Customer-Perceived Last-Mile Delivery Performance in Malaysian E-Commerce: A Proposed Framework

Low Ying Ying[1], Syed Asim Ali Shah[2]*, Budi Suprapto[3], Chai Gao Yee[4], Kiran Shah[5], Tiara Turay[6]

[1,2,3,4,6] Faculty of Technology Management and Technopreneurship, Universiti Teknikal Malaysia Melaka, Malaysia

[5] Metropolitan International United College, Islamabad, Pakistan

***Corresponding Author**

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ABSTRACT

The last mile is the final stage of e-commerce fulfilment and the part of the logistics process that most directly connects an online transaction with the customer's receipt of a physical order. Delays, incorrect deliveries, limited tracking information and unsatisfactory courier interactions may influence how customers evaluate delivery performance. This paper proposes a framework for understanding customer-perceived last-mile delivery performance in Malaysian e-commerce. It retains four factors: delivery speed, delivery accuracy, tracking system and courier service quality. Expectation-Confirmation Theory (ECT) provides the principal theoretical lens for explaining how customers evaluate delivery experiences in relation to their prior expectations. Drawing on the existing literature on last-mile delivery, logistics service quality and e-commerce fulfilment, the paper examines the relevance of the four factors to customers' overall assessment of delivery performance. Four propositions are developed to suggest positive relationships between delivery speed, delivery accuracy, tracking-system quality and courier service quality, respectively, and customer-perceived last-mile delivery performance. The framework distinguishes these delivery attributes from the overall performance outcome and from related constructs such as customer satisfaction and continuance intention. The proposed framework is intended to provide a structured basis for subsequent empirical investigation in the Malaysian e-commerce context. Its practical implications highlight the importance of considering delivery timeliness, order correctness, tracking information and courier interactions when evaluating last-mile delivery services. However, the framework remains conceptual and future research should assess the proposed relationships using an appropriate research design and a measurement instrument that clearly distinguishes the four delivery factors from the overall performance construct. The paper offers a foundation for further investigation into customer-perceived last-mile delivery performance and its relevance to e-commerce fulfilment in Malaysia.

Keywords: Last-mile delivery; E-commerce; Delivery performance; Malaysia; Expectation-Confirmation Theory.

INTRODUCTION

E-commerce fulfilment does not end when a customer places an order or when a retailer dispatches a parcel. The delivery stage completes the transaction from the customer's perspective, and the final movement of an order to the recipient is commonly described as last-mile delivery. Although it is only one segment of the wider logistics network, the last mile is highly visible to consumers because it determines when an order arrives, whether the correct items are received, how delivery progress is communicated and how the courier interacts with the recipient. Research on e-commerce logistics has therefore considered last-mile delivery as an important part of the customer's overall online retail experience [4, 8, 9, 12, 17].

The Malaysian e-commerce context provides a relevant setting in which to examine these customer-facing delivery attributes. Consumers may use different online marketplaces and courier providers, and their experience of the final delivery stage can vary according to delivery time, parcel accuracy, visibility of shipment status and

the quality of courier interactions. Existing research underpinning this paper focuses on four factors: delivery speed, delivery accuracy, tracking system and courier service quality. These factors are retained without changing the original research focus.

Existing research has linked logistics service quality and last-mile delivery experiences with customer satisfaction, purchase-related evaluations and continued use of online services. However, these outcomes are not identical to customer-perceived last-mile delivery performance. Satisfaction is an evaluative response; loyalty and continuance intention concern future behaviour; and perceived delivery performance refers more directly to a customer's overall judgement of how well the delivery service performed. These constructs may be related, but they should not be treated as interchangeable [2, 12]. The present paper therefore retains customer-perceived last-mile delivery performance as its focal outcome.

The purpose of this paper is to propose a conceptual framework that organises four delivery-related attributes in relation to customer-perceived last-mile delivery performance in Malaysian e-commerce. ECT provides a theoretical lens for considering how customers evaluate an experienced service against their prior expectations [3, 11]. The paper does not report an empirical test. Instead, it develops propositions to guide subsequent research and discusses how the framework could be assessed, after the instrument's measurement items have been checked for construct consistency.

1.1 Aim and objectives

The aim is to propose a conceptual framework for customer-perceived last-mile delivery performance in Malaysian e-commerce.

1. To explain the conceptual relevance of delivery speed, delivery accuracy, tracking system and courier service quality to customer-perceived last-mile delivery performance.
2. To use Expectation-Confirmation Theory as a theoretical lens for interpreting customers' evaluations of last-mile delivery.
3. To formulate propositions and identify priorities for future empirical validation in the Malaysian e-commerce context.

CONCEPTUAL AND THEORETICAL BACKGROUND

2.1 Last-mile delivery and customer-perceived performance

Last-mile delivery refers to the final stage in the delivery process through which an order is transferred to the customer. The literature emphasises that last-mile logistics involves both operational choices and customer-facing service encounters. Research has examined delivery models, consumer-driven logistics design and alternatives to home delivery, demonstrating that last-mile outcomes depend on the configuration of logistics operations and the needs of recipients [4, 7, 8, 9, 12, 14].

For this paper, customer-perceived last-mile delivery performance is defined conceptually as the customer's overall assessment of how effectively the delivery stage fulfilled the order. This definition is deliberately distinct from a single service attribute. Speed, accuracy, tracking information and courier service quality are proposed antecedent dimensions; perceived performance is the overall evaluative outcome. The distinction is important because an item measuring whether a delivery was fast should not also be used as an item measuring overall performance without a clear conceptual rationale.

The four dimensions are selected because they represent distinct, directly observable aspects of the customer-facing delivery experience. Delivery speed captures the temporal dimension; delivery accuracy captures whether the order is fulfilled correctly; tracking-system quality captures the information available to the customer while the parcel is in transit; and courier service quality captures the interpersonal and service-response dimension. Together, they cover delivery outcome, information visibility and service interaction without treating these elements as interchangeable. Other factors may also matter, but are outside the present framework's defined scope. Delivery cost is an economic consideration that may influence perceived value; flexibility concerns the

availability of delivery options or rescheduling; convenience is a broader evaluation that may overlap with access and flexibility; and reverse logistics concerns returns and product recovery after delivery. These may be examined as extensions, but including them here would broaden the model beyond its focus on the customer's assessment of the forward last-mile delivery service.

2.2 Delivery speed

Delivery speed concerns the time taken for an order to reach the customer and whether delivery occurs within the expected timeframe. Timeliness is a recognisable dimension of logistics service quality, and last-mile studies have considered delivery timing and the management of delivery windows as operational and customer-facing concerns [2, 4, 10, 15, 16]. From the customer's perspective, speed is not necessarily equivalent to the shortest possible delivery time: the service may be judged against the delivery promise, the type of product and the urgency of the order. The proposed framework therefore treats perceived delivery speed as the customer's evaluation of delivery timeliness, rather than a purely objective measure of elapsed time.

2.3 Delivery accuracy

Delivery accuracy concerns whether the customer receives the correct order and whether the delivery outcome corresponds with the purchase. It is conceptually different from speed: a parcel can arrive quickly but contain an incorrect item, or arrive later than expected while still containing the correct items. A framework that separates these dimensions allows researchers to examine their distinct proposed relationships with overall perceived delivery performance. In empirical work, measurement items for accuracy should refer to correctness of the order, parcel and delivery outcome, rather than repeating statements about speed or delays [5, 18].

2.4 Tracking system

A tracking system provides information about the progress and status of a parcel. Its customer-facing value depends not only on whether tracking is available, but also on whether information is timely, understandable and accurate. Electronic logistics service quality research recognises the importance of information-related service dimensions in e-commerce fulfilment [6, 15, 19]. Tracking information can reduce uncertainty by helping customers understand where an order is and what to expect next. Nevertheless, tracking visibility should not be equated with physical delivery performance: accurate information can improve the experience even when a parcel is delayed, while inaccurate updates can undermine confidence in an otherwise satisfactory delivery.

2.5 Courier service quality

Courier service quality refers to the customer's evaluation of the service delivered by courier personnel and the provider's customer-facing processes. Relevant aspects may include professional conduct, communication, parcel handling and responsiveness when delivery problems occur. The wider logistics service quality literature conceptualises service as a combination of performance dimensions that matter to customers rather than as a single operational outcome [10]. SERVQUAL also provides a longstanding basis for thinking about perceived service quality, although its dimensions should not be transferred mechanically to last-mile delivery without contextual justification [6, 13, 19].

2.6 Expectation-Confirmation Theory

Expectation-Confirmation Theory provides the theoretical foundation for this proposed framework. Oliver [11] explains satisfaction decisions through a cognitive evaluation involving expectations and perceived performance. Bhattacherjee [3] later developed an expectation-confirmation model to explain information-systems continuance. The latter application is not identical to parcel delivery, so the present paper uses ECT as a theoretical lens for expectation-based evaluation rather than claiming that the original information-systems model directly validates the proposed logistics framework.

Applied to last-mile delivery, customers may form expectations from delivery promises, past experience, platform information or communications from a courier. They then evaluate the delivery they experience. A

delivery attribute can therefore be assessed both in absolute terms and in relation to the expectation that preceded it. For example, a delivery time that is acceptable for a standard shipment may be viewed less favourably when a faster delivery promise was made. Similarly, a tracking system may be available but still fail to meet expectations if updates are inaccurate or infrequent [16, 18].

The current framework does not add expectation confirmation as a separately measured mediator because the present paper is conceptual and does not operationalise it as a distinct construct. Instead, ECT informs the explanation of how customers interpret the four attributes. A later empirical extension could measure expectation confirmation directly, but that would require a revised instrument and a separate theoretical and measurement justification.

2.7 Synthesis of selected literature and research gap

Table 1 compares selected studies relevant to last-mile delivery and customer evaluations. The comparison is intended as a focused synthesis of relevant literature rather than an exhaustive systematic review. It indicates that prior work has examined broad last-mile processes, delivery timing, customer experience and last-mile delivery quality, while the present framework focuses specifically on four customer-facing attributes and customer-perceived last-mile delivery performance in Malaysian e-commerce.

The studies differ in both unit of analysis and outcome. Masorgo et al. [9] map last-mile delivery as an end-to-end process, which is useful for identifying operational stages but does not isolate customers' evaluations of the four attributes proposed here. Olsson et al. [12] examine experience in unattended delivery, demonstrating the importance of delivery context, while Song et al. [16] use transaction data to show that delivery timing and promised-time effects are reflected in customer ratings. These studies therefore offer complementary, rather than directly interchangeable, evidence: one is process-oriented, one context-specific and experiential, and one focused on the timing dimension. The Malaysian survey by Abdul Hamid et al. [1] provides the closest geographical comparison, but its outcome is customer satisfaction. The present paper instead defines perceived delivery performance as the customer's overall assessment of how effectively the delivery stage fulfilled the order. This distinction, together with the separate treatment of tracking-system quality and courier service quality, defines the narrower contribution of the proposed framework. The selected evidence is not sufficient to claim that the same relationships have been established across Southeast Asian markets; cross-country comparison remains a matter for subsequent research.

Table 1. Comparison of selected studies and the proposed framework

Study	Focus and context	Approach / emphasis	Relevance to proposed framework	Gap addressed by the present paper
Masorgo, Dobrzykowski, and Fugate (2024)	B2C last-mile delivery across the wider literature	Review of 104 articles; process view spanning pre-delivery, delivery, and post-delivery activities	Provides a broad process-level map and identifies future research opportunities	The proposed paper narrows attention to four customer-facing attributes and one defined outcome: customer-perceived last-mile delivery performance
Olsson, Hellström, and Vakulenko [17]	Customer experience in unattended home delivery	Empirical field study of households using unattended delivery	Shows that last-mile experience is multidimensional and depends on delivery context	The proposed framework focuses on speed, accuracy, tracking system, and courier service quality rather than the wider experience dimensions of unattended delivery

Study	Focus and context	Approach / emphasis	Relevance to proposed framework	Gap addressed by the present paper
Song, Xu, Chen, and Zhang (2024)	Delivery time and online sellers' logistics service quality using Alibaba order data in China	Large-scale transaction data; examines time-of-day effects and promised delivery	Provides strong evidence that timing influences customer ratings of logistics service quality	The proposed framework includes multiple customer-facing dimensions and is situated in Malaysian e-commerce; it does not assume that speed alone captures performance
Aljohani [2]	Last-mile delivery quality and satisfaction in online retail experience	Empirical analysis of last-mile delivery quality and customer satisfaction	Directly relevant to the relationship between delivery quality and customer evaluations	The proposed framework distinguishes overall perceived delivery performance from satisfaction and explicitly includes tracking-system quality and courier service quality as separate predictors
Abdul Hamid, Low, and Bakri (2025)	Malaysian e-commerce; delivery speed, accuracy, reliability, and communication in relation to customer satisfaction	Survey of 150 Malaysian consumers; proposes a strategic framework	A close contextual comparator showing that Malaysian delivery factors and customer outcomes have already been studied	The present papers narrower distinction is the outcome of perceived delivery performance, the explicit tracking-system construct, and a conceptual framework that remains untested
Proposed framework (this paper)	Malaysian e-commerce; delivery speed, delivery accuracy, tracking system, and courier service quality	Conceptual synthesis informed by Expectation-Confirmation Theory; four propositions, not empirically tested	Brings four defined customer-facing delivery attributes together around customer-perceived last-mile delivery performance	Offers a focused conceptual model for later empirical validation; the contribution is integrative and context-specific.

Taken together, the selected studies support the relevance of delivery timing and broader last-mile service quality, but they do not by themselves establish that the exact four-factor model proposed here is absent from all prior research. The gap is therefore framed cautiously: the present paper distinguishes customer-perceived delivery performance from satisfaction and proposes a focused combination of delivery speed, delivery accuracy, tracking-system quality, and courier service quality for the Malaysian e-commerce context. A comprehensive database search would be required before making a stronger claim of novelty.

FRAMEWORK AND PROPOSITIONS

Figure 1 presents the proposed framework. Delivery speed, delivery accuracy, tracking system and courier service quality are retained as the four proposed predictors of customer-perceived last-mile delivery performance. ECT is shown as the theoretical foundation informing the interpretation of customer evaluations, rather than as a measured variable in the current model.

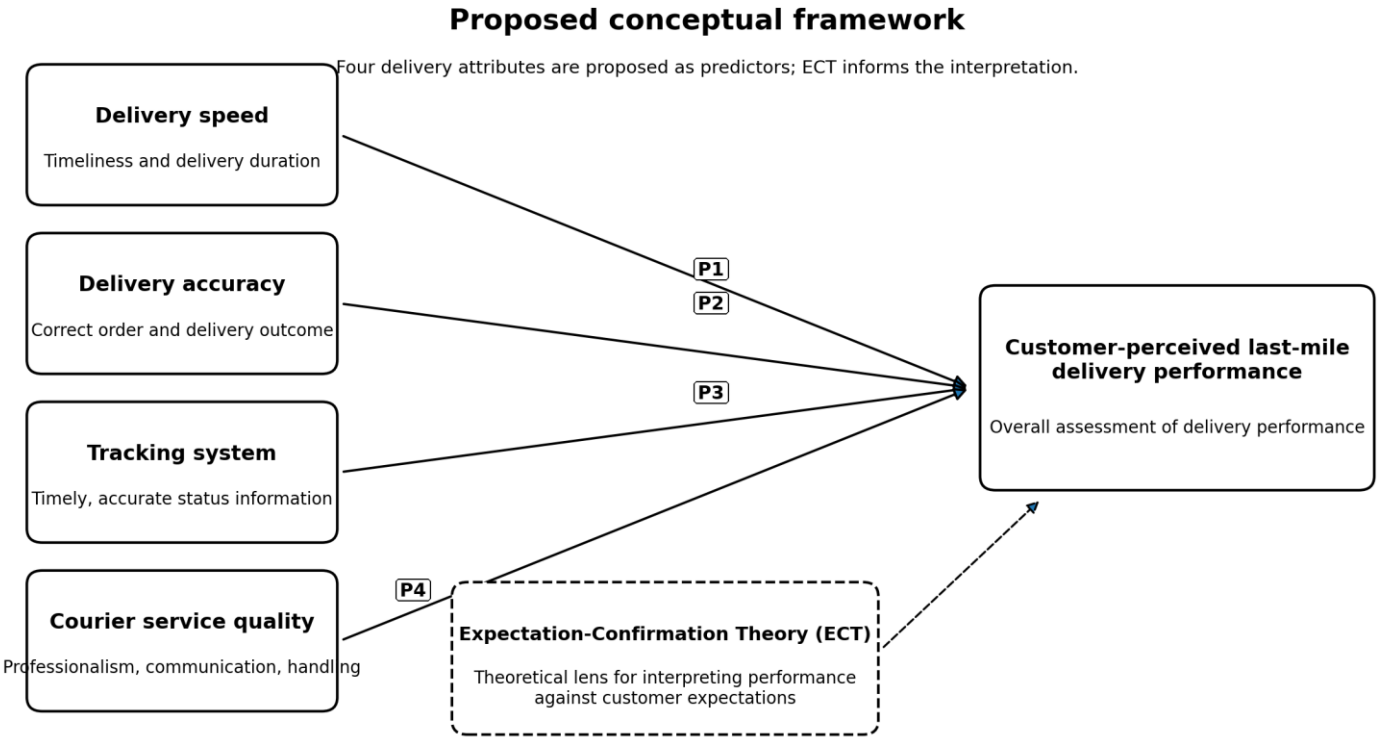


Figure 1. Proposed conceptual framework for customer-perceived last-mile delivery performance in Malaysian e-commerce, with propositions P1–P4.

3.1 Proposition 1: Delivery speed

Delivery speed is proposed to be positively associated with customer-perceived last-mile delivery performance. Timely delivery can indicate that the delivery process has fulfilled its operational promise, whereas delays may lead customers to evaluate the service less favourably. The relationship should be interpreted in terms of perceived timeliness and the delivery promise, not as a claim that the fastest possible delivery is always preferred by every customer.

P1: Higher perceived delivery speed is expected to be positively associated with customer-perceived last-mile delivery performance.

3.2 Proposition 2: Delivery accuracy

Delivery accuracy is proposed to be positively associated with customer-perceived last-mile delivery performance. Receiving the correct items and a delivery outcome consistent with the order is central to fulfilment. Speed cannot compensate fully for a wrong or incomplete order, so accuracy represents a distinct dimension of the customer's evaluation.

P2: Higher perceived delivery accuracy is expected to be positively associated with customer-perceived last-mile delivery performance.

3.3 Proposition 3: Tracking system

Tracking system quality is proposed to be positively associated with customer-perceived last-mile delivery performance. Timely and accurate status information can reduce uncertainty and allow customers to monitor progress. The proposed relationship concerns the usefulness and reliability of tracking information, rather than the mere existence of a tracking function.

P3: Higher perceived tracking-system quality is expected to be positively associated with customer-perceived last-mile delivery performance.

3.4 Proposition 4: Courier service quality

Courier service quality is proposed to be positively associated with customer-perceived last-mile delivery performance. The courier may be the most visible human representative of the delivery provider, and interactions involving communication, professionalism, parcel handling and problem resolution can shape the customer's assessment of the service. This dimension complements rather than duplicates the operational attributes of speed and accuracy.

P4: Higher perceived courier service quality is expected to be positively associated with customer-perceived last-mile delivery performance.

3.5 Integrating the four propositions

The four propositions form an integrated framework for considering customer-facing delivery attributes together. Their joint inclusion does not mean that the factors are interchangeable or that they necessarily have equal effects. The model proposes that each dimension contributes a distinct aspect of the delivery experience that may be relevant to the customer's overall performance judgement. The relative strength of the relationships, potential overlap between constructs and any differences between platforms or courier providers remain questions for empirical investigation.

The contribution of the framework is therefore integrative and context-focused: it brings together four identifiable delivery attributes around the specific outcome of customer-perceived last-mile delivery performance in Malaysian e-commerce.

3.6 Indicative measurement framework

Table 2 outlines indicative areas that could inform the development of measurement items for the four proposed predictors and the overall performance outcome. The indicators are illustrative rather than validated questionnaire items; their wording, dimensionality and reliability would need to be assessed in a subsequent study with Malaysian e-commerce consumers. Items should be phrased so that the four attributes are not repeated in the overall performance measure.

Table 2. Indicative measurement areas for the proposed framework

Construct	Indicative measurement areas	Measurement focus
Delivery speed	Delivery within the promised timeframe; perceived timeliness; consistency of delivery time	Customer assessment of how promptly the order arrives relative to the delivery promise.
Delivery accuracy	Correct item and quantity; delivery to the intended recipient or address; order received in the expected condition	Correctness and completeness of the delivery outcome.
Tracking-system quality	Accuracy of status information; timeliness of updates; ease of understanding and accessing tracking information	Usefulness and reliability of information provided while the parcel is in transit.
Courier service quality	Professional conduct; communication; care in parcel handling; responsiveness when delivery problems arise	Quality of the customer-facing interaction and service response.
Customer-perceived last-mile delivery performance	Overall assessment of delivery effectiveness; perceived dependability of the delivery process; extent to which the delivery fulfilled the order	Global evaluation of the delivery stage, without simply repeating individual predictor items.

DISCUSSION

4.1 Theoretical implications

The proposed framework contributes by distinguishing four delivery attributes from the overall customer-perceived performance outcome. This separation can help avoid conceptual conflation between operational characteristics, service quality and broader responses such as satisfaction or continuance intention. The framework also makes the role of ECT more explicit: customer evaluation is understood in relation to expectations, but expectation confirmation is not presented as an empirically tested mediator in this paper.

The model complements logistics service quality research by focusing on a defined group of customer-facing attributes at the final delivery stage. Prior research on logistics service quality and electronic logistics service quality offers a foundation for studying timeliness, information and service performance [10, 15]. Research on online retail experience also supports the importance of last-mile delivery as part of the customer's overall experience [9, 12, 17]. The present framework narrows this broader discussion to the four dimensions retained from the authors research.

4.2 Practical implications

For e-commerce platforms, the framework suggests that delivery performance should not be monitored through delivery time alone. A balanced review can consider whether parcels arrive within the promised timeframe, whether the correct order is delivered, whether tracking updates are useful and accurate, and whether courier interactions meet reasonable service expectations. Platforms may use these dimensions to organise customer feedback and identify where complaints originate [2, 18].

For courier providers, the framework highlights the need to distinguish operational performance from information and interaction quality. Speed and accuracy concern the delivery outcome, tracking concerns visibility and information, and courier service quality concerns service encounters and response to problems. This distinction may help managers diagnose performance concerns more precisely.

The Malaysian context is retained because it is the setting of the original authors' research and is the intended context for later validation. Differences in platform use, courier arrangements, delivery locations and customer expectations may be relevant contextual considerations, but their influence must be established through reliable evidence or future data collection.

4.3 Limitations and future research

Future research could extend the proposed framework by incorporating expectation confirmation as a measurable construct to examine whether it mediates the relationships between delivery attributes and customer-perceived last-mile delivery performance. This would provide an opportunity to assess the explanatory contribution of Expectation-Confirmation Theory beyond its role as the theoretical foundation of the present framework. Further studies could investigate whether the relationships differ across urban and rural delivery contexts, e-commerce platforms or customer groups in Malaysia, using appropriate comparative methods. Another direction would be to examine the relationship between customer-perceived delivery performance and actual operational indicators, such as delivery time, order accuracy and the timeliness of tracking updates. Where longitudinal data are available, researchers could also investigate how customer perceptions change following repeated delivery experiences or improvements in delivery services. These extensions would help to establish its applicability across different delivery contexts and strengthen understanding of the relationship between customer perceptions and operational last-mile delivery performance.

CONCLUSION

This paper advances a theoretically informed framework for examining customer-perceived last-mile delivery performance in Malaysian e-commerce by integrating four distinct customer-facing dimensions: delivery speed, delivery accuracy, tracking-system quality and courier service quality. Grounded in Expectation-Confirmation

Theory (ECT), the framework positions customer evaluations of last-mile delivery within an expectation-based assessment process, recognizing that the perceived effectiveness of a delivery service may depend not only on its operational attributes but also on how the experienced service corresponds with customer expectations. The four propositions establish a structured basis for examining the proposed relationships between these delivery attributes and overall customer-perceived last-mile delivery performance.

A key contribution of the framework is its construct-level differentiation between specific delivery attributes and the overall performance outcome. By distinguishing operational timeliness and order correctness from information visibility and interpersonal service quality, the framework provides a more structured basis for investigating the multidimensional nature of last-mile delivery performance. It also maintains a clear conceptual boundary between perceived delivery performance and related outcomes, particularly customer satisfaction and continuance intention, thereby reducing the risk of construct conflation in subsequent empirical research. This distinction is important for developing a theoretically coherent measurement model and for assessing the unique contribution of each proposed predictor.

From a practical perspective, the framework offers e-commerce platforms and logistics providers an analytical structure for organizing delivery-performance assessment across operational, informational and service-interaction dimensions. Rather than treating delivery speed as the sole indicator of effective fulfilment, the model directs attention to the complementary roles of order accuracy, tracking-system quality and courier service quality in shaping customers' overall performance evaluations. Overall, the framework provides a focused foundation for advancing research on customer-perceived last-mile delivery performance and for developing a more differentiated understanding of customer-facing logistics performance in Malaysian e-commerce.

Ethical Approval

Ethical approval was not applicable because this paper develops a conceptual framework and reports no research involving human participants or animals.

Conflict Of Interest

The authors declare no conflict of interest.

Data Availability

No new datasets were generated or analysed for this conceptual paper; therefore, data sharing is not applicable.

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