

Factors Influencing Customer Loyalty in Last-Mile Delivery Services: The Roles of Service Recovery, Service Quality, Customer Sacrifice, Service Value, and Customer Satisfaction

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[Abstract]

As the importance of last-mile delivery has increased with the rapid growth of e-commerce and contactless consumption, this study empirically examined the structural relationships among service recovery, service quality, customer sacrifice, service value, customer satisfaction, and customer loyalty in the context of last-mile delivery services. To examine these relationships, a survey of users of last-mile delivery services was conducted, and the proposed hypotheses were tested using PLS-SEM. The results indicate that service recovery indirectly enhances customer satisfaction through service quality, while customer sacrifice negatively influences perceived service value. In addition, service value positively affects both customer satisfaction and customer loyalty and further contributes to customer loyalty through customer satisfaction. These findings extend the understanding of customer evaluation and loyalty formation in last-mile delivery services and provide practical implications for developing effective customer retention strategies.

▶ **Key words:** Last-mile delivery service, Recovery, Sacrifice, Service quality, Service value

[요 약]

본 연구는 전자상거래의 성장과 비대면 소비의 확산으로 라스트마일 배송서비스의 중요성이 증가함에 따라 서비스회복, 서비스품질, 고객희생, 서비스가치, 고객만족 및 고객충성도 간의 구조적 관계를 실증적으로 분석하였다. 이를 위해 라스트마일 배송서비스 이용자를 대상으로 설문조사를 실시하고, 부분최소제곱 구조방정식모형을 활용하여 연구가설을 검증하였다. 분석 결과, 서비스회복은 서비스품질을 매개로 고객만족에 간접적으로 긍정적인 영향을 미치는 것으로 나타났으며, 고객희생은 서비스가치에 부정적인 영향을 미치는 것으로 확인되었다. 또한 서비스가치는 고객만족과 고객충성도에 직접적으로 긍정적인 영향을 미쳤으며, 고객만족을 매개로 고객충성도 형성에 기여하는 것으로 나타났다. 본 연구는 서비스회복과 고객희생을 포함한 통합적 연구모형을 통해 라스트마일 배송서비스에서 고객평가와 고객충성도가 형성되는 과정을 보다 체계적으로 설명하였으며, 서비스 경쟁력과 고객충성도 제고를 위한 실무적 시사점을 제시한다.

▶ **주제어:** 라스트마일 배송 서비스, 서비스회복, 희생, 서비스품질, 서비스가치

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I. Introduction

The rapid growth of e-commerce and contactless consumption has transformed logistics from a back-end operational function into a key determinant of customer experience. Among logistics activities, last-mile delivery, which refers to the final stage of delivering goods to end customers, has become one of the most important sources of customer satisfaction and competitive advantage because it represents the most customer-visible stage of the logistics process [1].

The last-mile delivery market has expanded rapidly with the growth of online shopping. The annual parcel delivery volume in South Korea increased from 3.374 billion parcels in 2020 to 6.41 billion parcels in 2025, while annual parcel usage per capita increased from 65.1 to 125.5 during the same period. [2]. To meet increasingly diverse customer expectations, logistics providers now compete not only through delivery speed and operational efficiency but also by enhancing convenience, accessibility, flexibility, and overall customer experience through services such as convenience-store pickup, parcel lockers, real-time tracking, and AI-based delivery systems [3].

Previous studies have primarily examined logistics service quality in terms of operational performance, including timeliness, reliability, and information quality [4-6]. However, relatively limited attention has been paid to how customers evaluate service recovery efforts and perceived sacrifice during the last-mile delivery process and how these factors jointly influence service value, satisfaction, and loyalty. In practice, customers often accept slower delivery, self-pickup, or alternative delivery options when they perceive greater convenience, flexibility, or cost savings. Accordingly, customer evaluations are determined not only by service quality but also by the trade-off between perceived benefits and perceived sacrifice.

Service failures also remain a critical issue in last-mile delivery services. Delivery delays,

damaged parcels, inaccurate tracking information, and failed delivery attempts continue to occur despite technological advances, making effective service recovery increasingly important for maintaining customer satisfaction and long-term relationships. Nevertheless, few studies have developed an integrated framework that simultaneously considers service recovery, customer sacrifice, service value, satisfaction, and loyalty in the context of last-mile delivery services.

Therefore, this study develops and empirically tests an integrated research model examining the relationships among service recovery, service quality, customer sacrifice, service value, satisfaction, and loyalty in last-mile delivery services. By extending the traditional service quality-satisfaction-loyalty framework to incorporate service recovery, customer sacrifice, and service value, this study contributes to a more comprehensive understanding of customer value formation and loyalty development in last-mile delivery services. The findings also provide practical implications for logistics service providers seeking to strengthen customer retention and sustainable competitiveness.

II. Theoretical Background and Hypothesis

1. Service Recovery in Last-Mile Delivery Services

Service recovery is defined from two main theoretical perspectives. First, from a firm-centered perspective, service recovery refers to organizational actions undertaken to resolve customers' negative experiences resulting from service failures [7, 8]. Second, from a customer-centered perspective, service recovery reflects customers' evaluations of a firm's efforts to rectify service failures and restore service performance [9].

In the context of last-mile delivery services, service failures frequently occur because the final

delivery stage involves direct interaction between logistics providers and customers under conditions characterized by uncertainty, time sensitivity, and operational complexity. Common service failures include delivery delays, damaged parcels, lost shipments, inaccurate tracking information, failed delivery attempts, and communication breakdowns [10]. Since the last mile represents the most customer-visible stage of logistics operations, customers often evaluate service providers not only based on delivery outcomes but also on how effectively firms respond when failures occur.

Justice theory suggests that customers evaluate recovery efforts based on distributive justice, procedural justice, and interactional justice [11]. When customers perceive recovery procedures as fair, efficient, and respectful, they are more likely to maintain positive attitudes toward service providers despite experiencing service failures [12]. Furthermore, the service recovery paradox suggests that customers who experience successfully resolved service failures may report satisfaction levels comparable to or even higher than those of customers who have never experienced service failures [13, 14]. These perspectives highlight the strategic importance of service recovery in customer relationship management.

Previous studies have shown that effective recovery efforts improve customers' evaluations of service performance and overall service quality. Schweikhart et al. [15] argued that service recovery can reduce customer dissatisfaction while simultaneously improving perceived service quality. Similarly, Cho et al. [16] and In et al. [17] demonstrated that effective recovery strategies enhance customers' overall perceptions of service quality in hospitality settings.

Within logistics services, Mentzer et al. [6] introduced the concept of order discrepancy handling, which refers to a firm's ability to effectively resolve problems arising after order fulfillment. They argued that effective problem

resolution can compensate for weaknesses in other logistics service quality dimensions and help maintain positive customer evaluations. More recently, Tang et al. [18] and Uvet et al. [10] found that prompt and appropriate responses to delivery-related problems significantly improve customer satisfaction in e-commerce and logistics service environments.

Based on these findings, service recovery is expected to directly influence customer satisfaction and improve overall evaluations of last-mile service quality. Therefore, the following hypotheses are proposed.

H1: Service recovery has a significant positive impact on customer satisfaction in last-mile delivery services.

H2: Service recovery has a significant positive impact on last-mile service quality.

2. Last-Mile Service Quality

The theoretical foundation for logistics service quality research has primarily been based on Parasuraman et al.'s [19] SERVQUAL model and Mentzer et al.'s [5] Logistics Service Quality (LSQ) model. Parasuraman et al. [20] initially identified ten determinants of service quality, including reliability, responsiveness, competence, access, courtesy, communication, credibility, security, understanding the customer, and tangibles. These dimensions were later refined into five dimensions consisting of tangibles, reliability, responsiveness, assurance, and empathy [19].

Recognizing the unique characteristics of logistics services, Bienstock et al. [4] argued that traditional SERVQUAL dimensions were not entirely suitable for evaluating logistics services because logistics service encounters involve the movement of goods rather than direct service interactions with customers. Consequently, they proposed the Physical Distribution Service Quality (PDSQ) model consisting of timeliness, availability, and condition. Later, Mentzer et al. [5] developed the Logistics Service Quality (LSQ) model, which expanded

logistics service quality measurement by incorporating dimensions such as information quality, ordering procedures, order accuracy, timeliness, order condition, order discrepancy handling, and personal contact quality.

With the rapid growth of e-commerce, the concept of logistics service quality has evolved into last-mile service quality. Last-mile delivery represents the final stage of the delivery process where customers directly experience logistics services [1]. Consequently, customers increasingly evaluate logistics providers based not only on delivery performance but also on delivery visibility, flexibility, accessibility, and responsiveness throughout the delivery process.

Recent studies have highlighted the importance of service quality in the last-mile delivery context. Uvet et al. [10] found that logistics service quality dimensions such as timeliness, order accuracy, and information quality positively influence customer satisfaction and customer loyalty. Tandon and Ertz [21] similarly demonstrated that e-logistics service quality positively affects customer satisfaction and repurchase intention. Kawa and Światowiec-Szczepańska [22] argued that logistics value dimensions including delivery monitoring, delivery flexibility, and delivery convenience significantly improve customer satisfaction. Furthermore, Huang [23] found that delivery timeliness, delivery accuracy, delivery safety, and problem-solving capability play important roles in the formation of customer loyalty.

According to the means-end chain model proposed by Zeithaml [24], customers evaluate service value through a comparison between perceived quality and perceived sacrifice. In the context of last-mile delivery services, customers assess value not only based on delivery outcomes but also based on convenience, accessibility, flexibility, and delivery experience. Therefore, improvements in last-mile service quality are expected to enhance customer satisfaction, perceived service value, and loyalty.

In this study, last-mile service quality is conceptualized as customers' overall evaluation of delivery performance during the final stage of parcel fulfillment. Drawing on SERVQUAL [19], LSQ [5], and recent last-mile delivery studies [10, 25], service quality is represented by delivery timeliness, responsiveness, competence, accessibility, tracking visibility, cost transparency, delivery condition, and personalized service. Based on these findings, we hypothesize the following.

H3: Last-mile service quality has a significant positive impact on satisfaction.

H4: Last-mile service quality has a significant positive impact on service value.

H5: Last-mile service quality has a significant positive impact on loyalty.

3. Sacrifice

Sacrifice refers to what consumers must give up or expend in order to obtain a product or service and is commonly categorized into monetary and non-monetary costs [24]. In the study of Oh [26], perceived sacrifice was operationalized as perceived price, representing the monetary costs customers bear in exchange for the service received. Research exploring the direct causal relationship between sacrifice and service value in logistics services remains relatively limited. However, Zeithaml's [24] means-end model suggests that perceived sacrifice directly influences consumers' value perceptions, and numerous studies across service industries have confirmed the negative relationship between sacrifice and perceived value [27, 28].

In the context of last-mile delivery services, customer sacrifice can be understood as the perceived monetary and non-monetary resources required to receive delivery services. Customers evaluate delivery services not only in terms of the price paid but also in terms of the time and effort required throughout the delivery process. Therefore, delivery services that help customers save time, reduce effort, and improve cost efficiency are likely

to generate higher perceived value.

Previous studies have provided empirical support for this relationship. In transportation services, Sumaedi et al. [27] found that sacrifice is a key predictor of service value. Similarly, Usman et al. [28] examined sacrifice by distinguishing between monetary and non-monetary dimensions and found that both significantly influence perceived value. Furthermore, studies in e-commerce logistics suggest that delivery convenience and process efficiency contribute to reducing customers' perceived sacrifice and improving overall service value [22]. Based on these findings, we hypothesize the following.

H6: Sacrifice has a significant negative impact on service value in last-mile delivery services.

4. Service Value

The conceptual definition of service value varies among researchers with different perspectives and interpretations. Zeithaml [24] classified perceived value into four dimensions: low price, desired benefits, quality relative to price, and overall value exchange. Integrating these perspectives, perceived value is generally defined as the trade-off between what customers receive and what they give. Bolton and Drew [29] further argued that perceived value differs across customers because it is influenced by both perceived benefits and various monetary and non-monetary sacrifices. Sweeney and Soutar [30] developed the PERVAL scale, which conceptualizes perceived value as consisting of emotional value, social value, and functional value, with the latter including both price/value for money and performance/quality.

However, the multidimensional conceptualization of value is not the only approach in prior research. Some studies have modeled customer value as a single overall evaluative item, treating benefits and sacrifices as antecedent constructs, rather than decomposing value into multiple sub-dimensions [26, 31]. Similarly, prior service research has examined customer value as a holistic or overall

evaluation within integrative models linking service quality, value, satisfaction, and behavioral outcomes [32, 33]. Thus, depending on the purpose of the study, value may be examined either through its individual dimensions or as an overall evaluation resulting from customers' assessments of the benefits and sacrifices associated with a specific service experience.

In the context of last-mile delivery services, service value represents customers' overall assessment of whether the benefits obtained from the delivery service outweigh the monetary and non-monetary sacrifices required to receive it. Thus, customers perceive greater service value when they receive reliable and convenient delivery services while expending less time, effort, and cost throughout the delivery process. Previous studies have shown that flexible delivery options, smart parcel lockers, and enhanced customer control over delivery arrangements can increase perceived value by reducing customer effort and improving convenience [22,25].

Cronin et al. [34] and Parasuraman and Grewal [35] argued that service quality alone cannot fully explain customer satisfaction and loyalty, emphasizing the mediating role of perceived value. Likewise, Usman et al. [27] demonstrated that service quality and customer sacrifice jointly determine perceived service value, while Marcos and Coelho [36] found that higher perceived service value significantly enhances both customer satisfaction and customer loyalty. Therefore, customers who perceive higher value from last-mile delivery services are expected to exhibit higher levels of satisfaction and loyalty. Based on these findings, the following hypotheses are proposed.

H7: Service value has a significant positive impact on satisfaction in last-mile delivery services.

H8: Service value has a significant positive impact on loyalty in last-mile delivery services.

5. Customer Satisfaction and Loyalty

Customer satisfaction is a key predictor of a firm's performance and long-term competitiveness, and previous studies in logistics and delivery services have consistently demonstrated its influence on customer behavioral intentions [10, 21, 23]. Customer satisfaction is generally defined as a customer's overall evaluation of whether a service experience meets or exceeds prior expectations [36]. In the context of last-mile delivery services, customer satisfaction reflects customers' overall assessment of their delivery experience during the final stage of the logistics process, including perceptions of delivery reliability, convenience, information availability, and service performance.

Previous studies have shown that satisfied customers are more likely to exhibit favorable behavioral responses toward service providers. Specifically, Huang [23] found that customer satisfaction positively influences customer loyalty, including purchase intentions and positive word-of-mouth behaviors. Tandon and Ertz [21] demonstrated that customer satisfaction significantly affects customers' intentions to continue using a service, while Uvet et al. [10] reported that customer satisfaction enhances customer loyalty through recommendation intentions and positive word-of-mouth communication.

In last-mile delivery services, customers who are satisfied with the overall delivery experience are more likely to regard a service provider as their preferred choice, recommend the service to others, and increase their frequency of service usage. Therefore, customer satisfaction is expected to be a key antecedent of customer loyalty.

Based on these findings, we hypothesize the following.

H9: Satisfaction has a significant positive impact on loyalty in last-mile delivery services.

The research model for the hypotheses based on theoretical background mentioned earlier is shown in Figure 1.

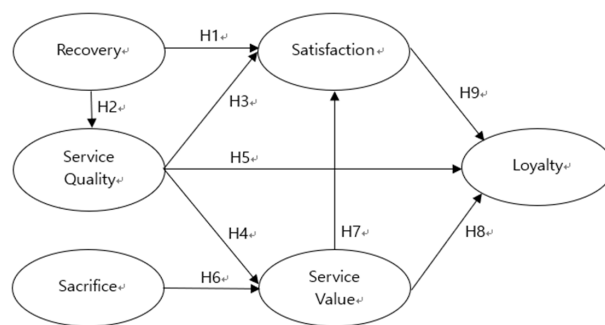


Fig. 1. Research Model

III. Empirical Analysis

1. Data Collection and Sample Characteristics

Considering the characteristics of last-mile delivery services, the measurement items were adapted from previous studies, as presented in Table 2. For the empirical analysis, the constructs were operationally defined according to their respective roles in the last-mile delivery service context. Service recovery refers to the extent to which the service provider provides appropriate responses, resolves problems, and communicates appropriately following a service failure [7, 8, 11, 12]. Service quality represents customers' overall evaluation of the performance of last-mile delivery services, including relevant dimensions of logistics and delivery service performance [4-6, 10, 18]. Customer sacrifice refers to the monetary, effort-related, and time-related burdens associated with using the service [24, 27-29]. Service value was defined as customers' overall evaluation of the value obtained from their most recent last-mile delivery service experience, reflecting their assessment of the benefits received relative to the sacrifices incurred [24, 29-34]. Satisfaction refers to customers' overall evaluative response to their most recent last-mile delivery service experience [31, 36, 37]. Finally, loyalty represents customers' intention to maintain a continuing relationship with the service provider through continued use and favorable behavioral intentions [31-33, 36].

The original customer sacrifice items were

positively worded to assess cost efficiency, effort reduction, and time saving. Prior to the revised analysis, all three items were reverse-coded so that higher scores consistently represented greater customer sacrifice in terms of monetary cost, effort, and time.

Unlike the other constructs, service value was operationalized as a single-item measure capturing respondents' overall evaluation of the value obtained from their most recent last-mile delivery experience. Although perceived value has been conceptualized as a multidimensional construct in prior research [29], this study focuses on a global assessment of overall value for a specific delivery service rather than its individual dimensions [31, 32]. Furthermore, PLS-SEM can effectively accommodate single-item measures without encountering identification issues [38].

The questionnaire was reviewed by experts in logistics and service management to ensure content validity. All items were measured using a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree).

consumers who had experience using at least one last-mile delivery service, including home delivery, convenience store-based pickup, and unmanned parcel locker services. Respondents were instructed to evaluate their most recent last-mile delivery experience and to answer all questionnaire items with reference to that specific experience and the service provider or channel involved in that delivery.

A total of 175 responses were obtained, of which 155 valid responses were retained after excluding incomplete or invalid questionnaires. The sample size exceeded the minimum requirements for PLS-SEM analysis based on the ten-times rule and statistical power recommendations [38].

This study adopted PLS-SEM for the following reasons. First, PLS-SEM is well suited to the primary objective of this study, which focuses on predicting the relationships among inner model latent variables rather than theory confirmation. Second, PLS-SEM produces reliable results even with relatively small sample sizes and does not require the assumption of multivariate normality, making it appropriate for the present study with a sample of 155 respondents. Third, service value in this study was operationalized as a single-item measure, which would give rise to identification problems in covariance-based SEM (CB-SEM) but can be effectively accommodated within the PLS-SEM framework [37].

The demographic characteristics of the respondents are presented in Table 1. Because many South Korean consumers use multiple last-mile delivery channels, respondents were not classified by a single delivery format. Instead, they evaluated their most recent delivery experience. This approach reduces response ambiguity while allowing the proposed constructs—service recovery, service quality, sacrifice, service value, satisfaction, and loyalty to be examined across diverse last-mile delivery contexts.

Table 1. Sample Characteristics

Category		Number of Respondents	Percentage (%)
Gender	Male	79	51.0
	Female	76	49.0
Age	Under 30	46	29.7
	30 ~ 39	70	45.2
	40 or above	39	25.1
Job	Student	6	3.9
	Job seeker	4	2.6
	Office worker	98	63.2
	Civil servant	29	18.7
	Self-employed	9	5.8
	Professional	9	5.8
Education	High school graduate	21	13.5
	College graduate	131	84.6
	Graduate degree	3	1.9
Total		155	100

Data were collected through Pickply, a professional online survey panel provider in South Korea. The survey targeted South Korean adult

2. Reliability and Validity Assessment

The reliability and validity of the measures in this study were verified using Smart PLS 3. For the reliability assessment, Cronbach's α coefficients were calculated.

Table 2. Reliability and Confirmatory Factor Analysis

Factor	Measurement Item	Coefficient	T-value	α
REC	problem resolution	.914	50.692***	.921
	appropriate response to a service failure	.931	43.357***	
	proper reporting of service failure	.945	89.369***	
SQ	delivery timeliness	.576	8.301***	.832
	responsiveness	.665	12.712***	
	competence	.671	10.215***	
	accessibility	.683	14.457***	
	tracking visibility	.801	27.511***	
	cost transparency	.638	11.900***	
	delivery condition	.634	10.338***	
SAC	personalized service	.751	21.493***	.743
	cost required	.884	37.647***	
	effort required	.699	7.869***	
SAT	time required	.757	9.506***	.920
	overall satisfaction	.950	83.921***	
	perceived satisfaction	.938	81.557***	
LOY	service satisfaction	.896	42.590***	.845
	reuse intention	.898	44.248***	
	word-of-mouth	.815	20.282***	
	future usage	.905	46.579***	

*: $p < .1$ **: $p < .05$ ***: $p < .01$

REC: recovery, SQ: service quality, SAC: sacrifice, SAT: satisfaction, LOY: loyalty

As shown in Table 2, all constructs had α values exceeding .7, confirming internal consistency. Validity was assessed through confirmatory factor analysis (CFA). The results of the analysis showed that the path coefficient t-values of all measures were statistically significant at the .01 level of significance. However, service value was measured with a single item and thus excluded from this analysis.

The average variance extracted (AVE) value for service quality was slightly below .5, but as all Composite Reliability (CR) values exceeded .7, convergent validity can be considered established [39]. For discriminant validity, the square root of AVE values and correlation coefficients between constructs are presented on and below the diagonal in Table 3, respectively. Although the square root

of AVE for service quality was slightly lower than the correlation coefficient between service quality and satisfaction, additional verification using the heterotrait-monotrait ratio (HTMT) showed that all values met Henseler et al.'s [40] proposed criterion of being below .90, as shown above the diagonal in Table 3, thus confirming discriminant validity.

To assess the potential influence of common method bias (CMB), Harman's single-factor test was conducted. The first unrotated factor accounted for less than 50% of the total variance, which is below the commonly accepted threshold, suggesting that common method bias was unlikely to pose a serious concern in this study. In addition, all variance inflation factor (VIF) values were below the recommended threshold, providing further evidence that common method bias was not a significant issue [41, 42].

Table 3. Validity and HTMT Ratio of Correlations

Construct	CR	AVE	Construct					
			REC	SQ	SAC	SV	SAT	LOY
REC	.950	.864	.930	.829	.535	.309	.553	.441
SQ	.872	.463	.721	.681	.883	.585	.855	.737
SAC	.826	.614	-.427	-.691	.784	.666	.743	.743
SV [†]	1.000	1.000	.296	.530	-.696	1.000	.533	.532
SAT	.949	.862	.508	.752	-.624	.696	.929	.818
LOY	.906	.763	.388	.629	-.602	.489	.732	.874

Diagonal bold numbers are square root of the AVE.

Numbers below the diagonal are correlation coefficients. Numbers above the diagonal are heterotrait-monotrait ratio of correlations. [†]: Single-item construct.

3. Results and Discussion

This study conducted path analysis to test the hypotheses, and the results are presented in Table 4. In evaluating the model fit, the path model showed determination coefficients (R^2) of the endogenous variables as follows: service quality .514, service value .493, satisfaction .583, and loyalty .560. Additionally, the global model fit (global GoF) value proposed by Tenenhaus et al. [43] was confirmed to be .639, exceeding the maximum criterion.

The specific results of the path analysis are as follows. First, recovery was found to have no significant direct effect on satisfaction; therefore,

H1 was not supported. Therefore, an additional mediation analysis was conducted, and the results presented in Table 5 show that recovery significantly influenced satisfaction indirectly through service quality. Furthermore, recovery also exerted a significant indirect effect on loyalty through the sequential mediation of service quality and satisfaction, while the indirect effect through service quality alone was marginally significant.

This finding is theoretically consistent with prior service recovery research suggesting that the effect of recovery on satisfaction is not always direct, but is often mediated by customers' updated perceptions of service quality following a recovery encounter [11, 12].

Table 4. Result of Hypothesis Test

Hypotheses	Coefficient	T-value
H1 REC → SAT	-.041	.502
H2 REC → SQ	.717	15.089***
H3 SQ → SAT	.710	7.206***
H4 SQ → SV	.131	1.399
H5 SQ → LOY	.131	1.990**
H6 SAC → SV	-.606	6.495***
H7 SV → SAT	.134	1.828*
H8 SV → LOY	.126	1.902*
H9 SAT → LOY	.568	6.597***

*: p<.1 **: p<.05 ***: p<.01

When a service failure occurs, customers tend to reassess their overall perception of the service provider's competence, responsiveness, and reliability based on how effectively the problem is resolved. It is this updated quality perception, rather than the recovery effort itself, that ultimately drives satisfaction. From a practical standpoint, this finding implies that in last-mile delivery services, where failures such as delayed deliveries, damaged parcels, and inaccurate tracking information are relatively common, the mere existence of a recovery mechanism is insufficient to generate customer satisfaction. Rather, the quality of the recovery response – including the speed, appropriateness, and transparency of problem resolution – must be sufficient to meaningfully improve customers'

perceptions of overall service quality before satisfaction can be enhanced.

Recovery was also found to have a significant positive effect on service quality, supporting H2. These results highlight the strategic importance of recovery efforts in last-mile delivery services, where customers frequently experience service failures such as delayed deliveries, damaged parcels, inaccurate tracking information, and unsuccessful delivery attempts.

Second, service quality had a significant positive effect on satisfaction, supporting H3. However, its direct effect on service value was not significant; therefore, H4 was not supported.

This result suggests that in the last-mile delivery context, service quality may function more as a baseline expectation than as a differentiating factor that incrementally enhances perceived value. As last-mile delivery services in South Korea have become increasingly standardized, with most major providers offering comparable levels of delivery timeliness, tracking visibility, and delivery condition, customers tend to regard a certain level of service quality as a minimum hygiene condition rather than a source of added value, such that improvements beyond this threshold do not necessarily translate into higher perceptions of service value. Furthermore, in last-mile delivery encounters, customers' perceptions of value may be more directly shaped by what they must give up – namely, time, effort, and monetary cost – than by what they receive in terms of service quality. Consequently, the non-significant effect of service quality on service value in this study may reflect the unique characteristics of the last-mile delivery environment, where sacrifice dominates value formation more than quality improvements alone.

Service quality showed a statistically significant positive effect on loyalty, supporting H5. These findings indicate that service quality directly enhances both customer satisfaction and loyalty. In addition, the significant indirect effect of service quality on loyalty through satisfaction suggests that

customer satisfaction serves as an important mediating mechanism through which service quality further contributes to customer loyalty in last-mile delivery services. Accordingly, customer satisfaction appears to be the primary mechanism through which service quality contributes to loyalty in last-mile delivery services.

Third, sacrifice was found to have a significant negative effect on service value, supporting H6. In addition, sacrifice indirectly influenced both satisfaction and loyalty through service value, although these indirect effects were significant only at the significance level. These findings indicate that reducing customers' monetary and non-monetary sacrifices—including time, effort, inconvenience, and delivery-related burdens—can improve perceived service value, thereby contributing to higher satisfaction and loyalty.

Fourth, service value had a significant positive effect on satisfaction, supporting H7. Service value also had a significant positive effect on loyalty, supporting H8. Furthermore, the indirect effect analysis revealed that service value significantly influenced loyalty through customer satisfaction. These findings indicate that service value contributes to customer loyalty both directly and indirectly by enhancing customer satisfaction. In other words, when customers perceive that the benefits obtained from a last-mile delivery service outweigh the monetary and non-monetary sacrifices required to use it, they are more likely to be satisfied with the service and develop stronger loyalty toward the service provider. Therefore, delivery service providers should enhance customers' perceptions of service value by providing convenient, accessible, and customer-oriented delivery services while simultaneously reducing the monetary and non-monetary sacrifices associated with the delivery experience.

Finally, satisfaction had a significant positive effect on loyalty, supporting H9. Satisfaction also served as a key mediating mechanism linking

service value to loyalty. These findings confirm that customer satisfaction is an important antecedent of customer loyalty in last-mile delivery services. Therefore, last-mile delivery providers should continuously improve customer satisfaction through reliable delivery performance, accurate tracking information, convenient delivery options, effective service recovery, and customer-oriented service management. Such efforts can strengthen customer loyalty and improve the sustainable competitiveness of delivery service providers in increasingly competitive last-mile delivery markets.

Table 5. Results of Indirect Effects

Path	Mediating Effect	T-value
REC → SQ → SAT	.509	6.419***
REC → SQ → LOY	.094	1.949*
REC → SQ → SAT → LOY	.289	4.756***
SQ → SAT → LOY	.404	4.989***
SAC → SV → SAT	-.081	1.728*
SAC → SV → LOY	-.076	1.838*
SV → SAT → LOY	.076	1.734*

*: $p < .1$ **: $p < .05$ ***: $p < .01$

IV. Conclusions

This study examined the relationships among service recovery, service quality, customer sacrifice, service value, satisfaction, and loyalty in the context of last-mile delivery services. The findings indicate that service recovery enhances customer satisfaction indirectly through service quality and also contributes to customer loyalty through indirect pathways involving service quality and satisfaction. Customer sacrifice negatively affects perceived service value, whereas service value positively influences both satisfaction and loyalty and further contributes to loyalty through satisfaction. In addition, service quality directly enhances both satisfaction and loyalty. These findings suggest that customer loyalty in last-mile delivery services is shaped through multiple pathways involving service recovery, service quality, customer sacrifice, service value, and

customer satisfaction.

This study makes three major contributions. First, it extends the traditional service quality-satisfaction-loyalty framework by incorporating service recovery and customer sacrifice into an integrated framework for explaining customer evaluations and loyalty formation in last-mile delivery services. Second, it demonstrates the mediating roles of service quality, service value, and satisfaction in explaining the mechanisms through which customer evaluations contribute to loyalty. Third, it operationalizes last-mile service quality using delivery-specific indicators, thereby reflecting the characteristics of contemporary delivery environments.

The findings also provide practical implications for last-mile delivery service providers. Firms should focus not only on improving service quality but also on establishing effective service recovery systems to address delivery failures and on reducing customers' monetary and non-monetary sacrifices. Improving delivery performance and recovery effectiveness while reducing customers' time, effort, inconvenience, and other delivery-related burdens can enhance perceived service value and customer satisfaction and, ultimately, strengthen customer loyalty.

This study has several limitations. First, it examined last-mile delivery services as a broad service category without distinguishing among specific delivery formats. Future research should compare channels such as home delivery, convenience-store pickup, and smart parcel lockers to identify channel-specific customer evaluation mechanisms. Second, the cross-sectional design limits causal inference: future studies should employ longitudinal or experimental designs. Third, measuring customer sacrifice using positively framed items, such as cost efficiency, effort reduction, and time saving, may have created ambiguity relative to its theoretical definition. Future research should directly measure customer sacrifice using

negatively framed items reflecting higher costs, greater effort, and longer time requirements. Finally, future research should examine how emerging technologies, including AI-based delivery platforms, smart parcel lockers, and autonomous delivery systems, influence customer value formation and loyalty.

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