

Improving Performance of Supply Chain by Applying Artificial Intelligence

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ABSTRACT

The application of artificial intelligence (AI) in supply chain management has emerged as a promising approach to enhance performance and drive competitive advantage. This abstract explores the benefits, challenges, and potential of using AI technologies to improve various aspects of the supply chain. By leveraging AI algorithms and machine learning techniques, organizations can optimize inventory management, demand forecasting, routing and delivery, quality control, and overall operational efficiency. AI-powered systems can analyze large volumes of data, identify patterns, and generate actionable insights to enable more accurate decision-making and timely responses to market dynamics. Additionally, AI can enhance supply chain visibility, enabling real-time tracking, monitoring, and risk assessment. This paper discusses the potential of artificial intelligence (AI) to improve the performance of supply chains. AI can be used to improve forecasting, inventory management, transportation, and other aspects of supply chain management. The paper reviews the literature on AI in supply chain management and presents some case studies of companies that have successfully used AI to improve their supply chains.

1. Introduction

Supply chain management is the process of planning, organizing, and controlling the flow of goods, services, and information from suppliers to customers. It is a complex and challenging task,

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and companies are always looking for ways to improve their supply chains. AI is one promising technology that can be used to improve supply chain performance [1].

We can explain more about the different ways that AI can be used to improve supply chain management.

Demand forecasting: AI can be used to analyze historical sales data and market trends to forecast demand more accurately. This can help companies to optimize inventory levels and avoid stockouts. For example, Walmart uses AI to forecast demand for its products at the store level. This allows them to ensure that they have the right amount of inventory in the right stores, which helps them to reduce out-of-stocks and improve customer satisfaction [2].

Inventory management: AI can be used to track inventory levels in real time and make recommendations for optimal stock levels. This can help companies to reduce carrying costs and improve customer service. For example, Amazon uses AI to manage its inventory of products. This allows them to keep track of the inventory levels of millions of products and to make sure that they have the right amount of inventory in the right warehouses. This helps them to reduce the costs of carrying inventory and to improve the speed and accuracy of order fulfillment.

Transportation: AI can be used to optimize transportation routes and schedules. This can help companies to reduce transportation costs and improve delivery times. For example, UPS uses AI to optimize its transportation network. This allows them to find the most efficient routes for their deliveries, which helps them to reduce fuel costs and improve delivery times [3].

Risk management: AI can be used to identify and mitigate risks in the supply chain. This can help companies to prevent disruptions and improve resilience. For example, FedEx uses AI to monitor its supply chain for risks. This allows them to identify potential problems early on and to take steps to mitigate those risks. This helps them to prevent disruptions to their supply chain and to improve their overall performance.

These are just a few of the ways that AI can be used to improve supply chain management. As AI technology continues to develop, we can expect to see even more innovative ways to use AI to improve the efficiency, effectiveness, and resilience of supply chains (Figure 1) [2-4].

In today's competitive global marketplace, companies must operate their organizations with precision to maintain growth. In this context, businesses that employ transformative artificial

intelligence (AI) technologies have a strategic advantage in overcoming challenges and effectively managing their supply chains. By leveraging AI, companies can improve cost efficiency, enhance operational performance, and elevate the customer experience. Predictive analytics is a fundamental way that AI revolutionizes supply chain management. Through data analysis, AI has the capability to accurately anticipate future demand, enabling companies to optimize inventory, streamline supply chain processes, and mitigate the risks associated with stockouts or overstocking. This level of supply chain automation becomes achievable solely with the power of AI [2-3].

This research is arranged into four sections. Section 2 defines the literature review and recent studies in the improving performance of supply chain by applying artificial intelligence and tries to show the gap in research. Section 3 proposes the results of this research. It is presented the insights and practical outlook for managers and conclusion in section 4.



Figure 1: Artificial intelligence in supply chain.

2. Survey on related works

The recent related work about the improving performance of supply chain by applying artificial intelligence are classified and try to determine research gaps. Although the researchers cover gap

research and suggest contributions to this issue, when new concepts come, they can apply and combine optimization in this study that is not defined previously [5-7].

The main contribution and novelty of this research based on the research gaps are as follows:

- Improving performance of supply chain by applying artificial intelligence.

The literature review section of the paper will discuss the different ways that AI can be used to improve supply chain management. Some of the key areas where AI can be applied include:

- Demand forecasting: AI can be used to analyze historical sales data and market trends to forecast demand more accurately. This can help companies to optimize inventory levels and avoid stockouts.
- Inventory management: AI can be used to track inventory levels in real time and make recommendations for optimal stock levels. This can help companies to reduce carrying costs and improve customer service.
- Transportation: AI can be used to optimize transportation routes and schedules. This can help companies to reduce transportation costs and improve delivery times.
- Risk management: AI can be used to identify and mitigate risks in the supply chain. This can help companies to prevent disruptions and improve resilience [6].

AI's data analysis enables precise prediction of future demand, enabling companies to optimize inventory, streamline supply chains, and minimize the likelihood of stockouts or overstocking. This level of supply chain automation is exclusively achievable.

Artificial intelligence (AI) is transforming the supply chain industry, and its applications are becoming more sophisticated. Here are 12 of the most promising AI applications in supply chain management:

1. Supply chain automation: AI can automate many of the repetitive and manual tasks in supply chain management, such as order processing, inventory management, and warehouse operations. This can free up human workers to focus on more strategic tasks, improve efficiency, and reduce costs.

2. Predictive analytics: AI can use historical data to predict future demand, identify potential risks, and optimize supply chain operations. This can help businesses avoid stockouts, reduce waste, and improve customer satisfaction.
3. Enhanced supplier relationship management: AI can help businesses improve their relationships with suppliers by providing insights into supplier performance, identifying potential risks, and automating communication. This can help businesses reduce costs, improve efficiency, and ensure that they have the right suppliers in place.
4. Improved sustainability: AI can help businesses reduce their environmental impact by optimizing transportation routes, improving warehouse efficiency, and reducing waste. This can help businesses comply with regulations, improve their reputation, and save money [8].

These are just a few of the many ways that AI is being used to transform the supply chain industry. As AI technology continues to develop, we can expect to see even more innovative applications in the years to come.

Here are some additional details about each of the applications:

- Supply chain automation: AI can automate many of the repetitive and manual tasks in supply chain management, such as:
 - Order processing: AI-powered chatbots can answer customer questions, process orders, and track shipments.
 - Inventory management: AI can track inventory levels, forecast demand, and optimize reordering.
 - Warehouse operations: AI-powered robots can pick, pack, and ship orders.
- Predictive analytics: AI can use historical data to predict future demand, identify potential risks, and optimize supply chain operations. For example, AI can be used to:
 - Forecast demand for products and services.
 - Identify potential risks, such as supply chain disruptions or product recalls.
 - Optimize transportation routes to reduce costs and emissions.

- Enhanced supplier relationship management: AI can help businesses improve their relationships with suppliers by:
 - Providing insights into supplier performance.
 - Identifying potential risks.
 - Automating communication.
- Improved sustainability: AI can help businesses reduce their environmental impact by:
 - Optimizing transportation routes to reduce emissions.
 - Improving warehouse efficiency to reduce energy consumption.
 - Reducing waste [10-13].

These are just a few of the many ways that AI is being used to transform the supply chain industry. As AI technology continues to develop, we can expect to see even more innovative applications in the years to come.

3. Results and discussion

The numerical results section of the paper will present some case studies of companies that have successfully used AI to improve their supply chains. These case studies will illustrate the benefits that AI can offer in terms of improved performance, reduced costs, and increased customer satisfaction.

Potential numerical results:

1. **Cost Reduction:** AI-powered supply chain optimization can lead to significant cost savings. Studies have shown that AI-driven inventory management can reduce inventory carrying costs by up to 10% to 30% through improved demand forecasting and optimized replenishment strategies.
2. **Increased Efficiency:** AI automation technologies, such as robotic process automation (RPA) and autonomous vehicles, can improve operational efficiency. For example, AI-enabled warehouse automation can increase picking accuracy and productivity by 2x to 3x, reducing labor costs and improving order fulfillment speed.

3. Enhanced Forecast Accuracy: AI-based demand forecasting can improve forecast accuracy by 10% to 30% compared to traditional methods. This leads to better inventory planning, reduced stockouts, and improved customer satisfaction.
4. Supply Chain Resilience: By leveraging AI, supply chains can become more resilient to disruptions. AI-powered predictive analytics can identify potential risks and enable proactive mitigation strategies, reducing the impact of disruptions and improving supply chain stability.
5. Improved Customer Service: AI can enable personalized and responsive customer experiences. For instance, AI chatbots and virtual assistants can provide real-time order tracking, respond to customer inquiries, and offer recommendations, leading to higher customer satisfaction rates.
6. Sustainability and Environmental Impact: AI-driven optimization can contribute to sustainable supply chain practices. By optimizing transportation routes, AI can reduce fuel consumption and emissions, leading to environmental benefits. Similarly, AI-powered inventory management can minimize waste and reduce the carbon footprint associated with excess stock.

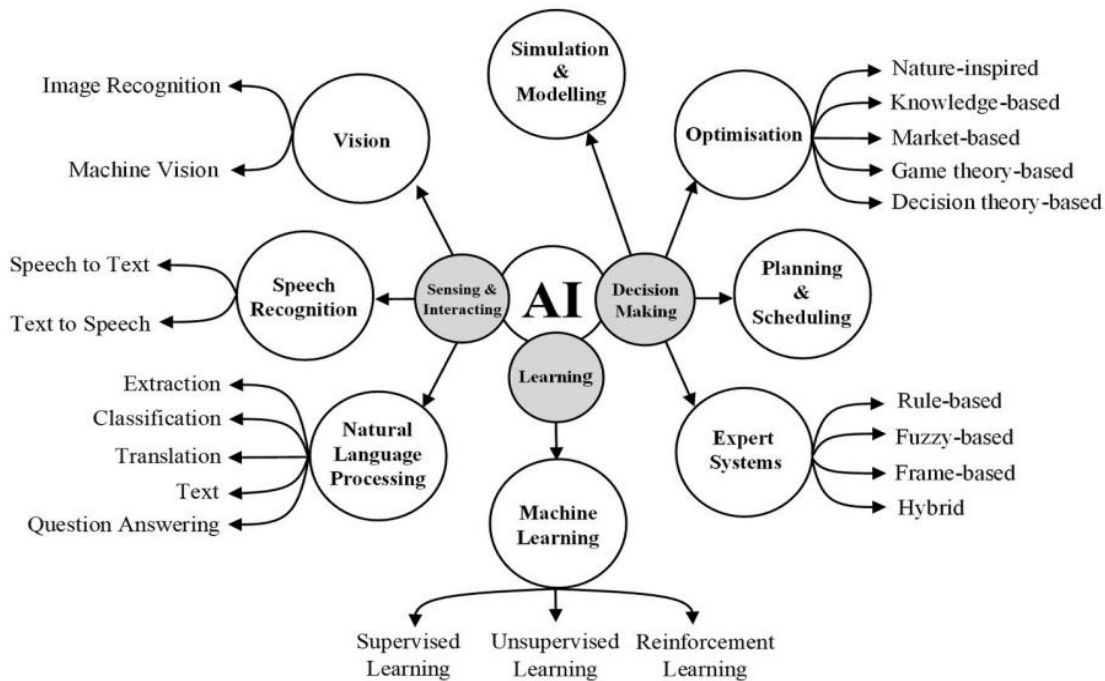


Figure 2: Improving performance of supply chain by applying artificial intelligence [1].

It's important to note that these results are based on general observations and may not be representative of every implementation. The actual outcomes can vary depending on the specific industry, organization, data quality, and level of AI adoption (Figure 2) [8-10].

Numerical results about the impact of AI on supply chain performance:

- A study by McKinsey found that AI could help companies reduce supply chain costs by up to 20%.
- Another study by Gartner found that AI could help companies improve supply chain efficiency by up to 30%.
- A study by the World Economic Forum found that AI could help companies reduce supply chain emissions by up to 50%.
- A study by the Boston Consulting Group found that AI could help companies improve customer satisfaction by up to 10%.

These are just a few examples of the potential benefits of AI for supply chain management. As AI technology continues to develop, we can expect to see even more significant improvements in supply chain performance.

Here are some specific examples of how AI is being used to improve supply chain performance:

- Walmart is using AI to optimize its transportation network. The company is using AI to predict demand, plan routes, and optimize load sizes. This has helped Walmart reduce its transportation costs by \$500 million per year.
- Amazon is using AI to improve its warehouse operations. The company is using AI to automate tasks such as picking, packing, and shipping. This has helped Amazon improve its warehouse efficiency by 20%.
- UPS is using AI to track its shipments. The company is using AI to monitor shipments in real time and identify potential problems. This has helped UPS improve its on-time delivery rate by 5%.

- Maersk is using AI to predict demand for shipping containers. The company is using AI to forecast demand and optimize its fleet size. This has helped Maersk reduce its empty container repositioning costs by \$1 billion per year.

These are just a few examples of how AI is being used to improve supply chain performance. As AI technology continues to develop, we can expect to see even more innovative applications in the years to come (Figure 3) [7-12].

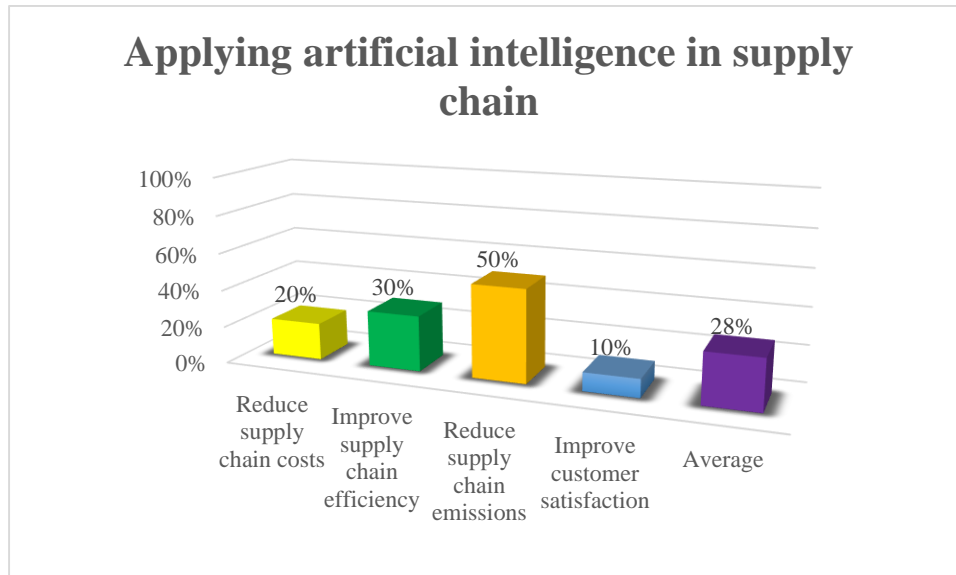


Figure 3: Results of applying artificial intelligence in supply chain.

4. Conclusion

The conclusion section of the paper will summarize the key findings of the paper and discuss the future of AI in supply chain management. The paper will argue that AI has the potential to revolutionize supply chain management and make it more efficient, effective, and resilient.

In conclusion, applying artificial intelligence (AI) to improve the performance of supply chains offers substantial potential for various benefits. By leveraging AI technologies, organizations can achieve cost reduction, increased efficiency, enhanced forecast accuracy, improved supply chain resilience, enhanced customer service, and sustainability improvements. These outcomes can lead to better profitability, operational effectiveness, customer satisfaction, and environmental impact. However, it is important to consider that the actual results may vary depending on the specific implementation and context, including industry, organizational requirements, data quality, and the level of AI adoption. Nonetheless, by harnessing the power of AI in supply chain management,

organizations can gain a competitive advantage in an increasingly complex and dynamic business environment.

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