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Improving Industrial Chemical Supply Chain Reliability through Customer Feedback in the Pulp and Paper Sector

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ABSTRACT

Increasing competition in Indonesia's pulp and paper industry requires industrial chemical suppliers to strengthen supply chain performance and customer relationships. This study evaluates customer perceptions of chemical quality, supply reliability, service responsiveness, technical support, complaint handling, business communication, and customer value using the Customer Satisfaction Index (CSI) and Importance Performance Analysis (IPA). Data were collected through questionnaires distributed to customers from eight pulp and paper companies in Indonesia. The results show that chemical quality, supply reliability, and business communication are the main factors supporting supply chain reliability and customer satisfaction. Meanwhile, service responsiveness, technical support, and complaint handling still require improvement due to their influence on operational effectiveness and customer experience. The findings provide practical insights for improving service quality, strengthening customer value, and enhancing long-term competitiveness in the industrial chemical supply chain sector.

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INTRODUCTION

Indonesia's pulp and paper industry plays an important role in economic growth and export performance [1]. Rising demand has increased the need for efficient supply chains, consistent product quality, and reliable chemical supply to support production activities [2]. As competition intensifies, suppliers must enhance service quality, responsiveness, and customer relationships to remain competitive and support operational performance [3].

Many industrial chemical suppliers continue to focus primarily on price and product specifications rather than overall supply chain performance [4]. This approach can reduce their understanding of customer operational needs and weaken supply chain collaboration [5]. As a result, customer feedback has become essential for improving service quality, coordination, and long-term business performance [6].

Customer feedback is essential for improving service quality, customer satisfaction, and supply chain performance [7]. In B2B markets, it also helps companies respond more effectively to customer needs and strengthen supply chain collaboration [8]. However, studies on customer feedback in Indonesia's pulp and paper chemical supply chain remain limited [9].

This study proposes a customer feedback based approach to improve supply chain service performance in industrial chemical companies [10]. Customer evaluations were used to identify service gaps and operational improvement priorities [11]. The proposed approach aims to strengthen customer relationships, improve supply

chain coordination, and support sustainable sales performance [12].

This study examines customer feedback in the industrial chemical supply chain and sales activities [13]. It highlights the importance of technical service and long-term partnerships in supporting B2B performance [14]. The findings also emphasize continuous improvement in service and sales to strengthen overall supply chain effectiveness [15].

Supply Chain Management

Supply Chain Management emphasizes long-term collaboration among B2B partners [16]. Strong relationships improve trust, coordination, and supply chain performance [17]. Customer satisfaction supports stable and lasting business cooperation [18]. Customer feedback helps companies understand customer needs and improve supply chain responsiveness [19].

Customer Relationship Management

Customer Relationship Management emphasizes creating value by meeting customer expectations through ongoing interactions [20]. Customer feedback supports service improvement and continuous innovation [21]. In industrial chemical sales, it helps companies better understand customer operational needs [22]. This strengthens customer loyalty and improves competitiveness in the pulp and paper supply chain [23].

Customer Feedback

Customer Feedback Management Theory highlights the value of customer input for continuous business improvement [24]. Customer feedback supports service enhancement and innovation [25]. In industrial chemical sales, it helps

companies understand customer needs and refine sales strategies [26].

This study evaluates customer feedback using seven attributes: chemical quality [27], supply reliability [28], service responsiveness [29], technical support [30], complaint handling [31], business communication [32], and customer value [33]. These attributes were used to assess service and sales performance in the industrial chemical sector. Their application can improve customer loyalty and support sustainable sales growth in the pulp and paper industry [34].

Integrated Theoretical Framework and Attribute Selection



Figure 1. Integrated Theoretical and Analytical Framework

RESEARCH METHOD

Research Design

This study used a quantitative descriptive approach to examine customer feedback on industrial chemical sales in the pulp and paper industry. Numerical data were analyzed to measure customer satisfaction and identify priorities for service improvement. A systematic research process was applied to ensure valid and reliable findings.

Research Location and Time

The study was conducted at PT XYZ, an industrial chemical supplier serving pulp and paper companies in Indonesia. Respondents were selected from seven client companies, identified as Company A to Company H to preserve confidentiality. Data collection and analysis were carried out from January to May 2026.

SCM, CRM, and Customer Feedback Management are integrated to explain supply chain reliability and customer relationships. Seven attributes chemical quality, supply reliability, service responsiveness, technical support, complaint handling, business communication, and customer value represent key customer and operational aspects, while other factors such as price transparency, contract flexibility, and sustainability are outside the study scope. CSI, IPA, and FMEA provide complementary assessments of satisfaction, performance gaps, and operational risks. Figure 1 summarizes this framework and its resulting improvement priorities.

Population and Sample

Population

The study population consisted of customers from pulp and paper companies in Indonesia that partner with PT XYZ for industrial chemical procurement. Respondents were employees involved in purchasing, production, quality control, and technical evaluation. To maintain confidentiality, the participating companies are referred to as Company A through Company H.

Sample

The sample size was determined using Slovin's formula with the specified margin of error, resulting in a minimum requirement of 36 respondents. Accordingly, the study included 36 respondents representing relevant customers in the industrial chemical supply chain. Respondents were selected based

on their direct experience with the supplier's products and services.

The study involved 36 key informants drawn from eight pulp and paper companies across Indonesia. These respondents were selected from roles that are directly engaged in procurement, production processes, quality control, and technical evaluation of industrial chemical usage. Companies A–D contributed five respondents each, while Companies E–H contributed four respondents each. Given

the relatively balanced distribution, no weighting adjustment was applied.

Data Collection Technique

Questionnaire

A questionnaire was used to collect customer feedback and evaluate service performance. The instrument measured product quality, delivery, responsiveness, technical support, complaint handling, communication, and customer value. Each attribute was assessed using a 5-point Likert scale to measure its importance and performance.

Table 1. Customer Feedback Attributes and Sub Attributes in the Pulp and Paper Industry

Attributes		Sub Attributes		
Chemical Quality	Product Stability	Quality Consistency	Process Compatibility	Product Reliability
Supply Reliability	Delivery Accuracy	Supply Continuity	Quantity Accuracy	Schedule Compliance
Service Responsiveness	Response Speed	Information Clarity	Service Accessibility	Follow-up Action
Technical Support	Technical Assistance	Solution Accuracy	Staff Competence	Problem Resolution
Complaint Handling	Complaint Response	Issue Resolution	Follow-up Seriousness	Resolution Clarity
Business Communication	Communication Quality	Professional Attitude	Customer Understanding	Relationship Quality
Customer Value	Price Suitability	Service Benefit	Cost Efficiency	Overall Satisfaction

[Table 1](#) presents the customer feedback attributes used in this study. The evaluation covers chemical quality, supply reliability, responsiveness, technical support, complaint handling, communication, and customer value. Relevant service indicators represent each attribute. These variables were used to assess customer perceptions and identify improvement priorities.

Documentation

Documentation was used to collect secondary data for the research. The documents included company profiles,

customer complaint records, sales reports, and customer lists. These data supported the analysis and strengthened the interpretation of the findings.

Literature Review

The literature review drew on books, journal articles, and previous studies related to customer feedback and satisfaction. It provided the theoretical foundation for the research framework. The review also supported the application of the CSI and IPA methods.

Research Instrument

The main research instrument used in this study was a structured questionnaire. The questionnaire was developed based on dimensions related to customer feedback and service quality in industrial chemical sales. All statements were measured using a Likert scale ranging from 1 to 5.

Validity and Reliability Testing

The questionnaire was tested for validity and reliability before data collection. Validity testing used product-moment correlation analysis to ensure each item measured the intended concept accurately. Reliability testing used Cronbach's Alpha to evaluate the consistency of the instrument.

Research Procedure

The study began by identifying issues related to sales performance and the use of customer feedback at PT XYZ. It then proceeded with a literature review, questionnaire development, and respondent selection. The collected data were analyzed using CSI, IPA, and FMEA to generate improvement recommendations.

Research Procedure Algorithm

The research stages included problem identification, literature review, questionnaire development, respondent selection, and data collection. The collected data then underwent validity and reliability testing before being analyzed using CSI and IPA methods. The final stage involved interpreting the findings and preparing the research report.

Data Analytics Technique

Customer Satisfaction Index

Customer Satisfaction Index (CSI) was used to measure overall customer satisfaction toward PT XYZ's products and services. The analysis is based on Mean Importance Score (MIS), Mean Satisfaction Score (MSS), Weight Factor (WF), and Weight Score (WS). A higher CSI value indicates a higher level of customer satisfaction [35].

The Mean Importance Score (MIS) represents how important a specific attribute is perceived by customers. It is calculated using the following formula:

$$MIS_i = \frac{\sum Y_i}{n} \quad (1)$$

The Mean Satisfaction Score (MSS) reflects the actual performance perception of customers toward each service attribute. It is calculated as follows:

$$MSS_i = \frac{\sum X_i}{n} \quad (2)$$

The Weight Factor (WF) represents each attribute's proportional contribution to the overall importance score. It is calculated by dividing the Mean Importance Score (MIS) of each attribute by the total MIS of all attributes, as follows:

$$WF_i = \frac{MIS_i}{\sum MIS_i} \quad (3)$$

The Weight Score (WS) represents each attribute's contribution to overall customer satisfaction. The formula is:

$$WS_i = WF_i \times MSS_i \quad (4)$$

The Customer Satisfaction Index (CSI) is calculated by dividing the total Weight Score by the highest scale used in the questionnaire. The formula is:

$$CSI = \frac{\sum WS}{HS} \quad (5)$$

Table 2. CSI Interpretation Criteria

CSI Value	Category
0,81 – 1,00	Very Satisfied
0,66 – 0,80	Satisfied

CSI Value	Category
0,51 – 0,65	Fairly Satisfied
0,35 – 0,50	Dissatisfied
0,00 – 0,34	Very Dissatisfied

[Table 2](#) presents the Customer Satisfaction Index (CSI) interpretation used in this study. The CSI values classify customer satisfaction into five levels, from very dissatisfied to very satisfied. Higher CSI scores indicate more positive evaluations of service performance. These criteria were used to assess overall customer satisfaction with industrial chemical services.

Importance Performance Analysis (IPA)

Importance Performance Analysis (IPA) compare the importance of service attributes with their actual performance [\[36\]](#). The method is widely applied in service quality research as a tool for managerial decision-making [\[37\]](#). IPA helps organizations identify which attributes need improvement, should be maintained, or receive lower priority.

The analysis maps attributes into four quadrants using average importance and performance scores. The quadrant intersection is determined from the mean values of all evaluated attributes [\[38\]](#). The formulas are presented as follows:

$$\hat{x} = \frac{\sum \bar{x}_i}{k}; \hat{y} = \frac{\sum \bar{y}_i}{k} \quad (6)$$

The four quadrants are interpreted as follows: Quadrant I requires immediate improvement, Quadrant II should be maintained, Quadrant III has low priority, and Quadrant IV indicates excessive performance on less important attributes.

Failure Mode and Effect Analysis (FMEA)

Failure Mode and Effects Analysis (FMEA) was used to identify potential service failures in industrial chemical sales for the pulp and paper industry. The method evaluated risks related to chemical quality, delivery, technical support, complaint handling, and communication. FMEA prioritizes improvement actions by assessing the severity, occurrence, and detection of potential failures. Each potential failure was evaluated using three FMEA criteria: Severity (S), Occurrence (O), and Detectability (D), with scores from 1 to 10. The Risk Priority Number (RPN) was calculated as $RPN = S \times O \times D$ to determine the risk level. Higher RPN values indicate issues that should receive priority for corrective action.

Table 3. FMEA Assessment Criteria

Criteria	Description	Scale
Severity (S)	Impact of failure on customer operations	1 = Very Low, 10 = Very High
Occurrence (O)	Frequency of failure occurrence	1 = Rare, 10 = Very Frequent
Detectability (D)	Ability to detect failure before customer impact	1 = Early Detected, 10 = Difficult to Detect

[Table 3](#) presents the FMEA criteria used to evaluate potential risks in industrial chemical sales. The assessment applies Severity, Occurrence, and Detectability, each measured on a 1–10 scale. Higher

scores indicate greater risk and operational impact. These criteria help identify improvement priorities and support more effective corrective actions.

RESULT AND DISCUSSION

Result

The study involved 36 key informants drawn from eight pulp and paper companies across Indonesia. These respondents were selected from roles that are directly engaged in procurement, production processes, quality control, and

technical evaluation of industrial chemical usage. Their involvement ensures that the data reflects informed and practical assessments of product performance and supplier service quality in real industrial operations.

Table 4. Characteristic of Respondents

Age (Years)	%	Education	%	Position	%	Working Experience	%
30 – 35	16,7	Diploma	25	Procurement Staff / Manager	37,5	5 – 8 years	15,0
36 – 40	37,5	Bachelor (S1)	62,5	QC Staff / Engineer	29,2	9 – 12 years	33,3
41 – 45	29,2	Master (S2)	12,5	Production Staff / Manager	20,8	13 – 16 years	25
> 45	16,7			Technical Staff / Manager	12,5	> 16 years	16,7

[Table 4](#) shows that the respondent profile supports the relevance of the collected feedback to industrial chemical supply decisions. The combination of professional experience and operational involvement provides a suitable basis for evaluating supplier performance, particularly in areas requiring practical knowledge of product quality, supply reliability, technical support, and service responsiveness. Thus, the respondent characteristics strengthen the contextual relevance of the findings rather than merely describing the sample

composition. The distribution of procurement, quality control, production, and technical personnel also provides balanced insights across the industrial chemical supply chain. Each functional area interacts with PT XYZ from a different operational perspective, allowing the study to capture diverse customer expectations and service experiences. As a result, the findings offer a comprehensive basis for identifying improvement priorities and supporting more effective sales and service strategies.

Table 5. Statistic Descriptive

Attributes	Statistic Descriptive							
	Performance				Importance			
	Min	Max	Mean	Std. Dev.	Min	Max	Mean	Std. Dev.
Chemical Quality	3,194	4,861	3,851	0,878	3,000	4,389	3,611	0,924
Supply Reliability	2,278	4,500	3,229	1,352	1,306	4,278	3,097	1,531
Service Responsiveness	2,333	3,583	2,889	1,473	2,444	4,556	3,503	1,184
Technical Support	1,556	3,778	2,465	1,160	2,306	4,528	3,233	1,349
Complaint Handling	1,472	3,722	2,524	1,116	2,111	4,389	3,266	1,388
Business Communication	2,556	4,139	3,217	1,330	1,694	4,528	3,257	1,408
Customer Value	1,063	3,688	2,431	1,615	1,833	4,083	2,583	1,266

[Table 5](#) shows noticeable differences between customer ratings of service performance and the importance assigned to each attribute. Chemical Quality recorded the highest performance score with relatively low variation, indicating that customers consistently perceive PT XYZ's product quality as reliable. In contrast, lower performance scores for Technical Support, Complaint Handling, and Customer Value suggest these areas need more attention to better match customer expectations.

The importance ratings indicate that customers reliable supply, responsive service, and effective technical support. The relatively large standard deviations for several attributes show that customer experiences vary across companies, highlighting opportunities for more consistent service delivery. These findings are important because they help identify service gaps and provide a clear basis for prioritizing improvement efforts that can strengthen customer satisfaction and long-term business relationships.

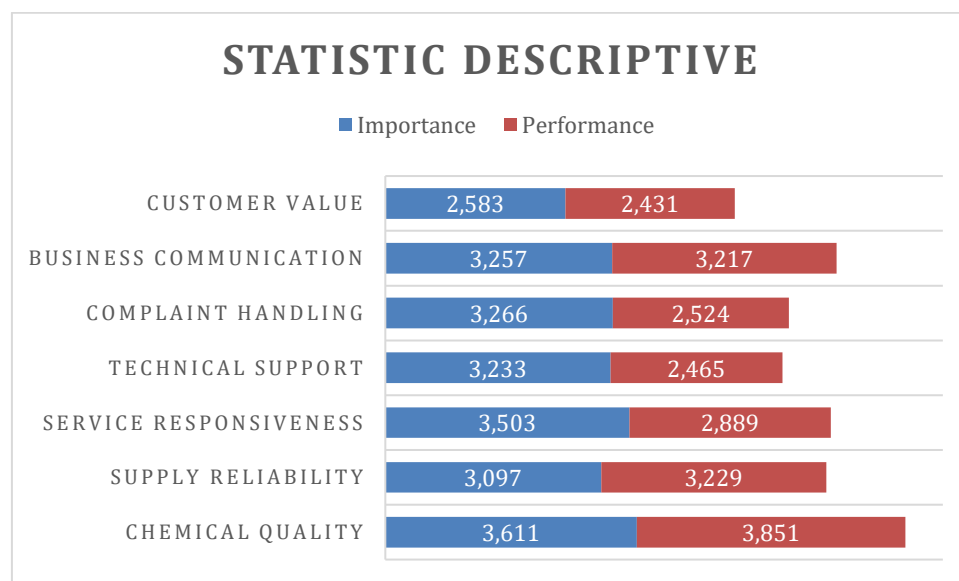


Figure 2. Comparison Statistic Descriptive Importance – Performance

[Figure 2](#) compares customers' perceived importance and actual performance across seven customer feedback attributes. Chemical Quality received the highest scores for both dimensions, whereas Complaint Handling exhibited the most noticeable gap between expectations and performance. Service Responsiveness and

Technical Support also performed below customer expectations, while Supply Reliability slightly exceeded its importance rating. These findings suggest that improvements in customer support and complaint resolution could further enhance supply chain reliability and customer satisfaction.

Table 6. Validity and Reliability Test Result

Attributes	Validity		Reliability	
	Importance	Performance	Importance	Performance
Chemical Quality	0,334 – 0,820	0,377 – 0,885	0,712	0,767
Supply Reliability	0,372 – 0,969	0,545 – 0,907	0,859	0,847

Attributes	Validity		Reliability	
	Importance	Performance	Importance	Performance
Service Responsiveness	0,542 – 0,917	0,827 – 0,991	0,816	0,938
Technical Support	0,347 – 0,892	0,322 – 0,916	0,914	0,824
Complaint Handling	0,349 – 0,960	0,318 – 0,954	0,897	0,806
Business Communication	0,325 – 0,965	0,321 – 0,948	0,824	0,905
Customer Value	0,530 – 0,904	0,393 – 0,922	0,895	0,843

Table 6 shows the assessment of indicator validity and instrument reliability for both the importance and performance dimensions. Correlation coefficients ranged from 0.318 to 0.991, showing that all measurement items satisfied the

required validity criteria. Moreover, Cronbach's alpha values between 0.712 and 0.938 indicate that the questionnaire provided consistent and dependable results.

Table 7. Customer Satisfaction Index (CSI) based on Customer Feedback

Attributes	MIS	MSS	WF	WS	CSI
Chemical Quality	3,611	3,851	0,160	0,617	0,123
Supply Reliability	3,097	3,229	0,137	0,443	0,088
Service Responsiveness	3,503	2,889	0,155	0,449	0,089
Technical Support	3,233	2,465	0,143	0,353	0,070
Complaint Handling	3,266	2,524	0,145	0,366	0,073
Business Communication	3,257	3,217	0,144	0,465	0,092
Customer Value	2,583	2,431	0,115	0,278	0,055

$\Sigma \text{CSI} = 0,594 = 59,4\%$
(Fairly Satisfied)

Example of CSI calculation for Chemical Quality

$$MIS_i = \frac{\sum Y_i}{n} = \frac{2080}{144} = 3,611$$

$$MSS_i = \frac{\sum X_i}{n} = \frac{2218}{144} = 3,851$$

$$WF_i = \frac{MIS_i}{\sum MIS} = \frac{3,611}{22,550} = 0,160$$

$$WS_i = WF_i \times MSS_i = 0,160 \times 3,851 = 0,617$$

$$CSI_i = \frac{\sum WS}{HS} = \frac{2,971}{5} = 0,123$$

Table 7 shows that Chemical Quality had the strongest contribution to overall customer satisfaction (12.33%), while Customer Value contributed the least (5.57%). This pattern suggests that product-related performance is a stronger driver of satisfaction, whereas customer value represents a relatively weaker area requiring attention. Improving technical support, complaint handling, and customer value while maintaining product quality may therefore strengthen overall supply chain service performance.

Chemical Quality, Supply Reliability, and Business Communication received the highest scores, reflecting strong product quality, reliable delivery, and effective customer communication. These factors are essential because pulp and paper production depends on consistent chemical performance and stable supply. The results support Relationship Marketing Theory, which emphasizes trust and communication in building long-term business relationships.

Service Responsiveness, Technical Support, and Complaint Handling scored lower than customer expectations. This suggests that customers expect faster responses, stronger technical support, and more effective complaint resolution from PT XYZ. The findings support Customer Satisfaction Theory and Customer Feedback Management Theory, showing that customer feedback helps identify

service gaps and guide improvement strategies.

A Kruskal–Wallis test examine whether satisfaction ratings differed across the eight participating companies. The test showed an overall significant difference ($H(7) = 27.755$, $p < 0.001$); however, no individual pair remained significant after Holm-adjusted post-hoc comparisons. Therefore, the findings are interpreted primarily as an overall assessment of customer feedback rather than company-specific performance.

The Importance–Performance Analysis (IPA) was conducted using the mean importance and performance scores obtained from the customer feedback survey. Each attribute was plotted on the IPA matrix based on these average scores, allowing the attributes to be classified into four quadrants according to their relative importance and performance. This classification provides the basis for identifying attributes that should be maintained, improved, or given lower managerial priority, as presented in [Table 8](#).

Table 8. Importance Performance Analysis (IPA) based on Customer Feedback

Attributes	Importance	Performance	Classification	Identification
Chemical Quality	3,611	3,851	Quadrant II	Keep up the good work
Supply Reliability	3,097	3,229	Quadrant II	Keep up the good work
Service Responsiveness	3,503	2,889	Quadrant I	Concentrate here
Technical Support	3,233	2,465	Quadrant I	Concentrate here
Complaint Handling	3,266	2,524	Quadrant I	Concentrate here
Business Communication	3,257	3,217	Quadrant II	Keep up the good work
Customer Value	2,583	2,431	Quadrant III	Low priority

[Table 8](#) indicates that service responsiveness, technical support, and complaint handling require the greatest managerial attention, as their importance scores exceed their current performance levels. These gaps suggest that customers expect stronger service support in areas directly affecting operational continuity and problem resolution. From a managerial perspective, companies should prioritize faster response mechanisms, strengthen technical expertise, and establish more effective complaint-handling procedures to improve service reliability and customer confidence.

Chemical quality, supply reliability, and business communication show relatively strong performance in relation to their importance, indicating that these capabilities should be maintained through

consistent quality control, dependable supply processes, and effective communication with customers. Customer Value is classified as a lower-priority area because both its importance and performance are relatively lower than those of the other attributes; however, it should still be monitored to identify opportunities to increase customers' perceived benefits. Overall, the findings suggest that improvement resources should be concentrated on service responsiveness, technical support, and complaint handling while preserving the strengths already demonstrated in product quality, supply reliability, and communication.

Meanwhile, customer value is positioned in the lower-priority category because both its perceived importance and

performance are relatively lower than those of the other attributes. Although it does not require immediate intervention, this attribute should continue to be monitored as customer preferences and market conditions evolve. Overall, the IPA findings provide a practical basis for allocating improvement resources toward service attributes that are expected to generate the greatest impact on customer satisfaction and supply chain effectiveness.

Quadrant I – Concentrate Here

Service responsiveness, technical support, and complaint handling require priority improvement because their importance exceeds current performance. PT XYZ should focus on faster responses, stronger technical support, and more structured complaint resolution.

Quadrant II – Keep Up the Good Work

Chemical quality, supply reliability, and business communication show satisfactory performance in areas considered important by customers. These strengths should be maintained through consistent quality control, reliable supply, and effective customer communication.

Quadrant III – Low Priority

Customer Value has relatively low importance and performance. Major resource allocation is therefore not immediately required, although customer perceptions should be monitored for changing expectations.

Quadrant IV – Possible Overkill.

No attribute falls into Quadrant IV, indicating no clear evidence of high performance in a low-importance area. Improvement resources can therefore remain focused on the gaps identified in Quadrant I, that can be seen in [Figure 3](#).

The IPA findings support targeted service development by prioritizing responsiveness, technical support, and complaint handling. These areas should be strengthened through faster responses, improved technical capabilities, and systematic complaint resolution. The findings contribute an evidence-based basis for resource allocation and continuous customer service improvement.

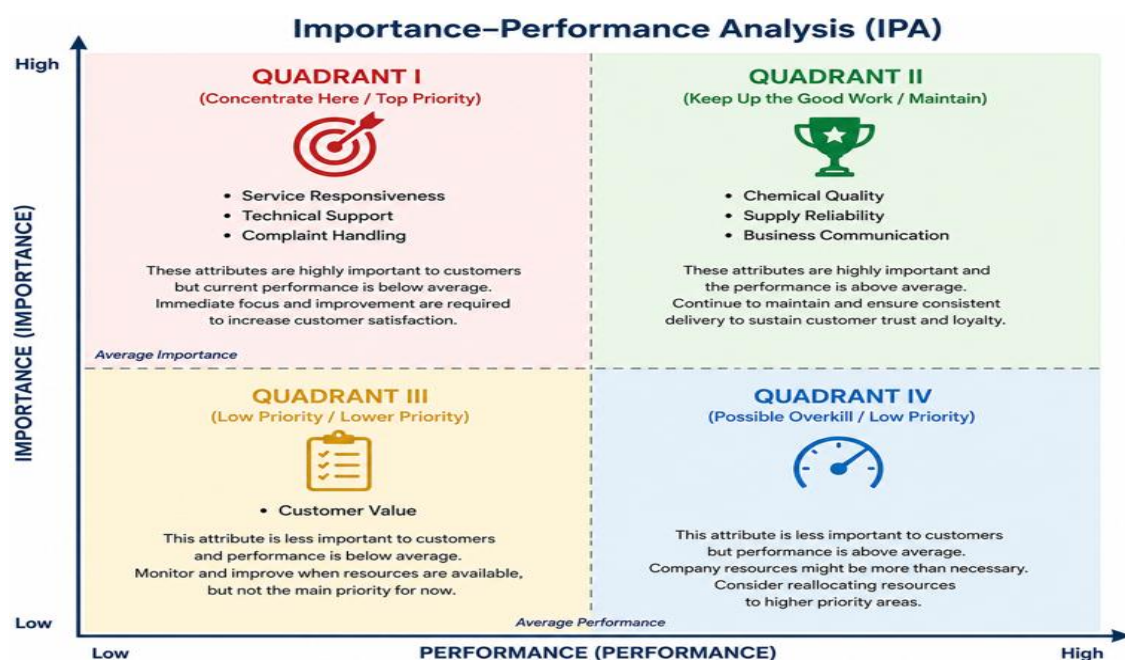


Figure 3. Importance Performance Analysis based on Customer Feedback

Discussion

This section discusses the strategic priorities identified from customer feedback and their implications for improving industrial chemical sales performance. The post-improvement RPN values are prospective estimates, not measured outcomes, based on expected

changes in Severity, Occurrence, and Detection after implementing the proposed strategies. A moderate and an optimistic scenario were used to assess potential risk reduction; therefore, the projected RPN reductions should be validated through future post-implementation measurements.

Table 9. FMEA Risk Assessment and Projected Improvement Scenarios

Attributes	Improve - Performance	Factor	Strategy	RPN Before	Moderate Scenario	Optimistic Scenario	Implication
Chemical Quality	Quality Consistency	Method	SOP Revision	$8 \times 6 \times 4 = 192$	$7 \times 5 \times 3 = 105$	$6 \times 1 \times 2 = 12$	Process Standardization
	Product Reliability	Material	Material Testing	$9 \times 6 \times 4 = 216$	$8 \times 5 \times 3 = 120$	$5 \times 1 \times 3 = 15$	Supplier Management
	Quantity Accuracy	Material	Inventory Audit	$9 \times 7 \times 4 = 252$	$8 \times 6 \times 3 = 144$	$8 \times 1 \times 2 = 16$	Inventory Optimization
Supply Reliability	Schedule Compliance	Man	Driver Training	$8 \times 7 \times 4 = 224$	$7 \times 6 \times 3 = 126$	$8 \times 1 \times 1 = 8$	Workforce Development
Service Responsiveness	Follow-up Action	Method	Follow-up SOP	$8 \times 6 \times 5 = 240$	$7 \times 5 \times 4 = 140$	$5 \times 1 \times 2 = 10$	Process Efficiency
	Response Speed	Man	Staff Training	$8 \times 7 \times 5 = 280$	$7 \times 6 \times 4 = 168$	$7 \times 1 \times 2 = 14$	Staff Responsiveness
	Technical Assistance	Man	Skill Enhancement	$9 \times 6 \times 5 = 270$	$8 \times 5 \times 4 = 160$	$7 \times 1 \times 1 = 7$	Technical Capability
Technical Support	Problem Resolution	Method	Resolution SOP	$9 \times 7 \times 5 = 315$	$8 \times 6 \times 4 = 192$	$6 \times 1 \times 1 = 6$	Process Discipline
	Follow-up Seriousness	Environment	Complaint Tracking	$10 \times 7 \times 5 = 350$	$9 \times 6 \times 4 = 216$	$4 \times 1 \times 1 = 4$	Complaint Visibility
	Resolution Clarity	Money	Budget Support	$9 \times 7 \times 5 = 315$	$8 \times 6 \times 4 = 192$	$3 \times 1 \times 1 = 3$	Resource Allocation
Complaint Handling	Communication Quality	Method	Communication SOP	$8 \times 5 \times 4 = 160$	$7 \times 4 \times 3 = 84$	$5 \times 1 \times 1 = 5$	Communication Excellence
	Professional Attitude	Man	Service Training	$7 \times 5 \times 4 = 140$	$6 \times 4 \times 3 = 72$	$2 \times 1 \times 1 = 2$	Professional Competence
Business Communication	Service Benefit	Material	Service Improvement	$7 \times 5 \times 4 = 140$	$6 \times 4 \times 3 = 72$	$3 \times 3 \times 1 = 9$	Service Enhancement
	Cost Efficiency	Money	Cost Control	$8 \times 5 \times 4 = 160$	$7 \times 4 \times 3 = 84$	$4 \times 2 \times 1 = 8$	Cost Optimization
Customer Value							

The FMEA analysis in [Table 9](#) was used to identify the main operational risks and examine how these risks might change under two improvement scenarios. The moderate scenario represents a cautious estimate of improvement, whereas the optimistic scenario assumes that the proposed actions are implemented more effectively. Since these post-improvement scores have not yet been observed in practice, they are presented as projected

values rather than actual performance results.

Chemical Quality

Method and Material are the main factors affecting chemical quality. RPNs for quality consistency decline from 192 to 105 and 12, while product reliability falls from 216 to 120 and 15 under the Moderate and Optimistic scenarios. The findings highlight the need for clearer SOPs, process standardization, raw-material testing, and

supplier quality control. These measures can improve process consistency in SCM, strengthen customer confidence in CRM, and help Customer Feedback Management identify recurring quality complaints. The results support previous research on process standardization and supplier quality management [39], [40].

Supply Reliability

Material and Man are the main factors affecting supply reliability, particularly quantity accuracy and schedule compliance. Their RPNs decline from 252 to 144 and 16, and from 224 to 126 and 8, under the Moderate and Optimistic scenarios. The findings emphasize inventory control, accurate material records, driver training, and workforce capability. These measures can support stable material flows and delivery coordination while improving customer confidence and helping identify recurring delivery problems through feedback. Previous studies similarly link inventory practices and employee capability with delivery performance and customer satisfaction [41], [42].

Business Communication

Environment and Method are the main factors associated with communication risks. RPNs for communication quality decrease from 160 to 84 and 5, while professional attitude falls from 140 to 72 and 2 under the Moderate and Optimistic scenarios. The findings emphasize an appropriate communication environment, adequate resources, and standardized communication procedures. These measures can improve coordination and information sharing within SCM, support consistent customer interactions, and provide clearer feedback for monitoring communication effectiveness. Previous research also links communication quality

with service performance and customer satisfaction [43], [44].

Service Responsiveness

Method and Man are the main factors affecting follow-up actions and response speed. Their RPNs decrease from 240 to 140 and 10, and from 280 to 168 and 14, under the Moderate and Optimistic scenarios. The findings highlight standardized follow-up procedures, staff training, and stronger responsiveness. These measures can improve coordination and problem resolution in SCM, support timely customer interactions, and help Customer Feedback Management identify recurring response delays. Previous research also recognizes responsiveness as an important element of service quality and customer satisfaction [40], [45].

Technical Support

Man and Method are the key factors affecting technical assistance and problem resolution. Their RPNs fall from 270 to 160 and 7, and from 315 to 192 and 6, under the Moderate and Optimistic scenarios. The results highlight technical skill development and standardized resolution procedures. These measures can strengthen knowledge sharing and collaborative problem solving in SCM, increase customer confidence in technical assistance, and help identify recurring technical issues through customer feedback. The findings are consistent with research linking employee competence and service capability to customer satisfaction and relationship quality [39], [40].

Complaint Handling

Environment and Money are the main factors affecting complaint-handling risks. Their RPNs decline from 350 and 315 to 216 and 192 under the Moderate scenario, and to 4 and 3 under the Optimistic

scenario. The findings emphasize complaint tracking, visibility, and adequate resources for resolution. These measures can help SCM identify operational weaknesses, support customer trust through effective CRM, and turn complaints into input for continuous improvement. Previous studies similarly highlight structured complaint management as important for maintaining customer satisfaction and long-term relationships [46], [47].

Customer Value

Material and Money are the main factors related to service benefits and cost

CONCLUSION

The study found an overall Customer Satisfaction Index (CSI) of 59.4%, indicating that customers were fairly satisfied with the industrial chemical supply and services provided by PT XYZ. The IPA identified service responsiveness, technical support, and complaint handling as the main areas requiring improvement, while chemical quality, supply reliability, and business communication were identified as strengths and customer value as a lower immediate priority. FMEA showed that the highest initial risks were follow-up seriousness (RPN = 350), problem resolution (RPN = 315), and resolution clarity (RPN = 315), with other notable risks involving response speed, technical assistance, and quantity accuracy. Although the Moderate and Optimistic scenarios indicate potential reductions in these risks through standardized procedures, employee development, complaint tracking, inventory control, and stronger technical capabilities, the projected RPN reductions have not been empirically verified. Several limitations

efficiency. Their RPNs decrease from 140 to 72 and 9, and from 160 to 84 and 8, under the Moderate and Optimistic scenarios. The findings emphasize service enhancement, cost control, and efficient resource use. These measures can support operational efficiency and value creation in SCM, strengthen perceived value in CRM, and help monitor alignment between service benefits and customer expectations. Previous research similarly associates customer value with service quality, efficiency, and relationship performance [48], [49].

should be noted. The study involved one industrial chemical supplier and 36 respondents from eight customer companies, which limits the generalizability of the findings. The analysis was also descriptive and did not test the statistical significance of importance–performance gaps or differences among respondent groups. In addition, the Moderate and Optimistic FMEA RPN values are scenario-based estimates and should be validated after implementation. Future studies could examine whether improvements in service responsiveness, technical support, and complaint handling lead to significant gains in customer satisfaction. Longitudinal research could compare actual RPN values before and after interventions, while larger samples across multiple pulp and paper companies could assess the consistency of these priorities. Further research could also explore digital feedback systems, customer analytics, and AI-based monitoring for detecting response delays, technical issues, and complaint-resolution problems in real time.

REFERENCES

- [1] D. D. Furszyfer Del Rio *et al.*, "Decarbonizing the pulp and paper industry: A critical and systematic review of sociotechnical developments and policy options," *Renew. Sustain. Energy Rev.*, vol. 167, no. April, p. 112706, 2022, [doi: 10.1016/j.rser.2022.112706](https://doi.org/10.1016/j.rser.2022.112706).
- [2] J. Almanza Floyd, I. D'Adamo, S. Fosso Wamba, and M. Gastaldi, "Competitiveness and sustainability in the paper industry: The valorisation of human resources as an enabling factor," *Comput. Ind. Eng.*, vol. 190, no. March, p. 110035, 2024, [doi: 10.1016/j.cie.2024.110035](https://doi.org/10.1016/j.cie.2024.110035).
- [3] T. E. Oladimeji, M. Oyedemi, M. E. Emeteri, O. Agboola, J. B. Adeoye, and O. A. Odunlami, "Review on the impact of heavy metals from industrial wastewater effluent and removal technologies," *Heliyon*, vol. 10, no. 23, p. e40370, 2024, [doi: 10.1016/j.heliyon.2024.e40370](https://doi.org/10.1016/j.heliyon.2024.e40370).
- [4] L. Malehmirchegini and A. J. Chapman, "Strategies for achieving carbon neutrality within the chemical industry," *Renew. Sustain. Energy Rev.*, vol. 217, no. October 2024, p. 115762, 2025, [doi: 10.1016/j.rser.2025.115762](https://doi.org/10.1016/j.rser.2025.115762).
- [5] M. Banka *et al.*, "Understanding corporate concerns. Barriers and challenges in corporate–start-up collaboration," *J. Open Innov. Technol. Mark. Complex.*, vol. 10, no. 4, p. 100388, 2024, [doi: 10.1016/j.joitmc.2024.100388](https://doi.org/10.1016/j.joitmc.2024.100388).
- [6] G. Agag *et al.*, "Understanding the link between customer feedback metrics and firm performance," *J. Retail. Consum. Serv.*, vol. 73, no. February, p. 103301, 2023, [doi: 10.1016/j.jretconser.2023.103301](https://doi.org/10.1016/j.jretconser.2023.103301).
- [7] A. H. Tahir, M. Adnan, and Z. Saeed, "The impact of brand image on customer satisfaction and brand loyalty: A systematic literature review," *Heliyon*, vol. 10, no. 16, p. e36254, 2024, [doi: 10.1016/j.heliyon.2024.e36254](https://doi.org/10.1016/j.heliyon.2024.e36254).
- [8] M. Nilashi *et al.*, "The nexus between quality of customer relationship management systems and customers' satisfaction: Evidence from online customers' reviews," *Heliyon*, vol. 9, no. 11, p. e21828, 2023, [doi: 10.1016/j.heliyon.2023.e21828](https://doi.org/10.1016/j.heliyon.2023.e21828).
- [9] B. K. Sovacool, M. Bazilian, S. Griffiths, J. Kim, A. Foley, and D. Rooney, "Decarbonizing the food and beverages industry: A critical and systematic review of developments, sociotechnical systems and policy options," *Renew. Sustain. Energy Rev.*, vol. 143, no. February, p. 110856, 2021, [doi: 10.1016/j.rser.2021.110856](https://doi.org/10.1016/j.rser.2021.110856).
- [10] J. Shin, Y. J. Kim, S. Jung, and C. Kim, "Product and service innovation: Comparison between performance and efficiency," *J. Innov. Knowl.*, vol. 7, no. 3, p. 100191, 2022, [doi: 10.1016/j.jik.2022.100191](https://doi.org/10.1016/j.jik.2022.100191).

- [11] A. L. Roggeveen and S. Rosengren, "From customer experience to human experience: Uses of systematized and non-systematized knowledge," *J. Retail. Consum. Serv.*, vol. 67, no. February, p. 102967, 2022, [doi: 10.1016/j.jretconser.2022.102967](https://doi.org/10.1016/j.jretconser.2022.102967).
- [12] I. Farida and D. Setiawan, "Business Strategies and Competitive Advantage: The Role of Performance and Innovation," *J. Open Innov. Technol. Mark. Complex.*, vol. 8, no. 3, p. 163, 2022, [doi: 10.3390/joitmc8030163](https://doi.org/10.3390/joitmc8030163).
- [13] T. G. Walmsley *et al.*, "Hybrid renewable energy utility systems for industrial sites: A review," *Renew. Sustain. Energy Rev.*, vol. 188, no. February, 2023, [doi: 10.1016/j.rser.2023.113802](https://doi.org/10.1016/j.rser.2023.113802).
- [14] A. Purmonen, E. Jaakkola, and H. Terho, "B2B customer journeys: Conceptualization and an integrative framework," *Ind. Mark. Manag.*, vol. 113, no. May, pp. 74–87, 2023, [doi: 10.1016/j.indmarman.2023.05.020](https://doi.org/10.1016/j.indmarman.2023.05.020).
- [15] R. S. Anwar, R. R. Ahmed, D. Streimikiene, W. Strielkowski, and J. Streimikis, "Customer engagement, innovation, and sustainable consumption: Analyzing personalized, innovative, sustainable phygital products," *J. Innov. Knowl.*, vol. 10, no. 1, p. 100642, 2025, [doi: 10.1016/j.jik.2024.100642](https://doi.org/10.1016/j.jik.2024.100642).
- [16] J. A. Tessaro, R. Harms, and H. Schiele, "How startups become attractive to suppliers and achieve preferred customer status: Factors influencing the positioning of young firms," *Ind. Mark. Manag.*, vol. 113, no. April, pp. 100–115, 2023, [doi: 10.1016/j.indmarman.2023.05.024](https://doi.org/10.1016/j.indmarman.2023.05.024).
- [17] O. A. Gansser, S. Boßow-Thies, and B. Krol, "Creating trust and commitment in B2B services," *Ind. Mark. Manag.*, vol. 97, pp. 274–285, Aug. 2021, [doi: 10.1016/j.indmarman.2021.07.005](https://doi.org/10.1016/j.indmarman.2021.07.005).
- [18] W. J. Reinartz, "Customer Relationship Management: Past, Present, and Future," *Int. J. Res. Mark.*, vol. 43, no. 1, pp. 8–27, 2025, [doi: 10.1016/j.ijresmar.2025.12.001](https://doi.org/10.1016/j.ijresmar.2025.12.001).
- [19] X. Xie, T. T. Hoang, and Q. Zhu, "Green process innovation and financial performance: The role of green social capital and customers' tacit green needs," *J. Innov. Knowl.*, vol. 7, no. 1, p. 100165, 2022, [doi: 10.1016/j.jik.2022.100165](https://doi.org/10.1016/j.jik.2022.100165).
- [20] J. Bollenbach, S. Halbrügge, L. Wederhake, M. Weibelzahl, and L. Wolf, "Customer satisfaction at large charging parks: Expectation-disconfirmation theory for fast charging," *Appl. Energy*, vol. 365, no. April, p. 122735, 2024, [doi: 10.1016/j.apenergy.2024.122735](https://doi.org/10.1016/j.apenergy.2024.122735).
- [21] A. A. Salamah *et al.*, "Customer retention through service quality and satisfaction: using hybrid SEM-neural network analysis approach," *Heliyon*, vol. 8, no. 9, p. e10570, 2022, [doi: 10.1016/j.heliyon.2022.e10570](https://doi.org/10.1016/j.heliyon.2022.e10570).

- [22] M. A. I. Gazi, M. F. Yusof, M. A. Islam, M. Bin Amin, and A. R. bin S. Senathirajah, "Analyzing the impact of employee job satisfaction on their job behavior in the industrial setting: An analysis from the perspective of job performance," *J. Open Innov. Technol. Mark. Complex.*, vol. 10, no. 4, p. 100427, 2024, [doi: 10.1016/j.joitmc.2024.100427](https://doi.org/10.1016/j.joitmc.2024.100427).
- [23] D. Pakkala, J. Kääriäinen, and T. Mätäsniemi, "Improving efficiency and quality of operational industrial production assets information management in customer–vendor interaction," *J. Ind. Inf. Integr.*, vol. 41, no. June, 2024, [doi: 10.1016/j.jii.2024.100644](https://doi.org/10.1016/j.jii.2024.100644).
- [24] M. A. I. Gazi, A. Al Mamun, A. Al Masud, A. R. bin S. Senathirajah, and T. Rahman, "The relationship between CRM, knowledge management, organization commitment, customer profitability and customer loyalty in telecommunication industry: The mediating role of customer satisfaction and the moderating role of brand image," *J. Open Innov. Technol. Mark. Complex.*, vol. 10, no. 1, p. 100227, 2024, [doi: 10.1016/j.joitmc.2024.100227](https://doi.org/10.1016/j.joitmc.2024.100227).
- [25] S. Li Pira, A. Cabigiosu, and D. Campagnolo, "When customer involvement promotes innovation performance: The moderating roles of coordination mechanisms with customers and external collaboration strategies," *J. Bus. Res.*, vol. 192, no. March, p. 115292, 2025, [doi: 10.1016/j.jbusres.2025.115292](https://doi.org/10.1016/j.jbusres.2025.115292).
- [26] N. V. Wunderlich *et al.*, "How to use emerging service technologies to enhance customer centricity in business-to-business contexts: A conceptual framework and research agenda," *J. Bus. Res.*, vol. 192, no. January 2024, 2025, [doi: 10.1016/j.jbusres.2025.115284](https://doi.org/10.1016/j.jbusres.2025.115284).
- [27] B. S. Byers, D. Raghu, A. Olumo, C. De Wolf, and C. Haas, "From research to practice: A review on technologies for addressing the information gap for building material reuse in circular construction," *Sustain. Prod. Consum.*, vol. 45, no. December 2023, pp. 177–191, 2024, [doi: 10.1016/j.spc.2023.12.017](https://doi.org/10.1016/j.spc.2023.12.017).
- [28] W. M. Lim and T. Rasul, "Customer engagement and social media: Revisiting the past to inform the future," *J. Bus. Res.*, vol. 148, no. May, pp. 325–342, 2022, [doi: 10.1016/j.jbusres.2022.04.068](https://doi.org/10.1016/j.jbusres.2022.04.068).
- [29] K. T. Tran and H. T. Le, "Service delivery options and customer reviews in food and beverage establishments: Exploring spatial spillover effects," *Soc. Sci. Humanit. Open*, vol. 12, no. August, p. 101908, 2025, [doi: 10.1016/j.ssaho.2025.101908](https://doi.org/10.1016/j.ssaho.2025.101908).
- [30] A. Tadesse Bogale and K. L. Debela, "Organizational culture: a systematic review," *Cogent Bus. Manag.*, vol. 11, no. 1, p., 2024, [doi: 10.1080/23311975.2024.2340129](https://doi.org/10.1080/23311975.2024.2340129).
- [31] N. Cristache, G. Croitoru, and N. V. Florea, "The influence of knowledge management on innovation and organizational performance," *J. Innov. Knowl.*, vol. 10, no. 5, p. 100793, 2025, [doi: 10.1016/j.jik.2025.100793](https://doi.org/10.1016/j.jik.2025.100793).

- [32] M. Majeed, C. Asare, A. Fatawu, and A. Abubakari, "An analysis of the effects of customer satisfaction and engagement on social media on repurchase intention in the hospitality industry," *Cogent Bus. Manag.*, vol. 9, no. 1, 2022, [doi: 10.1080/23311975.2022.2028331](https://doi.org/10.1080/23311975.2022.2028331).
- [33] K. Q. T. Nguyen and H. M. Nguyen, "Factors affecting supply chain efficiency in commercial banks' operations–Case in Vietnam," *Cogent Bus. Manag.*, vol. 10, no. 1, 2023, [doi: 10.1080/23311975.2023.2175438](https://doi.org/10.1080/23311975.2023.2175438).
- [34] K. Onufrey and A. Bergeek, "Transformation in a mature industry: The role of business and innovation strategies," *Technovation*, vol. 105, no. January 2020, p. 102190, 2021, [doi: 10.1016/j.technovation.2020.102190](https://doi.org/10.1016/j.technovation.2020.102190).
- [35] C. Truong, T. H. Nguyen, and T. Huynh, "Customer satisfaction and the cost of capital," *Rev. Account. Stud.*, vol. 26, no. 1, pp. 293–342, Mar. 2021, [doi: 10.1007/s11142-020-09555-8](https://doi.org/10.1007/s11142-020-09555-8).
- [36] V. Vidyanto, B. N. Bertus, S. Krisnasari, and M. R. Napirah, "Analysis of Satisfaction Levels of Patients on Service Quality with The Importance Performance Analysis (IPA) Method," *J. Heal. Nutr. Res.*, vol. 2, no. 3, pp. 109–119, 2023, [doi: 10.56303/jhnresearch.v2i3.207](https://doi.org/10.56303/jhnresearch.v2i3.207).
- [37] H. O. K. Ahmed, "How to use importance-performance analysis (IPA)-based SWOT analysis as a new quantitative methodology for developing actual strategic plans in universities," *SN Soc. Sci.*, vol. 1, no. 1, p. 32, Jan. 2021, [doi: 10.1007/s43545-020-00039-9](https://doi.org/10.1007/s43545-020-00039-9).
- [38] Z. Zhang, T. Sangsawang, K. Vipahasna, and M. Pigultong, "A Mixed-Methods Data Approach Integrating Importance-Performance Analysis (IPA) and Kaiser-Meyer-Olkin (KMO) in Applied Talent Cultivation," *J. Appl. Data Sci.*, vol. 5, no. 1, pp. 256–267, 2024, [doi: 10.47738/jads.v5i1.170](https://doi.org/10.47738/jads.v5i1.170).
- [39] A. M. Khedr and S. R. S, "Enhancing supply chain management with deep learning and machine learning techniques: A review," *J. Open Innov. Technol. Mark. Complex.*, vol. 10, no. 4, p. 100379, 2024, [doi: 10.1016/j.oiitmc.2024.100379](https://doi.org/10.1016/j.oiitmc.2024.100379).
- [40] F. Petropoulos *et al.*, "Operations & supply chain management: principles and practice," *Int. J. Prod. Res.*, vol. 64, no. 1, pp. 330–513, Jan. 2026, [doi: 10.1080/00207543.2025.2555531](https://doi.org/10.1080/00207543.2025.2555531).
- [41] A. M. Azis and M. Irjayanti, "Strengthening the accuracy and visibility of supply chain management data in the coffee industry," *Cogent Bus. Manag.*, vol. 11, no. 1, Dec. 2024, [doi: 10.1080/23311975.2024.2380811](https://doi.org/10.1080/23311975.2024.2380811).

- [42] Y. Wang, "Supply Chain Management and Customer Relationship Management," in *The Palgrave Handbook of Supply Chain Management*, Cham: Springer International Publishing, 2024, pp. 1087–1113. [doi: 10.1007/978-3-031-19884-7_60](https://doi.org/10.1007/978-3-031-19884-7_60).
- [43] C. Ledro, A. Nosella, A. Vinelli, I. Dalla Pozza, and T. Souverain, "Artificial intelligence in customer relationship management: A systematic framework for a successful integration," *J. Bus. Res.*, vol. 199, p. 115531, Oct. 2025, [doi: 10.1016/j.ibusres.2025.115531](https://doi.org/10.1016/j.ibusres.2025.115531).
- [44] D. Martinho, J. Farinha, and V. Ribeiro, "The Impact of Customer Relationship Management Systems on Business Performance of Portuguese SMEs," *Sustainability*, vol. 17, no. 12, p. 5647, Jun. 2025, [doi: 10.3390/su17125647](https://doi.org/10.3390/su17125647).
- [45] M. Haji, L. Kerbache, and T. Al-Ansari, "Evaluating the Performance of a Safe Insulin Supply Chain Using the AHP-TOPSIS Approach," *Processes*, vol. 10, no. 11, p. 2203, Oct. 2022, [doi: 10.3390/pr10112203](https://doi.org/10.3390/pr10112203).
- [46] L. T. P. Miranda, J. A. Mendonça, E. O. B. Nara, and G. B. Benitez, "The dynamics and contingencies of marketing and business performance relationship: A meta-analysis," *Eur. Res. Manag. Bus. Econ.*, vol. 32, no. 3, p. 100321, Sep. 2026, [doi: 10.1016/j.iedeen.2026.100321](https://doi.org/10.1016/j.iedeen.2026.100321).
- [47] O. Kosasih, K. Hidayat, B. Hutahayan, and Sunarti, "Achieving Sustainable Customer Loyalty in the Petrochemical Industry: The Effect of Service Innovation, Product Quality, and Corporate Image with Customer Satisfaction as a Mediator," *Sustainability*, vol. 16, no. 16, p. 7111, Aug. 2024, [doi: 10.3390/su16167111](https://doi.org/10.3390/su16167111).
- [48] R. M. Sari, E. Nugraha, and A. Kurniawan, "Value Chain: a Strategy to Ensure the Sustainability of Online Transportation Services," *J. Manaj. Ind. dan Logistik*, vol. 9, no. 1, pp. 1–19, 2025, [doi: 10.30988/jmil.v9i1.1421](https://doi.org/10.30988/jmil.v9i1.1421).
- [49] R. M. Sari and E. Nugraha, "Optimizing Online Transportation Efficiency with a Value Chain Taguchi Method Approach," *J. Manaj. Ind. dan Logistik*, vol. 9, no. 2, pp. 118–137, 2025. [doi:10.30988/jmil.v9i2.1639](https://doi.org/10.30988/jmil.v9i2.1639)

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