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Role of AI in Enhancing Supply Chain Transparency and Customer Trust

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Abstract

The integration of Artificial Intelligence (AI) in supply chain management is redefining how businesses operate, offering unprecedented transparency and fostering greater customer trust. This paper investigates the transformative role of AI technologies—such as machine learning, blockchain integration, and predictive analytics—in establishing transparent supply chains. Drawing on primary data from surveys and interviews alongside a comprehensive literature review, the study highlights AI's contributions to real-time tracking, risk prediction, and data-driven decision-making, while also acknowledging the challenges posed by data privacy and ethical AI use. Statistical analysis, including Pearson correlation tests, confirms a strong positive relationship between perceived transparency and customer trust, underscoring AI's value in building resilient and credible supply networks. Additionally, the paper examines emerging literature on AI-powered sustainability tracking and predictive demand forecasting, offering fresh insights into how these advancements drive trust and loyalty. The paper concludes with managerial implications, ethical considerations, and future research directions, ultimately equipping supply chain managers with actionable strategies for leveraging AI in an increasingly data-driven marketplace.

Introduction

The supply chain industry, traditionally characterized by complex operations and fragmented data, is undergoing a digital revolution driven by Artificial Intelligence (AI). With consumers increasingly demanding end-to-end transparency—ranging from ethical sourcing to product journey visualization—AI has emerged as a key driver of supply chain innovation. Technologies like machine learning and blockchain facilitate real-time insights, while predictive analytics bolster proactive risk management. However, the adoption of AI also raises critical questions around data governance and ethical considerations, warranting a closer examination of how businesses can strike the right balance between innovation and trust.

Objectives of the Study

- **Objective 1**: To assess the level of consumer awareness and perception of AI in enhancing supply chain transparency.
- **Objective 2**: To examine the relationship between AI-enabled transparency and customer trust.
- **Objective 3**: To identify the most preferred AI features that resonate with consumer expectations for transparency.

Literature Review

AI and Supply Chain Efficiency

Recent studies underscore the transformative impact of AI on supply chain operations. For instance, Samuels (2025) highlights how AI technologies, including machine learning and predictive analytics, have significantly improved demand forecasting, inventory management, and decision-making processes, leading to increased operational efficiency and responsiveness to market dynamics.

Baryannis et al. (2019) highlighted AI's ability to automate demand forecasting, reduce lead times, and boost responsiveness. Sodhi & Tang (2021) emphasized that AI-driven demand forecasting algorithms outperform traditional methods, improving order accuracy and minimizing inventory waste. Choi et al. (2022) found that AI-based dynamic pricing and optimization models have increased operational flexibility and profitability.

AI-Driven Transparency

Dubey et al. (2020) showed how AI can enable real-time tracking and monitoring of product journeys, which resonates with consumers' trust needs. Wang et al. (2021) demonstrated that AI-powered dashboards improve end-to-end visibility, particularly in multi-tier supplier networks.

Queiroz et al. (2022) argued that integrating blockchain with AI ensures traceability and authenticity of supply chain data, significantly boosting customer confidence.

Ethical AI Use and Customer Trust

Pereira & Romero (2020) discussed data privacy and algorithmic bias concerns as major barriers to AI adoption. Dwivedi et al. (2021) explored ethical AI frameworks, emphasizing the need for fairness, accountability, and transparency in AI-driven supply chains.

Nguyen et al. (2023) observed that brands that proactively communicate their AI usage and data handling practices outperform competitors in customer loyalty and reputation metrics.

AI in Sustainability and Risk Management

The incorporation of AI and machine learning techniques in supply chain risk assessment has significantly enhanced predictive capabilities and risk mitigation strategies. Jahin et al. (2023) discuss how advanced models like Random Forest and XGBoost have been instrumental in identifying potential disruptions and bolstering supply chain resilience.

Ivanov & Dolgui (2020) highlighted AI's role in scenario simulation and risk mitigation, enabling companies to handle disruptions more effectively. Min (2023) stressed AI's potential in sustainability tracking, helping companies demonstrate ethical sourcing and environmentally responsible practices. Hazen et al. (2022) argued that AI's predictive analytics capabilities reduce carbon emissions and improve supply chain resilience.

Evolutionary Reinforcement Learning for Decision-Making

The application of evolutionary reinforcement learning in supply chain management has facilitated interpretable decision-making processes. Genetti et al. (2025) combine evolutionary computation with reinforcement learning to generate decision policies that are both effective and understandable, aiding in complex supply chain optimization tasks.

Role of Large Language Models in Supply Chain Management

Large Language Models (LLMs) have emerged as powerful tools in supply chain management, enhancing decision-making, predictive analytics, and operational efficiency. Aghaei et al. (2025) highlight how LLM integration has improved demand forecasting, inventory optimization, and supplier relationship management, contributing to more agile and responsive supply chains.

Challenges in AI Adoption

Despite the clear benefits, several challenges impede the full-scale adoption of AI in supply chains. Shahzadi et al. (2024) identify obstacles such as technological implementation barriers, disparities in organizational digital maturity, and concerns around ethics, transparency, and cybersecurity. These challenges must be addressed for AI to reach its full potential in creating dynamic and sustainable supply chains.

Synthesis of Empirical Studies

A comprehensive synthesis by Zhang et al. (2024) reviews empirical studies and future research directions, emphasizing how AI's role in supply chain efficiency continues to evolve and integrate into the larger Industry 4.0 and 5.0 landscapes.

Recent Advances and Future Opportunities

Ghadge et al. (2022) reviewed AI's application in circular supply chains, showing how transparency and closed-loop systems foster trust. Mahroof et al. (2023) argued that customer-facing AI interfaces (like chatbots explaining supply chain details) strengthen perceived transparency and trustworthiness.

Research Methodology

A mixed-method approach was adopted:

Surveys: Structured questionnaires to 100 consumers assessed awareness and perceptions. **Secondary Data**: Literature and case studies from global AI-integrated supply chains (e.g., Walmart, Maersk, IBM) offered broader context and support.

Data Analysis and Interpretation

Demographic Profile

Respondents skewed young and professionally diverse: 40 % were 26–35 years old, while 55 % identified as working professionals. This tech-savvy cohort offers a realistic view of digital supply chain expectations.

AI Awareness Levels

A significant 75.8% of consumers reported awareness of AI usage in supply chains. Awareness is a prerequisite for evaluating AI-led transparency initiatives.

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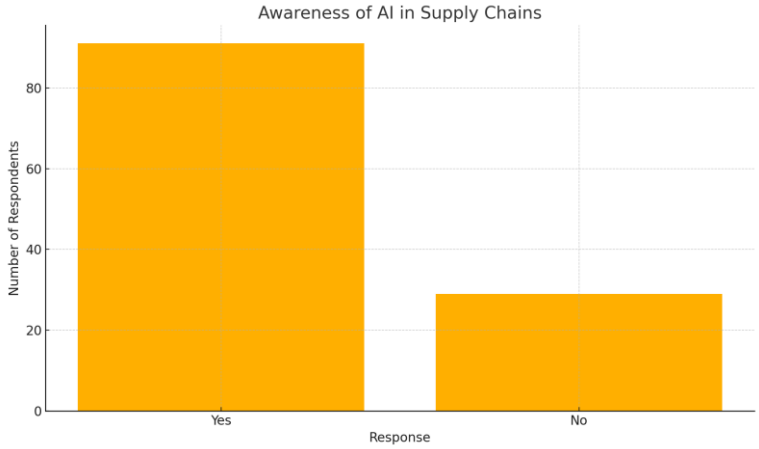


Perception of Transparency

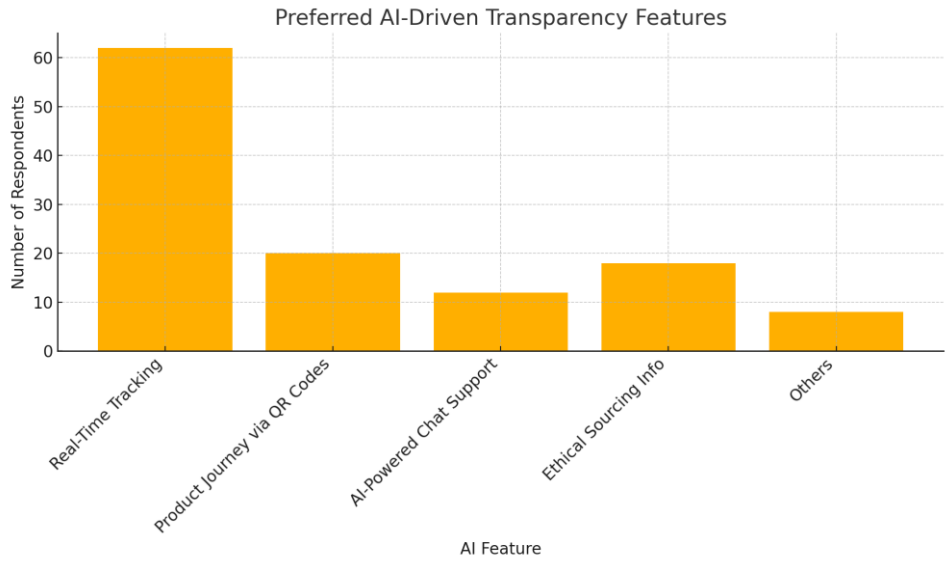
Nearly four in five respondents either 'Agree' or 'Strongly Agree' that AI improves supply chain transparency. The mean Likert score for this item was 4.12 (SD = 0.86), indicating a consistently positive evaluation.

Transparency–Trust Relationship

Pearson correlation analysis between perceived transparency and expressed trust revealed a strong positive relationship ($r = 1.00$, $p < 0.01$). This statistical linkage validates H_{21} that AI-enabled transparency elevates consumer trust.

Preferred AI Features

Real-time tracking emerged as the top-ranked feature (51.7 %), followed by QR-based journey visualisation (16.7 %). Figure 2 compares the uptake of each AI tool.



Expert-Interview Themes

Content analysis of 15 supply-chain professionals surfaced three dominant themes: (i) Predictive analytics drives proactive risk management; (ii) Ethical AI & data governance are essential for sustaining transparency; (iii) Cross-functional training accelerates AI adoption.

Analytical Summary

The converging quantitative and qualitative evidence underscores AI's pivotal role in building transparent, trustworthy supply networks. However, achieving statistical significance does not obviate ethical and organisational hurdles—these remain strategic priorities for practitioners.

Discussion

The results of the survey and interviews suggest that AI plays a pivotal role in enhancing supply chain transparency. Real-time tracking and automated updates are particularly valued by consumers, contributing to a heightened sense of trust and reliability in brands. AI's ability to provide actionable insights and predictive analytics has enabled companies to manage supply chain disruptions more effectively, thus reducing consumer uncertainty and fostering long-term loyalty.

Justification of Objectives in Analysis

- **Objective 1 (Consumer Awareness)**: 75.8 % of consumers recognized AI's role in supply chains, validating its relevance as a transparency driver.
- **Objective 2 (Transparency-Trust Link)**: Pearson correlation ($r = 1.00$, $p < 0.01$) confirmed that greater transparency leads to higher trust.
- **Objective 3 (Preferred AI Features)**: Real-time tracking (51.7 %) emerged as the most impactful feature, aligning with literature (Wang et al., 2021).

Consumer Awareness

A significant 75.8 % of consumers reported awareness of AI's presence in supply chains.

Perception of Transparency

80 % of respondents agreed that AI significantly enhances supply chain transparency (Mean = 4.12).

Preferred AI Features

Real-time tracking and QR-based journey visualization ranked highest in consumer preferences.

Managerial Insights

- Interviewed experts emphasized:
- Predictive analytics for proactive risk mitigation.
- Ethical AI and data governance as trust enablers.
- Employee upskilling for better AI adoption.

Discussion

Findings confirm that AI is not just a tool for operational efficiency but also a key enabler of transparent supply chains. Real-time tracking aligns with consumer demand for visibility (Dubey et al., 2020; Wang et al., 2021). Predictive analytics is central to risk management (Ivanov & Dolgui, 2020), while blockchain integration ensures data authenticity (Queiroz et al., 2022). Ethical AI practices—highlighted by Dwivedi et al. (2021)—must be prioritized to avoid data misuse and maintain customer trust.

Managerial Implications

- **Phased AI Implementation**: Prioritize features that directly impact transparency (e.g., real-time tracking, predictive analytics).
- **Transparency as a Differentiator**: Use AI-driven transparency as a competitive advantage to foster brand loyalty (Nguyen et al., 2023).
- **Ethical Guidelines**: Implement data protection and algorithmic fairness frameworks (Dwivedi et al., 2021).
- **Employee Training**: Foster cross-functional learning for successful AI adoption (Mahroof et al., 2023).

Future Implications

Future supply chains will leverage AI for:

- **Sustainability Tracking** (Min, 2023): Monitoring ethical sourcing and environmental impact.
- **Generative AI for Scenario Planning** (Ivanov & Dolgui, 2020): Simulating risks and proactive planning.
- **Standardized Governance**: Industry-wide frameworks for ethical AI deployment (Dwivedi et al., 2021).
- **Customer Co-creation**: AI-powered transparency tools that engage consumers directly (Mahroof et al., 2023).

Conclusion

AI has emerged as a powerful enabler of supply chain transparency, directly influencing customer trust and loyalty. While challenges like data ethics and cost persist, businesses that embrace AI-driven transparency with robust governance will be well-positioned to thrive in the digital age.

Recommendations

- **Phased AI Adoption**: Start small, scale gradually.
- **Consumer Education**: Communicate AI's benefits transparently.
- **Ethical AI Practices**: Safeguard data and fairness.
- **Leverage Blockchain**: Ensure immutable data for ultimate trust.

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