How quality, service, and marketing drive customer satisfaction in medium-scale manufacturing companies

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Abstract

This study aims to examine the influence of product quality, after-sales service, and marketing communications on customer satisfaction in a medium-scale manufacturing industry in Indonesia. An exploratory quantitative approach was applied using survey data collected from 120 customers of Adisa Jaya Industri, a metal-milling machine manufacturer in Gresik. The data were analyzed using SEM-AMOS. The results indicate that product quality, after-sales service, and marketing communications each have a positive and significant influence on customer satisfaction. Improved machine reliability, service responsiveness, and consistent digital communications strengthen customer trust and loyalty. These findings confirm that satisfaction in the manufacturing sector depends not only on product excellence but also on the effectiveness of technical support and communication strategies, in the context of B2B manufacturing, an area that remains underexplored in previous research. These findings provide managerial insights for manufacturing companies to enhance competitiveness through sustainable integrated quality management, strengthened after-sales services, and consistent digitalization of marketing communications. This study provides empirical evidence that customer satisfaction in the manufacturing industry is not only determined by product quality, but is also influenced by after-sales service and effective marketing communications, especially in medium-scale manufacturing companies

Keywords: *product quality, after-sales service, marketing communication, customer satisfaction, manufacturing industry*

Introduction

Customer satisfaction plays a critical role in determining the sustainability and competitiveness of firms, particularly within the manufacturing sector. In an increasingly competitive business environment, companies are not only required to deliver high-quality products but also to ensure that the overall customer experience—from pre-purchase to post-purchase stages—meets or exceeds customer expectations. Customer satisfaction has been widely recognized as a key driver of customer loyalty, positive word-of-mouth, and long-term business performance (Kotler & Keller, 2016; Zeithaml et al., 2020).

According to the Expectation–Confirmation Theory Oliver (1980), customer satisfaction arises when perceived performance meets or surpasses prior expectations. In this context, product quality, after-sales service, and marketing communication represent critical determinants that shape customers' evaluations of a firm's offerings. High product quality reflects reliability, durability, and functional performance, while effective after-sales service ensures continuous support through warranty handling, technical assistance, and complaint resolution. In addition, well-structured marketing communication enhances customer understanding, builds trust, and reinforces brand credibility.

Previous studies have consistently demonstrated that product quality significantly

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influences customer satisfaction (Garvin, 1987; Kotler & Keller, 2016; Ariestania & Dwiarta, 2020). Likewise, after-sales service has been identified as a key factor in sustaining long-term customer relationships by increasing perceived value and reducing post-purchase uncertainty (Lovelock & Wirtz, 2016; Ahn et al., 2016). Furthermore, marketing communication plays a strategic role in shaping customer perceptions and attitudes through consistent, informative, and persuasive messaging (Belch & Belch, 2021; Shimp & Andrews, 2018). Despite the extensive body of literature on customer satisfaction, most existing studies have focused on large-scale enterprises or service-based industries. Empirical evidence examining the simultaneous effects of product quality, after-sales service, and marketing communication within medium-scale manufacturing firms remains limited, particularly in emerging economies such as Indonesia. Manufacturing firms operating at the medium scale often face distinct challenges, including limited resources, inconsistent service systems, and constrained communication capabilities, which differentiate them from large corporations (Nguyen & Nguyen, 2022).

Moreover, prior studies tend to investigate these determinants in isolation, providing limited insight into their combined influence on customer satisfaction. This fragmented approach highlights a significant research gap, as understanding the integrated effect of these factors is essential for developing comprehensive managerial strategies. Addressing this gap is particularly important in industrial regions such as Gresik, where manufacturing companies face increasing competition and rising customer expectations. Therefore, this study aims to examine the effects of product quality, after-sales service, and marketing communication on customer satisfaction in medium-scale manufacturing firms located in Gresik, Indonesia. By integrating these three constructs into a unified analytical framework, this research seeks to contribute theoretically to the marketing and operations management literature, while also offering practical insights for managers seeking to enhance customer satisfaction and strengthen long-term competitiveness.

Meanwhile, product quality is a key determinant of customer satisfaction, particularly in the manufacturing sector, which emphasizes product reliability, durability, and performance. According to Garvin (1987), product quality encompasses the dimensions of performance, reliability, durability, conformance to specifications, and ease of maintenance. High-quality products tend to meet or even exceed customer expectations, thus creating a positive evaluation of the company.

The Expectancy-Confirmation Theory Oliver (1980) explains that customer satisfaction arises when a product's actual performance meets or exceeds the customer's initial expectations. In the manufacturing industry, consistent product quality plays a crucial role in building customer trust and reducing post-purchase uncertainty. Several empirical studies also show that product quality has a positive and significant influence on customer satisfaction (Kotler & Keller, 2016; Ariestania & Dwiarta, 2020; Kaur & Soch, 2018). Based on these theoretical arguments and empirical findings, the following hypothesis is formulated:

H1: Product quality has a positive influence on customer satisfaction.

After-sales service is a crucial element in building long-term relationships between companies and customers, particularly in manufacturing industries that involve long-term product use. After-sales service encompasses technical support, complaint handling,

warranty service, and spare parts availability (Lovelock & Wirtz, 2016).

According to SERVQUAL theory Parasuraman et al. (1988), the dimensions of reliability and responsiveness are key factors in shaping perceptions of service quality. Responsive and professional after-sales service can increase customer trust and strengthen post-purchase satisfaction. Several empirical studies have shown that after-sales service quality has a significant impact on customer satisfaction, particularly in the manufacturing and technology-based industries (Ahn et al., 2016; Lee & Kim, 2021). Therefore, the following hypothesis can be formulated:

H2: After-sales service has a positive effect on customer satisfaction.

Marketing communications play a strategic role in shaping customer perceptions, attitudes, and trust toward a brand. According to the Integrated Marketing Communications (IMC) concept, consistent, informative, and persuasive communications can strengthen customers' understanding of a product's value and reduce uncertainty in the decision-making process (Belch & Belch, 2021). In the manufacturing industry, effective marketing communications help customers understand a product's technical specifications, usage benefits, and available after-sales support. Previous research shows that clear and credible marketing communications contribute significantly to increased customer satisfaction (Shimp & Andrews, 2018; Rahman & Dewi, 2020). Furthermore, transparent communications strengthen perceptions of a company's professionalism and commitment to customers. Based on this description, the following hypothesis is formulated:

H3: Marketing communications have a positive effect on customer satisfaction.

Referring to Service Dominant Logic Vargo and Lusch (2004), the combined influence of product quality, after-sales service, and marketing communications produces a synergistic effect, indicating that managing these factors together has a greater impact on satisfaction than managing them separately. Thus, the conceptual framework model in this study can be illustrated in Figure 1.

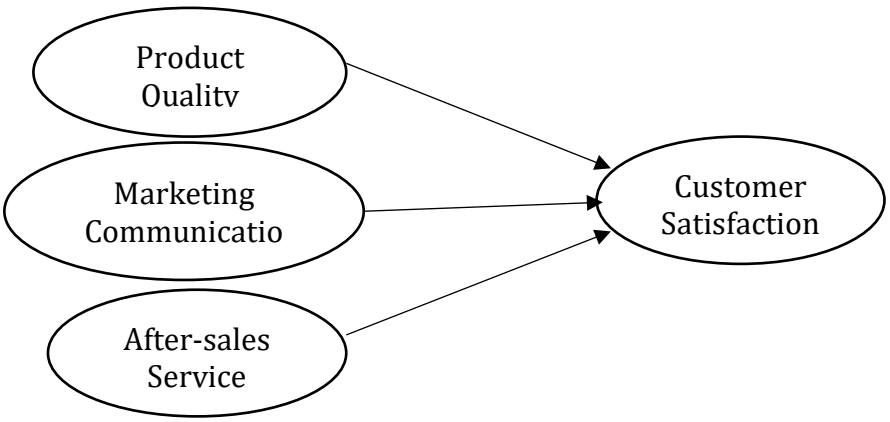

Figure 1. Conceptual framework

Methods

The study population consisted of customers of the medium-sized manufacturing company Adisa Jaya Industri, located in Sidojangkung, Menganti, Gresik, East Java, which produces milling machines and metal-based industrial products. From a total population of 350 customers, the sample size was determined using the Slovin formula with a 5% margin of error, resulting in 120 respondents. A purposive sampling technique was used to select participants who had purchased the company's products at least twice in the past year (2025), ensuring that respondents had sufficient experience with the company's products and services. Primary data were collected through a structured questionnaire distributed in printed form. The questionnaire consisted of two main sections: (1) the respondents' demographic profile and (2) statements measuring the research variables. All items were scored using a five-point Likert scale (1 = strongly disagree to 5 = strongly agree). Prior to full-scale data collection, a pilot test involving 30 respondents was conducted to evaluate the reliability and clarity of the questionnaire items. The collected data were analyzed using Structural Equation Modeling (SEM) with AMOS version 26.0.

Each variable is then broken down into several measurement indicators adapted from relevant literature sources and tailored to the context of the milling machine industry at Adisa Jaya Industri. These are shown in Table 1.

Table 1 Operational definitions of variables

Variables	Definitions	Indicator Measurement	Source
Product Quality	The ability of a product to meet or exceed customer expectations in terms of performance, durability, and conformance to standards.	Performance, reliability, durability, fit, aesthetics	Kotler and Keller (2016), Garvin (1987)
After-sales Service	Post-purchase activities provided to maintain customer satisfaction and loyalty	Warranty, responsiveness, complaint handling, spare parts availability	Chakraborty et al. (2021), Ariyanto et al. (2025)
Marketing Communications	Company communication to inform, persuade, and remind customers about a product or service	Message clarity, consistency, credibility, and engagement	Belch and Belch (2020), Zeithaml et al. (2018)
Customer Satisfaction	Consumers' overall evaluatio of a product or service experience basedon a comparison of expectations and performance	Confirmation of expectations, perceived value, repurchase intention	Parasuraman et al. (1988), Tjiptono (2019)

Results and Discussions

The demographic profile of respondents provides an overview of the individuals who participated in this study, representing customers of Adisa Jaya Industri—a medium-scale manufacturing company producing grinding machines in Gresik, East Java. A total of 120 valid responses were collected from customers who have purchased the company's products at least twice within the past year. The demographic characteristics include gender, age, education level, and business type, as presented in Table 2.

Tabel 2. Demographic characteristics of respondents

Variable	Category	Frequency (n)	Percentage (%)
Gender	Male	95	79.2
	Female	25	20.8
Age	< 30 years	18	15.0
	31–40 years	37	30.8
	41–50 years	45	37.5
	> 50 years	20	16.7
Education	Junior High School	40	33.3
	Senior High School	25	20.8
	Diploma	48	40.0
	Bachelor's Degree	7	5.8
Type of Business	Rice Milling	55	45.8
	Corn Milling	35	29.2
	Feed Production	20	16.7
	Other Machinery Uses	10	8.3

As shown in Table 2, most respondents were male (79.2%), reflecting the dominance of male operators or business owners in the agricultural and manufacturing equipment sectors. In terms of age, the largest proportion (37.5%) ranged from 41 to 50 years, indicating that the majority of customers are in their productive working age and have considerable business experience. Regarding education level, 40% of respondents held a bachelor's degree, suggesting that customers are relatively well-educated and capable of making rational purchasing decisions. Furthermore, most respondents (45.8%) were engaged in rice milling businesses, followed by corn milling (29.2%) and feed production (16.7%). These results confirm that Adisa Jaya Industri's main market segment consists of small and medium-scale agricultural entrepreneurs who rely heavily on grinding machinery for operational efficiency. The data analysis began with validity and reliability testing to ensure that each indicator accurately and consistently measured its respective construct. This is shown in the following table 2. The test results show that all items from the indicator measurements for the four variables meet the validity and reliability criteria. The validity values generated from all items are higher than 0.30, indicating that the constructs of all items are able to adequately explain the indicator variance. Furthermore, the Cronbach's Alpha values generated for each indicator exceed 0.60, confirming that the measurement instrument has excellent internal consistency. Thus, the four variables used in the structural model are considered suitable for use in further structural analysis.

Table 2. Validity and Reliability Test

Item	CTIC	Reliability	Explanation
Product Quality			
The product has good performance according to its function	.654	.781	Valid and Reliable
The product works reliably and rarely experiences interruptions	.623		Valid and Reliable
The product has good durability in long-term use	.732		Valid and Reliable
The product meets my specifications and needs	.637		Valid and Reliable
This product increases my desire to buy or use the product	.682		Valid and Reliable
After-sales Service			
The warranty provides a sense of security when using the product	.577	.685	Valid and Reliable
The company responded quickly to my complaint	.616		Valid and Reliable
The company is open to customer feedback and complaints	.603		Valid and Reliable
The availability of spare parts ensures smooth product use	.517		Valid and Reliable
Marketing Communications			
Product information is presented clearly and easily understood.	.584	.625	Valid and Reliable
There is no discrepancy between promotional information and the actual product	.506		Valid and Reliable
The company presents information honestly and transparently	.667		Valid and Reliable
I feel emotionally connected to this brand.	.495		Valid and Reliable
Customer Satisfaction			
The product experience met my expectations	.753	.857	Valid and Reliable
This product provides benefits that exceed its price	.753		Valid and Reliable
I intend to purchase this product again in the future	.691		Valid and Reliable

Before conducting the SEM analysis, validity and reliability tests were conducted to ensure that each indicator in the research construct met the criteria for good measurement. Validity testing was conducted using Confirmatory Factor Analysis (CFA) by examining factor loading values. Meanwhile, construct reliability was tested using Composite Reliability (CR) values. Table 3 below displays the reliability test results for each construct.

Table 3. CFA and Composite Reliability

Variables	Indicator	Factor Loading	Composite Reliability (CR)
Product Quality	QP1	0.876	0.851
	QP2	0.749	
	QP3	0.725	
	QP4	0.630	
	QP5	0.664	
After-Sales Service	ASS1	0.743	0.846
	ASS2	0.740	
	ASS3	0.792	
	ASS4	0.636	
Marketing Communication	MC1	0.628	0.817
	MC2	0.640	
	MC3	0.692	
	MC4	0.626	
Customer Satisfaction	CS1	0.852	0.881
	CS2	0.928	
	CS3	0.875	

From table 3 it is explained that the five indicators are stated as Fit based on the standardized loading factor shown in each indicator, namely performance produces 0.876 greater than 0.50; reliability produces 0.749 greater than 0.50; durability produces 0.725 greater than 0.50; suitability produces 0.630 greater than 0.50; and aesthetics produces 0.664 greater than 0.50 so that it is stated as appropriate or accepted as a CFA measurement model, because the model formed by product quality against the five indicators can be accepted in supporting the structural model. Furthermore, the validity results on the items built by each indicator (five indicators) against the product quality variable are stated as statistically reliable with a composite reliability value of 0.851 greater than 0.70, because the composite reliability value is above the limit categorized as having a strong enough influence, so that the five indicators are considered to meet as a measure of the product quality construct.

From table 3 it is explained that the four indicators are stated as Fit based on the standardized loading factor shown in each indicator, namely warranty produces 0.743 greater than 0.50; respondness produces 0.740 greater than 0.50; complaint handling produces 0.792 greater than 0.50; and spare parts availability produces 0.636 greater than 0.50; so it is stated as appropriate or accepted as a CFA measurement model, because the model formed by after-sales service against the four indicators can be accepted in supporting the structural model. Furthermore, the validity results on the items built by each indicator (four indicators) against the after-sales service variable are stated as statistically reliable with a composite reliability value of 0.846 greater than 0.70, because the composite reliability value is above the limit categorized as having a strong enough influence, so that the four indicators are considered to meet as a measure of the after-sales service construct.

Table 3 explains that the four indicators are stated as Fit based on the standard loading

factors shown in each indicator, namely the clarity of the message produced is 0.628 greater than 0.50; the consistency produced is 0.640 greater than 0.50; the credibility produced is 0.692 greater than 0.50; and the involvement produced is 0.616 greater than 0.50; so that it is stated as appropriate or accepted as a CFA measurement model, because the model formed by marketing communications against the four indicators can be accepted in supporting the structural model. Furthermore, the validity results on the items built by each indicator (four indicators) against the marketing communications variable are stated to be statistically reliable with a composite reliability value of 0.817 greater than 0.70, because the composite reliability value is above the limit categorized as having a fairly strong influence, so that the four indicators are considered to meet as a measure of the marketing communications construct.

From table 3 it is explained that the three indicators are stated as Fit based on the standardized loading factor shown in each indicator, namely confirmation of expectations produces 0.852 greater than 0.50; perceived value produces 0.928 greater than 0.50; and repurchase intention produces 0.875 greater than 0.50; so it is stated as appropriate or accepted as a CFA measurement model, because the model formed by customer satisfaction with the three indicators can be accepted in supporting the structural model. Furthermore, the validity results on the items built by each indicator (the three indicators) against the customer satisfaction variable are stated as statistically reliable with a composite reliability value of 0.881 greater than 0.70, because the composite reliability value is above the limit categorized as having a fairly strong influence, so that the three indicators are considered to meet as a measure of customer satisfaction construct.

The model evaluation in this study employed the *Structural Equation Modeling* (SEM) approach using the *one-step* method, in which both the measurement and structural models were estimated simultaneously. The initial results indicated that the model did not fully meet the recommended *goodness-of-fit* criteria. Although the conceptual framework developed and grounded in theory was empirically supported, the initial model demonstrated limited explanatory power regarding the relationships among variables. Therefore, a model modification analysis was conducted to achieve a better fit. This approach allows for a comprehensive examination of causal relationships among variables within a single analytical process (Hair et al., 2017). After modification, the estimated model is expected to more accurately represent the relationships among research variables, as illustrated in Figure 2.

The results of the model evaluation from Figure 2 based on the goodness-of-fit indicate that the proposed model meets the recommended adequacy criteria. Therefore, it can be concluded that the developed structural model is consistent with the empirical data. The corresponding fit indices supporting this conclusion are presented in Table 4. Table 4 displays the goodness-of-fit results used to assess the overall suitability of the structural model. Based on the test results, the resulting Chi-square value indicates no significant difference between the model data and the observational data, as the result of 73.115 is smaller than the limit of 98.484. This indicates that the model fully fits the empirical data because the value is significant at the 0.05 level. However, this index is known to be very sensitive to sample size, so the assessment of model feasibility is not only based on Chi-square alone but can be seen from the results of other criteria. The Probability value of 0.604 (p-value) is above the 0.05 threshold, indicating that the model is acceptable. In addition,

the resulting Goodness of Fit Index (GFI) value is 0.932, which is above the 0.90 threshold, indicating that the model is acceptable. Then the resulting Adjusted Goodness of Fit (AGFI) is 0.912, which is above the 0.90 threshold, indicating that the model is acceptable. The Comparative Fit Index (CFI) was 1.000, above the 0.90 threshold, the Tucker Lewis Index (TLI) was 1.000, above 0.90, and the Normative Fit Index (NFI) was 0.942, above the 0.90 threshold. This indicates a comparison between the hypothesized model and the independence model (null model) and the saturated model, indicating a very good level of model fit.

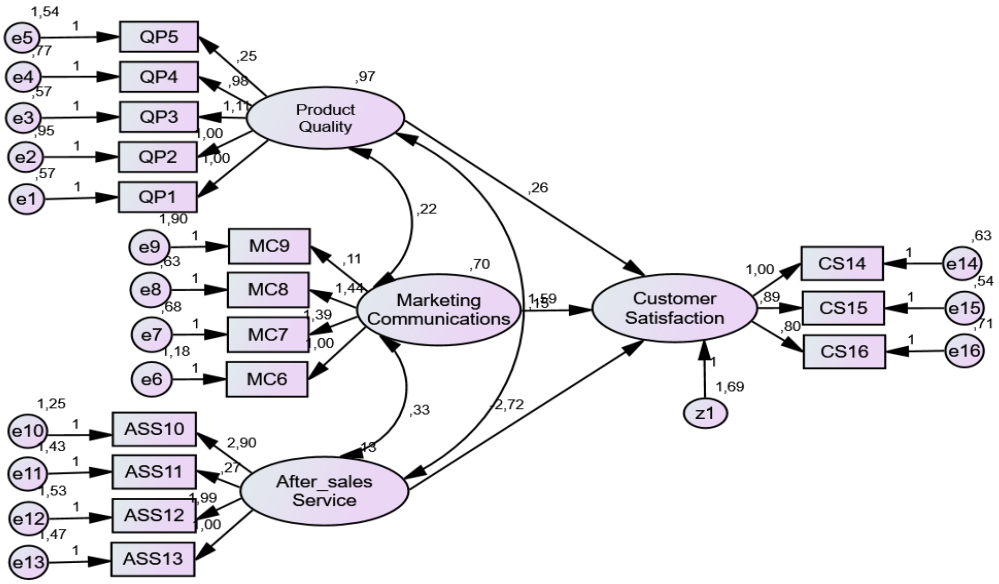

Figure 2. The conceptual framework developed

Table 4. Evaluation Goodness of Fit

Criteria	Results	Cut-off Value	Evaluasi Model
Chi-squares	73.115	< 98.484	Fit
Cmin/DF	0.950	≤ 2,00	Fit
Probability	0.604	> 0,053	Fit
GFI	0.932	≥ 0,90	Fit
RMSEA	0.025	≤ 0,08	Fit
AGFI	0.912	≥ 0,90	Fit
CFI	1.000	≥ 0.95	Fit
TLI	1.000	≥ 0,90	Fit
NFI	0.942	≥ 0,90	Fit
PNFI	0.605	≤ 0,90	Fit
PCFI	0.642	≤ 1,00	Fit

Meanwhile, the Root Mean Square Error of Approximation (RMSEA) was 0.025, below 0.08, indicating a low level of approximation error between the model and the data. The Non-Normative Parsimony Fit Index (PNFI) was 0.605, below the 0.90 threshold, and the Comparative Parsimony Fit Index (PCFI) was 0.642, below the 1.00 threshold. Both are fit indices used in Structural Equation Modeling (SEM) analysis to evaluate how well a model fits the data, considering model parsimony. Overall, these results confirm the Fit results

because the developed model meets all model fit criteria, including absolute, incremental, and parsimony. Therefore, the proposed structural model is considered suitable for use in testing the relationships between latent variables in the next stage. After confirming the validity and reliability of the measurement model, the next step is to test the structural model to verify the proposed hypotheses. This analysis aims to determine the direction and significance of the relationships between the latent constructs as defined in the conceptual framework. Table 5 below summarizes the results of the hypothesis testing, including path coefficient estimates, CR statistics, and significance levels for each proposed relationship.

Table 5. Results of the Inter-Variable Influence

Paath	Estimate	C.R.	P	Explanation
Marketing Communications → Customer Satisfaction	.284	2.417	.016	Sig.
Product Quality → Customer Satisfaction	.259	2.183	.026	Sig.
After-Sales Service → Customer Satisfaction	.341	3.026	.002	Sig.

As presented in Table 5, all hypothesized relationships among the main constructs were positive and statistically significant. First, the Quality Product variable has a positive and significant effect on Customer Satisfaction**,** with a path coefficient of 0.259, a *CR-statistic* of 2.183, and a *p-value* of 0.036 (< 0.05). This result indicates that the higher the company's effort to improve product quality, particularly in terms of the reliability and performance of milling machines, the greater the level of customer satisfaction achieved. Therefore, H1 is accepted. Second, the After-Sales Service variable shows a positive and significant influence on Customer Satisfaction, with a path coefficient of 0.341, a CR-statistic of 3.026, and a p-value of 0.002 (< 0.05). This suggests that responsive after-sales services—such as warranty handling, regular maintenance, and technical support—enhance customers' perception of company reliability, thereby strengthening their satisfaction. Hence, H2 is accepted. Third, the Marketing Communication variable also has a positive and significant effect on Customer Satisfaction, with a path coefficient of 0.284, a CR-statistic of 2.417, and a p-value of 0.016 (< 0.05). This result demonstrates that consistent, informative, and persuasive marketing communication helps customers better understand product benefits, build trust, and foster post-purchase loyalty. Therefore, H3 is accepted. Overall, the findings confirm that product quality, after-sales service, and marketing communication jointly play a crucial role in enhancing customer satisfaction within medium-scale manufacturing firms.

The results of this study indicate that product quality has a positive and significant effect on customer satisfaction. This finding supports the Expectation–Confirmation Theory Oliver (1980), which explains that satisfaction is formed when product performance meets or exceeds consumer expectations. This finding aligns with research by Nguyen and Nguyen (2022) and Zeithaml et al. (2020), which found that product quality is a primary determinant of customer satisfaction in the manufacturing sector. In the context of the grinding machine industry in Gresik, increased machine precision and reliability strengthen customer perceptions of value and trust. Therefore, this study strengthens empirical evidence that product quality remains a crucial factor in building customer satisfaction in the medium-scale manufacturing industry in Indonesia. The findings of this study indicate that after-sales service has a positive and significant effect on customer satisfaction,

underscoring the critical role of warranty handling, maintenance support, and technical assistance in sustaining long-term customer relationships. This result supports the SERVQUAL framework (Parasuraman et al., 1988), which emphasizes reliability and responsiveness as fundamental dimensions of perceived service quality that shape post-purchase evaluations.

Consistent with the findings of Ahn, Kim, and Lee (2016) and Lee and Kim (2021), responsive and effective after-sales service enhances customers' perceptions of a firm's commitment and accountability, which in turn strengthens trust and loyalty. In the context of manufacturing firms, particularly in capital-intensive products such as grinding machines, after-sales service reduces operational uncertainty and perceived risk, thereby increasing satisfaction. For Adisa Jaya Industri, these findings suggest that improving service response times, strengthening technical support, and implementing more systematic warranty tracking mechanisms can significantly enhance customer satisfaction and reinforce long-term relational value. The results also demonstrate that marketing communications positively and significantly influence customer satisfaction, highlighting the importance of delivering clear, consistent, and credible information to customers. This finding aligns with the principles of Integrated Marketing Communications (IMC) Belch and Belch (2021), which argue that coordinated and persuasive communication enhances customer understanding and evaluation of a product. Effective marketing communication fosters clarity, trust, and post-purchase confidence, which are essential determinants of satisfaction (Shimp & Andrews, 2018). In the manufacturing context, transparent communication regarding product specifications, performance, and after-sales support helps manage customer expectations and reduces information asymmetry. Thus, this study extends prior research by demonstrating that, beyond product performance and service quality, strategic communication plays a crucial role in shaping customer satisfaction in business-to-business manufacturing settings, particularly among medium-scale industrial firms. Overall, these findings suggest that building customer satisfaction in mid-sized manufacturing companies relies not only on superior product quality but also on effective after-sales service and marketing communications. Together, these three factors build a strong foundation for maintaining customer relationships and competitive advantage in an increasingly demanding industrial marketplace.

Conclusion

The results of this study demonstrate that product quality, after-sales service, and marketing communications have positive and significant effects on customer satisfaction in medium-scale manufacturing firms. Product reliability, precision, and durability play a crucial role in shaping positive customer evaluations and satisfaction levels. In addition, effective after-sales service—such as responsive warranty handling, maintenance support, and technical assistance—strengthens customer trust and fosters long-term relationships. Furthermore, clear and consistent marketing communications enhance customers' understanding of product benefits, reduce post-purchase uncertainty, and reinforce perceptions of company credibility. Overall, these findings confirm that customer satisfaction in the manufacturing sector is influenced not only by product excellence but also by the quality of post-purchase services and communication strategies.

Overall, this study concludes that customer satisfaction in the medium-scale

manufacturing industry is fostered through the synergy between superior product quality, responsive after-sales service, and effective marketing communications. These three factors complement each other in creating a positive and sustainable customer experience.

This study has several limitations that require attention. First, the data was collected using a survey method with a cross-sectional approach, so the results are unable to capture changes in customer satisfaction perceptions over the long term. Second, the research subjects were limited to medium-sized manufacturing companies, so the generalizability of the research results to other industrial sectors or different business scales is limited. Third, this study only examined three independent variables, so other factors that could potentially influence customer satisfaction, such as price, trust, and brand loyalty, were not comprehensively addressed. Future research is recommended to extend this study by incorporating additional relational variables such as customer trust, perceived value, or customer loyalty to better explain long-term outcomes beyond customer satisfaction. Further studies may also examine the moderating effects of digital transformation, firm size, or industry characteristics to capture contextual differences within the manufacturing sector. Moreover, applying longitudinal or mixed-methods approaches and expanding the research setting across different regions or manufacturing industries would enhance the generalizability and robustness of the findings.

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