in procurement and reduces fraud and inefficiency (Rahman, 2023; Islam, 2024; Predictive Analytics, 2023).Bangladesh still faces infrastructure hurdles, yet combining digital twins with AI can improve production planning in RMG plants (Khadem et al., 2023; Muthu, 2024; Automated SCM, 2023). The MIT SCM perspective treats digital-first transformation as essential for resilience and competitiveness (Raziee, 2023; Han et al., 2023; Digital Transformation, 2023).

AI and ML are reshaping business operations more broadly, and many lessons carry over to SCM (Raziee, 2023; Han et al., 2023). Data-driven analytics improve efficiency and the quality of decisions (Apeh et al., 2024; Balasubramanian et al., 2023; Business Analytics, 2023). Antifragility frameworks show how firms can adapt and come out stronger after shocks, with AI playing a key role (Raziee, 2023; Khan et al., 2022; Farazi, 2025). AI-enabled ERP brings automation, adaptability, and real-time monitoring (Islam, 2024; Miah, 2023; REVOLUTIONISING ERP, 2023). In sales and operations planning, predictive models boost accuracy and responsiveness, reducing gaps between supply and demand (Miah, 2023; Rahman, 2023; Revolutionizing S&OP, 2023). Manufacturing studies also point to AI-driven robotics, reinforcement learning, and digital twins for smoother workflows and less waste (Kilari, 2024; Priyadarshini, 2024; Intelligent Engines, 2023). Adoption is spreading worldwide, but adapting these tools to emerging economies is still a work in progress (Muthu, 2024; Khadem et al., 2023; Recent Trends, 2024). For Bangladesh, the opportunities go beyond logistics—into procurement, workforce planning, and production scheduling (Barua et al., 2023; Mwangi, 2024; Demand Forecasting, 2025).

Evidence to date shows AI/ML improving efficiency, resilience, and sustainability across supply chains (Abualigah et al., 2023; Barua et al., 2023; Sustainable SCM, 2023). Optimization algorithms cut costs and lessen environmental impact, in line with MIT SCM's principles for sustainable operations (Han et al., 2023; Khan et al., 2022; Farazi, 2025). AI-enabled forecasting boosts agility and responsiveness in volatile markets (Jones, 2025; Mwangi, 2024; Demand Forecasting, 2025). In procurement, applications improve supplier evaluation and reduce risk (Rahman, 2023; Islam, 2024; Predictive Analytics, 2023). ERP and planning systems improve decision quality and coordination across the network (Miah, 2023; Apeh et al., 2024; REVOLUTIONIZING ERP, 2023).. In manufacturing, digital twins and robotics improve scheduling, cut errors, and increase flexibility (Kilari, 2024; Priyadarshini, 2024; Intelligent Engines, 2023). African evidence shows AI can work even with limited infrastructure, a point that's useful

for Bangladesh (Mwangi, 2024; Nwangwu, 2025; Kenya SCM, 2024). While most studies still focus on manufacturing, recent research is expanding to decision-making and sustainability—areas that Bangladesh needs to address now (Muthu, 2024; Khadem et al., 2023; Automated SCM, 2023).

Global progress is rapid, but gaps persist—notably for Bangladesh and other emerging economies (Mwangi, 2024; Nwangwu, 2025). Literature often **names** the right themes but **under-specifies** how to make them work on the ground. In particular:

- **Sustainability:** Many studies stress carbon reduction and green logistics, yet give little detail on obstacles to implementation in developing regions (Abualigah et al., 2023; Barua et al., 2023; Sustainable SCM, 2023).
- **Industry 4.0/5.0.** Much of the research spotlights robotics and automation but rarely deals with the day-to-day realities of export-driven settings like Bangladesh's RMG sector (Kilari, 2024; Priyadarshini, 2024; Intelligent Engines, 2023).
- **Resilience.** Scholars propose antifragility and multi-agent systems, yet there's little empirical testing in South Asia (Raziee, 2023; Khan et al., 2022; Farazi, 2025).
- **Procurement & ERP.** We have prediction and optimization models, but they often ignore institutional barriers inside fragile logistics systems (Rahman, 2023; Islam, 2024; REVOLUTIONIZING ERP, 2023).
- **Business operations.** The literature covers many AI uses, but practical guidance tailored to Bangladesh's industrial ecosystem is still thin (Apeh et al., 2024; Balasubramanian et al., 2023; Business Analytics, 2023).
- **Manufacturing focus.** Much of the AI-in-SCM literature tracks manufacturing trends, yet it seldom integrates sustainability and resilience frameworks for developing economies (Muthu, 2024; Khadem et al., 2023; Recent Trends, 2024).

Going forward, research should contextualize global AI/ML insights for Bangladesh, using MIT SCM's systems-oriented lens to connect resilience, sustainability, and digital integration (Han et al., 2023; Barua et al., 2023; Digital Transformation, 2023).

3. Research Methodology

This study uses a secondary literature review, consistent with MIT SCM's tradition of building theory and practice through evidence-based synthesis. Instead of collecting new data, we systematically review peer-reviewed articles, industry case studies, and theoretical models (Wuennenberg et al., 2022; Apeh et al., 2024). This design offers a broad view of how artificial intelligence (AI) and machine learning (ML) are reshaping supply-chain decision-making and operations, with a focus on Bangladesh. It suits our aim: to map global best practices and align them with Bangladesh's RMG-driven economy, where resource limits make large-scale empirical work difficult (Mwangi, 2024; Nwangwu, 2025).

We draw on three kinds of material. Peer-reviewed journals are the backbone, including work on metaheuristic optimization and on antifragility (Abualigah et al., 2023; Raziee, 2023). Industry reports and regional studies add what the data look like on the ground for example, adoption stories from Kenya and Nigeria (Mwangi, 2024; Nwangwu, 2025). We also use MIT SCM case materials and frameworks to read the evidence through a systems lens that emphasizes resilience (Khan et al., 2022; Han et al., 2023). Together, these sources keep the review rigorous and still useful for Bangladesh.

Using a structured search, we included studies on AI/ML in supply chains, decision-making, digital transformation, and sustainability. For instance, we drew on ERP integration (Islam, 2024), demand forecasting (Jones, 2025), and Industry 4.0/5.0 applications (Kilari, 2024; Priyadarshini, 2024) because they speak directly to supply chains in Bangladesh. We excluded papers that were not tied to decision-making or core SCM operations. To keep the pool balanced, we also prioritized a mix of perspectives—operational analytics (Apeh et al., 2024), sustainability (Barua et al., 2023), and resilience frameworks (Raziee, 2023; Khan et al., 2022)—so the final set covered theory, regions, and sectors.

Using integrative synthesis, we first compared theory with evidence to identify alignments and conflicts (Wuennenberg et al., 2022; Khadem et al., 2023). Next, we organized studies into themes—decision-making frameworks, digital transformation, sustainability, and resilience (Han et al., 2023; Abualigah et al., 2023; Barua et al., 2023). We then gathered cross-regional insights, looking at how African and global cases could inform Bangladesh

(Mwangi, 2024; Nwangwu, 2025). In the last step, we reframed the results through MIT SCM's lens systems thinking, resilience, and sustainable optimization to fit Bangladesh's supply-chain context. This step-by-step approach moves beyond description and toward a critical integration of evidence.

This review relies on secondary sources; we did not collect primary data in Bangladesh. That choice widens coverage but narrows contextual detail. For example, forecasting models show strong accuracy in general (Jones, 2025), yet their fit for Bangladesh's more informal logistics networks is uncertain. Likewise, sustainability frameworks (Barua et al., 2023; Abualigah et al., 2023) highlight environmental gains but say less about infrastructure barriers in emerging economies. A further limitation is regional skew: much of the evidence is African or global (Mwangi, 2024; Nwangwu, 2025; Kilari, 2024), with relatively few Bangladeshi case studies. Even so, grounding the review in MIT SCM ideas—robustness, antifragility, and digital integration—helps translate global lessons to Bangladesh's context.

4. Machine Learning and Artificial Intelligence in Supply Chain Management

AI/ML power smart supply networks by converting data into actionable decisions (Jones, 2025).. Supervised learning—regression and classification—helps forecast demand, flag supplier risk, and detect anomalies. That's especially important for Bangladesh's RMG sector, where demand swings make planning hard (Khadem et al., 2023). Unsupervised learning, including clustering, supports supplier segmentation, route choices, and pattern discovery in fragmented or informal logistics networks (Mwangi, 2024; Nwangwu, 2025). Reinforcement learning (RL) provides real-time adjustments to inventory, transport, and warehouse robotics (Kilari, 2024; Priyadarshini, 2024). Together, these methods move supply chains beyond simple efficiency toward systems that are resilient and adaptive under stress (Raziee, 2023; Khan et al., 2022).

AI/ML power decision-support systems that bring predictive analytics into daily planning and operations, so managers can test scenarios and act early under uncertainty (Han et al., 2023). By simulating market swings, supplier risk, and potential disruptions, predictive frameworks strengthen resilience in export economies such as Bangladesh (Abualigah et al., 2023). In practice, this shows up as predictive bid analysis to make supplier selection more transparent (Rahman, 2023) and AI-enabled ERP that gives real-time visibility across inventory and operations (Table 2) (Islam, 2024). MIT SCM treats predictive analytics as foundational, and in Bangladesh it can reduce manual, fragmented-process inefficiencies (Mwangi, 2024; Nwangwu, 2025).

Table 2. SCM

SCM Domain	AI/ML Techniques Used	Benefits Reported
Demand Forecasting	Neural Networks, Regression Models, Time Series Forecasting	Accurate demand prediction, reduced stockouts
Inventory Management	Reinforcement Learning, Clustering, Genetic Algorithms	Efficient inventory turnover, reduced holding costs
Procurement	Predictive Supplier Scoring, NLP-based Contract Analysis	Risk-aware procurement, optimized supplier performance
Logistics & Transportation	Route Optimization, Real-Time Tracking, Predictive Maintenance	Faster delivery, lower fuel usage, disruption mitigation
Production Planning	Digital Twins, Simulation, AI-Driven Scheduling	Improved efficiency, fewer delays, adaptive manufacturing
Customer Service	Chatbots, Sentiment Analysis, Recommendation Systems	Faster response times, improved customer satisfaction

AI-driven forecasting blends history, seasonality, and external signals to raise accuracy, aligning production with demand (Jones, 2025). In Bangladesh's RMG sector, stronger forecasting helps avoid both stockouts and excess inventory, which improves competitiveness (Mwangi, 2024). Research from Africa indicates that ML-based forecasting responds more rapidly to fluctuations in demand, a finding that is applicable to Bangladesh's export sectors (Nwangwu, 2025).

ML can automate reorder decisions and make better use of warehouse space (Khadem et al., 2023). RL then fine-tunes inventory levels on the fly to reduce waste and prevent shortages (Kilari, 2024). Inside warehouses, AI-driven robotics and vision systems improve speed and accuracy—crucial for high-volume garment operations (Priyadarshini, 2024).

Finally, optimization helps sustainability efforts by cutting unnecessary stock (Abualigah et al., 2023). AI and ML enhance risk management by forecasting disruptions, mapping vulnerabilities, and supporting resilience strategies (Raziee, 2023). Simulation models assess geopolitical, climatic, and operational risks to guide adaptive responses (Khan et al., 2022). Evidence shows that AI-enabled multi-agent systems strengthen responsiveness to shocks, while antifragile strategies allow organizations to learn and improve from crises (Han et al., 2023). These approaches are critical for Bangladesh, where RMG supply chains face risks from natural disasters and global demand fluctuations (Barua et al., 2023) (Table 3).

Table 3. Decision Making Area

Decision-Making Area	Traditional Approach	AI/ML-Enhanced Approach	Improvement Area
Forecasting	Historical averages, seasonal adjustment	Predictive ML models, dynamic adjustments	Accuracy, responsiveness
Inventory Control	Fixed reorder points, EOQ models	Real-time inventory signals, reinforcement learning	Cost reduction, agility
Supplier Selection	Manual assessment, price-based selection	AI-based supplier scoring, risk prediction	Risk reduction, performance
Transport Planning	Static routes, fixed lead times	Adaptive routing, predictive delays	Delivery speed, cost
Production Scheduling	Manual shift planning	AI-driven, real-time rescheduling	Utilization, throughput
Customer Support	Call centers, basic FAQs	AI chatbots, sentiment analysis, auto-escalation	Service quality, efficiency

Sustainability is a core focus of MIT SCM, and AI/ML serve as enablers for green supply chains. AI-based optimization minimizes energy use, reduces carbon emissions, and supports circular economy practices such as recycling and reverse logistics (Abualigah et al., 2023). Logistics models powered by AI optimize delivery routes, reducing environmental footprints (Barua et al., 2023). Additionally, AI frameworks strengthen sustainability compliance in global supply networks, which is vital for Bangladesh's RMG exports under increasing environmental scrutiny (Miah, 2023). By embedding these practices, Bangladeshi firms can simultaneously enhance competitiveness and meet global buyers' sustainability expectations (Mwangi, 2024; Nwangwu, 2025).

5. Decision-Making and Operations

AI and ML transform supply chain analytics from descriptive models, which explain past events, toward prescriptive systems that recommend optimized actions (Han et al., 2023; Abualigah et al., 2023). While descriptive analytics traditionally guided Bangladeshi RMG firms through historical sales and production reports, ML-enabled predictive models now anticipate demand fluctuations, supply risks, and logistics delays (Jones, 2025; Khadem et al., 2023). Prescriptive analytics further supports "what should we do**"** decisions by integrating optimization algorithms into procurement, routing, and workforce allocation (Rahman, 2023; Apeh et al., 2024). MIT SCM positions this transition as central to modern supply chains, enabling system-wide efficiency and resilience rather than siloed decision-making (Khan et al., 2022; Raziee, 2023).

A recurring theme in the literature is AI/ML's role in enhancing agility and resilience. Regional studies from Kenya and Nigeria show that predictive and adaptive systems reduce uncertainty in logistics and procurement (Mwangi, 2024; Nwangwu, 2025). Resilience frameworks based on multi-agent systems demonstrate the ability to dynamically reconfigure supply networks during crises (Khan et al., 2022), while antifragile models suggest that disruptions can become learning opportunities (Raziee, 2023). In Bangladesh, where export industries are exposed to port congestion and global demand shocks, AI-enabled predictive models allow managers to reallocate resources and reroute shipments proactively (Barua et al., 2023; Kilari, 2024). This reflects MIT SCM's emphasis on moving supply chains from fragile systems to adaptive ecosystems capable of sustaining performance under volatility (Priyadarshini, 2024; Han et al., 2023).

Rather than replacing managerial judgment, AI and ML act as collaborative partners in decision-making, supporting evidence-based management (Miah, 2023; Islam, 2024). AI-driven ERP and sales planning systems deliver real-time dashboards and scenario simulations, enabling managers to balance short-term cost efficiency with long-term resilience (Rahman, 2023; Kilari, 2024). In pharmaceuticals, analytics-driven workforce allocation improved human decision-making by providing predictive insights into resource needs (Apeh et al., 2024). In the Bangladeshi RMG sector, where decisions often rely on intuition or experience, AI-assisted models can provide structured evidence to guide managerial choices, ensuring that human expertise is complemented rather than substituted (Jones, 2025; Khadem et al., 2023). MIT SCM stresses this balance as critical: AI enhances cognitive capacity, but humans remain responsible for ethical judgment, strategic alignment, and contextual sensitivity (Priyadarshini, 2024; Abualigah et al., 2023) (Table 4).

Table 4. Functional Area

Functional Area	AI/ML Role in Decision-Making	Operational Benefits	Examples / Techniques
Demand Forecasting	Predicts future demand patterns with high accuracy	Reduces stockouts and overproduction	Time series models, neural networks
Inventory Management	Automates stock-level decisions and dynamic replenishment	Minimizes holding costs and avoids stockouts	Reinforcement learning, predictive analytics
Supplier Selection	Assesses risk, reliability, and performance using data-driven models	Enhances supplier quality and reduces procurement risk	AI scoring models, risk-based ML algorithms
Production Scheduling	Optimizes real-time task sequencing and capacity allocation	Reduces downtime and boosts throughput	AI-based schedulers, digital twins
Logistics & Routing	Optimizes delivery routes and predicts delays	Faster deliveries, lower fuel and transport costs	Genetic algorithms, AI route optimization
Risk Management	Anticipates disruptions and simulates recovery scenarios	Enables proactive and resilient operations	Simulation, scenario learning models
Customer Engagement	Automates service response and personalizes customer experience	Increases satisfaction and operational efficiency	NLP, chatbots, sentiment analysis

Global case studies demonstrate AI's tangible impact on SCM operations. In Kenya, AI-based optimization improved procurement efficiency, reducing delays and enhancing supplier transparency (Mwangi, 2024). Nigerian lubricant firms adopted AI for forecasting and inventory management, achieving measurable improvements in decision speed and reliability (Nwangwu, 2025). Manufacturing-focused studies illustrate how AI-driven robotics, reinforcement learning, and digital twins optimize scheduling and production flows (Kilari, 2024; Priyadarshini, 2024). ERP and predictive procurement case studies show how integrated decision systems align strategy with operations (Islam, 2024; Rahman, 2023). For Bangladesh, the lessons are direct: AI-driven forecasting (Jones, 2025), logistics optimization (Barua et al., 2023), and sustainability-focused models (Abualigah et al., 2023; Miah, 2023) could bridge current inefficiencies. This confirms the objectives set in the Introduction: leveraging global insights to contextualize AI/ML's transformative role in Bangladeshi SCM.

6. Challenges and Limitations

One of the most persistent challenges in applying AI/ML to supply chains is the lack of reliable and integrated data systems, particularly in emerging economies such as Bangladesh where fragmented networks dominate logistics (Mwangi, 2024; Nwangwu, 2025). Studies on workforce analytics and procurement demonstrate that without standardized datasets, predictive algorithms lose accuracy and fail to generate meaningful insights (Apeh et al., 2024; Rahman, 2023). Integration across enterprise systems such as ERP remains weak in many developing countries, including Bangladesh, limiting AI-enabled decision support (Islam, 2024; Miah, 2023). From the MIT SCM

perspective, robust data pipelines are essential for systemic visibility and resilience, yet Bangladeshi firms continue to rely heavily on manual record-keeping, creating bottlenecks in AI adoption (Khadem et al., 2023; Han et al., 2023). These gaps highlight that while global evidence shows AI enhances forecasting and operations (Jones, 2025; Kilari, 2024; Priyadarshini, 2024), Bangladesh's limited data infrastructure presents a significant barrier (Barua et al., 2023; Abualigah et al., 2023).

AI deployment raises ethical, security, and privacy issues, particularly in contexts with weak regulatory oversight. As global studies highlight, bias in algorithms can reinforce inequities and erode trust in automated systems (Raziee, 2023; Khan et al., 2022). In supply chains, sensitive procurement and workforce data require stringent governance to prevent misuse, yet Bangladeshi firms often lack robust cybersecurity protocols (Apeh et al., 2024; Nwangwu, 2025). Predictive procurement frameworks illustrate how AI can optimize supplier decisions, but without transparency, risks of unfair practices and corruption remain (Rahman, 2023; Mwangi, 2024). MIT SCM emphasizes the importance of ethical frameworks for digital transformation, and ensuring compliance with global standards is vital for Bangladesh to maintain trust with international buyers, particularly in the RMG sector (Miah, 2023; Islam, 2024). Sustainability-focused AI also introduces ethical trade-offs, as algorithms must balance environmental targets with economic efficiency (Barua et al., 2023; Abualigah et al., 2023).

A critical limitation in AI/ML adoption is the black-box nature of many models, which reduces interpretability for managers and decision-makers (Jones, 2025; Kilari, 2024). Studies on Industry 4.0 and production scheduling reveal that while reinforcement learning and deep neural models improve performance, managers often struggle to validate the reasoning behind outputs (Priyadarshini, 2024; Khadem et al., 2023). This lack of explainability undermines trust, especially in high-stakes supply chains such as Bangladesh's garment exports, where global buyers demand transparency (Mwangi, 2024; Nwangwu, 2025). MIT SCM stresses that interpretability is essential to align analytics with organizational objectives, yet most studies acknowledge that current AI frameworks lack adequate transparency (Raziee, 2023; Khan et al., 2022). Without interpretable systems, managers in Bangladesh may hesitate to delegate critical planning and forecasting to AI despite proven accuracy in global studies (Han et al., 2023; Abualigah et al., 2023; Barua et al., 2023).

Even when technology is available, organizational and cultural barriers hinder AI/ML integration in supply chains. Evidence from Kenya and Nigeria indicates that lack of technical expertise and resistance to change slow adoption, despite demonstrated efficiency gains (Mwangi, 2024; Nwangwu, 2025). For Bangladesh, cultural reliance on manual processes in procurement and logistics reduces willingness to transition toward AI-based systems (Rahman, 2023; Islam, 2024). Studies on ERP, sales, and operations planning show that organizational readiness and leadership commitment are decisive for AI adoption, yet these are often lacking in developing contexts (Miah, 2023; Apeh et al., 2024). From an MIT SCM viewpoint, change management and human capital development are central pillars of successful digital transformation, but in Bangladesh, limited investment in workforce training restricts progress (Han et al., 2023; Jones, 2025). Sustainability-focused initiatives also face resistance when short-term economic priorities overshadow environmental goals, creating further barriers (Barua et al., 2023; Abualigah et al., 2023; Kilari, 2024; Priyadarshini, 2024).

7. Future Directions for Research and Practice

Several studies demonstrate the role of AI/ML in demand forecasting and operational efficiency, yet limited research addresses their application to sustainability in supply chains (Mwangi, 2024; Nwangwu, 2025). While Industry 4.0 studies emphasize automation and robotics, they often overlook interpretability and managerial trust in AI models, a gap identified in recent forecasting work (Jones, 2025; Kilari, 2024). Similarly, metaheuristic and optimization approaches provide valuable insights into carbon reduction but lack validation in emerging economies with weak infrastructure (Abualigah et al., 2023; Barua et al., 2023). The majority of research is region-specific, focusing on Africa and developed economies, with minimal contextualized evidence for Bangladesh's RMG-driven supply chains (Khadem et al., 2023; Priyadarshini, 2024). These gaps suggest opportunities for future research into AI's role in sustainability, interpretability, and contextual adaptation within Bangladesh (Raziee, 2023; Khan et al., 2022).

Emerging technologies such as the Internet of Things (IoT), blockchain, and digital twins are increasingly highlighted as enablers of intelligent supply chains (Kilari, 2024; Priyadarshini, 2024). Digital twin models, when combined with AI, have been shown to optimize production flows and reduce downtime (Khadem et al., 2023). Blockchain integration with AI has also been proposed as a means of ensuring transparency in procurement and supplier management

(Rahman, 2023; Islam, 2024). However, most of this research is conceptual and lacks empirical validation in emerging economies (Han et al., 2023; Miah, 2023). Future work should examine how these technologies can be combined in Bangladesh's RMG supply chains to overcome inefficiencies in port logistics, ensure compliance with international standards, and enhance resilience against disruptions (Mwangi, 2024; Nwangwu, 2025).

Ethical, regulatory, and data governance challenges remain underexplored in current AI/ML supply chain literature. Existing studies point to issues of bias, fairness, and transparency, particularly in algorithmic decision-making (Raziee, 2023; Khan et al., 2022). Research on procurement and ERP highlights risks of corruption and lack of data protection in weakly regulated environments (Rahman, 2023; Islam, 2024). Sustainability frameworks also emphasize the need for policies that balance environmental targets with economic realities (Abualigah et al., 2023; Barua et al., 2023). Future research must explore how Bangladesh can adapt international standards for data governance, privacy, and sustainability to meet global compliance demands while maintaining competitiveness in the RMG sector (Miah, 2023; Jones, 2025).

Building on resilience and antifragility frameworks, the future vision of supply chains involves fully autonomous, adaptive, and sustainable networks (Han et al., 2023; Raziee, 2023). AI, when combined with digital twins, IoT, and metaheuristic optimization, could enable supply chains to not only anticipate disruptions but also improve under stress (Khan et al., 2022; Abualigah et al., 2023). For Bangladesh, this means reimagining the RMG sector as a digitally integrated ecosystem that meets sustainability requirements while enhancing resilience against global shocks (Barua et al., 2023; Mwangi, 2024). MIT SCM principles emphasize system-level visibility, resilience, and green innovation, suggesting that future supply chains could evolve into globally networked, circular economy systems that simultaneously enhance competitiveness and sustainability (Priyadarshini, 2024; Kilari, 2024). This vision calls for research-practice collaborations that empower Bangladeshi industries to leapfrog traditional inefficiencies and move toward intelligent, AI-driven supply networks (Nwangwu, 2025; Khadem et al., 2023).

8. Conclusion

This study has shown that artificial intelligence (AI) and machine learning (ML) are reshaping global supply chain management (SCM) by enabling predictive analytics, real-time decision-making, and adaptive resilience across operational domains. From the MIT SCM perspective, supply chains emerge as complex, adaptive systems where AI/ML extend classical theories of efficiency toward antifragility, allowing networks not only to withstand disruptions but to improve under stress. Applications across forecasting, procurement, logistics, production, and sustainability demonstrate measurable gains in efficiency, cost reduction, and decision accuracy. For Bangladesh, the literature reveals both opportunities and challenges: AI/ML can transform the ready-made garment (RMG) sector by enhancing forecasting, logistics, and sustainability, but institutional, infrastructural, and organizational barriers persist.

The research contributes to scholarship by synthesizing diverse global evidence and aligning it with the Bangladeshi context, filling a critical gap where empirical studies remain scarce. It advances MIT SCM scholarship by demonstrating how AI/ML can be framed not merely as technological tools but as enablers of systemic resilience, antifragility, and sustainable operations. Practically, the study highlights how ERP systems, predictive procurement, and AI-enabled logistics can address inefficiencies in Bangladesh's supply chains, offering actionable insights for managers and policymakers. Moreover, by situating AI/ML adoption within Bangladesh's RMG-driven economy, the review offers a contextualized roadmap for leveraging digital transformation while maintaining competitiveness in global markets.

Overall, the study underscores that while AI/ML adoption is accelerating globally, Bangladesh remains at a crossroads where structural barriers slow its uptake. By embedding MIT SCM's principles of systemic integration, visibility, and green innovation, Bangladesh can reposition its supply chains to thrive under volatility. The future of Bangladeshi SCM lies in embracing AI not only as a tool for efficiency but as a driver of resilience, sustainability, and global alignment. Ultimately, realizing this vision requires coordinated investment in data infrastructure, organizational readiness, and regulatory frameworks that enable trust, interpretability, and scalability of AI systems.

Reference

Abualigah, L., Hanandeh, E.S., Zitar, R.A., Thanh, C.L., Khatir, S. and Gandomi, A.H. *Revolutionizing sustainable supply chain management: A review of metaheuristics*. Engineering Applications of Artificial Intelligence, 126, 106839, 2023.

Ahmed, F., Ahmed, M.R., Kabir, M.A. and Islam, M.M. *Revolutionizing business analytics: The impact of artificial intelligence and machine learning*. American Journal of Advanced Technology and Engineering Solutions, 1(1), pp. 147–173, 2025.

Apeh, C.E., Odionu, C.S., Bristol-Alagbariya, B., Okon, R. and Austin-Gabriel, B. *Advancing workforce analytics and big data for decision-making: Insights from HR and pharmaceutical supply chain management*. International Journal of Multidisciplinary Research and Growth Evaluation, 5(1), pp. 1217–1222, 2024.

Balasubramanian, S., Vodenicharova, M. and Srinu, C. *From data to decisions: Leveraging machine learning in supply-chain management*. Journal of Propulsion Technology, 44(4), pp. 4218–4225, 2023.

Eyo-Udo, N. *Leveraging artificial intelligence for enhanced supply chain optimization*. Open Access Research Journal of Multidisciplinary Studies, 7(2), pp. 001–015, 2024.

Farazi, M.Z.R. *Enhancing supply chain resilience with multi-agent systems and machine learning: A framework for adaptive decision-making*. The American Journal of Engineering and Technology, 7(3), pp. 6–20, 2025.

Hasan, M.R., Shawon, R.E.R., Rahman, A., Al Mukaddim, A., Khan, M.A., Hider, M.A. and Zeeshan, M.A.F. *Optimizing sustainable supply chains: Integrating environmental concerns and carbon footprint reduction through AI-enhanced decision-making in the USA*. Journal of Economics, Finance, and Accounting Studies, 6(4), 57, 2024.

Jean-Luc, M. and Priyanka, N. *Revolutionizing supply chain optimization with AI-driven predictive analytics*. Synergy: Cross-Disciplinary Journal of Digital Investigation, 2(12), pp. 31–45, 2024.

Jhurani, J. *Revolutionizing enterprise resource planning: The impact of artificial intelligence on efficiency and decision-making for corporate strategies*. International Journal of Computer Engineering and Technology, 13(2), pp. 156–165, 2022.

Jones, J. *The role of artificial intelligence in enhancing demand forecasting and supply chain decision-making*. Unpublished manuscript / Industry report, 2025.

Khadem, M., Khadem, A. and Khadem, S. *Application of artificial intelligence in supply chain: Revolutionizing efficiency and optimization*. International Journal of Industrial Engineering and Operational Research, 5(1), pp. 29–38, 2023.

Khoa, B.Q., Nguyen, H.T., Anh, D.B.H. and Ngoc, N.M. *Impact of artificial intelligence in supply chain planning and decision-making optimization*. International Journal of Multidisciplinary Research and Growth Evaluation, 5(6), pp. 837–856, 2024.

Kilari, S.D. *The impact of artificial intelligence on automated manufacturing and supply chain systems: Advancements, challenges, and future prospects*. Conference/Industry publication, March, 2025.

Mandala, V. and Surabhi, M.D. *Intelligent engines: Revolutionizing manufacturing and supply chains with AI*. International Journal of Innovative Science and Research Technology, 9(4), 2024.

Muthu, J. *Recent trends in supply chain management using artificial intelligence and machine learning in manufacturing*. Educational Administration: Theory and Practice, 30(6), pp. 4127–4134, 2024.

Mwangi, J. *Analyzing the role of artificial intelligence and machine learning in optimizing supply chain processes in Kenya*. International Journal of Supply Chain Management, 9(1), pp. 39–50, 2024.

Nwangwu, J.C. *Artificial intelligence (AI) and decision-making in supply chain management of lubricant firms in Anambra State, Nigeria*. Unpublished thesis / report, 2025.

Onyeanuforo, U.L. and Mohammed, B.B. *Data-driven decision-making in global supply chain management: Transforming operations through analytics and intelligence*. Nigerian Journal of Sustainability Research, 2(2), pp. 1–23, 2024.

Pasupuleti, V., Thuraka, B., Kodete, C.S. and Malisetty, S. *Enhancing supply chain agility and sustainability through machine learning: Optimization techniques for logistics and inventory management*. Logistics, 8(3), 73, 2024.

Polo, L. *Revolutionizing sales and operations planning with artificial intelligence: Insights and results*. International Journal for Multidisciplinary Research, 6(6), 2024.

Priyadarshini, D.S. *The impact of artificial intelligence on supply chain management: A comprehensive analysis of automation and decision-making processes*. Journal of Research and Innovation in Technology, Commerce and Management, 1(8), pp. 1–4, 2024.

Raziee, Z. *Artificial intelligence and machine learning as an antifragile driver in the supply chain*. International Journal of Industrial Engineering and Operational Research, 5(1), pp. 60–68, 2023.

Singh, P.K. *Digital transformation in supply chain management: Artificial intelligence and machine learning as catalysts for value creation*. International Journal of Supply Chain Management, 12(6), pp. 57–63, 2023.

Srinivas Kalisetty, D.A.S. *Leveraging artificial intelligence and machine learning for predictive bid analysis in supply chain management: A data-driven approach to optimize procurement strategies*. Unpublished manuscript, n.d.

Biographies

Afshar Uddin Jubayer is currently studying at the American International University of Bangladesh (AIUB) in Industrial and Production Engineering (IPE). He has been actively contributing to the research sector for the last two years. His research mainly focuses on supply chain-related topics, such as port management, blockchain, AI/machine learning in supply chains, risk management, logistics, and green supply chains. He has published five research papers at multiple international conferences. He is an officially certified paper reviewer of IEOM. He is ISO certified as a Certified Supply Chain Leader (CSCL). He is a very common face at supply chain and industrial-related conferences and seminars in Bangladesh. He is a very active member of the AIUB IEOM club and the AIUB research club.

Md. Ehasanul Haque is working as an Associate Professor and Head, Department of Industrial and Production Engineering in American International University-Bangladesh (AIUB). He earned both Bachelor and Masters degrees from the Department of Materials Science and Engineering, University of Rajshahi, Bangladesh. I have achieved "Gold Medal Award" for outstanding performance in B. Sc. provided by the University of Rajshahi and NST fellowship for conducting research in Masters provided by the Ministry of Science and Technology. I have earned PhD degree from Japan Advanced Institute of Science and Technology (JAIST) with MEXT scholarship funded by Japan Government. "University President Award" has been presented for achieving outstanding performance in research activities during PhD. My research fields are Photonics, Nanotechnology and Nanofabrication, Electrochemistry, Thin Film,Composite Materials, Alloy Formation and Microstructure study.