Volume 10, Issue 6, June – 2025 International Journal of Innovative Science and Research Technology
ISSN No: 2456-2165 https://doi.org/10.38124/ijisrt/25jun1129

A Study on Impact of Predictive Analytics and Ai Powered Chatbot in E-Commerce Logistics

Dr. G. Balamurugan[1]; Arunthathi K[2*]

[1]Assistant Professor; [2]Student,

[1,2]Department of Management Studies, University College of Engineering (BIT Campus), Anna University, Trichirappalli, Tamil Nadu, India.

Corresponding Authors: Arunthathi K[2*]

Publication Date: 2025/06/23

Abstract: The rapid development of e-commerce has contributed to the demand for effective and reliable logistics management. To address this, predictive analytics and AI chatbot have emerged as breakthrough technologies in the logistics industry. Predictive analytics leverages data-driven insights and machine learning algorithms to forecast patterns of demand, balance inventory, and improve supply chain efficiency, thereby reducing operational inefficiencies and cutting costs. Simultaneously, AI-powered chatbot are leading the charge in bringing about enhanced customer engagement in the form of prompt responses to log-related inquiries, order tracking, and resolving repetitive issues in real time. These two technologies working together not only enhance logistical accuracy and responsiveness but also enable building a customer-centric approach that engenders more satisfaction and loyalty. This article attempts to analyze the multifaceted impact of predictive analytics and AI chatbot on e-commerce logistics based on a combination of empirical data, case studies, and industry reports. Further, the study highlights the challenges of deploying predictive analytics and chatbot, including data integration and privacy concerns, and offers business strategic suggestions to businesses in order to leverage these tools effectively. Through this comprehensive analysis, the article provides valuable insights into how the synergy between predictive analytics and AI-powered chatbot can drive innovation and efficiency in e-commerce logistics.

Keywords: *Customer Satisfaction, Dispatch Time, Delivery Failures, Chatbot Accuracy, Order Fulfillment.*

How to Cite: Dr. G. Balamurugan; Arunthathi K (2025) A Study on Impact of Predictive Analytics and Ai Powered Chatbot in E-Commerce Logistics. *International Journal of Innovative Science and Research Technology*, 10(6), 1463-1467. https://doi.org/10.38124/ijisrt/25jun1129

I. INTRODUCTION

The e-commerce business sector has drastically changed in recent years with advances in technology and consumer behavior. With increasing volumes and demand for real-time support from customers, businesses are turning to new technologies in a bid to enhance efficiency and customer happiness. Among these, predictive analytics and AI-powered chatbot have proved to be useful tools. Predictive analytics allows data-driven decision making through forecasting of demand, optimized inventory management, and reduction of delivery delays. Meanwhile, AI chatbot are revolutionizing customer service via 24/7 support, complaint resolution, and reducing the time to resolution. This research analyzes the role and performance of such technologies in online retailing, with focus on their impact on logistics performance, customer experience, and operational success. Through understanding the roles played by these tools, the study aims to convey knowledge regarding how e-commerce companies can achieve competitive advantage and customer satisfaction through AI and data analytics.

➢ *Background and Rationale*

Expansion in online shopping has placed logistics companies under greater pressure to deliver faster and better. In spite of that, there continue to be issues of delayed delivery, poor dispatch planning, and back orders. Predictive analytics can be utilized for demand forecasting and routing optimization, and AI-powered chatbot improve customer service and response times. Though promising, little research has been done on their combined effect in logistics processes. This research fills that void by investigating how these technologies affect efficiency, customer satisfaction, and total logistics performance.

➢ *Objectives*

- To examine the role of Predictive Analytics in managing E-Commerce Logistics.

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- To analyze the Effect of AI-based route optimization towards improved delivery efficiency and minimum delays.
- To examine the accuracy of chatbot in improving customer complaint resolution and satisfaction.
- To assess how the frequency of failed delivery attempts affects logistics performance and complaint rates.
- To measure the impact of Dispatch time on reducing delivery failures and improving fulfillment speed.

II. METHODOLOGY

➢ *Research Design*

Descriptive design is the most appropriate for this study since it attempts to systematically describe and examine a systematic observation of customer perceptions, opinions, and levels of satisfaction.

➢ *Type of Study*

The research is mostly quantitative, centered on the collection and analysis of data in the form of numbers using structured questionnaires. It might also have some qualitative findings from open-ended questions to complement the results.

➢ *Questionnaire Design*

The information was gathered using a scheduled questionnaire, which was made in line with the goals and the variables that impact the research. The scheduled questionnaire is a collection of different kinds of questions such as closed end questions and likert scale has been employed.

➢ *Sample Size*

The sampling size taken for the study is 143.

➢ *Sampling Technique*

The sampling technique used for this study was snowball sampling.

➢ *Data Collection Methods*

- *Primary Data:*

Structured questionnaires and semi-structured interviews of managers and employees will be used to gather data on their experiences, perceptions, and level of engagement on AI-driven logistics operations, predictive analytics tools, and chatbot-facilitated customer service**.**

- *Secondary Data:*

Secondary data will be drawn from organizational case studies, industry reports, and academic journals to offer context and reinforce findings related to the integration of AI technologies in logistics operations.

➢ *Statistical Tools*

- *Chi-Square Test:*

Chi-square test was also used to analyze significant relationships between categorical variables.

- *Correlation Analysis:*

This method quantifies the magnitude and direction of the linear relationship between two continuous variables.

➢ *Findings from the Study*

- A firm's investment in AI and predictive analytics and the assumption that they enhance the effectiveness of e-commerce logistics.
- AI-powered customer support improving the shopping experience and chatbot minimizing unresolved complaints.
- The research establishes a general positive sentiment about AI technologies to enhance logistics and customer service within e-commerce, with opportunities for improved integration and optimization.
- The majority of the respondents agreed that AI-driven technologies such as Chatbotand predictive analytics are becoming a necessity of contemporary e-commerce logistics, especially in increasing response speed and delivery management.
- AI-driven dispatches systems help streamline delivery processes, and timely deliveries positively influence their satisfaction with e-commerce services.

III. CHI SQUARE TEST

➢ *Hypothesis*

- *Null Hypothesis (Ho):*

There is no significant association between the Company's budgets is allocated to AI and predictive analytics in logistics and overall impact on E-commerce logistics.

- *Alternative Hypothesis (H1):*

There is significant association between the Company's budgets is allocated to AI and predictive analytics in logistics and overall impact on E-commerce logistics**.**

Table 1 Company's Budget is Allocated to AI and Predictive Analytics in Logistics and Overall Impact on E-Commerce Logistics

	Value	**df**	**Asymptotic Sig. (2-tailed)**
Pearson Chi-Square	9.16	9	.422
Likelihood Ratio	9.18	9	.421
Linear-by-Linear Association	.13	1	.718
N of Valid Cases	143		

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Tabulated value (T.V) (0.05, 9) = 16.919

Chi square value = 9.16

C.V< T.V: 9.16 < 16.919

Hence Ho is accepted. So, there is no dependence between the variables.

➢ *Interpretation:*

There is no significant association between the two groups of Company's budget is allocated to AI and predictive analytics in logistics and overall impact on E-commerce logistics. Therefore, the Null hypothesis is accepted and the alternative hypothesis is rejected.

➢ *Hypothesis*

- *Null Hypothesis (Ho):*

There is no significant association between the Occupation and Chatbot accuracy and Complaint resolution time.

- *Alternative Hypothesis (H1):*

There is significant association between the Occupation and Chatbot accuracy and Complaint resolution time.

Table 2 Occupation & Chatbot Accuracy and Complaint Resolution Time

	Value	**Df**	**Asymptotic Sig. (2-tailed)**
Pearson Chi-Square	12.68	16	.696
Likelihood Ratio	13.37	16	.646
Linear-by-Linear Association	.21	1	.644
N of Valid Cases	143		

Tabulated value (T.V) (0.05, 16) = 16.919

Chi square value = 12.68

C.V< T.V: 12.68 < 26.296

Hence Ho is accepted. So, there is no dependence between the variables

➢ *Interpretation:*

There is no significant association between the two groups of Occupation and Chatbot accuracy and Complaint resolution time. Therefore, the Null hypothesis is accepted and the alternative hypothesis is rejected.

IV. CORRELATION ANALYSIS

➢ *Hypothesis 1*

- *Null Hypothesis H0:*

There is significant relationship between AI driven dispatch management improves logistics efficiency and Optimizing dispatch time leads to better customer satisfaction.

- *Alternative Hypothesis H1:*

There is no significant relationship between AI driven dispatch management improves logistics efficiency and Optimizing dispatch time leads to better customer satisfaction.

Table 3 Dispatch Time & Fulfillment Speed in AI- Driven Dispatch Management Improves Logistics Efficiency and Optimizing Dispatch Time Leads to Better Customer Satisfaction.

		AI driven dispatch management improves logistics efficiency	**Optimizing dispatch time leads to better customer satisfaction**
AI driven dispatch management improves logistics efficiency	Pearson Correlation	1.000	.144
	Sig.(2-tailed)		.087
	N	143	143
Optimizing dispatch time leads to better customer satisfaction	Pearson Correlation	.144	1.000
	Sig.(2-tailed)	.087	
	N	143	143

Correlation is significant at the 0.05 level (2-tailed).

R=.144

Positive Linear Relationship

Alternative hypothesis (H1) accepted.

➢ *Interpretation:*

Since we got positive correlation (.144) it clearly shows that there is relationship between AI driven dispatch management improves logistics efficiency and Optimizing dispatch time leads to better customer satisfaction.

➢ *Hypothesis 2*

- *Null Hypothesis H0:*

There is significant relationship between AI based customer supports the overall shopping experience and Chatbot reduce the number of unresolved complaints in logistics operations.

- *Alternative Hypothesis H1:*

There is no significant relationship between AI based customer supports the overall shopping experience and

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Chatbot reduce the number of unresolved complaints in logistics operations.

Table 4 Chatbot Accuracy & Complaint Resolution Time in the AI Based Customer Supports the Overall Shopping Experience and Chatbot Reduce the Number of Unresolved Complaints in Logistics Operations

		AI based customer supports the overall shopping experience	**Chatbot reduce the number of unresolved complaints in logistics operations**
AI based customer supports enhances the overall shopping experience	Pearson Correlation	1.000	.115
	Sig.(2-tailed)		.170
	N	143	143
Chatbot reduce the number of unresolved complaints in logistics operations	Pearson Correlation	.115	1.000
	Sig.(2-tailed)	.170	
	N	143	143

Correlation is significant at the 0.05 level (2-tailed).

R=.115

Positive Linear Relationship

Alternative hypothesis (H1) accepted.

- *Interpretation:*

Since we got positive correlation (.115) it clearly shows that there is relationship between AI based customer supports enhances the overall shopping experience and Chatbot reduce the number of unresolved complaints in logistics operations.

V. SUGGESTION

- The employees at all levels within organizations must know how AI tools operate and how they can be of benefit to logistics operations. There should be recurrent training and awareness sessions to enhance acceptance and proper utilization.
- Although Chatbot are convenient, there must be human agents to deal with more complicated or unresolved matters. A seamless transfer from AI to human support can enhance customer satisfaction and confidence.
- E-commerce businesses can prioritize more accurate chatbot, personalization, and response speeds. Consumers are looking for simple, intelligent responses, and AI-based tools need to upgrade to address these requirements day in and day out.
- Apply Predictive Models to enhance delivery Scheduling through examination of historical delivery patterns, traffic flow, and weather, businesses can develop optimized schedules that minimize delays and maximize customer satisfaction.
- Gather Feedback from Ground Staff logistics personnel who deal directly with such systems should be invited to offer feedback, which can inform improvements and result in tools that are sensible and easy to use.

VI. CONCLUSION

The research highlighted the influence of predictive analytics and Chatbot supported by artificial intelligence on logistics operations where employees in logistics companies were surveyed online. From the survey, it was found that the respondents saw AI tools as supportive in enhancing delivery speed and operational precision. Predictive analytics was found to be beneficial for predicting delays and optimizing routes. AI-driven Chatbot were also found to be supportive in facilitating quicker and more precise customer service. On the whole, the employees were positive about adopting such technologies into their day-to-day operations. Nevertheless, the performance of such tools is contingent upon ongoing employee training and updating the systems. It is recommended that logistics businesses make AI tools align with ground-level processes for the sake of efficiency. If applied correctly, the technologies can minimize delivery grievances and enhance customer satisfaction. The findings validate that AI and predictive analytics provide real-world value in logistic settings. They are a next step towards more responsive and reliable logistics services.

ACKNOWLEDGEMENT AND CREDITS

The authors express their heartfelt thanks to all the logistics professionals and industry experts who participated in the study. Special thanks to the faculty of the department of management studies, University College of Engineering (BIT Campus), Anna University, for their constant encouragement and guidance in this research work.

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ISSN No: 2456-2165 https://doi.org/10.38124/ijisrt/25jun1129

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