



IMPACT OF LAST-MILE DELIVERY EFFICIENCY ON CUSTOMER SATISFACTION

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ABSTRACT

This study examined the impact of last-mile delivery (LMD) efficiency on customer satisfaction among online shoppers in India, addressing a critical empirical gap in the context of an emerging market. The primary objective was to determine how the four key dimensions of delivery efficiency Delivery Speed and Reliability, Order Accuracy, Delivery Communication, and Delivery Flexibility individually and collectively influenced customer satisfaction and subsequent behavioural intentions.

A descriptive and analytical research design was adopted. Primary data were collected from 337 respondents using a structured, self-administered questionnaire comprising seven sections and fourteen Likert scale items across the four delivery efficiency constructs, plus items measuring customer satisfaction and behavioural intention. Data were analysed using Python (v. 3.x) with Pandas and SciPy libraries. The analytical techniques employed included descriptive statistics, Cronbach's alpha reliability testing, and Pearson correlation analysis to test three research hypotheses at a significance level of $\alpha = 0.05$.

All three research hypotheses were supported at the 0.05 level of significance. The overall LMD efficiency index was found to have a moderate to strong positive correlation with customer satisfaction ($r = 0.612, p < 0.001$). Among the individual constructs, Delivery Speed and Reliability emerged as the strongest predictor of satisfaction ($r = 0.527$), followed by Delivery Flexibility ($r = 0.249$), Order Accuracy ($r = 0.232$), and Delivery Communication ($r = 0.183$). Order Accuracy recorded the highest construct mean ($M = 3.938$), indicating that respondents rated product fulfilment most positively, while Delivery Speed and Reliability had the lowest mean ($M = 3.350$), pointing to

the most significant service gap. Customer Satisfaction ($M = 3.564$) was strongly correlated with Behavioural Intention ($r = 0.669$), confirming the satisfaction-loyalty linkage. Late delivery, difficulty in tracking, and poor communication were the most commonly reported service failures, consistent with the constructs that scored lowest in the study.

The study filled a significant gap in the existing literature by providing multi dimensional empirical evidence on last-mile delivery and customer satisfaction in an emerging market context, where infrastructure constraints and consumer expectations differ markedly from those in developed economies. The findings offered actionable insights for Indian e-commerce and logistics operators on prioritising operational improvements that yield the highest marginal gains in customer satisfaction and long-term loyalty.

KEYWORDS: Last mile delivery, Customer satisfaction, Delivery speed, Order accuracy, Delivery communication, Delivery flexibility, Behavioural intention, E-commerce, Pearson correlation

1.INTRODUCTION

The rise of e-commerce platforms has completely changed how people shop and how logistics networks around the world have to work. As digital retail grows quickly, people are paying a lot of attention to the logistics infrastructure that needs to support it, especially the last stage. Last-mile delivery (LMD), which is the movement of goods from a distribution hub to the end customer, has become the most important, expensive, and visible part of the entire supply chain (Aljohani, 2024; Boysen et al., 2021; Gevaers et al., 2014). The last mile is a logistical challenge and a business opportunity because it can cost up to 53% of the total shipping costs (Gevaers et al., 2014; McKinnon, 2016). This stage is the last point of physical contact between the retailer and the customer, and it has the biggest impact on how people think about service quality, brand reputation, and overall shopping satisfaction (Lim et al., 2018; Hübner et al., 2016; Mangiaracina et al., 2019). The

effectiveness of last-mile delivery is a multifaceted concept that includes a number of service features that depend on each other. These include how fast the delivery is, how well the order is filled, how well the goods are received, how clear the communication is through tracking and proactive notifications, and how flexible the time window selection and rescheduling options are (Vrhovac et al., 2024; Vakulenko et al., 2019; Rao et al., 2011).

Scholarly evidence consistently affirms that contemporary online shoppers evaluate retailers not solely on product quality or pricing, but increasingly on the convenience, reliability, and

responsiveness of their delivery operations (Lim et al., 2018; Vrhovac et al., 2024; Parasuraman et al., 1988). At this point, failures like delays, damaged packages, or communication breakdowns lead to disproportionately negative customer reactions, as shown by low ratings, bad word-of-



mouth, and less willingness to buy again (Trung, 2025; Karlı, 2024; Anderson & Sullivan, 1993).

India offers a particularly intriguing and intricate environment for the examination of last-mile delivery. Indian logistics operators face a unique set of structural problems because the country has one of the fastest-growing e-commerce markets in the world. These problems include poor infrastructure quality, big differences in delivery conditions between cities and rural areas, a broken and inconsistent address system, and a very diverse consumer base with different expectations and levels of digital literacy (Shuaibu et al., 2025; Hübner et al., 2016; Kumar & Anbanandam, 2020). In India, last-mile operations are made even harder by things like the popularity of cash on delivery, traffic jams, and strict rules (NITI Aayog, 2021; World Bank, 2022). These conditions create a delivery environment that is very different from developed economies, which is why localized empirical research is needed.

Even though more and more researchers are interested in last-mile logistics, there are still big gaps in the data. Most studies look at delivery features one at a time instead of all at once, which makes it hard to understand how they all affect satisfaction (Esper et al., 2003; Vakulenko et al., 2018; Griffis et al., 2012). Also, there isn't much evidence from emerging markets yet, where the way things work and what consumers expect are very different from what they are in developed economies (Sheth, 2011; Bhatnagar & Ghose, 2004). There hasn't been enough research on how multi-dimensional LMD efficiency affects customer satisfaction and behavioral intention in the Indian e-commerce setting.

This study seeks to fill these gaps by conducting a quantitative investigation, drawing on primary survey data from 337 online shoppers, to empirically test the relationship between four key LMD efficiency constructs and customer satisfaction using Pearson correlation analysis. By offering a comparative evaluation of delivery dimensions, the research contributes to a more nuanced understanding of how logistics performance translates into consumer satisfaction outcomes in emerging markets.

2.LITERATURE REVIEW

2.1The Strategic Importance of Last-Mile Delivery in E-Commerce

The academic study of last mile delivery can be traced to foundational logistics research that first identified the disproportionate cost and complexity of the final delivery stage relative to other segments of the supply chain. Esper et al. (2003), in a seminal contribution, established that last mile delivery strategies in online retail directly and significantly affect post-purchase consumer evaluations, laying the groundwork for subsequent empirical inquiry into how specific delivery attributes shape customer satisfaction. Building on this, Gevaers et al. (2014) provided an operational cost-modelling framework that quantified the last mile as the most expensive segment of the logistics chain, situating it as both a financial burden and a strategic differentiator for B2C operators. These early works collectively underscored that the last mile was not merely a logistical endpoint, but a moment of truth in the consumer and retailer relationship that demanded

focused managerial and academic attention (Lim et al., 2018).

2.2 Delivery Speed, Reliability, and Their Impact on Customer Satisfaction

As the field matured, researchers began to isolate and test specific delivery efficiency attributes. Speed of delivery and on-time performance consistently emerged as the most powerful drivers of customer satisfaction in the empirical literature. Karlı (2024) demonstrated that superior last-mile performance, particularly in terms of punctuality, produced a measurable and statistically significant uplift in repeat purchase intention among e-commerce consumers, establishing delivery efficiency as a genuine competitive differentiator rather than merely a hygiene factor. Trung (2025) reinforced this finding by documenting the asymmetric damage caused by delivery failures: late or missed deliveries eroded customer trust and loyalty at a rate far exceeding the satisfaction gains produced by equivalent improvements in on-time performance. Together, these studies suggested that for e-commerce firms, addressing speed and reliability deficits is not merely about meeting expectations, but about preventing the disproportionate harm that delivery failures inflict on long-term customer relationships (Esper et al., 2003; Karlı, 2024).

2.3 Order Accuracy, Parcel Integrity, and Perceived Service Value

Parallel to the work on speed and reliability, a distinct stream of literature examined the physical dimensions of the delivery experience - specifically, the accuracy of order fulfilment and the condition in which parcels arrived. Vakulenko et al. (2018), in a foundational contribution to this theme,

explored the concept of consumer value creation at the moment of parcel receipt, demonstrating that physical integrity and fulfilment accuracy were prerequisite conditions for positive satisfaction evaluations. Their work was among the first to frame the parcel handover itself as a value-generating interaction rather than a neutral logistical transaction. Aljohani (2024) subsequently confirmed that order accuracy was one of the most consistently well rated LMD attributes among e-commerce consumers, reflecting the maturation of warehouse automation and picking technology in modern fulfilment operations. Vakulenko et al. (2019) further extended this line of enquiry by positioning the physical delivery experience as a mediating mechanism between the broader online retail experience and ultimate customer satisfaction, reinforcing the central role of the last mile in the service quality evaluation chain (Lim et al., 2018).

2.4 Communication, Tracking, and Flexibility as Emerging Satisfaction Drivers

As e-commerce consumers grew more sophisticated, scholarship progressively shifted attention towards the informational and scheduling dimensions of the delivery experience. Vakulenko et al. (2019) documented a robust association between proactive delivery communication including real time tracking updates and status notifications and customer satisfaction, observing that gaps in end to end parcel visibility generated consumer anxiety, increased inbound



service enquiries, and ultimately degraded satisfaction outcomes. Guerra-Regalado et al. (2025) extended this evidence base to include delivery flexibility, establishing that the capacity to select delivery time windows and to reschedule appointments had transitioned from a premium convenience feature to a baseline consumer expectation in urban markets. Hübner et al. (2016) had earlier contextualised these developments within the broader omni-channel retail framework, noting that consumer expectations of delivery agility and transparency were being shaped and escalated by the seamless digital experiences offered across the retail journey, making the final delivery step the critical frontier of service differentiation (Lim et al., 2018; Guerra-Regalado et al., 2025).

2.5 Multi-Dimensional Modelling, Technology, and the Satisfaction-Loyalty Chain

The more recent literature has moved towards integrative, multi-attribute frameworks that model the simultaneous contributions of several delivery dimensions to satisfaction and downstream behavioural outcomes. Vrhovac et al. (2024) deployed Structural Equation Modelling (SEM) to test the combined effects of delivery speed, reliability, and communication on customer satisfaction, finding that most attributes exerted strong positive effects, though the relative salience of individual constructs varied across market contexts - a finding with important implications for context-specific

research. Shuaibu et al. (2025) simultaneously advanced understanding of the technological enablers of LMD performance, documenting the positive effects of AI-driven route optimisation, predictive demand analytics, and real-time tracking on first-attempt delivery success rates, while also surfacing the inherent tension between delivery speed and environmental sustainability. Methodologically, the literature has converged on multi item Likert scale instruments and regression or SEM based hypothesis testing as the standard approach for capturing latent constructs such as perceived service quality and satisfaction (Vrhovac et al., 2024; Esper et al., 2003; Hair et al., 2010). The satisfaction-loyalty chain, wherein high satisfaction translates into repurchase intention and positive word of mouth has been empirically validated across multiple retail and logistics contexts (Karlı, 2024; Aljohani, 2024), forming the theoretical bedrock upon which the present study's hypotheses were constructed.

2.6 Last-Mile Delivery in Emerging Markets: The Indian Context

While the bulk of the empirical evidence on LMD and customer satisfaction has been generated in developed Western markets or in East Asian e-commerce contexts, a nascent but growing body of work has begun to address the specific dynamics of emerging markets. Aljohani (2024) contributed a significant recent study that affirmed the central importance of delivery quality in shaping e-retail satisfaction, while simultaneously noting that the strength and pattern of individual attribute effects can vary meaningfully across market settings. Boysen et al. (2021) provided a comprehensive operational perspective, cataloguing the structural and logistical challenges unique to high-density and dispersed delivery environments conditions closely mirrored in the Indian context, where urban

congestion, rural accessibility gaps, and address system fragmentation create distinctive operational hurdles. Shuaibu et al. (2025) further highlighted that these infrastructure constraints demand contextualised technological and managerial responses that cannot simply be transplanted from developed-economy models. Despite these insights, systematic empirical investigation that simultaneously tests multiple LMD efficiency dimensions against customer satisfaction outcomes within the Indian e-commerce environment remained sparse, pointing to a clear need for dedicated, context grounded quantitative research (Trung, 2025; Vrhovac et al., 2024).

RESEARCH GAP

The foregoing review reveals that while the literature on last-mile delivery has grown substantially, it remains characterised by a series of critical empirical and contextual deficiencies. Most studies have examined individual delivery attributes in isolation testing the effect of speed, or communication, or accuracy separately rather than simultaneously estimating and comparing the relative contributions of multiple constructs within a unified analytical framework (Esper et al., 2003; Vrhovac et al., 2024). This fragmented approach has prevented a clear, rank ordered understanding of which dimensions of LMD efficiency matter most to customers. Furthermore, direct empirical linkages between an aggregate, multi-dimensional measure of LMD efficiency and both customer satisfaction and behavioural intention (repurchase and recommendation) remain scarce in the literature, leaving important questions about the end to end customer journey unanswered (Karlı, 2024; Aljohani, 2024). The near-universal reliance on subjective survey data without triangulation against objective operational performance metrics, such as GPS verified on time rates or first attempt delivery success ratios further limits the validity and generalisability of existing findings (Vrhovac et al., 2024; Vakulenko et al., 2018). Most critically, the vast majority of extant empirical work is situated in developed Western markets or advanced East Asian e-commerce ecosystems, leaving a substantial and largely unaddressed void with respect to emerging markets such as India, where structural infrastructure constraints, urban-rural delivery disparities, address system fragmentation, and diverse consumer expectations create a fundamentally different LMD operating environment (Shuaibu et al., 2025; Boysen et al., 2021; Trung, 2025). The present study directly responds to these gaps by providing a multi-dimensional, quantitative empirical investigation of LMD efficiency and its relationship with customer satisfaction and behavioural intention among Indian online shoppers.

The specific gaps addressed are detailed below:

1. The majority of the literature evaluates each factor of the last-mile delivery separately, but not in combination and in comparison to each other in terms of their impact on customer satisfaction.
2. There is a paucity of direct empirical studies that directly connect the last-mile delivery efficiency as an aggregate measure with customer satisfaction and repeat purchase intention concomitant.
3. The customer perception research seldom incorporates



the objective data of delivery performance with subjective satisfaction results, which restricts the generalisability.

4. There is limited empirical evidence on the effect of last-mile delivery on customer satisfaction in emerging markets, such as India, compared to its developed economy counterparts.
5. There has been a lack of customer view on the trade-offs between the efficiency of delivery, cost and environmental sustainability.

3.OBJECTIVES OF THE STUDY

Primary Objective: To test how efficiently the last-mile delivery affects customer satisfaction among online shoppers.

Secondary Objectives

- In order to determine the most important last-mile delivery efficiency drivers that impact customer satisfaction.
- To examine the perception of the customers in terms of speed of delivery, reliability and communication.
- To investigate the correlation between the efficiency of the delivery and the repeat purchase and recommendation intention.
- To determine the measurement scales reliability in measuring last-mile delivery constructs.

4.HYPOTHESES OF THE STUDY

The hypotheses to be used were developed based on the aims of the study and analysis of the literature:

H 1: Customer satisfaction is greatly affected positively by the last-mile delivery efficiency.

H 2: There is a significant positive effect of the delivery speed on customer satisfaction.

H 3: Customer satisfaction is very much influenced by the reliability of delivery (on time delivery).

5. RESEARCH METHODOLOGY

Research Design

The study adopts a descriptive and analytical research design. Descriptive approach was used to describe the demographic profile of the respondents and summarized their perception of the last-mile delivery on various dimensions. The nature and the strength of relationships between constructs of delivery efficiency and customer satisfaction were studied with an analytical approach. This two-facet design is suitable in studies that are aimed at describing a phenomenon as well as testing hypotheses that are hypothesized based on theories about relationship between variables.

Population and Sample

The population under study included those that had made at least one online order and have been delivered to their homes within the six months before the survey. To make sure that all respondents had to satisfy this eligibility criterion, a screening

question (Q1) was added. To collect respondents, convenience sampling was used to identify 337 respondents. Convenience sampling has been selected because it is both practical and cost-effective in reaching a geographically diverse group of online shoppers, and it is also in line with its general applicability in quantitative consumer behaviour and service quality perception research (Hair et al., 2010).

Data Collection Instrument

The use of a structured, self-administered questionnaire with seven sections was used to gather primary data. The required screening question was in the first section (section 1). Section 2 consisted of demographic data (age, gender, occupation). Online shopping frequency was evaluated in Section 3. Section 4 and 5 recorded the perceptions of the last-mile delivery efficiency and customer satisfaction respectively on a five-point Likert-scale, with the first point of 1 (Strongly Disagree) and the final point of 5 (Strongly Agree). Section 6 gauged behavioural intentions (repurchase and recommendation). Section 7 documented delivery problems encountered by the respondents. Peer-reviewed journals, industry reports, and government publications were used as sources of secondary data.

Variables

Speed and reliability of delivery (Q698); Accuracy of order (Q910); Delivery communication (Q1112); Delivery flexibility (Q1314).

Customer Satisfaction (Q1516)

Additional Outcome Variable: Behavioural Intention (Q17-Q19).

Analytical Tools

The analysis of data was performed with Python (v. 3.x) and Pandas and SciPy. The techniques used were:

- Demographic profiling (percentage).
- Calculation of mean and standard deviation of all Likert-scale items.
- Cronbach alpha factor of internal consistency (reliability) evaluation.
- Pearson correlation analysis to test bivariate relationships between constructs.
- Pearson r hypothesis testing and p-values at a level of significance = 0.05.

6.DATA ANALYSIS AND INTERPRETATION

Demographic Profile of Respondents

Table 1 presents the socio-demographic characteristics of the 337 respondents that took part in the study.



Table 1: Demographic Profile of Respondents (n = 337)

Variable	Category	Frequency	Percentage (%)
Age	Below 20	90	26.7
	21–30	146	43.3
	31–40	69	20.5
	Above 40	32	9.5
Gender	Male	165	49.0
	Female	155	46.0
	Other	17	5.0
Occupation	Student	140	41.5
	Employed	134	39.8
	Self-employed	54	16.0
	Other	9	2.7
Shopping Frequency	Rarely	54	16.0
	Occasionally	107	31.8
	Frequently	101	30.0
	Very Frequently	75	22.2

Most respondents (43.3%) were in the 2130 age bracket with the Below 20 group (26.7%). Such an age break down shows the digitally native population that is disproportionate in the context of adopting e-commerce in India. It was fairly balanced with 49.0% males and 46.0% females as respondents and the remaining (5.0) was considered to be other. Students made up the highest occupational group (41.5) and the second occupational group (39.8) was filled by employed people which is not surprising given that student and young professional group is the most active in online shopping. Regarding the shopping frequency, 31.8% of the respondents would sometimes online shop, 30.0% would often shop, 22.2% would

very often and 16.0% would rarely shop which corroborated the fact that all the respondents had an interesting exposure to the last-mile delivery experiences.

Descriptive Statistics of Likert-Scale Items

Table 2 shows the means and standard deviations of all the fourteen items in the six constructs on the Likert scale. Scores are interpreted using the following scale: 1.00–2.49 = Strongly Negative; 2.50–3.49 = Neutral; 3.50–4.49 = Positive; 4.50–5.00 = Strongly Positive.

Table 2: Descriptive Statistics of Measurement Items (n = 337)

Construct	Item	Statement	Mean	SD
Delivery Speed & Reliability	Q6	Orders are delivered quickly	3.424	1.124
	Q7	Orders delivered within the promised time	3.323	1.220
	Q8	Delays in delivery are rare	3.303	1.271
Order Accuracy	Q9	I receive the correct items as ordered	4.012	0.805
	Q10	My orders are complete without missing items	3.864	1.026
Delivery Communication	Q11	I receive timely updates about my order status	3.510	1.108
	Q12	Tracking information is clear and useful	3.386	1.286
Delivery Flexibility	Q13	I can choose convenient delivery time slots	3.460	1.149
	Q14	The delivery service allows easy rescheduling	3.368	1.317
Customer Satisfaction	Q15	I am satisfied with the overall delivery service	3.591	0.723
	Q16	The delivery experience meets my expectations	3.537	1.080
Behavioural Intention	Q17	I feel confident ordering again from the same platform	3.638	1.023
	Q18	I am likely to repurchase from the same platform	3.573	1.027
	Q19	I would recommend this delivery service to others	3.593	0.959



The highest mean scores recorded in all the constructs were the Order Accuracy items. The highest mean was 4.012 (SD = 0.805) in the item I receive the correct items as ordered (Q9) which suggests an overall positive expression regarding the accuracy of fulfilment of orders. Items in the category of Delivery Speed and Reliability, on the other hand, had the lowest mean scores in the survey: 'Delays in delivery are rare' (Q8) scored 3.303 (SD = 1.271) and 'Orders are delivered within the promised time' (Q7) scored 3.323 (SD = 1.220), both of which were in the neutral The behavioural intention items,

especially the item stating that I feel confident when ordering again on the same platform (Q17,

M = 3.638), demonstrate moderate-to-positive attitudes towards the post-delivery despite the perceived weaknesses in the speed of the delivery.

Construct-wise Means and Reliability Analysis

Table 3 contains the aggregated construct means, standard deviations and Cronbachs alpha reliability coefficients of each of the six constructs.

Table 3: Construct-wise Mean Scores, Standard Deviations, and Cronbach's Alpha (n = 337)

Construct	No. of Items	Construct Mean	Std. Dev.	Cronbach's α	Interpret ation
Delivery Speed & Reliability	3	3.350	1.105	0.904	Neutral
Order Accuracy	2	3.938	0.839	0.792	Positive
Delivery Communication	2	3.448	1.136	0.884	Neutral
Delivery Flexibility	2	3.414	1.176	0.896	Neutral
Customer Satisfaction	2	3.564	0.826	0.763	Positive
Behavioural Intention	3	3.601	0.783	0.679	Positive

Note: Cronbach's $\alpha > 0.70$ indicates acceptable reliability; $\alpha > 0.80$ indicates good reliability (Hair et al., 2010).

The construct with the largest mean (M = 3.938, SD = 0.839) was the Order Accuracy, which falls in the positive interpretation range. Customer Satisfaction (M = 3.564) and Behavioural Intention (M = 3.601) were within the positive range as well. Other three constructs namely, Delivery Speed and Reliability (M = 3.350), Delivery Flexibility (M = 3.414), and Delivery Communication (M = 3.448) fell within the neutral zone implying that there were no firm statements and disagreement that the respondents had regarding the service delivery.

The analysis of reliability showed that five out of six constructs passed the generally considered reliability level, Cronbachs 0.70 (Hair et al., 2010). The internal consistency of Delivery Speed and

Reliability (0.904), Delivery Communication (0.884) and Delivery Flexibility (0.896) was great, and Order Accuracy (0.792) and Customer Satisfaction (0.763) were good. The Behavioural Intention (alpha = 0.679) was marginally less than the traditional value, which means that the three items that constitute it, however, correlated, are gauging slightly different post-purchase intention.

Pearson Correlation Analysis

The complete Pearson correlation table of all the six constructs is shown in Table 4. At the 0.01 level (defined as statistical significance), the significance is denoted as.

Table 4: Pearson Correlation Matrix - Construct Scores (n = 337)

Construct	DS	OA	DC	DF	CS	BI
Delivery Speed & Reliability (DS)	1.000	0.054	0.019	0.001	0.527	0.466
Order Accuracy (OA)	0.054	1.000	0.062	0.051	0.232	0.217
Delivery Communication (DC)	0.019	0.062	1.000	0.025	0.183	0.189
Delivery Flexibility (DF)	0.001	0.051	0.025	1.000	0.249	0.250
Customer Satisfaction (CS)	0.527	0.232	0.183	0.249	1.000	0.669
Behavioural Intention (BI)	0.466	0.217	0.189	0.250	0.669	1.000

The significance at the 0.01 level (2-tailed) is significant. DS = Delivery Speed & Reliability; OA = Order Accuracy; DC = Delivery Communication; DF = Delivery Flexibility; CS = Customer Satisfaction; BI = Behavioural Intention.

There are some interesting trends in the correlation matrix. Customer Satisfaction (CS) is most strongly correlated with Delivery Speed and Reliability (DS: $r = 0.527$, $p < 0.001$), followed by Delivery Flexibility (DF: $r = 0.249$, $p < 0.001$), Order Accuracy (OA: $r = 0.232$, $p < 0.001$), and Delivery Communication (DC: $r = 0.183$, $p < 0.001$). The theoretical model is confirmed with all the four independent constructs



being significantly and positively correlated with Customer Satisfaction.

Customer Satisfaction and Behavioural Intention have the robust correlation ($r = 0.669$, $p < 0.001$), which empirically supports the theoretical hypothesis that satisfied customers have a much higher chance to repeat purchasing and refer to the service. Remarkably, inter-correlations among the four independent constructs are very low (ranging between $r = -$

0.062 to $r = 0.054$) which means that they are measuring different, non-overlapping dimensions of last-mile delivery efficiency and that multicollinearity is not an issue in the data.

Delivery Issues Faced by Respondents

Table 5 presents the frequency distribution of delivery issues reported by respondents in response to the multiple-choice item Q20.

Table 5: Delivery Issues Faced by Respondents (n = 337)

Issue Reported	Frequency	Percentage (%)	Rank
No issues faced	186	55.2	1
Late delivery	51	15.1	2
Difficulty in tracking	47	13.9	3
Poor communication	44	13.1	4
Wrong item delivered	5	1.5	5
Damaged product	4	1.2	6

Most of the respondents (55.2, $n = 186$) indicated that they had no delivery problems that is a generally positive result. Late delivery was the most prevalent issue among the individuals who did experience problems (15.1, $n = 51$), then the inability to track (13.9, $n = 47$) followed by poor communication (13.1, $n = 44$). All three of these problems are the most common number of complaints documented and directly relate to the smallest two constructs in the research: Delivery Speed and Reliability and Delivery Communication. Issues associated with products, such as wrong items delivered

(1.5% $n=5$) and damaged products (1.2% $n=4$) were relatively rare, implying that order accuracy failures are not uncommon, though they are.

7.HYPOTHESIS TESTING

Pearson correlation analysis was used to test the three research hypotheses at a significance level of $\alpha = 0.05$. Table 6 summarises the results.

Table 6: Summary of Hypothesis Testing Results (n = 337)

Hypothesis	Path	Pearson r	p-value	Decision	Result
H ₁	Overall LMD Efficiency → Customer Satisfaction	0.612	0.000	Reject H ₀	Support ed
H ₂	Delivery Speed & Reliability → Customer Satisfaction	0.527	0.000	Reject H ₀	Support ed
H ₃	On-time Delivery → Customer Satisfaction	0.498	0.000	Reject H ₀	Support ed

Note: Significance level $\alpha = 0.05$ | Pearson r interpretation: $r > 0.7$ = Strong; $r 0.5-0.7$ = Moderate-Strong; $r 0.3-0.5$ = Moderate; $r < 0.3$ = Weak.

H₁: Last-mile delivery efficiency has a significant positive impact on customer satisfaction. Customer Satisfaction was correlated with the overall LMD efficiency index (mean of all four delivery efficiency constructs) and the correlation was $r = 0.612$ ($p < 0.000$). This is a moderate to strong positive correlation and it rejects the null hypothesis. H 1 is thus upheld.

H₂: Delivery speed has a significant positive effect on customer satisfaction. Customer Satisfaction was correlated with the Delivery Speed and Reliability construct, with a $r = 0.527$ ($p < 0.000$). This correlation between moderate and strong positive is statistically significant and the null hypothesis is rejected. H₂ is thus supported.

H₃: Customer satisfaction is greatly dependent on delivery reliability (on-time delivery). Customer Satisfaction was correlated with the individual item Q7 (Orders are delivered within the promised time) and the $r = 0.498$ ($p < 0.000$) was the result. This positive correlation is moderate and statistically significant and the null hypothesis is rejected. H 3 is thus justified.

8.RESULTS AND FINDINGS

The following principal findings emerge from the data analysis:

- Each of the three hypotheses of the research was accepted at the level of significance 0.05, which proves the existence of the statistically significant positive effect of the last-mile delivery efficiency, speed of delivery, and on-time delivery on customer satisfaction.

1. The overall last-mile delivery efficiency is positively correlated with customer satisfaction with a moderate-strong value ($r = 0.612$, $p < 0.001$), meaning that gains in the four dimensions of delivery are combined to yield significantly higher satisfaction ratings.
2. The strongest single predictors of customer satisfaction are Delivery Speed and Reliability ($r = 0.527$), then Delivery Flexibility ($r = 0.249$), Order Accuracy ($r = 0.232$), and Delivery Communication ($r = 0.183$). The four relationships are all statistically significant.
4. The construct mean ($M = 3.938$) of Order Accuracy was



the highest of all dimensions of delivery efficiency, indicating that the respondents are most content with the accuracy of fulfilling items. The lowest construct mean ($M = 3.350$) was in the Delivery Speed and Reliability, and it was the dimension that was most distant in its expectation and experience.

5. Both Customer Satisfaction ($M = 3.564$) and Behavioural Intention ($M = 3.601$) are in the positive range and the fact that the two are strongly correlated ($r = 0.669$) attests to the fact that satisfied customers exhibit very high repurchase and recommendation intention.
6. The three most common delivery problems that were reported were late delivery (15.1%), inability to track (13.9%), and poor communication (13.1), which were consistent with the lowest-ranking constructs in the study.
7. The measurement instrument was validated by the reliability analysis that demonstrated that five out of the six constructs had good to excellent internal consistency (Cronbachs 0.763 and above).

9.DISCUSSION

The results of this research are in line with and complementary to the current literature on the topic of last-mile delivery and customer satisfaction. The three hypotheses have been confirmed, which corresponds to the theoretical suggestion stating that last-mile delivery efficacy is a key factor of customer satisfaction in e-commerce settings (Aljohani, 2024; Vrhovac et al., 2024). The moderate strong overall correlation ($r = 0.612$) supports the thesis put forward by Karl (2024) that efficiency of the delivery is a strategically important competitive advantage of e-commerce operators.

It is interesting to note that the Delivery Speed and Reliability were the most predictive of satisfaction ($r = 0.527$) even though the mean score ($M = 3.350$) was lowest. Such a combination of high predictive significance and low perceived performance suggests speed and on time delivery as the most pressing area to enhance operations. The result supports those by Trung (2025) and Esper et al. (2003), who discovered that delivery on time always takes the lead in consumer considerations in post-purchase reviews. This conclusion is supported by the analysis of the issues: the most frequently mentioned issues among the dissatisfied respondents were late delivery (15.1%), followed by the inability to track and poor communication (27% each).

The fact that Order Accuracy recorded the best construct mean ($M = 3.938$) is an encouraging indicator of the current situation of e-commerce fulfilment in India, which indicates that the selection and packing of items are mostly dependable. The outcome is in line with that of Vakulenko et al. (2018), who established that customer satisfaction and perceived service value are established on the physical integrity and accuracy of the received parcels. The analysis of the issues (wrong items: 1.5; damaged goods: 1.2) also confirms this interpretation as the frequency of product accuracy failures is relatively low.

Customer Satisfaction and Behavioural Intention have a strong relationship ($r = 0.669$) which is empirical evidence of well-founded frameworks of service quality such as the satisfaction-loyalty chain as described in service marketing literature. This observation has direct business implications: the

investments in the last mile delivery enhancement which increases the satisfaction scores can be predicted to produce quantifiable changes in the repurchase rates and positive word-of-mouth that translate the quality of operations to revenue results (Vakulenko et al., 2019).

The minimal inter-correlations between the four independent constructs ($r = -0.062$ to 0.054) show that each of the four dimensions of the last-mile delivery efficiency measure a different experiential area. It implies that the strategies to be used to improve should be multi-dimensional: the increase in the order accuracy will not necessarily lead to the increase in the speed of delivery and the investments in the communication infrastructure will not replace the increase in the flexibility of the schedule. The result is in line with the multi-dimensional conceptualisation of last-mile efficiency furthered by Vrhovac et al. (2024) and emphasises the significance of construct-specific and differentiated operational improvement.

Demographically, the age group of 21-30 years (43.3) and the students (41.5) in the sample are representative of the age group and students who form the major consumer base of e-commerce in India. These groups are defined as extremely digital, knowledgeable about real-time tracking and with increased expectations of speed of delivery and communication. This population segment supports the observation that speed and quality of communication are key sources of satisfaction because digitally native consumers are used to, and expect these characteristics of service.

10.CONCLUSION

This paper aimed to analyse how the efficiency of the last-mile delivery affects the customer satisfaction of online shoppers, specifically how the four dimensions of delivery efficiency affect customer satisfaction, namely: Delivery Speed and Reliability, Order Accuracy, Delivery Communication and Delivery Flexibility. Based on primary survey data of 337 respondents and using Pearson correlation analysis, the study presents solid empirical findings in support of the three research hypotheses.

The findings affirm that the ability of last-mile delivery to influence customer satisfaction is relevant and important ($r = 0.612$, $p < 0.001$). The most important individual predictor of satisfaction is Delivery Speed and Reliability, and the most positively viewed by respondents is the Order Accuracy. The positive behavioural intentions, such as repurchase and recommendation, are, in turn, firmly linked to customer satisfaction ($r = 0.669$). The fact that the most common consumer pain points are identified as late delivery, tracking difficulty, and poor communication gives practical advice to the logistics operators interested in focusing on the investments aimed at improving their services.

The present research adds to the expanding empirical evidence on the topic of last-mile logistics in the environment of emerging markets and provides a multi-dimensional measurement framework that can be reproduced in other e-commerce environments. The results are especially applicable to Indian e-commerce and logistics companies, where last-mile delivery is a key cost centre as well as the main competitive differentiator.



11.RECOMMENDATIONS

1. The enhancement in the speed of delivery and on-time performance should be considered one of the priorities of the e-commerce and logistics companies since this is the most powerful predictor of satisfaction and the least-rated dimension in the study. It is advisable to invest in the technology of route optimisation, regional micro-fulfilment centres, and personnel during the peak demand periods.
2. The real-time tracking feature and proactive notifications on the status of delivery should be improved. Considering that the second and third most common issues reported are difficulty in tracking and poor communication, the improvement in the level of satisfaction through enhanced communication interface (push notifications, SMS alerts, live tracking maps) can be achieved at a comparably low cost.
3. Flexibility of deliveries such as time-window choice and rescheduling must be increased. As the lifestyles of consumers grow more diverse, the capacity to match the delivery with personal availability is an increasing factor of satisfaction.
4. The high standards of accuracy in the data concerning order accuracy ($M = 3.938$) should be upheld and strengthened by firms. The quality control measures in the warehouse level such as automated scanning, multi-point verification and simplification of returns must be maintained and enhanced constantly.
5. Since customer satisfaction and behavioural intention demonstrate a significant relationship ($r = 0.669$), customer satisfaction score can be used as a leading indicator to determine retention and lifetime value estimates by incorporating terms of delivery score into their CRM and loyalty programme strategies.

12.LIMITATIONS OF THE STUDY

1. The research was solely based on self-reported survey data, which are prone to response bias, social desirability and misinterpretation of questionnaire items. Triangulation was not possible with objective data on delivery performance (e.g., actual on-time delivery rates, tracking log data).
2. It utilized convenience sampling, which reduces the representativeness of the sample and curtails the extrapolation of the results to the larger group of online Indian shoppers.
3. The cross-sectional research design will capture the perceptions of the respondents at one point in time. Longitudinal studies would give more information on the change in satisfaction with delivery over time and in different experiences of delivery.
4. The researchers failed to distinguish between delivery service providers (courier companies), as well as to consider platform specific variables (marketplace vs. direct-to-consumer models), which could mediate the correlation between delivery efficiency and satisfaction.
5. The alpha of Behavioural Intention construct (0.679) was slightly lower than the traditional value of 0.70, which indicates that the three items might not be representative

of a single dimensional construct and scale optimization is possibly justified.

13.FUTURE SCOPE

1. Further studies need to use Structural Equation Modelling (SEM) to approximate the direct and indirect effects of multiple delivery efficiency constructs on both satisfaction and behavioural intention to facilitate a decomposition of the mediated paths and enhance causal inference.
2. A multiple regression analysis, with all four of the constructs of delivery efficiency as simultaneous predictors, would yield beta coefficients and an R^2 value, which would allow a clear estimate of the portion of variance accounted by and the added value of each predictor.
3. Comparative research across various delivery service providers, product type, and geographical locations in India would help shed light on how context moderately influences the delivery-satisfaction relationship.
4. Combination of objective operational data (e.g., GPS based on time delivery rates, first-attempt success rates, parcel damage frequencies) and subjective satisfaction scores would allow to conduct a more rigorous assessment of the perception-performance fit.
5. A longitudinal panel study that follows the same respondents throughout several delivery experiences would offer an insight into how the expectations of satisfaction change over time and the long run effects of delivery performance on loyalty.

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