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Smart logistics in e-Commerce: Blockchain for transparency and IoT for real-time tracking

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ABSTRACT

With a focus on understanding transparency, data integrity, and consumer perception, this study investigates how Blockchain and Internet of Things (IoT) reshape e-Commerce logistics. Blockchain ensures secure and tamper-proof records that build trust and accountability, while IoT-enabled real-time tracking allows consumers to monitor their orders closely, enhancing confidence in delivery services. Together, these technologies address key challenges such as lack of transparency, delivery delays, and consumer distrust, thereby transforming logistics into a more reliable and efficient system. The study, which involved 253 e-commerce consumers in Coimbatore, Tamil Nadu, used percentage analysis, descriptive analysis, ANOVA, t-Test to evaluate how blockchain-driven transparency and IoT-based tracking influence consumer trust, delivery satisfaction, and long-term loyalty.

KEY WORDS

Smart Logistics, Data Integrity, Delivery Efficiency, Supply Chain Innovation.

INTRODUCTION

Smart logistics in e-commerce refers to the use of advanced technologies such as Blockchain and the Internet of Things (IoT) to create faster, more transparent, and reliable delivery systems. Blockchain ensures secure and tamper-proof records that strengthen trust and accountability, while IoT enables real-time tracking of products from warehouse to doorstep.

Together, these innovations not only improve delivery efficiency but also enhance transparency, giving customers greater confidence in their shopping experience. By reducing delays, increasing visibility, and building trust, smart logistics transforms traditional supply chains into consumer-centric systems that drive satisfaction and long-term loyalty in the digital marketplace.

STATEMENT OF THE PROBLEM

The logistics systems in e-Commerce often face challenges of inefficiency, lack of transparency, and limited consumer trust. While technologies such as Blockchain and the Internet of Things (IoT) have the potential to address these issues by ensuring data integrity and enabling real-time tracking, many companies struggle to implement them effectively. Consumers increasingly demand faster deliveries with full visibility, yet delays, data inaccuracies, and poor communication remain common. This mismatch between consumer expectations and operational performance highlights the need for smart logistics solutions. By integrating Blockchain for transparency and IoT for real-time tracking, this study seeks to explore how technology can bridge these gaps, improve delivery reliability, and strengthen long-term customer loyalty in the digital marketplace.

OBJECTIVES

- To evaluate how Blockchain-based systems contribute to transparency, data integrity, and consumer trust in e-Commerce logistics.
- To explore the influence of Internet of Things (IoT)-enabled real-time tracking systems on consumer perception of delivery services.

NEED OF THE STUDY

With the rapid growth of e-Commerce, understanding how delivery efficiency and transparency influence consumer satisfaction and loyalty have become essential. While technologies like automation, artificial intelligence, and real-time tracking have transformed logistics, many companies still struggle to meet customer expectations consistently. Most research has examined efficiency or transparency separately, leaving a gap in understanding how they jointly impact long-term loyalty. Addressing this gap is crucial in today's competitive digital marketplace, where a single negative delivery experience can drive customers to switch brands. By exploring how technology-enabled logistics integrates efficiency, transparency, and loyalty, this study aims to provide valuable insights for businesses, policymakers, and logistics

providers, helping them enhance operations, build stronger customer relationships, and turn technological investments into sustainable competitive advantage.

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

In the study, **The impact of real-time order tracking on customer satisfaction and loyalty in Chennai's online food delivery services**, **Udayakumar and Nagarajan (2024)[1],** investigate how technology-driven features like real-time order tracking influence customer experience in a rapidly growing urban market. The research highlights that with the rise of smartphones and internet access, real-time tracking has become a key differentiator in the online food delivery industry, offering transparency, reliability, and a sense of control to customers. Using a quantitative approach with a structured questionnaire distributed to 500 respondents in Chennai, the authors find a strong positive relationship between real-time tracking and customer satisfaction, as well as between satisfaction and loyalty measured through repeat purchase intentions and referral likelihood. Mediation analysis further reveals that customer satisfaction acts as a bridge between tracking and loyalty, amplifying the effect of technology on retention. The study concludes that real-time order tracking is not just a convenience feature but a strategic tool for enhancing service quality, deepening consumer trust, and sustaining loyalty in a highly competitive food delivery market.

In the study, **Strengthening e-Commerce customer satisfaction through delivery Service transparency, Emiliana and Efawati (2025)[2],** examine how real-time tracking systems (RTTS) enhance transparency in last-mile delivery (LMD) and improve customer

satisfaction among active e-commerce users. Focusing on 112 vocational students in Bandung an especially tech-savvy demographic the study uses correlation and regression analysis to assess the relationships between RTTS, LMD transparency, and satisfaction. The findings reveal that RTTS significantly improves delivery transparency and accounts for 55.6% of the variation in consumer satisfaction, underscoring its strategic role in reducing uncertainty and enhancing trust. The authors also highlight that LMD transparency mediates the effect of RTTS on satisfaction, meaning that real-time trackings full benefits are realized when combined with timely, reliable delivery performance. The study concludes that integrating real-time tracking with a smooth and transparent last-mile process not only elevates customer experience but also strengthens loyalty and provides e-commerce companies with a competitive edge in an increasingly demanding digital marketplace.

ANALYSIS AND INTERPRETATION

PERCENTAGE ANALYSIS

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
	Single	**220**	**87.0**

Marital status	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)

1. 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.
2. The analysis shows that most of the respondents (82.2%) are female, indicating that female respondents dominate compared to their male counterparts.
3. From the survey, nearly three-fourths of the respondents (75.5%) are undergraduate degree holders, which forms the largest educational group.
4. Percentage analysis further denotes that a significant proportion of the respondents (87.0%) are single, which is much higher compared to married respondents.
5. The survey also highlights that 75.5% of the respondents belong to nuclear families, showing a preference for this family structure.

6. In terms of earning members in the family, about 37.5% of the respondents reported having two earning members, marking the highest frequency.
7. 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.

8. 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

Blockchain for transparency and trust

Statement	N	Minimum	Maximum	Mean	S.D
I trust platforms more when there is transparency in delivery packing	253	1.00	5.00	2.2846	1.47399
Blockchain can help to ensure tamper-proof delivery and tracking data	253	1.00	5.00	2.7668	1.06391
Knowing that delivery data history is securely recorded would improve my trust	253	1.00	5.00	3.1344	.97474
I would prefer platforms that show verified delivery records	253	1.00	5.00	3.4664	1.09647
Platforms using secure, transparent tracking systems are more trustworthy	253	1.00	5.00	3.6126	1.29413
Lack of transparency in delivery process reduces my trust in the platform	253	1.00	5.00	3.2530	1.16464
I feel more confident ,shopping online when the delivery process is transparency and technology-driven	253	1.00	5.00	3.1621	1.26672

(Source: Computed)

In accordance with descriptive analysis, it is revealed that the most influential factor shaping consumer trust in blockchain-based delivery systems is the statement ―Platforms

using secure, transparent tracking systems are more trustworthy,‖ which obtained the highest mean score of 3.6126. This outcome suggests that consumers attach significant value to platforms that ensure visibility and reliability throughout the delivery journey. The findings emphasize that security and transparency are not only operational necessities but also critical elements that strengthen consumer confidence. By prioritizing blockchain-enabled systems that guarantee tamper-proof and transparent delivery records, e-Commerce platforms can build stronger trust, encourage repeat purchases, and establish long-term customer loyalty.

ANOVA

Table 3

Agreeability score of the respondents towards the opinion on IoT and real-time tracking in consumer perception

Demographic profile	**Groups**	**Agreeability score of the respondents towards the opinion on IoT and real-time tracking in consumer perception**					
		N	**Mean**	**SD**	**F-value**	**Sig.value**	**S/NS**
Age	Below 20	177	3.0657	.93019	1.313	.271	NS
	21-30	62	3.3185	.82782			
	31-40	10	3.2375	1.04158			
	Above 40	4	2.8750	1.35015			
Gender	Male	45	3.1778	.99340	.139	.710	NS
	Female	208	3.1214	.90381			
Educational qualification	Higher secondary	34	2.9706	.90926	1.229	.300	NS
	Undergraduate	191	3.1387	.90579			
	Postgraduate	24	3.3750	.90139			
	Doctorate	4	2.6875	1.59915			
Marital status	Single	220	3.0960	.91049	2.520	.114	NS
	Married	33	3.3674	.95143			

Type of family	Nuclear family	191	3.1329	.86532	.002	.965	NS
	Joint family	62	3.1270	1.07398			
No of earning members in the family	1	69	3.0833	.83926	.523	.667	NS
	2	95	3.1921	1.00378			
	3	58	3.0366	.86666			
	More than 3	31	302298	.92876			
Family monthly income	Below ₹25,000	48	2.9010	.76011	1.253	.291	NS
	₹25000-₹50,000	75	3.1733	.81656			
	₹50,001-₹75,000	65	3.1962	.95452			
	₹75,001 and above	65	3.1885	1.08008			
Residential status	Urban	100	3.0250	.89453	1.946	.145	NS
	Semi-urban	96	3.1276	.89937			
	Rural	57	3.3246	.91857			

(Source: Computed)

ANOVA has been applied to test whether the agreeability scores towards IoT and real time tracking in delivery services differ significantly among respondents based on demographic factors such as age, gender, educational qualification, marital status, type of family, number of earning members, family monthly income, and residential status. The analysis shows that all demographic variables recorded significance values greater than 0.05, indicating no statistically significant differences across groups. As a result, the null hypothesis is accepted for all classifications, suggesting that consumer perceptions of IoT and real-time tracking remain largely uniform across different demographic profiles.

t-Test

Table 4

Agreeability score of the respondents towards the opinion on blockchain for transparency and trust

Demographic profiles	Groups	Agreeability score of the respondents towards the opinion on blockchain for transparency and trust					
		N	Mean	SD	t-value	Sig.value	S/NS
Gender	Male	45	3.1492	.97746	.447	.655	NS
	Female	208	3.0859	.83547			
Marital status	Married	220	3.0740	.84735	-1.102	.271	NS
	Unmarried	33	3.2511	.94426			
Type of family	Nuclear Family	191	3.1062	.80014	.294	.769	NS
	Joint family	62	3.0691	1.03202			

(Source: Computed)

t-Test have been used to analyse whether agreeability scores towards the role of blockchain in enhancing transparency and consumer trust differ across gender, marital status, and family type. The results indicate that one group recorded a slightly higher mean score, but the significance values across all categories were above 0.05, showing no statistically significant differences. Hence, the null hypothesis is accepted, suggesting that demographic factors do not significantly influence consumer perceptions of blockchain-based transparency, and views remain consistent across respondents.

SUGGESTIONS

- To build trust, companies should adopt blockchain-based systems that ensure transparent, secure, and tamper-proof delivery records. Special priority must be given to timely deliveries, as punctuality remains the most decisive trust factor for consumers.
- Businesses should invest in IoT-enabled real-time tracking systems, as consumers strongly associate them with reliability and modernity. Timely updates and transparent tracking features can greatly improve consumer confidence and satisfaction.

CONCLUSION

The study shows that blockchain-based systems play an important role in ensuring transparency, safeguarding data integrity, and strengthening consumer trust in e-commerce

logistics. At the same time, the use of Internet of Things (IoT) and real-time tracking systems improves consumer perceptions by providing greater visibility and assurance throughout the delivery process. Together, these technologies highlight how trust, transparency, and real-time information are crucial in shaping positive consumer experiences and building long-term loyalty in e-Commerce.

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