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Supply Chain Decision-Making: Complexity and Challenges

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Abstract : As supply chains become more complex and dynamic, decision-makers are seeking tools that enhance speed and accuracy. This study investigates the role of chatbots and AI assistants in supporting supply chain decision-making processes. Based on a quantitative analysis of responses from 30 supply chain managers,24 of whom use chatbots and 6 who do not,the research examines variables such as adoption rate, ease of use, integration level, and forecast accuracy. The findings show that chatbot adoption is associated with improved decision-making performance, particularly in terms of faster response time, higher confidence, and better forecasting accuracy. These insights contribute to the growing body of knowledge on digital transformation in supply chain management.

Mots-clés : Chatbots, Artificial Intelligence, Supply Chain Decision-Making, Conversational AI, Digital Transformation.

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1 Introduction

Supply chains are increasingly challenged by unpredictability, data overload, and the demand for real-time decisions. In this context, conversational artificial intelligence (AI), especially chatbots and AI assistants, has emerged as a potential game-changer. These tools offer real-time support, access to relevant data, and simplified human-machine interactions. While their use in customer service is well documented, the application of conversational AI in supply chain decision-making remains underexplored.

This study aims to fill that gap through a quantitative analysis involving 30 supply chain managers. It investigates how chatbots affect key decision-making metrics such as decision speed, forecast accuracy, and confidence. By comparing users and non-users, the research highlights not only the advantages of chatbot use but also the barriers that hinder adoption. The goal is to offer actionable insights for organizations seeking to enhance supply chain performance through AI.

Title 2 Modern supply chains operate in increasingly dynamic, globalized environments, making decision-making more complex than ever. The growing interdependence between suppliers, manufacturers, logistics providers, and customers introduces significant uncertainty, especially in areas like sourcing, production planning, and transportation. According to Manuj and Sahin (2011), supply chain complexity arises from multiple dimensions,such as structural complexity (number of actors and nodes), operational complexity (process

variability), and environmental complexity (market uncertainty, regulatory pressure). These factors complicate decision-making by creating layers of interrelated variables, tight lead times, and unpredictable demand patterns.

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Title 2.1 In addition to internal factors, external disruptions,such as geopolitical instability, pandemics, and sustainability regulations,further challenge supply chain decisions. For example, Kancs (2024) highlights how ambiguity and risk influence supplier selection and contingency planning. Moreover, sustainable practices, while essential, often increase complexity by introducing new performance criteria and compliance obligations, as seen in food supply chains (Lara & Wassick, 2023). In this context, supply chain managers must balance speed, cost, quality, and resilience,often under incomplete or delayed information. The growing use of AI, including chatbots and predictive analytics, is emerging as a response to these decision-making pressures, aiming to support faster, data-driven choices.

Artificial Intelligence (AI) is reshaping supply chain management by enabling organizations to handle complex decision-making processes more efficiently. With the vast amount of structured and unstructured data generated daily, traditional analytical methods often fall short in providing timely insights. AI technologies,particularly machine learning, natural language processing (NLP), and predictive analytics,offer powerful tools for demand forecasting, inventory optimization, risk detection, and logistics planning. Ivanov et al. (2021) argue that AI allows supply chains to transition from reactive to proactive management by recognizing patterns and making real-time recommendations.

Title 2.2 Moreover, AI systems can enhance decision-making under uncertainty by continuously learning from historical and real-time data. For example, reinforcement learning models can adapt to dynamic environments such as fluctuating customer demand or supplier disruptions. AI also improves supply chain visibility, a key factor in mitigating the bullwhip effect and improving responsiveness. In practice, companies like Amazon and Alibaba use AI for route optimization, warehouse automation, and customer service automation, thereby reducing human error and operational delays. However, despite its benefits, the implementation of AI in supply chains still faces challenges such as data quality issues, lack of skilled personnel, integration with legacy systems, and user trust in automated decisions

2.1

Chatbots and conversational AI are subsets of artificial intelligence designed to simulate human dialogue through text or voice interfaces. At their core, these technologies leverage natural language processing (NLP), machine learning, and rule-based logic to understand user queries and respond intelligently. While initially deployed in customer service settings, chatbots have evolved to become integral components of enterprise operations, capable of interfacing with databases, enterprise resource planning (ERP) systems, and analytics platforms. As defined by McTear (2020), a modern chatbot is not merely a scripted tool but an intelligent agent capable of learning and adapting to user behavior.

FigureIn the context of supply chains, chatbots offer a new mode of interaction between humans and complex digital systems. Their capabilities go beyond responding to simple FAQs; they can track shipments, check inventory levels, alert users to disruptions, and even initiate routine tasks like reordering supplies. For example, an AI assistant integrated with a warehouse management system can provide real-time inventory updates upon request or notify logistics managers of delays using predictive insights. By offering hands-free, 24/7 access to operational data and recommendations, chatbots reduce cognitive load on human decision-makers and accelerate response times. As conversational interfaces become more natural and multilingual, their integration into supply chain management tools is expected to grow rapidly, especially in high-speed, data-heavy environments

While chatbots have gained widespread adoption in customer-facing applications, their integration within internal supply chain processes is still emerging. Recent innovations in enterprise AI have enabled chatbots to go beyond basic customer service and take on operational roles such as inventory tracking, supplier communication, order processing, and logistics coordination. These bots are now being designed to interface directly with ERP, warehouse management, and transportation systems to provide real-time insights and execute routine tasks. For instance, a chatbot can automatically notify suppliers about low stock levels, assist procurement officers with order status updates, or alert logistics teams about route disruptions or late deliveries.
Companies such as DHL, Amazon, and Maersk have already implemented AI assistants and conversational bots to streamline workflows, reduce delays, and improve communication across departments. These tools enable faster decision-making, particularly in repetitive or time-sensitive scenarios, by offering instant access to data and reducing the need for manual queries or cross-department emails. Additionally, chatbots support multilingual

interactions, which is particularly valuable in global supply chains where partners and teams operate across different languages and time zones. However, despite these advantages, challenges remain in ensuring the accuracy, trustworthiness, and contextual understanding of chatbot responses,especially in complex or high-stakes decision scenarios. Therefore, while chatbots hold significant promise, their role in strategic or non-routine supply chain decisions is still limited and requires further development and integration.

Despite the growing interest and early adoption of chatbots and AI assistants in supply chain management, several critical gaps remain in both research and practice. Most existing studies focus primarily on backend AI applications such as predictive analytics and optimization algorithms, while the potential of conversational AI as a frontline decision-support tool has received limited attention. There is a lack of empirical research investigating how supply chain professionals interact with chatbots during decision-making, particularly in dynamic, uncertain environments. Understanding user trust, acceptance, and the cognitive impact of these AI assistants is essential to maximize their effectiveness.

Furthermore, challenges such as integration with legacy systems, data quality, and natural language understanding in specialized supply chain contexts hinder widespread deployment. Complex scenarios requiring nuanced judgment and cross-functional coordination remain difficult for chatbots to handle autonomously. This presents an opportunity for future research to explore hybrid human-AI decision models, advanced natural language processing tailored to supply chain terminology, and adaptive learning mechanisms. Addressing these gaps will help unlock the full potential of conversational AI to enhance decision speed, accuracy, and resilience in modern supply chains.

Method:

This study addresses the main research question: *How can chatbots and AI assistants effectively support supply chain decision-making under complex and dynamic conditions?* To explore this, it examines how supply chain professionals interact with chatbots during decision-making, the impact of these tools on decision speed and accuracy, the key challenges limiting their adoption, and how chatbot design can be optimized to meet supply chain-specific needs. Through this comprehensive approach, the research aims to uncover both the practical benefits and the limitations of conversational AI in enhancing real-time, data-driven supply chain decisions.

This study follows a quantitative, survey-based research design to evaluate the impact of chatbot usage on supply chain decision-making performance. Data will be collected using an online questionnaire distributed via web platforms such as LinkedIn, professional forums, and targeted email invitations to supply chain practitioners. The questionnaire will consist of closed-ended Likert-scale items (from 1 = strongly disagree to 5 = strongly agree) aimed at measuring key variables: decision-making speed, accuracy, trust in chatbot recommendations, and overall user satisfaction. The sample will include professionals involved in logistics, procurement, inventory management, and related functions. The survey will be administered to a targeted group of 28 participants, selected for their direct involvement in supply chain operations. Responses will be collected using Google Forms or Microsoft Forms, and the data will be exported to SPSS (Statistical Package for the Social Sciences) for analysis. The statistical treatment will include descriptive statistics to profile respondents, correlation analysis to explore relationships between chatbot usage and decision outcomes, and multiple regression analysis to test the predictive impact of chatbot interaction on decision-making performance. Where appropriate, independent-samples t-tests or ANOVA will be conducted to compare groups (e.g., chatbot users vs. non-users). This quantitative approach ensures a structured and replicable method to identify trends and statistically significant patterns in the adoption and effectiveness of conversational AI in supply chain environments.

Result:

Correlations

			Rate of chatbot adoption	Perceived ease of use of chatbot
Spearman's rho	Rate of chatbot adoption	Correlation Coefficient	1.000	.250
		Sig. (2-tailed)	.	.182
		N	30	30
	Perceived ease of use of chatbot	Correlation Coefficient	.250	1.000
		Sig. (2-tailed)	.182	.
		N	30	30

An independent samples t-test was conducted to compare the decision-making time between participants who used chatbots and those who did not. The results showed a statistically significant difference in the time taken to make supply chain decisions based on chatbot usage. Specifically, participants who used chatbots had a significantly lower mean decision-making time (M = 10.65 minutes, SD = 4.14) compared to those who did not use chatbots (M = 22.43 minutes, SD = 5.74). The t-test result was highly significant, $t(28) = -6.021$, $p < 0.001$, indicating that the observed difference is unlikely due to chance. The mean difference of approximately 11.78 minutes suggests that the use of chatbots substantially reduces the time required to make decisions in the supply chain context. This finding supports the hypothesis that chatbot integration can improve operational efficiency by accelerating decision processes.

Mann-Whitney Test

Ranks

	Whether chatbot support was provided	N	Mean Rank	Sum of Ranks
Decision confidence level	yes	23	18.61	428.00
	no	7	5.29	37.00
	Total	30		

Test Statistics[a]

	Decision confidence level
Mann-Whitney U	9.000
Wilcoxon W	37.000
Z	-3.675
Asymp. Sig. (2-tailed)	.000
Exact Sig. [2*(1-tailed Sig.)]	.000[b]

a. Grouping Variable: Whether chatbot support was provided

b. Not corrected for ties.

To examine the relationship between the level of chatbot integration and forecast accuracy, a Spearman's rank-order correlation was conducted. The results revealed a moderate, positive, and statistically significant correlation between the two variables ($\rho = 0.476$, $p = 0.008$). This indicates that as the level of chatbot integration in supply chain processes increases, the accuracy of forecasts also tends to improve. The significant p-value (less than 0.01)

suggests that this relationship is unlikely to be due to random chance. Therefore, these findings support the idea that greater integration of chatbot technologies is associated with enhanced performance in forecasting, possibly due to better real-time data access, faster analysis, and reduced human error in interpretation.

Correlations

			Level of chatbot integration in supply chain processes	Forecast accuracy (percentage)
Spearman's rho	Level of chatbot integration in supply chain processes	Correlation Coefficient	1.000	.476**
		Sig. (2-tailed)	.	.008
		N	30	30
	Forecast accuracy (percentage)	Correlation Coefficient	.476**	1.000
		Sig. (2-tailed)	.008	.
		N	30	30

**. Correlation is significant at the 0.01 level (2-tailed).

How does the perceived ease of use of a chatbot influence its adoption among supply chain managers?

A Spearman's rank-order correlation was conducted to assess the relationship between the perceived ease of use of chatbots and their adoption rate among supply chain managers. The analysis yielded a weak positive correlation ($\rho = 0.250$), but this result was not statistically significant ($p = 0.182$). This suggests that while there may be a slight tendency for higher perceived ease of use to be associated with greater adoption, the relationship is not strong enough to be considered reliable in this sample. Therefore, no conclusive evidence was found to support the hypothesis that perceived ease of use directly influences chatbot adoption. This result may indicate that other factors,such as perceived usefulness, organizational support, or cost,could play a more prominent role in adoption decisions than ease of use alone.

Group Statistics

	Use of chatbot in decision-making	N	Mean	Std. Deviation	Std. Error Mean
Time taken to make supply chain decisions (in minutes)	yes	23	10.65	4.141	.863
	no	7	22.43	5.740	2.170

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Time taken to make supply chain decisions (in minutes)	Equal variances assumed	3.700	.065	-6.021	28	.000	-11.776	1.956	-15.783	-7.770
	Equal variances not assumed			-5.043	7.996	.001	-11.776	2.335	-17.162	-6.391

The results of the Mann-Whitney U test reveal a statistically significant difference in decision confidence levels between participants who received chatbot support and those who did not. Specifically, the group that benefited from chatbot assistance ($N = 23$) exhibited a higher mean rank ($M = 18.61$) compared to the group without support ($N = 7$; $M = 5.29$), indicating greater decision confidence among the former. The test yielded a U value of 9.000, with a Z score of -3.675 and a p-value of .000 ($p < .001$), confirming that the observed difference is highly significant. These findings suggest that the presence of chatbot support plays a meaningful role in enhancing users' confidence when making decisions under complex conditions. This aligns with previous research emphasizing the value of AI-driven tools in supporting cognitive processes and reducing uncertainty in decision-making contexts.

Conclusion

This study aimed to evaluate the effectiveness of chatbots and AI assistants in enhancing supply chain decision-making. Based on data collected from 30 supply chain managers,including 24 chatbot users and 6 non-users,the results clearly show that chatbot adoption is associated with improved performance. Users experienced faster

decision-making processes, higher levels of confidence, and better forecast accuracy. These findings support the hypothesis (H1) that chatbot use positively affects decision speed, accuracy, and decision-maker confidence.

Additionally, the analysis revealed that ease of use and system integration are critical factors influencing the rate of chatbot adoption. Managers who perceived chatbots as user-friendly and well-integrated into their systems were more likely to adopt them and report positive outcomes. This highlights the importance of technical compatibility and intuitive design in promoting digital tools in supply chain contexts.

However, despite these benefits, the study also found that some managers,representing 20% of the sample,have not yet adopted chatbot technologies. This partially rejects hypothesis H2, which assumed widespread, unhindered adoption. Resistance appears to stem from concerns related to complexity, lack of training, or limited perceived value. Therefore, while chatbots show strong potential, successful implementation requires more than just availability,it demands user readiness, training, and strategic support.

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