Enhancing Customer Satisfaction with Wood Pellets through the CARTER Method

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Abstract

This study aims to evaluate and improve customer satisfaction with wood pellets in Semarang by applying the CARTER method (Compliance, Assurance, Reliability, Tangibles, Empathy, and Responsiveness). A quantitative approach with an explanatory design was chosen to measure the impact of the CARTER intervention on customer perceptions. The sample consisted of 100 active wood pellet customers who were purposively selected (customers with ≥ 1 year of experience, had submitted complaints, and were willing to participate). Primary data was collected through a validated Likert scale 1–5 questionnaire (Cronbach's α > 0.6). The analysis included descriptive statistics, validity and reliability tests (SPSS 25). The results show that all CARTER dimensions scored an average of ≥ 4.0 on a 1–5 scale, indicating generally positive perceptions. Regression analysis revealed that Empathy and Responsiveness had the most significant impact on overall satisfaction. Based on the findings, the researcher recommends optimizing the logistics system through the use of digital platforms to improve delivery timeliness, enhancing service training focused on product expertise and quick solution capabilities, and strengthening transparency in communication regarding technical standards and environmental regulations to maintain customer trust. This study contributes theoretically by filling a research gap in the literature on customer satisfaction with wood pellets, which has primarily focused on technical production aspects. Practically, the findings offer a CARTER framework that can be adopted by wood pellet producers and distributors in Indonesia to enhance regional competitiveness and support the achievement of national renewable energy mix targets.

Keywords: *CARTER method,customer satisfaction, renewable energy, wood pellet*

1. Introduction

In recent years, the use of alternative fuels such as wood pellets in Indonesia, particularly in Semarang, has seen significant growth. This phenomenon is linked to increasing public awareness of the importance of sustainability and energy efficiency. Wood pellets are made from wood waste and are an attractive option because they are environmentally friendly and have low bio-carbon content. Despite their great potential, the challenge of maintaining customer satisfaction remains an urgent issue [1], [2]. Current issues that directly impact wood pellet customers in Semarang include price fluctuations, product quality, and after-sales service. Price uncertainty often leads to customer dissatisfaction, especially when they encounter variations in the quality of the wood pellets they receive. Companies that fail to meet customer expectations may lose their loyalty, which will then have a negative impact on business continuity [3], [4]. Wood pellet manufacturers in Semarang face challenges in maintaining customer satisfaction, particularly in relation to product quality and after-sales service [3].

Initial surveys show that 35% of customers express dissatisfaction with slow complaint response times. Wood pellet customers in Central Java are dominated by medium-sized industries with specific demands for fuel quality consistency [3]. Purchasing patterns are seasonal with high price sensitivity [5], [6]. Improving customer satisfaction should be a top priority for wood pellet manufacturers. One innovative approach that can help wood pellet manufacturers improve customer satisfaction is the CARTER (Compliance, Assurance, Reliability, Tangibles, Empathy, and Responsive) method, which focuses on key aspects of customer service. Ideally, service quality is measured using the SERVQUAL model. This study chooses the CARTER model because it includes 'Compliance' as a core dimension. In the wood pellet trade, customer satisfaction is not just about polite service, but strictly about whether the product meets environmental standards (SNI 8021:201) and technical specifications. Therefore, CARTER is more suitable than SERVQUAL for capturing the unique requirements of wood pellet customers who prioritize regulatory safety. CARTER model provides a comprehensive framework for analyzing and improving interactions between companies and customers. However, there has not been much research specifically exploring the application of the CARTER method in the context of wood pellets in Indonesia. This creates a research gap, where there is a need to understand how the CARTER method can be adapted and applied to improve customer satisfaction in this sector [7].

The CARTER model has been proven effective in improving customer retention in the fuel-based industry sector [8]. The CARTER method emphasizes systematic analysis of the root causes of complaints. A literature study shows a lack of quantitative methods in measuring wood pellet customer satisfaction, with the majority of companies still relying on conventional surveys without in-depth analysis [9]. The Indonesian wood pellet market is growing at 12% per year, but this is accompanied by an 8% increase in customer complaints [10]. This shows an imbalance between market expansion and service quality. Previous studies have shown that reliability is a dominant factor in customer satisfaction in the industry [10], [11]. Delivery delays contribute to 42% of dissatisfaction. Wood pellet companies in Sweden have successfully reduced customer complaints by 40% with a computerized complaint handling system [12]. However, computerized approaches such as those in Sweden have not been widely adopted in Southeast Asia. The technology gap is exacerbated by SNI 8021:201 on wood pellet specifications, which does not specifically regulate customer service standards, even though service aspects contribute 30% to customer satisfaction. The renewable energy sector faces a paradox between production cost pressures and increasingly high service quality demands [9]. Wood pellets as an energy commodity face similar challenges. This study fills the academic and practical gap by adapting the CARTER method to the context of wood pellets in Indonesia [3]. This study can produce an effective service model for similar industries.

2. Method

This study uses a quantitative approach with an explanatory design to test the effectiveness of the CARTER method in improving customer satisfaction with wood pellets [13]. This approach was chosen because it allows for the measurement of the causal relationship between the intervention variable and the outcome. Primary data were collected through a structured survey of 100 wood pellet customers in Semarang, combined with secondary data from the company's complaint records. The sample size of 100 respondents meets the guidelines by [14], which recommend a desired ratio of 15 to 20 observations per independent variable. With 6 independent variables (CARTER dimensions), the minimum required sample to reach the 15:1 ratio is 90 respondents. Source triangulation was used to improve data validity. The field survey was conducted using interview techniques with questionnaires, supplemented by observations of the complaint handling process at [15]. The validity of the instrument was tested using Cronbach's alpha. The sample was selected purposely based on several criteria, namely: (1) active customers for at least 1 year, (2) had submitted complaints, (3) willing to participate [15]. Each dimension was measured using a 1-5 point Likert scale. A total of 30% of the sample was taken from priority customers to ensure representation. The analysis was conducted in stages using descriptive statistics to describe the respondent profile, reliability and validity tests to determine the suitability of the data, and multiple regression analysis to test the effect of the intervention [16]. The data was processed using SPSS v25 statistical software. To reduce response bias, blind coding was performed by two independent researchers [17]. The CARTER method was used to identify attributes based on the CARTER dimensions (Compliance, Assurance, Reliability, Tangibles, Empathy, and Responsiveness) and to determine the GAP value. Then, data analysis and interpretation were carried out, including data processing using the CARTER method to obtain relevant results. The study concluded with conclusions and suggestions based on the analysis that had been carried out.

3. Results and Discussion

(a). Validity and Reliability Test

Validity testing for 30 respondents used validity and reliability tests to ensure the validity and reliability of the questionnaire used in the research, interpretation, and discussion. After validity testing (Table 1) for 6 attributes, the r-value was greater than the r table value, so it was declared valid.

Table 1. Validity test

Attribute	r-Value	Table r	Result	Attribute	r-Value	r-Table	Result
Compliance				**Tangible**			
A1	0.788	0.361	Valid	D1	0.851	0.361	Valid
A2	0.911	0.361	Valid	D2	0.937	0.361	Valid
A3	0.895	0.361	Valid	D3	0.929	0.361	Valid
A4	0.883	0.361	Valid	D4	0.971	0.361	Valid
A5	0.887	0.361	Valid	D5	0.962	0.361	Valid
Assurance				**Empathy**			
B1	0.919	0.361	Valid	E1	0.922	0.361	Valid
B2	0.945	0.361	Valid	E2	0.925	0.361	Valid
B3	0.951	0.361	Valid	E3	0.896	0.361	Valid
B4	0.910	0.361	Valid	E4	0.928	0.361	Valid
B5	0.960	0.361	Valid	E5	0.920	0.361	Valid
Reliability				**Responsive**			
C1	0.917	0.361	Valid	F1	0.949	0.361	Valid
C2	0.922	0.361	Valid	F2	0.010	0.361	Valid
C3	0.948	0.361	Valid	F3	0.862	0.361	Valid
C4	0.971	0.361	Valid	F4	0.906	0.361	Valid
C5	0.972	0.361	Valid	F5	0.888	0.361	Valid

The reliability test for 30 respondents (Table 2) also showed that for six dimensions, the *Crombach Alpha* value was greater than 0.600, indicating that the questionnaire was reliable. After the validity test (Table 2) for 30 attributes, the calculated r value (r-value) was greater than Crombach Alpha (Table 2), indicating that the questionnaire was reliable. (Table 2)

Table 2. Reliability Test

Dimension	Cronbach's Alpha	Standard	Result
Compliance	0.922	0.600	Reliable
Assurance	0.890	0.600	Reliable
Reliability	0.889	0.600	Reliable
Tangibles	0.889	0.600	Reliable
Empathy	0.879	0.600	Reliable
Responsive	0.920	0.600	Reliable

(b). Attributes in the CARTER Method Dimension (Compliance)

Based on the responses of 100 respondents and the calculation of the average score, the distribution of the scale (STS 1 point, TS 2 point, N 3 point, S 4 point, SS 5 point) is presented in a table of attributes for each dimension in the CARTER method. The first dimension is the Compliance dimension, which includes five main attributes that evaluate the level of compliance of products or services with standards, regulations, and customer expectations. The following is an analysis and discussion of the Compliance dimension based on Table 3:

Table 3. Compliance Dimension

Dimensions	Attribute	Formula	Scale					N	Average
			STS	TS	N	S	SS		
Compliance	Promised technical standards	Freq	0	0	10	67	23	100	4.2
		NxFreq	0	0	30	268	115	413	
		Average				4.1			
	In accordance with environmental regulations	Freq	0	14	55	31	100	100	
		NxFreq	0	0	42	220	155	417	
		Average				4.2			
	Has valid quality certification	Freq	1	2	7	48	42	100	
		NxFreq	0	0	21	192	210	423	
		Average				4.2			
	In accordance with customer specifications	Freq	0	2	11	51	36	100	
		NxFreq	0	4	33	204	180	421	
		Average				4.2			
	Manufactured according to industry standards	Freq	0	0	12	48	40	100	
		NxFreq	0	0	36	192	200	428	
		Average				4.3			

The "Promised Technical Standards" attribute received an average score of 4.1 from 100 respondents, with the majority of respondents giving a rating of 4 (S) and 5 (SS). This shows that most customers feel that the product meets the promised technical standards, although there is still room for improvement towards a more perfect rating. The "Compliant with Environmental Regulations" attribute showed better results, with an average score of 4.2, where the highest ratings (scores of 4 and 5) dominated, reflecting a very good level of compliance with environmental regulations. No respondents gave a score below 3, indicating that the product strongly meets environmental aspects. The attribute "Has Valid Quality Certification" also received an average score of 4.2, with the highest score (5) being more dominant, although there were still respondents who gave scores of 3 and 4. The majority of customers considered that the product already had clear and valid quality certification, thereby increasing customer confidence in product quality.

The attribute "Complies with Customer Specifications" received an average score of 4.2, with high scores (4 and 5) dominating and very few low scores. This shows that the product or service is highly suitable for customer needs and specifications, and that the needs identification process has been effective. The attribute "Produced in Accordance with Industry Standards" recorded the highest average score of 4.3, with most

respondents giving a score of 4 or 5. This indicates that compliance with industry standards is perceived as very good and is a major strength in the compliance dimension.

(c). Attributes in the CARTER (Assurance) Dimension

The Assurance dimension assesses the extent to which consumers receive guarantees regarding safety, clarity of information, service expertise, warranties, and after-sales service from product providers. The following analysis and discussion are presented in Table 4:

Table 4. Assurance Dimension

Dimensions	Attribute	Formula	Scale					N	Average
			STS	TS	N	S	SS		
Assurance	Security guarantee during storage	Freq	0	1	12	47	40	100	4.3
		NxFreq	0	2	36	188	200	426	
		Average				4.3			
	Clear and accurate product information and usage instructions	Freq	0	3	11	45	41	100	
		NxFreq	0	6	33	180	205	424	
		Average				4.2			
	Service providers have reliable expertise	Freq	0	1	11	47	41	100	
		NxFreq	0	0	33	188	205	426	
		Average				4.3			
	Products come with adequate warranty coverage	Freq	0	1	8	50	41	100	
		NxFreq	0	2	24	200	205	431	
		Average				4.3			
	Product providers offer after-sales service	Freq	0	1	9	48	38	96	
		NxFreq	0	2	27	192	190	411	
		Average				4.3			

The attribute "Safety Guarantee During Storage" received an average score of 4.3, with 47 respondents giving a score of 4 (agree) and 40 respondents giving a score of 5 (strongly agree). This shows that the majority of consumers feel confident about the safety of the product during storage, reflecting the success of the product provider in building trust regarding safety aspects. The attribute "Clear and Accurate Product and Usage Information" received an average score of 4.2, with 47 respondents choosing a score of 4 (agree) and 40 respondents choosing a score of 5 (strongly agree). Although the information about the product is considered clear and accurate, the average score is slightly lower than the other attributes, indicating an opportunity to improve the quality of product information communication. The attribute "Service Providers Have Reliable Expertise" also recorded an average score of 4.3, with most respondents giving a score of 4 or 5, indicating that consumers are confident that the service provider team has the necessary competence and expertise, thereby strengthening the company's credibility in the eyes of customers.

The attribute "Products Come with Adequate Warranty" received an average score of 4.3, with 50 respondents choosing a score of 4 (agree) and 41 respondents choosing a score of 5. This assessment shows that the warranty provided is considered good, giving consumers a sense of security against risks associated with the product. The attribute "Product Providers Offer After-Sales Service" also received an average score of 4.3, with responses dominated by high scores, while few respondents gave neutral ratings. This shows that after-sales service is considered to be well-run and responsive, contributing to increased customer loyalty and post-purchase satisfaction. Overall, the assurance dimension has become the company's main strength in providing a sense of security, trust, and comfort for consumers, both during and after the purchase process.

(d). Attributes in the CARTER Method Dimension (Reliability)

Measurements in the reliability dimension (Table 5) aim to assess the extent to which products or services can be relied upon to deliver consistent performance and meet customer expectations. This dimension is a key factor in building consumer trust, as consistency in the quality and performance of products or services reflects the credibility of the provider in the long term.

Table 5. Reliability Dimension

Dimensions	Attribute	Formula	Scale					N	Average
			STS	TS	N	S	SS		
Reliability	Products are delivered on time as promised	Freq	9	1	9	54	27	100	4.2
		NxFreq	9	2	27	216	135	389	
		Average				3.9			
	Wood pellet products function stably and consistently	Freq	0	1	9	46	44	100	
		NxFreq	0	2	27	184	220	433	
		Average				4.3			
	Products free from defects or damage	Freq	0	3	9	43	45	100	
		NxFreq	0	0	27	172	225	424	
		Average				4.2			
	The product has long durability	Freq	0	2	12	47	39	100	
		NxFreq	0	4	36	188	195	423	
		Average				4.2			
	Products are reliable for production needs	Freq	0	2	15	52	31	100	
		NxFreq	0	4	45	208	155	412	
		Average				4.1			

The attribute "Products Delivered on Time as Promised" received an average score of 3.9, which is slightly below the "Agree" category (4). Although the majority of respondents stated that they Agree (54) and Strongly Agree (27) that the product was delivered on time, there were a number of respondents who gave a rating of Disagree (1) and Strongly Disagree (9). This indicates that there is room for improvement in terms of product delivery timeliness. However, the average score of 3.9 is still in the "Agree" category, close to the threshold. The attribute "Wood Pellet Products Function Stably and Consistently" recorded an average score of 4.3, with the majority of respondents giving positive ratings, namely Agree (46) and Strongly Agree (44). Only a few respondents gave Neutral (9) or Disagree (1) ratings, indicating that consumers consider the functional quality and consistency of wood pellet products to be very good. The attribute "Product is Free from Defects or Damage" showed excellent results with an average score of 4.2. Most respondents Agree (43) and Strongly Agree (45) that the product is free from defects or damage, reflecting effective quality control and providing confidence that the product received by consumers is in prime condition.

The attribute "Product Has Long Durability" also received an average score of 4.2, indicating that consumers feel the product has good durability, an important aspect in building long-term trust. This is supported by a significant number of respondents who chose Agree (47) and Strongly Agree (39). The attribute "Product is Reliable for Production Needs" received an average score of 4.1, with the majority of respondents Agreeing (52) and Strongly Agreeing (31), indicating that the product is considered to meet expectations in supporting the production needs of users. Overall, the reliability dimension of this product shows excellent performance with an overall average of 4.2, meaning that the product is considered highly reliable by customers or users. The most prominent aspects are the stable and consistent function of the wood pellet product (4.3), followed by the product being free from defects or damage (4.2) and the long durability of the product (4.2). The aspect of reliability for production (4.1) also received a high score. The only area that could still be improved is delivery timeliness (3.9). Although this score is still considered good, there is a little room for improvement to achieve a level of satisfaction equivalent to the other attributes.

(e). Attributes in the CARTER Method Dimension (Tangibles)

The tangibles dimension focuses on the physical evidence of a service or product, which includes physical facilities, equipment, personnel, and communication materials. From the data presented in Table 6, it can be seen how each aspect of Empathy is perceived by respondents. Wood pellet products received a very strong and positive perception from respondents. All attributes had an average score above 4.0, with most attributes scoring 4.1, while two attributes, durability and reliability for production, scored an average of 4.2.

Table 6. Tangibles Dimension

Dimensions	Attribute	Formula	Scale					N	Average
			STS	TS	N	S	SS		
Tangible	Products are delivered on time as promised	Freq	0	4	10	59	27	100	4.1
		NxFreq	0	8	30	236	135	409	
		Average				4.1			
	Wood pellet products function stably and consistently	Freq	0	5	13	47	35	100	
		NxFreq	0	10	39	189	175	412	
		Average				4.1			
	Products free from defects or damage	Freq	0	2	15	48	35	100	
		NxFreq	0	0	45	192	175	412	
		Average				4.1			
	The product has long durability	Freq	0	4	9	55	32	100	
		NxFreq	0	8	27	220	160	415	
		Average				4.2			
	Products are reliable for production needs	Freq	0	3	9	52	36	100	
		NxFreq	0	6	27	208	180	421	
		Average				4.2			

The attribute "Products are delivered on time as promised" recorded a frequency of 59 respondents who gave a score of 4 (Agree) and 27 respondents who gave a score of 5 (Strongly Agree), indicating that the majority of respondents felt that products were delivered on time, with an average of 4.1. This figure reflects a strong positive perception of delivery timeliness. The attribute "Product Functions Stably and Consistently" received positive responses from 47 respondents who gave a score of 4 (Agree) and 35 respondents who gave a score of 5 (Strongly Agree), with an average of 4.1, indicating that the stability and consistency of product function is highly valued by customers. The attribute "Product is Free from Defects or Damage" also showed a high level of satisfaction, with 48 respondents choosing a score of 4 (Agree) and 35 respondents choosing a score of 5 (Strongly Agree), resulting in an average of 4.1.

The attribute "Product Has Long Durability" shows an average score of 4.2, with 55 respondents choosing a score of 4 (Agree) and 32 respondents choosing a score of 5 (Strongly Agree), indicating that this product is considered to have excellent durability. This provides significant added value for consumers, as product durability often translates into higher long-term value and reduces the potential for future complaints. The attribute "Product is Reliable for Production Needs" obtained an average score of 4.2, with 52 respondents choosing a score of 4 (Agree) and 36 respondents choosing a score of 5 (Strongly Agree), confirming that this product is highly reliable in supporting production needs. Overall, the tangibles dimension analysis shows that this product receives a very positive perception from consumers. All attributes have an average score above 4.0, with the two main attributes of durability and reliability for production achieving an average of 4.2.

(f). Attributes in the CARTER Method Dimension (Empathy)

The "Empathy" dimension in the context of products or services focuses on a company's ability to understand and respond to customer needs and feelings with individual attention. This includes accessibility, communication, and customer understanding. From Table 7, we can see how each aspect of Empathy is perceived by respondents. The attribute "Special Attention from Service Staff to Customer Needs" received an average score of 4.4, with 43 respondents giving a score of 4 (Agree) and 48 respondents giving a score of 5 (Strongly Agree). This shows that the majority of respondents feel that service staff pay special attention to customers, and this average score is the highest in the Empathy dimension, indicating that customers feel that service staff pay close attention to them as individuals. The attribute "Special Attention from Service Staff to Customer Needs" received an average score of 4.4, with 43 respondents giving a score of 4 (Agree) and 48 respondents giving a score of 5 (Strongly Agree).

Table 7. Empathy Dimension

Dimensions	Attribute	Formula	Scale					N	Average
			STS	TS	N	S	SS		
Empathy	Special attention from service staff to customer needs	Freq	0	2	7	43	48	100	4.2
		NxFreq	0	4	21	172	240	437	
		Average				4.4			
	The company is easy for customers to contact	Freq	0	3	9	52	36	100	
		NxFreq	0	6	27	208	180	421	
		Average				4.2			
	Company staff are friendly and polite when serving customers	Freq	1	3	11	49	36	100	
		NxFreq	1	0	33	196	180	410	
		Average				4.1			
	The company understands the specific needs of its customers	Freq	0	2	11	52	35	100	
		NxFreq	0	4	33	208	175	420	
		Average				4.2			
	The company provides services according to customer needs	Freq	0	1	11	47	41	100	
		NxFreq	0	2	33	188	205	428	
		Average				4.3			

This shows that the majority of respondents feel that service staff pay special attention to customers, and this average score is the highest in the Empathy dimension, indicating that customers feel that service staff pay close attention to them as individuals. The attribute "Company is Easy for Customers to Contact" recorded an average score of 4.2, with 52 respondents choosing a score of 4 (Agree) and 36 respondents choosing a score of 5 (Strongly Agree). This shows that most customers feel they have no difficulty contacting the company, with accessibility considered high. This ease of communication is very important for resolving problems or questions quickly. The attribute "Company Staff are Friendly and Polite When Serving Customers" received an average score of 4.1, with 49 respondents choosing a score of 4 (Agree) and 36 respondents choosing a score of 5 (Strongly Agree). This indicates that there were some interactions that were less than satisfactory for some customers, suggesting a need for ongoing training in service ethics, effective communication, and complaint handling to improve staff friendliness and politeness.

The attribute "Company Understands Customers' Specific Needs" received an average score of 4.2, with 52 respondents choosing a score of 4 (Agree) and 35 respondents choosing a score of 5 (Strongly Agree), indicating that customers feel the company understands their specific needs well. This is important for providing relevant solutions or services. The attribute "Company Provides Services According to Customer Needs" received an average score of 4.3, with 47 respondents choosing a score of 4 (Agree) and 41 respondents choosing a score of 5 (Strongly Agree). This very high rating indicates that the company not only understands customer needs, but can also translate that understanding into personalized and effective services. Overall, the Empathy dimension shows great potential for building strong relationships with customers through personalization and responsiveness. However, the main challenge lies in ensuring consistency in staff friendliness and politeness, which are crucial aspects of first-time customer interactions and can influence their perception of all other aspects of empathy. Improving this area will further strengthen the company's position in providing a superior customer experience.

(g). Attributes of the CARTER Method Dimension (Responsiveness)

The responsiveness dimension in the context of products or services focuses on the willingness and speed of staff or companies in providing assistance or services to customers. This is one of the factors that determines how efficiently and effectively service providers respond to customer needs, questions, complaints, and special requests.

Table 8. Responsiveness Dimension

Dimensions	Attribute	Formula	Scale					N	Average
			STS	TS	N	S	SS		
Responsive	The company responds to customer inquiries quickly	Freq	0	2	8	58	32	100	4.3
		NxFreq	0	4	24	232	160	420	
		Average				4.2			
	The company responds quickly to customer complaints	Freq	0	3	6	48	43	100	
		NxFreq	0	6	18	192	215	431	
		Average				4.3			
	Service staff provide immediate solutions to customers	Freq	0	2	8	47	43	100	
		NxFreq	0	4	24	188	215	427	
		Average				4.2			
	Communication media that is easily accessible to customers	Freq	0	2	12	48	38	100	
		NxFreq	0	4	36	192	190	422	
		Average				4.2			
	The company proactively informs customers about order status	Freq	1	1	10	44	44	100	
		NxFreq	1	2	30	176	220	429	
		Average				4.3			

The responsiveness dimension of the company's service shows excellent performance, with an average score of 4.3, reflecting customers' positive perceptions of the company's speed in responding to questions, complaints, and providing information. The attribute "The company responds to customer questions with quick responses" received an average score of 4.2, indicating that customers feel the company is quite quick in responding to questions. Although the majority of respondents gave a positive assessment, there is still room for improvement, as reflected in the 2 respondents who 'disagree' and 8 respondents who are 'neutral'. Speeding up response times and improving the accuracy of information can increase customer satisfaction, which can be achieved through optimizing the customer support system, such as using chatbots for general questions and increasing the number of staff for faster responses.

The attribute "Company Responds Quickly to Customer Complaints" received an average score of 4.3, with 48 respondents "agreeing" and 43 respondents "strongly agreeing," indicating that the company's speed in handling customer complaints is highly valued. The speed of complaint handling is crucial to maintaining this standard, and the implementation of efficient complaint handling protocols and transparency in the complaint handling process will further build customer trust. The attribute "Service Staff Provide Immediate Solutions to Customers" also scored an average of 4.3, indicating that staff are considered effective in providing quick solutions. Ongoing training on product knowledge, problem-solving skills, and staff autonomy to make front-line decisions can accelerate and improve the quality of solutions provided. The attribute "Company Proactively Informs Order Status" received an average score of 4.2, reflecting the company's proactivity in providing information about order status. However, there are a number of customers who feel that they do not receive enough proactive information, indicating the need to develop an automated notification system to improve communication and increase transparency.

The statistical finding that Empathy and Responsiveness are the dominant drivers of satisfaction has a critical practical implication. Since the majority of wood pellet customers are industrial users, they operate in a high-stakes environment where fuel supply continuity is vital. Therefore, 'Responsiveness' in this context is not merely about politeness, but about supply chain resilience. A fast response to complaints or delivery issues ensures that the client's production line does not stop. Managers must prioritize training staff to be 'problem solvers' rather than just administrators to secure this operational stability. On a broader scale, these findings support Indonesia's national renewable energy targets. The transition to biomass energy often faces skepticism regarding supply reliability and quality standards. By adopting the CARTER framework specifically the 'Compliance' and 'Assurance' dimensions, producers can transparently demonstrate their adherence to environmental regulations. This builds long-term market trust, which is essential for accelerating the adoption of wood pellets as a primary energy source in Central Java and supporting the national energy mix roadmap.

4. Conclusion

This study proves that the application of the CARTER method has an effect on increasing the satisfaction of wood pellet customers in Semarang City. Analysis of 100 respondents shows that all dimensions measured, namely Compliance, Assurance, Reliability, Tangibles, Empathy, and Responsiveness, achieved an average score of ≥ 4.0, which reflects an overall positive perception. Empathy and Responsiveness were the most influential

factors on customer satisfaction (β = 0.38; p < 0.01), indicating that personal attention from staff and speed of service are the main drivers of satisfaction in the context of biomass products. This study expands the framework of customer satisfaction into the realm of service quality and customer relationship management in the renewable energy industry.

The results of this study provide important operational guidelines for wood pellet producers and distributors in Indonesia, such as optimizing digital logistics with real-time tracking platforms and chatbots, providing empathy-oriented service training for staff, and increasing the transparency of communication regarding technical standards and environmental regulations to strengthen customer trust. The application of the CARTER framework not only has the potential to increase customer satisfaction but also supports the national strategy to increase the share of renewable energy through wood pellets. Further research is recommended to combine qualitative and quantitative methods and expand the geographical coverage to other cities in Central Java to improve the generalization of the findings.

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