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Electronic Word of Mouth, Brand Image, and Brand Trust on Brand Loyalty Mediated by Consumer Satisfaction

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Abstract

Purpose— To examine the relationships of electronic word of mouth (e-WOM), brand image, and brand trust with loyalty among Telkomsel users in Solo Raya, and the statistical mediating role of customer satisfaction.

Research Methodology— Data from a cross-sectional online questionnaire completed by 300 purposively recruited Telkomsel users were analyzed using PLS-SEM in SmartPLS 4.0.

Results— e-WOM, brand image, and brand trust showed positive associations with satisfaction. Brand image, brand trust, and satisfaction were positively associated with loyalty, whereas the direct e-WOM–loyalty relationship was not statistically significant. All three indirect paths through satisfaction were positive and significant.

Research limitations/Implications— Nonprobability recruitment, a cross-sectional self-report design, and inconsistent measurement indices constrain generalization and statistical interpretation. Reliable services and responsive complaint handling should accompany digital marketing efforts.

Originality— The study jointly examines three antecedents and a satisfaction-mediated association in a regional mobile-telecommunications setting, with complaint handling represented within the satisfaction measure.

Keywords: Electronic Word of Mouth; Brand Image; Brand Trust; Customer Satisfaction; Brand Loyalty.
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1. Introduction

Retaining subscribers is a continuing challenge in mobile telecommunications, where the perceived reliability of network access, service interactions, and brand promises may influence whether customers maintain an operator relationship. Evidence from different markets connects telecommunications service quality, trust, corporate image, and satisfaction with loyalty, although the specific models and populations vary (Abd-Elrahman, 2023; Hussain et al., 2025; Mohlala & Bankole, 2022). Research on Indonesian mobile users likewise associates service-related evaluations and trust with loyalty (Yacob et al., 2023). These findings establish the practical importance of customer retention but do not establish identical mechanisms across operators or geographic regions.

Brand loyalty is not reducible to subscription continuation or repeated purchases. Classical and recent scholarship distinguishes attitudinal commitment, cognitive

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preference, and behavioral manifestations, which need not move together (Bourdeau et al., 2024; Chaudhuri & Holbrook, 2001; Oliver, 1999). In the Telkomsel setting, studies have linked awareness and brand image with loyalty (Putri Amanta & Arqy Ahmadi, 2024), explored image, product quality, satisfaction, and loyalty among subscribers in Tompudau (Febrianti et al., 2022), and examined social-media marketing and brand trust for the by.U service (Firmansyah et al., 2025). Their populations, predictors, and operationalizations differ from those of the present survey; consequently, the studies inform rather than substitute for a regional test.

Electronic word of mouth (e-WOM) adds an information channel through which users encounter others' experience reports, recommendations, and complaints. Its informational credibility and effects depend on message content, the communicator, the platform, and the recipient (Cheung & Thadani, 2012; Pyle et al., 2021; Verma & Dewani, 2021). Exposure may help consumers form expectations about brands rather than directly producing durable loyalty (Krishnamurthy & Kumar, 2018). In separate product contexts, Srivastava and Sivaramakrishnan (2021) reported a nonsignificant direct e-WOM–loyalty relationship, while Walean et al. (2025) examined e-WOM, brand trust, and loyalty among Shopee users. These contextual contrasts make a direct and an indirect pathway worth evaluating separately.

Brand image and brand trust provide analytically distinct ways of understanding the customer–operator relationship. Image concerns the associations through which a company or service is perceived, whereas trust concerns confidence in its competence, reliability, and integrity. Evidence from mobile services in Malaysia and Brunei links image, trust, network and service quality, satisfaction, and loyalty in different combinations (Leong et al., 2022; Ting et al., 2020). Research with Indian telecom users further shows the relevance of trust to loyalty while allowing the strength of service relationships to vary across customer groups (Kalia et al., 2021). The local network and complaint-handling context may therefore matter when interpreting these constructs together.

Existing evidence covers several components of this relationship but provides no directly interchangeable estimate of the simultaneous e-WOM, image, and trust pathways through satisfaction for the specific Solo Raya respondents. The contribution pursued here is thus contextual integration, not a claim to have invented a new construct or established causal mediation. Complaint handling is included as one reported domain of the satisfaction measure, not tested as an independent determinant. This distinction matters because complaint-recovery experiences can shape trust and engagement in service contexts, although the relevant causal relationships cannot be assumed for Telkomsel without specific testing (Honora et al., 2023; Tax et al., 1998).

The study addresses three questions: (1) how e-WOM, brand image, and brand trust are related to satisfaction and loyalty; (2) how satisfaction is related to loyalty; and (3) whether satisfaction carries indirect statistical associations from each antecedent to loyalty. A purposive sample of 300 Telkomsel users in Solo Raya provides the empirical setting. The hypotheses, survey design, results, and implications are developed in the following sections without extending inference beyond the observed associations.

2. Review of Literature

2.1 Brand Loyalty

Loyalty involves more than a continued subscription: consumers may repeat a transaction because of convenience, inertia, limited alternatives, or attachment to the brand. Oliver (1999) described developmental elements of loyalty, while Bourdeau et al. (2024) show why distinct loyalty phases and outcomes should not be treated as interchangeable. Chaudhuri and Holbrook (2001) distinguish purchase and attitudinal loyalty in their examination of brand trust and affect. These distinctions are relevant to mobile services because intentions and self-reported preferences do not establish observed subscription renewal or switching behavior.

2.2 Electronic Word of Mouth

e-WOM comprises digitally transmitted opinions, experiences, and recommendations about products or services (Hennig-Thurau et al., 2004). Its measurement has addressed aspects such as communication intensity, valence, and content, although an established scale is not automatically equivalent to the items used in a particular study (Goyette et al., 2010). Credibility additionally depends on communication context and how consumers evaluate evidence and the motives behind a message (Pyle et al., 2021; Verma & Dewani, 2021). Expectations formed through such information might accompany subsequent satisfaction when actual service is assessed.

Empirical research separates e-WOM exposure from more durable customer outcomes. Krishnamurthy and Kumar (2018) examine its role in forming brand expectations, whereas Kumar et al. (2024) show that the platform carrying online reviews can condition relationships with brand attitudes and purchasing intentions. Importantly, Srivastava and Sivaramakrishnan (2021) found that e-WOM did not directly predict loyalty in two product contexts even though other paths were associated with satisfaction. For mobile subscribers, positive associations are hypothesized but a direct effect is not assumed to be inevitable.

H1. e-WOM is positively associated with customer satisfaction.
H2. e-WOM is positively associated with brand loyalty.

2.3 Brand Image

Brand image denotes the associations and evaluations through which consumers understand a brand. In telecommunications, those associations can include perceived network quality, the company's reputation, and consistency of the service experience. Leong et al. (2022) found that corporate image in a mobile-service setting was related to assessments of service and price fairness and, subsequently, customer evaluations. Ting et al. (2020) similarly connect corporate image with satisfaction and trust in a telecommunications model. Brand image is therefore expected to correlate with both satisfaction and loyalty, without implying that all image dimensions have identical roles.

H3. Brand image is positively associated with customer satisfaction.
H4. Brand image is positively associated with brand loyalty.

2.4 Brand Trust

Brand trust concerns a customer's confidence that a brand will behave competently, reliably, and with integrity. Chaudhuri and Holbrook (2001) provide a foundational basis for relating trust to loyalty, while Kalia et al. (2021) place trust within a contemporary telecommunications model. Riva et al. (2024), in a different market, demonstrate the importance of credible brand signals and consumer skepticism for trust formation. Because mobile services involve recurring performance and information-security concerns, trust can plausibly accompany favorable evaluations and longer-term commitment; this study, however, measures perceived associations rather than proving a temporal mechanism.

H5. Brand trust is positively associated with customer satisfaction.
H6. Brand trust is positively associated with brand loyalty.

2.5 Customer Satisfaction

Customer satisfaction evaluates whether a service experience is judged favorably relative to expectations and perceived value. Within mobile services, network performance, reliability, customer support, and privacy can all contribute to that evaluation. Abd-Elrahman (2023) reports relationships between telecommunications service-quality dimensions, satisfaction, and loyalty; Hussain et al. (2025) examine network quality, corporate image, and satisfaction alongside downstream customer outcomes. The present questionnaire also treats satisfaction with complaint handling as one indicator domain,

consistent with service-recovery research (Honora et al., 2023; Tax et al., 1998). That domain is not separately estimated as an independent construct.

H7. Customer satisfaction is positively associated with brand loyalty.

2.6 Satisfaction as a Statistical Mediator

A conceptual indirect relationship is plausible when digitally communicated expectations and brand perceptions coexist with an overall appraisal of service and a loyalty orientation. Research on mobile users supports examining satisfaction and trust as intervening variables, but the proposed pathways and research designs are not identical across studies (Ting et al., 2020; Yacob et al., 2023). Results from marketplace contexts likewise suggest satisfaction-related indirect associations with digital information, without demonstrating equivalence to telecom subscriptions (Wulandjani et al., 2025). Zhao et al. (2010) emphasize interpreting indirect effects directly rather than treating a nonsignificant direct relationship as proof of a universal mechanism.

The indirect paths in this study represent products of associations in a cross-sectional statistical model, not observed sequences of events. Customers who were already loyal might evaluate satisfaction more favorably, while previous satisfaction could also shape brand trust, image, and attention to online discussions. Measuring all constructs in a single survey wave cannot distinguish these alternative temporal explanations. Other service research has examined brand trust as a mediator of the e-WOM–loyalty relationship, which differs conceptually from the satisfaction pathway tested here (Aldulaimi et al., 2025).

H8a. Satisfaction statistically mediates the association between e-WOM and brand loyalty.

H8b. Satisfaction statistically mediates the association between brand image and brand loyalty.

H8c. Satisfaction statistically mediates the association between brand trust and brand loyalty.

3. Research Methodology

3.1. Design, Setting, and Sample

The study employed an explanatory, quantitative, cross-sectional survey of active Telkomsel users in Solo Raya, covering Surakarta, Boyolali, Sukoharjo, Karanganyar, Wonogiri, Sragen, and Klaten. Individual subscribers were the units of analysis. Purposive selection required residence in Solo Raya, use of a Telkomsel SIM card, and a minimum age of 12 years. The seven districts and municipalities delimit the target setting, without implying a proportionate allocation of participants across them. The analysis included 300 respondents. A practical sample-size benchmark was established by multiplying 25 indicators by ten (250) and adding 50 participants. This rule does not substitute for statistical power analysis of the smallest relevant path coefficient. Moreover, purposive recruitment and the absence of district-level participation probabilities preclude population-representative estimates for Solo Raya.

3.2. Data Collection

Responses were collected through a five-point Likert questionnaire circulated through Google Forms on WhatsApp and Instagram during August–September 2026. The response options ranged from 1 (strongly disagree) to 5 (strongly agree). Recruitment through social networks creates scope for self-selection and uneven access to the survey. These features are relevant when judging the representativeness of the sample and the transferability of the results. Predictors, satisfaction, and loyalty were measured from the same respondents within a single questionnaire wave, which makes common-method variation a plausible alternative contributor to their covariation. Procedural safeguards and statistical approaches for this risk have been discussed by Kock (2015) and Podsakoff

et al. (2003). The cross-sectional self-report design cannot, by itself, exclude this source of bias.

3.3. Constructs and Operationalization

The model comprised three exogenous constructs—e-WOM (X1), brand image (X2), and brand trust (X3)—customer satisfaction (Z) as a statistical mediator, and brand loyalty (Y) as the endogenous construct. Each construct was operationalized with five indicators, for a total of 25. All five constructs were modeled reflectively. Table 1 identifies their conceptual measurement domains.

A reflective model assumes that indicators are observable manifestations of a common latent construct. That assumption deserves particular attention for brand loyalty: affective and cognitive commitment, repeat purchasing, and willingness to pay a premium may represent distinguishable loyalty dimensions. Research on loyalty measurement and structural-equation specification therefore supports treating construct dimensionality as a substantive theoretical decision rather than a default software setting (Bourdeau et al., 2024; Sarstedt et al., 2016). The present interpretation follows the five-construct specification employed in the study.

Table 1. Construct operationalization and indicator domains

Construct	Indicator domains
e-WOM (X1)	Intensity; opinion valence; content; credibility; information usefulness.
Brand image (X2)	Corporate image; product image; user image; perceived quality; favorable associations.
Brand trust (X3)	Competence; benevolence; integrity; reliability; customer security.
Customer satisfaction (Z)	Overall satisfaction; service quality; expectation confirmation; perceived value; complaint handling.
Brand loyalty (Y)	Affective loyalty; cognitive loyalty; normative loyalty; repeat purchase; willingness to pay a premium.

Note. Five indicators represent each construct; the domains identify measurement content rather than verbatim questionnaire statements.

3.4. Analysis Strategy

The relationships were estimated with partial least squares structural equation modeling (PLS-SEM) in SmartPLS 4.0. Reflective measurement quality was considered in terms of outer loadings, average variance extracted (AVE), Cronbach's alpha, and composite reliability. Conventional reference values are 0.70 for loadings and internal consistency and 0.50 for AVE, interpreted in conjunction with substantive construct content (Fornell & Larcker, 1981; Hair et al., 2019, 2022). Discriminant validity also calls for evaluation of the heterotrait–monotrait ratio (HTMT) and the Fornell–Larcker criterion (Henseler et al., 2015). The structural model specifies seven direct paths and three indirect paths through satisfaction. Standardized path coefficients, t statistics, and p values were interpreted using a two-sided 5% significance threshold (approximately $|t| > 1.96$ or $p < 0.05$). Coefficients of determination (R^2) describe within-sample explanatory capacity. Variance inflation factors (VIF), f^2 effect sizes, and bootstrap confidence intervals are additional diagnostics important for assessing collinearity, relative contribution, and inferential precision (Cohen, 1988; Hair et al., 2019; Zhao et al., 2010).

4. Results and Discussion

4.1 Research Result

4.1.1. Measurement Model

Table 2 presents outer loadings for the 25 indicators. Z.2 and Y.2 each have a loading of 0.656, below the conventional 0.70 benchmark; such values call for considering content coverage, AVE, and reliability together rather than automatic item deletion. More importantly, all five satisfaction loadings match the corresponding loyalty loadings

exactly. This unusual equality across two conceptually distinct constructs weakens the basis for treating their measurement properties as independently established.

Table 2. Outer loadings for the reflective indicators

Construct	Indicator	Outer loading	Loading classification
e-WOM (X1)	X1.1	0.803	≥ 0.70
e-WOM (X1)	X1.2	0.753	≥ 0.70
e-WOM (X1)	X1.3	0.876	≥ 0.70
e-WOM (X1)	X1.4	0.855	≥ 0.70
e-WOM (X1)	X1.5	0.831	≥ 0.70
Brand image (X2)	X2.1	0.747	≥ 0.70
Brand image (X2)	X2.2	0.867	≥ 0.70
Brand image (X2)	X2.3	0.840	≥ 0.70
Brand image (X2)	X2.4	0.869	≥ 0.70
Brand image (X2)	X2.5	0.838	≥ 0.70
Brand trust (X3)	X3.1	0.722	≥ 0.70
Brand trust (X3)	X3.2	0.861	≥ 0.70
Brand trust (X3)	X3.3	0.838	≥ 0.70
Brand trust (X3)	X3.4	0.894	≥ 0.70
Brand trust (X3)	X3.5	0.858	≥ 0.70
Customer satisfaction (Z)	Z.1	0.874	≥ 0.70
Customer satisfaction (Z)	Z.2	0.656	< 0.70
Customer satisfaction (Z)	Z.3	0.854	≥ 0.70
Customer satisfaction (Z)	Z.4	0.842	≥ 0.70
Customer satisfaction (Z)	Z.5	0.809	≥ 0.70
Brand loyalty (Y)	Y.1	0.874	≥ 0.70
Brand loyalty (Y)	Y.2	0.656	< 0.70
Brand loyalty (Y)	Y.3	0.854	≥ 0.70
Brand loyalty (Y)	Y.4	0.842	≥ 0.70
Brand loyalty (Y)	Y.5	0.809	≥ 0.70

Note. The five Z and Y outer loadings are numerically identical; Z.2 and Y.2 are below the 0.70 reference value.

Table 3. Construct reliability and comparison of AVE values

Construct	AVE (summary)	AVE (from loadings)	Composite reliability	Cronbach's alpha
e-WOM (X1)	0.591	0.680	0.872	0.809
Brand image (X2)	0.657	0.695	0.905	0.867
Brand trust (X3)	0.680	0.700	0.914	0.882
Customer satisfaction (Z)	0.695	0.657	0.919	0.889
Brand loyalty (Y)	0.700	0.657	0.921	0.892

Note. AVE derived from loadings equals the mean of five squared standardized loadings. The two AVE columns differ by more than rounding error; neither column substitutes for establishing the correct underlying measurement model.

Table 3 compares AVE values in the construct summary with values calculated as the mean squared loadings from Table 2. The calculated AVE values are 0.680 for e-WOM, 0.695 for image, 0.700 for trust, and 0.657 for both satisfaction and loyalty. The summary figures—0.591, 0.657, 0.680, 0.695, and 0.700, respectively—are not compatible with the corresponding five outer loadings beyond ordinary rounding differences. This discrepancy matters because convergent-validity interpretations depend on the measurement specification actually estimated. The reliability coefficients do not eliminate that concern,

while the distinctiveness of satisfaction and loyalty also depends on discriminant-validity evidence.

4.1.2. Structural Model

The model accounted for $R^2 = 0.642$ of the variation in satisfaction and $R^2 = 0.720$ in brand loyalty (Table 4), equivalent to 64.2% and 72.0% within the sample. These values describe explained variance under the fitted specification, not prediction in a new sample. They also cannot substitute for assessment of predictor collinearity, individual f^2 values, or confidence intervals around path estimates. Table 5 summarizes the seven direct and three indirect paths in the fitted model.

Table 4. Coefficients of determination for the endogenous constructs

Endogenous construct	R^2
Customer satisfaction (Z)	0.642
Brand loyalty (Y)	0.720

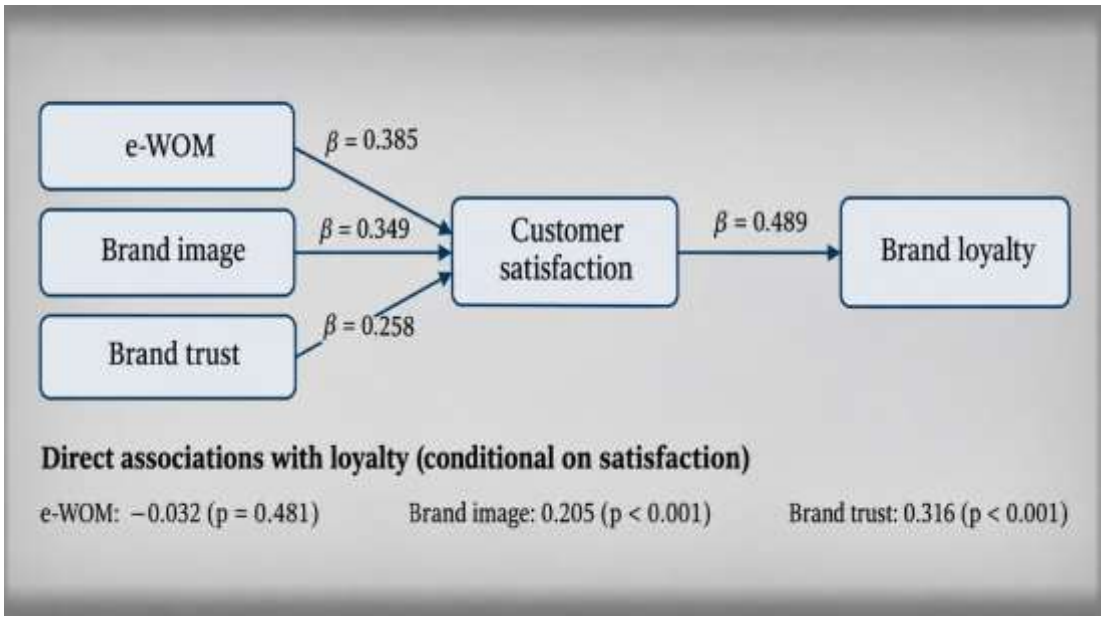
Note. R^2 represents in-sample explained variance rather than external predictive performance.

Table 5. Direct and indirect standardized path estimates

H	Path	β	t	p	Hypothesis test
H1	e-WOM → Customer satisfaction	0.385	9.229	< 0.001	Supported
H2	e-WOM → Brand loyalty	−0.032	0.705	0.481	Not supported
H3	Brand image → Customer satisfaction	0.349	8.868	< 0.001	Supported
H4	Brand image → Brand loyalty	0.205	5.086	< 0.001	Supported
H5	Brand trust → Customer satisfaction	0.258	6.048	< 0.001	Supported
H6	Brand trust → Brand loyalty	0.316	8.640	< 0.001	Supported
H7	Customer satisfaction → Brand loyalty	0.489	9.537	< 0.001	Supported
H8a	e-WOM → Customer satisfaction → Brand loyalty	0.188	6.662	< 0.001	Indirect path supported
H8b	Brand image → Customer satisfaction → Brand loyalty	0.171	6.569	< 0.001	Indirect path supported
H8c	Brand trust → Customer satisfaction → Brand loyalty	0.126	4.733	< 0.001	Indirect path supported

Note. The tests use a nominal two-sided 5% significance threshold. Confidence intervals for direct and indirect coefficients are not presented.

Figure 1. Standardized coefficients in the structural path model



Note. The figure 1 displays the direct path coefficients, including those shown as labels below the diagram. Arrows specify statistical model paths rather than causal effects.

Six of the seven direct paths were positive and statistically significant; the e-WOM–loyalty path was negative and nonsignificant ($\beta = -0.032$, t = 0.705, p = 0.481). Satisfaction showed the largest direct coefficient toward loyalty ($\beta = 0.489$), and nine of ten tests met the nominal 5% significance rule. Indirect associations through satisfaction amounted to 0.188 for e-WOM, 0.171 for brand image, and 0.126 for brand trust. These estimates agree, up to rounding, with the respective products of the direct antecedent–satisfaction coefficients and the satisfaction–loyalty coefficient. The nonsignificant direct e-WOM path contrasts with the significant direct image and trust paths. Nevertheless, the distinction between full and partial mediation concerns the statistical path pattern only; it does not establish a causal sequence in a cross-sectional design.

4.2 Discussion

The e-WOM result suggests a distinction between receiving digital information and developing an enduring loyalty orientation. In this sample, e-WOM was positively associated with satisfaction, but its conditional direct association with loyalty was not statistically distinguishable from zero. A comparable absence of a direct loyalty association was reported by Srivastava and Sivaramakrishnan (2021), although that research concerned other product categories and a different model. The Shopee results discussed by Walean et al. (2025) similarly caution against assuming every online-information pathway translates directly into loyalty. These similarities should be read as contextual comparisons, not confirmation of an identical causal mechanism.

One plausible interpretation is that online messages shape what subscribers expect, whereas satisfaction incorporates the judgment of actual coverage, billing, reliability, and complaint experiences. This is consistent with e-WOM and brand-expectation scholarship (Cheung & Thadani, 2012; Krishnamurthy & Kumar, 2018), but it was not tested as a sequential process in the present survey. Equally plausible is reverse selection: satisfied or loyal subscribers may search for, notice, or evaluate online comments differently. Cross-sectional covariance cannot adjudicate between these interpretations.

Brand image and brand trust were both positively associated with loyalty directly and indirectly through satisfaction, but the relative patterns differed. Image was more strongly associated with satisfaction, whereas trust had the larger direct loyalty coefficient. Telecommunications evidence from Brunei, Malaysia, and India also treats image, trust, service quality, and satisfaction as related but nonidentical correlates of continued customer relationships (Kalia et al., 2021; Leong et al., 2022; Ting et al., 2020). Differences in standardized coefficients do not constitute a ranking of the causal impact of alternative managerial interventions.

Satisfaction had the largest direct coefficient toward loyalty among the modeled predictors and participated in all three significant indirect paths. This pattern is broadly consistent with mobile-service evidence linking service quality, trust, satisfaction, and loyalty (Abd-Elrahman, 2023; Hussain et al., 2025; Yacob et al., 2023). Statistical mediation, however, follows an imposed direction in the model rather than establishing when users encountered e-WOM, formed brand trust, became satisfied, or developed loyalty. Studies with repeated observations or stronger identification would help distinguish the competing temporal accounts.

For management, the findings suggest that digital communication should be consistent with the service users actually receive. Clear promises, network stability, data-security practices, accessible support, and credible responses to complaints are operational areas worth evaluating. Complaint handling is especially salient because it appears among the satisfaction domains; research on service recovery underscores its relationship with subsequent trust and engagement (Honora et al., 2023; Tax et al., 1998). Yet the present model does not isolate a complaint-handling coefficient, and it cannot quantify the effect of any proposed service improvement.

The findings have several boundary conditions. Purposive social-media recruitment cannot support district-wide or national generalization, while package prices, usage

intensity, device characteristics, network coverage, and earlier service failures may act as unmeasured correlates of both satisfaction and loyalty. Simultaneous self-report measures can share method-related variation, and a five-item reflective loyalty construct may inadequately capture distinct cognitive, affective, and behavioral phases (Bourdeau et al., 2024; Kock, 2015; Podsakoff et al., 2003). These features limit interpretation of coefficient magnitudes as independent behavioral effects.

An important additional limitation concerns the measurement model. The identical satisfaction and loyalty loading patterns and the disagreement between the AVE indices and squared loadings do not support a definitive judgment of convergent or discriminant validity. Because satisfaction links the antecedents to loyalty, any misclassification or weak separation of these constructs would also affect the indirect-path interpretation. The coefficients therefore characterize the specified sample model but cannot establish a fully validated mediation mechanism.

5. Conclusion

Among the 300 purposively recruited Telkomsel users in Solo Raya, e-WOM, brand image, and brand trust were positively associated with satisfaction. Satisfaction, image, and trust were positively associated with loyalty, but the direct association between e-WOM and loyalty was not statistically significant. All three indirect associations through satisfaction met the nominal significance rule. Together, these patterns identify satisfaction as an important correlate of loyalty within the fitted model, not as proof of a causal sequence.

The contribution is the joint, context-specific examination of these three antecedents while explicitly including complaint handling within the satisfaction domain. The managerial implication is to align credible communications with dependable networks, trustworthy service practices, and responsive support rather than treating online promotion as sufficient in itself. Because complaint handling was not separately modeled, its independent effect remains a question for future investigation.

Nonprobability sampling, a single survey wave, and common-method risks limit the generalizability and interpretation of the associations. A further limitation is the inconsistency between reflective loadings and AVE as well as the lack of decisive evidence that satisfaction and loyalty are sufficiently distinct constructs. The minimum recruitment age also makes transparent participant-protection arrangements important. Future work should prioritize replicable measurement specifications, stronger longitudinal or behavioral outcomes, and explicit reporting of consent safeguards where younger respondents are eligible.

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The authors have nothing to report.

AUTHOR CONTRIBUTION

✉ **AMN:** Corresponding; Conceptualization; Methodology; Investigation; Formal analysis; Project administration; Writing – original draft; Writing – review & editing.
MN: Methodology; Investigation; Data curation; Formal analysis; Validation; Writing – review & editing; Resources; Visualization.

CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

DECLARATION OF GENERATIVE AI USE

During the preparation of this work, the author used generative artificial intelligence tools to support the scientific writing process. Grammarly was used to check grammar, refine writing style, and improve clarity in scientific writing. All interpretations, analyses, and conclusions presented in this study are the sole responsibility of the author.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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