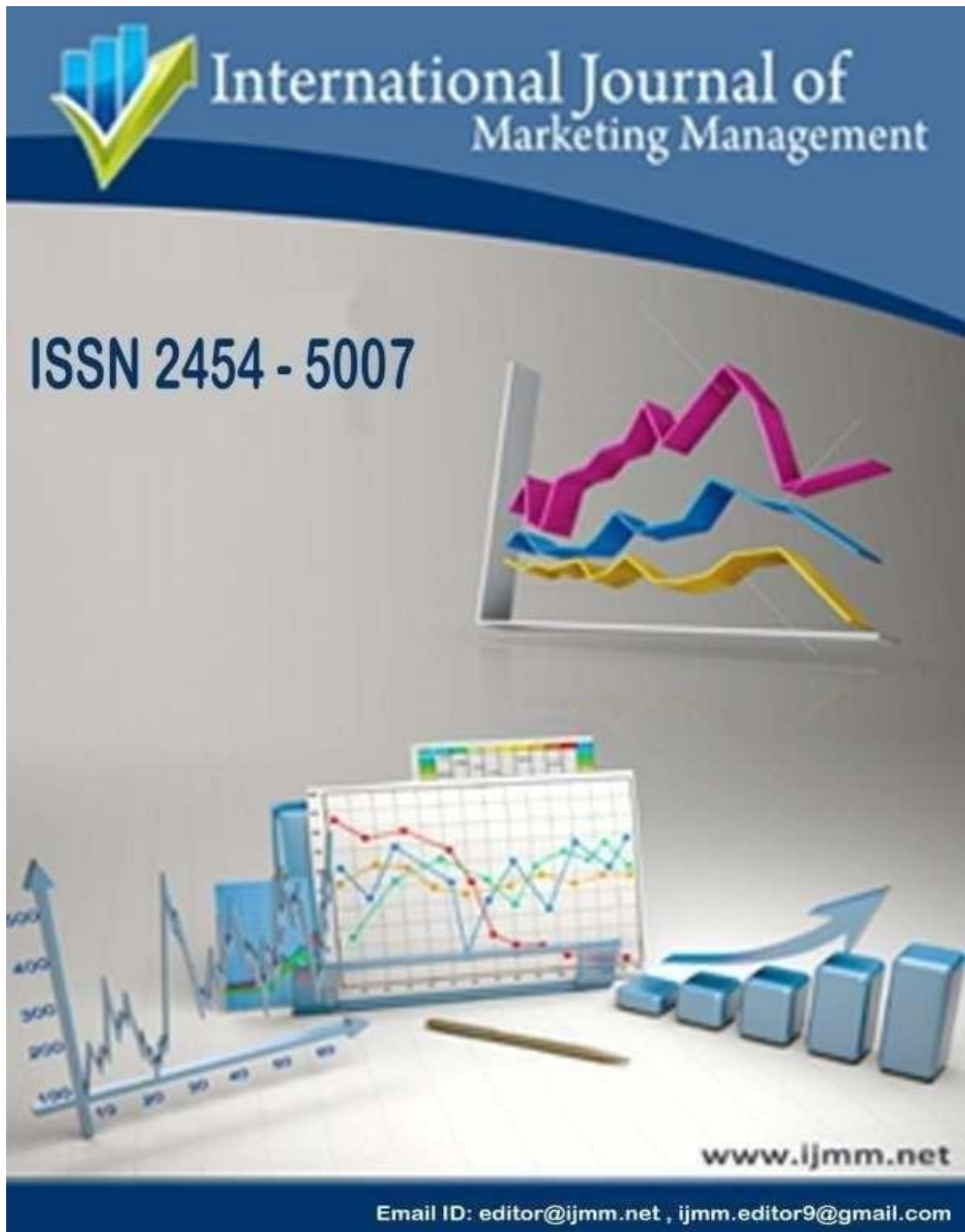




Technology-enabled last-mile logistics and its influence on consumer satisfaction and loyalty

By Dr. Deepalakshmi M ¹, Dharani K ², Arthi Sri K R ³, Chahana L ⁴, Elakkiya N ⁵

*1 - Associate Professor & Head of the Department of Bcom (e-com) & Bcom (SF)

*2 – Assistant professor, Department of Bcom (AM) & Bcom (FS)

* 3, 4,5 - Students of III Bcom (SF), the Department of Bcom (e-com) & Bcom (SF)

PSGR Krishnammal College for Women, Peelamedu, Coimbatore.

ABSTRACT

Focusing on delivery efficiency, transparency, and customer satisfaction, this study examines the influence of technology-enabled last-mile logistics within the e-Commerce industry. As online shopping continues to expand, last-mile delivery has become a critical element shaping customer experience and fostering long-term loyalty. Today's consumers seek not only quick and accurate deliveries but also transparent and dependable services that create trust. Advanced technologies such as Artificial Intelligence (AI), Machine Learning (ML), the Internet of Things (IoT), and Blockchain are reshaping logistics systems by enabling predictive delivery models, optimizing routes, and providing real-time tracking.

This research investigates how these technological innovations collectively enhance delivery performance, operational visibility, and consumer confidence. Conducted among 253 e-Commerce consumers in Coimbatore, Tamil Nadu, the study employs statistical tools such as Percentage Analysis, Descriptive Statistics, ANOVA, and t-Test to analyse the connection between technology adoption, delivery efficiency, and customer loyalty.

The findings reveal that efficiency and transparency in last-mile logistics significantly contribute to building trust, encouraging repeat purchases, and strengthening customer loyalty in the highly competitive digital marketplace.

KEY WORDS

Last-mile logistics, Consumer Satisfaction, Predictive Delivery, Logistics Optimization

INTRODUCTION

Technology-enabled last-mile logistics forms the most vital and final stage of the e-Commerce supply chain, connecting distribution centres to customers' doorsteps with greater speed, precision, and reliability. In today's dynamic digital marketplace, consumers expect not only prompt deliveries but also complete visibility, real-time updates, and safe handling of their purchases. These growing expectations have turned last-mile delivery into a key factor influencing customer satisfaction and long-term loyalty. Emerging technologies such as Artificial Intelligence

(AI), Machine Learning (ML), the Internet of Things (IoT), and Blockchain have transformed last-mile operations by supporting predictive route planning, automated dispatching, and real-time tracking, all of which reduce delays and promote transparency. With these advancements, businesses can deliver smoother, more efficient, and trustworthy experiences that enhance customer confidence. By combining technological innovation with operational transparency, this study explores how last-mile logistics impacts satisfaction, trust, and loyalty among e-Commerce consumers, highlighting its strategic importance for online retailers, logistics partners, and policymakers in maintaining competitiveness within the digital economy.

STATEMENT OF THE PROBLEM

The rapid expansion of e-Commerce has greatly influenced consumer expectations, with shoppers now seeking delivery services that are faster, more dependable, and fully transparent. Yet, last-mile delivery continues to pose significant challenges, as delays, inefficiencies, and the absence of real-time tracking often leads to customer dissatisfaction and declining loyalty. Although technologies such as Artificial Intelligence (AI) and Machine

Learning (ML) are increasingly being utilized to enhance predictive accuracy and streamline logistics operations, many e-Commerce companies still face hurdles in effectively implementing these tools. As a result, a noticeable gap persists between the level of delivery performance that consumers expect and what businesses are consistently able to provide. Therefore, understanding how technology-enabled last-mile logistics affects delivery efficiency, transparency, and consumer loyalty is essential for building trust and maintaining competitiveness in today's digital marketplace..

OBJECTIVES

- ❖ To examine the impact of last-mile delivery efficiency on consumer satisfaction and loyalty in e-Commerce.
- ❖ To analyse the role of Artificial Intelligence (AI) and Machine Learning (ML) in enhancing predictive delivery accuracy and logistics optimization.

NEED OF THE STUDY

The rapid growth of e-Commerce has transformed the way consumers shop, creating a new era where customers expect fast, transparent, and reliable delivery

services. Among all stages of the supply chain, last-mile delivery stands out as the most critical and complex, as even small delays or inefficiencies can directly influence customer satisfaction and loyalty. In this evolving digital landscape, technology plays a pivotal role in bridging the gap between consumer expectations and actual delivery performance. Advanced innovations such as Artificial Intelligence (AI), Machine Learning (ML), Internet of Things (IoT), and Blockchain are increasingly being adopted to enhance predictive accuracy, optimize delivery routes, and provide real-time tracking updates. However, many e-Commerce businesses continue to face challenges in effectively implementing these technologies within their logistics operations. This often results in a gap between the level of efficiency and transparency that consumers expect and what companies can consistently deliver. Therefore, understanding how technology-enabled last-mile logistics improves operational performance, visibility, and reliability is essential for enhancing customer satisfaction, strengthening long-term loyalty, and ensuring competitiveness in the modern e-Commerce marketplace.

RESEARCH METHODOLOGY

- | | |
|--------------------|--|
| 1. Area of study | Coimbatore,
Tamil Nadu |
| 2. Sample size | 253
respondents |
| 3. Sampling method | Simple
random sampling |
| 4. Data collection | Primary data |
| 5. Period of study | August 2025-
September 2025 |
| 6. Analysis Tools | Percentage
analysis, Descriptive Statistics,
ANOVA, t-Test |

LIMITATIONS OF THE STUDY

The sample of this study has been restricted to 253 respondents. This study is purely based on the information supplied by the respondents in Coimbatore district. The findings of the study are not applicable to any other area.

REVIEW OF LITERATURE

The study, “**The impact of e-Commerce-related last-mile logistics on cities: a systematic literature review**” by **Viu-Roig and Alvarez-Palau (2020)¹**, set out to examine how the rapid growth of online shopping is reshaping urban logistics. With e-Commerce expanding rapidly accelerated further by the COVID-19 pandemic the authors aimed to understand the economic, social, environmental, and

technological consequences of last-mile deliveries in cities. Using a systematic review approach guided by PRISMA standards, they analysed existing research to classify these impacts under the framework of sustainability. Their findings highlighted that while e-Commerce offers new opportunities for businesses and consumers, it also generates challenges such as congestion, pollution, and logistical inefficiencies. The study concluded that greater scholarly and policy attention is needed to balance these trade-offs and design urban systems that can handle the demands of the digital marketplace effectively.

In the study, **“Last-mile delivery with artificial intelligence: dynamic routing, predictive analytics, and sustainable logistics solutions in the e-Commerce era”**, Al-Khatib, Abu Saif, Al-Husseini, Al-Tamimi, Al-Qawasmeh,

ANALYSIS AND INTERPRETATION

PERCENTAGE ANALYSIS

Batan, and Al-Najjar (2020)², 11 explored how artificial intelligence can transform the most complex and costly stage of logistics last-mile delivery. The research highlights the growing pressure on e-commerce companies to balance speed, cost-efficiency, and environmental responsibility while meeting rising consumer expectations. By reviewing developments in AI-powered route optimization, predictive analytics, and resource allocation, the authors emphasize how technologies like machine learning, reinforcement learning, and real-time data can reduce delays, improve fleet utilization, and minimize emissions. The paper also acknowledges challenges such as data privacy, system integration, and ethical implications of automation. As a conclusion, the study underscores AI’s potential to make last-mile delivery not only faster and more reliable but also more sustainable and customer-focused in the evolving global e-Commerce landscape.

Table 1**Demographic profile of the respondents**

Demographic profiles	Particulars	Number of respondents	Percentage (%)
Age	Below 20	177	70.0
	21-30	62	24.5
	31-40	10	4.0
	Above 40	4	1.6
	Total	253	100.0
Gender	Male	45	17.8
	Female	208	82.2
	Total	253	100.0
Educational Qualifications	Higher secondary	34	13.4
	Undergraduate	191	75.5
	Postgraduate	24	9.5
	Doctorate	4	1.6
	Total	253	100.0
Marital status	Single	220	87.0
	Married	33	13.0
	Total	253	100.0
Type of family	Nuclear family	191	75.5
	Joint family	62	24.5
	Total	253	100.0

No. of earning members in the family	1	69	27.3
	2	95	37.5
	3	58	22.9
	4	31	12.3
	Total	253	100.0
Family monthly income	Below ₹25,000	48	19.0
	₹25000-₹50,000	75	29.6
	₹50,001-₹75,000	65	25.7
	₹75,001 and above	65	25.7
	Total	253	100.0
Residential Status	Urban	100	39.5
	Semi-Urban	96	37.9
	Rural	57	22.5
	Total	253	100.0

(Source: Computed)

- ❖ Percentage analysis reveals that the majority of the respondents (70.0%) fall under the age group of below 20 years, which holds the highest frequency among all age categories.
- ❖ The analysis shows that most of the respondents (82.2%) are female, indicating that female respondents dominate compared to their male counterparts.
- ❖ From the survey, nearly three-fourths of the respondents (75.5%) are undergraduate degree holders, which forms the largest educational group.
- ❖ Percentage analysis further denotes that a significant proportion of the respondents (87.0%) are single, which is much higher compared to married respondents.
- ❖ The survey also highlights that 75.5% of the respondents belong to nuclear families, showing a preference for this family structure.

- ❖ In terms of earning members in the family, about 37.5% of the respondents reported having two earning members, marking the highest frequency.
- ❖ The percentage analysis of income levels shows that nearly 29.6% of the respondents have a monthly family income ranging between ₹25,000 and ₹50,000, which forms the dominant income group.
- ❖ Finally, the analysis reveals that 39.0% of the respondents reside in urban areas, which is comparatively higher than those living in rural or semi-urban areas.

DESCRIPTIVE STATISTICS

Table 2

Impact of delivery efficiency on consumer satisfaction and loyalty

Statement	N	Minimum	Maximum	Mean	S.D
The delivery time promised during checkout is usually met.	253	1.00	5.00	2.2213	1.50608
The delivery staff is professional and courteous	253	1.00	5.00	2.6561	1.04099
I receive timely updates about my order during the delivery	253	1.00	5.00	3.1502	.84114
The product packaging is intact and undamaged at delivery	253	1.00	5.00	3.5138	1.04502
A smooth delivery process increases my trust and loyalty towards the platform	253	1.00	5.00	3.9842	1.31827
Fast and reliable delivery increases my trust in the platform	253	1.00	5.00	3.4625	1.20990

I am likely to shop again from platforms that consistently deliver on time	253	1.00	5.00	3.3755	1.09350
Efficient delivery directly influences my satisfaction as a online buyer	253	1.00	5.00	3.1700	1.27505
I feel less anxious about online shopping when the delivery process is quick and reliable	253	1.00	5.00	3.0672	1.44180

(Source: Computed)

In accordance with descriptive analysis, it is revealed that respondents show a strong preference for a smooth delivery process increases my trust and loyalty towards the platform, which holds the highest mean score of 3.9842. This indicates that customers closely associate seamless delivery experiences with greater trust and long term loyalty. Packaging quality and reliable delivery were also viewed positively, while lower ratings for staff professionalism and meeting promised delivery times highlight weaker areas needing improvement. Overall, the findings suggest that efficiency, consistency, and smooth processes in delivery are central to enhancing consumer satisfaction and loyalty in e-Commerce.

ANOVA

Table 3

Agreeability score of the respondents towards the opinion on AI and ML in Predictive Delivery & Optimization

Demographic profile	Groups	Agreeability score of the respondents towards the opinion on AI and ML in Predictive Delivery & Optimization					
		N	Mean	SD	F-value	Sig.value	S/NS

Age	Below 20	77	3.1517	.79162	.832	.477	NS
	21-30	62	3.2419	.85737			
	31-40	10	3.3000	.87663			
	Above 40	4	2.6429	1.07855			
Gender	Male	45	3.3524	.83611	2.713	.101	NS
	Female	208	3.1326	.80653			
Educational qualification	Higher secondary	34	3.1891	.94742	.226	.878	NS
	Undergraduate	191	3.1653	.76323			
	Postgraduate	24	3.2440	.93486			
	Doctorate	4	2.8929	1.45394			
Marital status	Single	220	3.1539	.81087	.801	.372	NS
	Married	33	3.2900	.84174			
Type of family	Nuclear family	191	3.1399	.78369	1.188	.277	NS
	Joint family	62	3.2696	.90281			
No of earning members in the family	1	69	3.1201	.70652	1.731	.161	NS
	2	95	3.3038	.84058			
	3	58	3.0074	.81843			
	More than 3	31	3.1889	.91725			
Family monthly income	Below ₹25,000	48	3.0030	.63989	.935	.424	NS
	₹25000-	75	3.1829	.71720			

	₹50,000						
	₹50,001- ₹75,000	65	3.2022	.90629			
	₹75,001 and above	65	3.2527	.93089			
Residential status	Urban	100	3.0114	.71837	3.603	.029	S
	Semi-urban	96	3.2351	.82078			
	Rural	57	3.3459	.92027			

(Source: Computed)

ANOVA has been applied to examine whether demographic factors such as age, gender, educational qualification, marital status, type of family, number of earning members, family monthly income, and residential status are significantly associated with the agreeability scores on AI and ML in predictive delivery and logistics optimization. The analysis reveals that, at a 5% significance level, only residential status shows a significant difference (F-value = 3.603, Sig. = 0.029), with rural respondents reporting the highest mean score. However, age, gender, education, marital status, family type, number of earning members, and income do not display any significant association, suggesting that consumer opinions on AI and ML adoption remain largely uniform across these groups.

t-Test

Table 4

Agreeability score of the respondents towards the opinion on impact of delivery efficiency on consumer satisfaction and loyalty

Demographic profiles	Groups	Agreeability score of the respondents towards the opinion on impact of delivery efficiency on consumer satisfaction and loyalty					
		N	Mean	SD	t-value	Sig.value	S/NS
Gender	Male	45	3.3136	81350	1.358	.176	NS

	Female	208	3.1485	72233			
Marital status	Married	220	3.1722	72734	-.312	.755	NS
	Unmarried	33	3.2155	83331			
Type of family	Nuclear Family	191	3.1675	73153	-.389	.698	NS
	Joint family	62	3.2097	77219			

(Source: Computed)

t-Test have been used to analyse whether agreeability scores towards the impact of delivery efficiency on consumer satisfaction and loyalty differ across gender, marital status, and family type. The results show that male respondents recorded the highest mean score of 3.3136, yet the significance values for all demographic groups were above 0.05, indicating no statistically significant differences. Hence, the null hypothesis is accepted, suggesting that demographic factors do not play a major role in shaping consumer opinions, and perceptions remain consistent across groups.

SUGGESTIONS

Companies should focus on creating smoother and more reliable delivery processes, with special attention to

verification at the point of delivery. Stronger security checks and consistent efficiency can directly boost customer trust and loyalty.

- ❖ e-Commerce platforms need to strengthen the use of AI and ML to provide accurate delivery insights and predictive updates. Emphasizing digital proof of delivery can further enhance reliability and build long-term confidence among consumers.

CONCLUSION

The study highlights that technology-enabled e-Commerce logistics plays a vital role in shaping consumer experiences and loyalty. Last-mile delivery efficiency is found to be a key driver of customer satisfaction, as timely and reliable delivery builds trust and repeat purchases. At the same time, the integration of Artificial Intelligence and Machine

Learning strengthens logistics by improving predictive accuracy and optimizing delivery processes. Together, these factors show that efficiency, transparency, and technology-driven solutions are essential for fostering consumer loyalty in the competitive e-Commerce landscape.

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