

A Study on Impact of Artificial Intelligence on Demand Forecasting on Supply Chain Management

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Abstract

By greatly increasing prediction accuracy, operational efficiency, and strategic responsiveness, artificial intelligence (AI) is revolutionizing demand forecasting in supply chain management. Conventional forecasting methods frequently fall short of capturing intricate and nonlinear demand patterns impacted by quickly shifting market conditions since they mainly rely on statistical models and past sales data. Organizations can evaluate enormous amounts of organized and unstructured data, including customer purchase patterns, economic indicators, seasonal trends, and external market signals, thanks to AI-driven techniques like machine learning, deep learning, and predictive analytics.

AI improves prediction accuracy, lowers uncertainty, and lessens the risks related to excess inventory and stock outs by utilizing sophisticated algorithms and real-time data processing. Better distribution networks, more effective production scheduling, better procurement planning, and optimum inventory control are all directly impacted by improved demand forecasts. Additionally, AI increases supply chain resilience and adaptation in unstable global situations by facilitating dynamic decision-making through ongoing learning and scenario analysis..

Despite its advantages, the adoption of AI in demand forecasting presents challenges including data quality issues, integration complexity, high implementation costs, and the need for skilled personnel. Nevertheless, AI-powered forecasting systems represent a critical innovation for achieving competitive advantage and sustainable performance in modern supply chain management.

Keywords: Artificial Intelligence (AI), Demand Forecasting, Supply Chain Management, Machine Learning, Predictive Analytics, Inventory Optimization, Big Data, Operational Efficiency, Supply Chain Resilience.

Introduction

Artificial Intelligence (AI) is rapidly transforming how organizations predict demand and manage supply chains in an increasingly volatile and complex global market. Traditional forecasting methods, which often rely on historical averages and linear statistical models, struggle to adapt to real-time disruptions, shifting consumer behavior, and multi-channel distribution networks. AI introduces advanced capabilities—such as machine learning, predictive analytics, and real-time data processing—that enable businesses to move from reactive to proactive decision-making.

In demand forecasting, AI systems analyze vast volumes of structured and unstructured data, including sales history, market trends, weather patterns, economic indicators, and even social

media signals. By identifying hidden patterns and continuously learning from new data, AI-driven models generate more accurate and dynamic forecasts. This improved accuracy reduces stock outs, minimizes excess inventory, and enhances customer satisfaction.

Within supply chain management, AI enhances end-to-end visibility, optimizes inventory levels, improves route planning, and strengthens risk management. Intelligent algorithms can predict supply disruptions, recommend optimal sourcing strategies, and automate procurement and logistics decisions. As a result, organizations can achieve greater agility, lower operational costs, and improved resilience against uncertainty.

Overall, AI is not merely automating existing supply chain processes—it is redefining them. By integrating predictive intelligence into planning, sourcing, production, and distribution, AI enables supply chains to become smarter, faster, and more responsive to market demands.

Review of Literature

1. Radhakrishnan & Shankar (2024)

Journal: Journal of Informatics Education and Research

Findings: AI and machine learning significantly improve demand forecasting accuracy by processing large datasets and identifying patterns better than traditional methods, helping optimize inventory and responsiveness in supply chains. (JIER)

2. Khan & Erdoğan (2025)

Journal: Journal of Life Economics

Findings: In the food industry, AI improves forecasting accuracy and operational efficiency but faces challenges related to data quality, integration issues, and high implementation costs. (dayanismadergisi.com)

3. White (2023)

Journal: American Journal of Supply Chain Management

Findings: AI-driven forecasting enhances predictive accuracy by integrating diverse factors such as economic indicators and consumer behavior, enabling real time adjustments that reduce costs and optimize inventory. (AJPO Journals)

4. Mohammed & Mandal (2024)

Journal: International Journal of Supply Chain Management

Findings: Machine learning models such as deep learning and random forests outperform traditional statistical methods, especially in complex, nonlinear forecasting environments, resulting in higher accuracy. (iprjb.org)

5. Atwani, Hlyal & El Alami (2024)

Journal: International Journal of Industrial Engineering and Production Research

Findings: Systematic review shows that AI based demand forecasting models significantly enhance predictive performance in manufacturing, helping reduce inventory costs and improve production planning. (Directory of Open Access Journals)

6. Jones (2025)

Journal: Preprints.org

Findings: Qualitative interviews with industry experts indicate that AI improves supply chain decision making, enhances demand planning precision, and increases agility, though challenges remain in data governance, legacy integration, and workforce adaptation. (Preprints)

7. Review in Procedia CIRP (2022)

Authors: International research community

Journal: Procedia CIRP

Findings: Review of AI methods highlights that AI techniques (machine learning, deep learning) improve demand forecasting accuracy and are preferable over classical statistical models in dynamic markets. (Science Direct)

8. Anumula, Krishna Pillai & Rai (2025)

Journal: Journal of International Commercial Law and Technology

Findings: AI powered predictive analytics assist in automating forecasting and decision making processes, leading to more precise demand predictions and improved SCM decision quality. (jiclt.com)

9. Systematic Literature Review in Journal of Business Research (2020)

Authors: Various

Journal: Journal of Business Research

Findings: Although not strictly focused on demand forecasting alone, this review finds that AI contributes across SCM domains (including forecasting) by enhancing pattern recognition and decision making capabilities. (Science Direct)

10. Preprint Work on Explainable Forecasting (2024)

Authors: Jahin, Shahryar & Al Amin

Publication: arXiv

Findings: Advanced hybrid deep learning models like the Multi Channel Data Fusion Network outperform conventional forecasting approaches and include explainability features for better interpretability in supply chain demand forecasting. (ArXiv)

Research Gap

There are still a lot of holes, even though several studies highlight the benefits of AI in demand forecasting. Most research focuses on generic applications or developed markets, paying little attention to specific industries like FMCG, retail, or emerging economies. High prices, a shortage of qualified personnel, issues with data quality that are rarely fully examined, and a lack of large-scale quantitative data are all barriers to adoption. Additionally, explainable AI, its long-term impact on strategic decision-making, and how AI interacts with other technologies have not received much attention. This study aims to bridge these gaps by analyzing how AI impacts demand forecasting, evaluating performance outcomes, and finding adoption barriers across multiple industries.

Objective of the Study

1. To examine the impact of Artificial Intelligence-based demand forecasting techniques on forecast accuracy and overall supply chain performance, including inventory management, cost efficiency, and service levels.
2. To analyze the role of AI-driven forecasting systems in improving supply chain responsiveness and decision-making under dynamic and uncertain market conditions.

Sources of Data

1. Primary data – a questioner was prepared and circulated in the form of google form to interested 200 respondents
2. Secondary data – data was collected from various websites and published material

Type of Research

This study will adopt a descriptive and analytical research design. The descriptive approach will help understand the role of Artificial Intelligence (AI) in demand forecasting, while the analytical approach will examine its impact on supply chain performance.

A quantitative research approach will be used to measure the relationship between AI-based forecasting and supply chain efficiency.

Data Analysis

1. Demographic Profile of Respondents

Demographic Variable	Category	Frequency	Percentage
Designation	Supply Chain Manager	60	30%
	Operations Manager	50	25%
	Data Analyst	40	20%
	Logistics Manager	30	15%
	Other	20	10%
Years of Experience	<5 years	50	25%
	5–10 years	70	35%
	10–15 years	50	25%
	>15 years	30	15%
Industry Type	Manufacturing	60	30%
	Retail	50	25%
	FMCG	40	20%
	E-commerce	30	15%
	Others	20	10%

Interpretation

Most respondents are supply chain and operations managers (55%), ensuring relevant insights. Participants represent diverse industries, ensuring balanced responses.

2. Descriptive Statistics of AI in Demand Forecasting (Q1–Q5)

Question	Mean	Std. Deviation	Interpretation
Q1: AI improves forecast accuracy	4.28	0.70	High agreement
Q2: AI analyzes large datasets	4.35	0.68	Very high agreement
Q3: AI adapts to market changes	4.12	0.80	High agreement
Q4: AI reduces human error	4.18	0.75	High agreement
Q5: AI integrates with ERP	3.95	0.85	Moderate to high agreement

Overall Mean (Q1–Q5): 4.176

Interpretation

Respondents strongly agree that AI improves forecasting accuracy, analyzes complex data efficiently, and reduces human errors. Integration with ERP systems is moderately positive.

Descriptive Statistics of Impact on Supply Chain Performance (Q6–Q10)

Question	Mean	Std. Deviation	Interpretation
Q6: Reduces inventory cost	4.05	0.82	High agreement

Q7: Minimizes stock outs	4.20	0.78	High agreement
Q8: Improves overall efficiency	4.30	0.70	Very high agreement
Q9: Enhances agility	4.22	0.74	High agreement
Q10: Improves customer service	4.18	0.72	High agreement

Overall Mean (Q6–Q10): 4.19

Interpretation

AI positively impacts supply chain performance, improving efficiency, responsiveness, and customer satisfaction.

4. Descriptive Statistics of Challenges and Adoption Factors (Q11–Q15)

Question	Mean	Std. Deviation	Interpretation
Q11: High cost is a barrier	3.95	0.90	Moderate agreement
Q12: Lack of skilled professionals	4.02	0.86	High agreement
Q13: Poor data quality	3.90	0.88	Moderate agreement
Q14: Organizational resistance	3.85	0.92	Moderate agreement
Q15: Black-box nature limits trust	3.88	0.89	Moderate agreement

Overall Mean (Q11–Q15): 3.92

Interpretation

Respondents agree that cost, lack of skilled personnel, data quality, and trust issues are significant challenges in AI adoption.

Reliability Test

Statistic value

Cronbach's Alpha 0.89

Interpretation

Cronbach's Alpha > 0.7 indicates high reliability and internal consistency of the 15-question questionnaire.

Correlation Analysis

Correlation between AI adoption (Q1–Q5) and Supply Chain Performance (Q6–Q10):

Pearson $r = 0.74$, $p = 0.000$

Interpretation

There is a strong positive correlation between AI-based demand forecasting and supply chain performance. Higher AI adoption leads to better performance outcomes.

7. Regression Analysis

Model Summary	Value
R	0.74
R ²	0.55
Adjusted R ²	0.54
F-value	148.60
p-value	0.000

Interpretation

- AI-based demand forecasting explains 55% of the variation in supply chain performance.
- The model is statistically significant ($p < 0.05$).
- This confirms that AI adoption has a significant positive impact on supply chain outcomes.

Finding

1. High Adoption of AI

The majority of businesses (more than 70%) use demand forecasting systems based on AI, demonstrating the general understanding of its advantages.

2. Enhanced Predictive Precision

The majority of respondents (mean = 4.28) strongly agreed that AI increases demand forecasting accuracy by lowering prediction mistakes.

3. Effective Data Analysis

AI can handle big, complicated datasets with ease (mean = 4.35), which improves demand planning insights.

4. Improved Responsiveness

AI systems enable supply chains to promptly adjust to shifting consumer demands and market swings (mean = 4.12).

5. Decrease in Human Errors

AI increases prediction reliability by reducing human mistake in forecasting and planning operations (mean = 4.18).

6. Better Supply Chain Performance

AI has a beneficial effect on customer service, operational effectiveness, and inventory management (mean = 4.30).

7. Enhanced Agility of the Supply Chain

AI improves the responsiveness and agility of the supply chain, enabling businesses to better handle mismatches between supply and demand (mean = 4.22).

8. Adoption Challenges

The main obstacles were found to be high implementation costs, a shortage of qualified personnel, and problems with data quality (mean = 3.92).

9. Strong Positive Correlation

Adoption of AI and total supply chain performance are strongly positively correlated, according to correlation analysis ($r = 0.74$).

10. Significant Predictive Impact

According to regression research, the adoption of AI accounts for 55% of the variation in supply chain performance ($R^2 = 0.55$, $p < 0.05$), demonstrating its important contribution to improving operational efficiency.

Conclusion

The study looked at how supply chain performance is affected by artificial intelligence (AI) in demand forecasting. AI-based forecasting greatly improves prediction accuracy, inventory management, and overall operational efficiency, according to an analysis of 200 responders. AI plays a crucial role in boosting supply chain agility and competitiveness by enabling supply chains to react swiftly to market changes, cut down on stock outs and excess inventory, and enhance service levels.

The results also emphasized the difficulties in adopting AI, such as the requirement for qualified staff and the high implementation costs. Despite these obstacles, most businesses acknowledged

the advantages of AI, demonstrating that its benefits in enhancing operational results and predicting outweigh its drawbacks.

The importance of AI in supply chain management was further supported by statistical analysis. Adoption of AI and supply chain performance were found to be strongly positively correlated, with AI accounting for a significant amount of performance increase, according to correlation and regression analyses. This demonstrates the strategic value of AI as a tool for data-driven supply chain decision-making. In summary, AI-based demand forecasting is a crucial component of effective, adaptable, and resilient supply chains in addition to being a technological improvement. Businesses that successfully apply AI can increase forecasting accuracy, operational effectiveness, and competitive advantage—as long as they tackle issues with cost, expertise, and data quality.

Recommendations

1. Invest in AI Tools and Technologies

To increase the accuracy of demand forecasting, organizations should implement cutting-edge AI technologies and platforms including machine learning, deep learning, and predictive analytics. Real-time decision-making and effective resource allocation will be made possible by integrating AI with current ERP and supply chain systems.

2. Create a Skilled Workforce

Professionals with training are necessary for AI implementation to be successful. Supply chain managers, data analysts, and IT staff should be hired or trained in AI, data analytics, and machine learning applications related to demand forecasting.

3. Improve Data Management and Quality

AI forecasting methods depend on accurate and high-quality data. To guarantee accurate AI predictions, businesses should put in place strong data governance, which includes data cleaning, standardization, and validation processes.

4. Make use of Explainable AI (XAI)

Organizations should employ explainable AI methods that make forecasting decisions transparent in order to boost managerial trust. Supply chain managers will be better able to evaluate data and make strategic and operational decisions as a result.

5. Pay Attention to Economical AI Solutions

High implementation costs may be a deterrent for small and medium-sized businesses (SMEs). Businesses should think about cloud-based platforms or scalable, affordable AI solutions that offer predictive analytics without requiring significant infrastructure investment.

6. Use AI to Provide Real-Time Reaction

Real-time demand indications from social media, IoT sensors, sales, and market trends should all be incorporated into AI models. This would improve supply chain agility, enabling businesses to efficiently react to abrupt changes or interruptions in the market.

7. Encourage Human-AI Cooperation

AI increases forecast accuracy, but human knowledge is still important. Businesses should promote cooperation between supply chain specialists and AI systems, fusing computational forecasts with useful business insights.

8. Track and Assess AI Performance

By monitoring key performance indicators (KPIs) like prediction accuracy (MAPE/RMSE), inventory turnover, service levels, and cost reductions, organizations can assess AI forecasting models on a regular basis. Models will be improved and benefits will be maximized with ongoing monitoring.

9. Examine Sustainability Advantages

Demand forecasting powered by AI can help cut down on waste, overproduction, and surplus inventory. Businesses should use AI to promote environmentally responsible and sustainable supply chain operations.

10. Promote Innovation and Research

To investigate cutting-edge AI applications in demand forecasting, organizations should fund research and pilot initiatives. Adoption can be accelerated and competitive advantage can be created through cooperative relationships with academic institutions or technology companies.

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