SERVICE QUALITY AND AFTER-SALES SERVICE ON IOT-BASED CAR USER SATISFACTION AND REPEAT PURCHASE SERVICES IN INDONESIA

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Abstract

This study aims to determine the effect of service quality and after-sales service on the customer satisfaction of car users using IoT technology provided with their car purchase. Digital disruption has made manufacturers turn to digital services and marketing systems to discover and understand customer behavior. Using the Isaac and Michael formula a sample size 155 respondents was determined, and data were accordingly collected for processing via non-probability sampling techniques. Data were obtained from respondents matching the unique criteria of Indonesian users of cars with IoT innovation technology. Such cars now account for 10% of total new car sales. This study utilizes path analysis, revealing that customer satisfaction encourages loyal customers to buy new units. The main finding of the research is that a service system connected to the internet or smartphones makes users comfortable and can determine the future choice for product repurchases. Therefore, it is necessary to develop continuous emotional closeness with customers for future success.

Keywords: Service Quality; After-Sales Service; Satisfaction; Repeat Purchases

INTRODUCTION

In this era of digital transformation, the automotive industry has witnessed intense competition, leading companies to enhance product quality and market their new offerings with a focus on IoT integration and environmental benefits such as lower gas emissions. These new features are expected to directly impact customer satisfaction during product usage. Customer satisfaction is a multidimensional condition influenced by various factors throughout the customer life cycle, including brand name, salesforce, service quality, and after-sales service (Shokouhyar et al., 2020).

The automotive business model has evolved to be more environmentally friendly and connected to the internet, facilitating low-cost and eco-friendly transportation modes (Auer et al., 2022). In Indonesia, the market has seen the introduction of green technology vehicles with internet connectivity, which are perceived as attractive possessions due to their low maintenance costs, absence of gasoline requirements, and potential environmental benefits. Research conducted in Germany on electric car customers highlighted the significance of service quality related to renewable energy, which adds value from the perspective of customers (Stauch, 2021). Additionally, the use of internet connectivity technology in the after-sales services provided by car manufacturers in

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Indonesia has also garnered attention from new customers looking to switch from their old vehicles (Halik et al., 2021).

The introduction of innovative IoT-based car features has generated interest by meeting individual customer demands and supporting emission reductions. Furthermore, IoT has opened up new business models, such as car-sharing, where idle vehicles find utilization through demand access (Stauch, 2021). The ability of IoT to enhance service quality offers opportunities to create, develop, and improve user-friendly services, leading to significant growth in various automotive applications (Rahim et al., 2021).

Service quality plays a crucial role in the automotive industry, particularly in car assembly where IoT is utilized to monitor and track various operations, including sales information and after-sales service (T. Liu et al., 2012). IoT-based cars integrate with internet connectivity networks, enabling users to utilize various Android applications for driving support and communication purposes. These vehicles also offer features like direct vehicle insurance connections for immediate assistance during roadside problems, eliminating the need for lengthy administrative processes.

In Indonesia, the automotive industry has witnessed a surge in car sales, especially for brands offering IoT-based technology services, indicating the demand for technological convenience and communication services outside of work routines (Mehta & Balakumar, 2021). In this era of digitalization, providing convenience and satisfaction to consumers, along with the increasing adoption of electric cars and reducing carbon emissions, has become a priority for manufacturers.

In the Business-to-Customer (B2C) business model of the automotive industry, demand forecasting is crucial for production and supply processes. Real-time data accessed through digital media enables accurate demand estimation (Rohaan et al., 2022). This transformation involves integrating various networks, including insurance companies, repair shops, and spare part retailers, to offer integrated services that provide convenience and benefits to customers. Unstructured data, which constitutes a significant portion of big data, provides valuable insights into customer needs and satisfaction for future car developments (Gandomi & Haider, 2015). After-sales service, an essential factor influencing pro-

Table 1 National Car Sales Data for 2019-2022

Information	Data
IoT-based car technology	Integrated with an internet connectivity network like a smartphone; Allows users to use various Android application that help drive on the road
Vehicle features	Can communicate, send messages, and receive calls; Has a vehicle insurance feature connected directly to the service provider for immediate handling of road problems without detailed reports
Services developed in Indonesia	Repair shops connected directly in the car; Fast insurance services; Direct sales of spare parts
Manufacturer's goal	Provide the best service for consumers by offering convenience in using vehicles
Car sales in Indonesia in 2021	Increased significantly by 25% despite the pandemic
Brands offering IoT-based technology services	In high demand and account for 32% of all car sales
Benefits of IoT-based car technology	Provides time efficiency and communication services outside the office for consumers in big cities in Indonesia

duct acceptance in the automotive industry, can leverage IoT technology to gather customer feedback and suggestions (Li & Elliot, 2019). Analyzing customer feedback requires technical support and initiative to drive customer satisfaction and industry growth (Rohaan et al., 2022).

In addition to physical product quality, customers also expect non-physical services throughout the product life cycle (Murali et al., 2016). An after-sales service system that focuses on user-oriented results is crucial to maintain customer satisfaction (Lin et al., 2010). Effective services that address customer needs and expectations, handle inquiries and complaints, provide information, and improve service effectiveness are vital components of a successful service program (Song et al., 2022). However, companies often overlook after-sales service, which is considered an intangible asset, leading to missed opportunities for future strategic interests. Hence, this study aims to investigate the gap between service quality and after-sales service in the automotive industry, specifically focusing on IoT-based technology features and their potential to enhance customer satisfaction and repeat purchase intentions.

This research paper aims to address the complex factors influencing auto purchase decisions, with a particular emphasis on the role of after-sales service in customer satisfaction and repurchase intentions. While various factors such as brand image, brand loyalty, warranties, price competition, and buying power have been well-established in research, the service paradigm and its impact on repurchase intentions requires further investigation. Limitations of this study include the potential lack of generalizability to other contexts or populations beyond the specific sample of IoT technology car users in Indonesia. The cross-sectional design limits establishing causal relationships between variables, and the reliance on self-reporting measures introduces potential biases. Additionally, the study did not consider other potential mediating and moderating variables. Research problem formulation:

1. Does the service quality of the automotive industry affect future customer satisfaction?
1. Does the after-sales service of the automotive industry affect customer satisfaction?
2. Does the automotive industry's service quality affect future repeat purchase decisions?
3. Will the after-sales service of the automotive industry influence future repeat purchase decisions?
4. Does customer satisfaction influence future repeat purchase decisions?

LITERATURE REVIEW

Service Quality

The era of disruption has changed perspectives of what it means to be transformative within the automotive industry (Ghobaei-Arani & Shahidinejad, 2022). IoT technology is deemed as necessary and has the potential to provide reliable service features (Auer et al., 2022), such as car damage services that can immediately serve customers with a pick-up system without consumers having to carry out or be bothered by technical mechanisms when the car has problems on the highway. The concept of a mobile insurance service that can be directly detected by the vehicle's operation system (OS) allows damage to be seen online and to be processed immediately. The theory in this area relates to service quality as viewed by both the company and the customer (Sakyi, 2020). Based on the literature review, a company is expected to be able to provide services to a certain level of quality with the hope that consumers can accept higher prices. Other companies will be considered the same with an equally high quality of the services provided. However, from the customer's point of view, service quality is viewed as an assessment of the company's performance (Riyadi et al., 2021).

When considering the SERVQUAL model, service quality must consider the expectations and feelings of customers (Murali et al., 2016). The SERVQUAL model uses 22 instruments to assess customer

perceptions in influencing customer satisfaction, and the five dimensions are service-tangible reliability, responsiveness—assurance, and empathy-developed. SERVQUAL has a weakness in capturing the quality of services provided (Liu & Chen, 2022). The evolution of service quality has developed with the extended short-them memory network (LSTM) method by considering time variations and studying time series data effectively. The following diagram shows the dimensions of SERVQUAL based on the hierarchical model.

The Hierarchical Service Quality Model is a framework used to assess the quality of services a business or organization provides to improve customer satisfaction and loyalty. The model proposes that service quality can be broken down into several dimensions or levels, each contributing to the overall perception of service quality. As described in "A Hierarchical Model of Service Quality for Higher Education" (Inder et al., 2022), the model consists of three levels: the core service, the service delivery system, and the supporting services. The core service refers to the organization's primary service, while the service delivery system refers to the processes and interactions involved in delivering the service. Finally, the supporting services refer to the additional services and resources that enhance the core service delivery. Each level of the model is further broken down into

specific dimensions or factors that contribute to service quality. For example, in "Assessing Service Quality in Private Higher Education Institutions using Hierarchical Service Quality Model", Adidin, Mohamed, and Sidi (2015), identified six dimensions of service quality within the service delivery system level: reliability, responsiveness, assurance, empathy, tangibility, and security.

The Hierarchical Service Quality Model has been applied to various industries, including hospitality and tourism (Wong & Lai, 2019), retail banking (Hossain et al., 2015), online shopping (Blut, 2016), and the airline industry (Wu & Cheng, 2013), among others. In each context, the model can be adapted and customized to reflect the unique characteristics and needs of the industry and the customers being served. The Hierarchical Service Quality Model provides a useful framework for businesses and organizations to assess and improve their service quality, with the intention to enhance customer satisfaction and loyalty.

This study measures service quality based on the value of the product provided to customers with specific attributes to meet customer needs; therefore, if the service can meet customer expectations, it will get a high score, and vice versa (Chang & Thai, 2016). In this study the quality of service the company provides includes both the quality of service provided during the purchasing of goods by
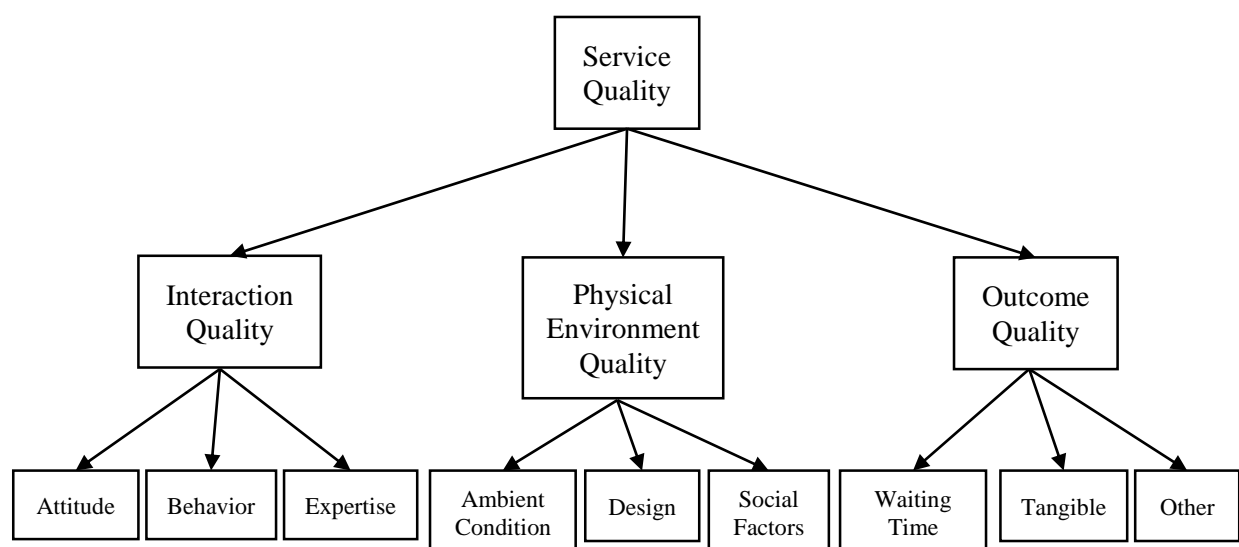
Figure 1 Hierarchical Service Quality Model.

customers, and the after-sales service provided during use of the product for the duration of the products expected life time (this ends at the point at which the customer is expected to make a repeat purchase for a newer product). With this, the company can assist and maintain good customer relationships in the long-term (Uzir et al., 2020). Research (Shah et al., 2020) explains service quality from the customer's point of view and demonstrates that service quality is an essential, non-negotiable factor. As in the service industry, companies with an asset base and physical products must be able to guarantee the best service quality to meet customers' high expectations. Service quality has been conceptualized in two models. First, service quality is a holistic conceptual term that subjectively evaluates quality during customer interactions and the extent to which this service has provided satisfaction and is in line with expectations (Guan et al., 2020). It is important to note from this that all activities should ensure that product services will always be available to consumers and that they are free from problems.

After-Sales Service

After-sales service is mainly used to provide an overview of the services provided after the goods are received to facilitate the use of the product by the customer throughout the product's life cycle or during the product's use (Mehta & Balakumar, 2021). Cars are products that were created as durable goods to meet long-term needs. This utilization value is referred to as after-sales service (Sun et al., 2022). Automotive industry services provide a different experience in the digital era by using Android-based services that can give other value to buyers (Farouk et al., 2022), for example, a feature for detection of the nearest appropriate refueling point through connection to the OS network in the car, and periodic oil changes and services at the nearest workshop; these are categorized as consumable operating supplies or services required by customers to meet their primary needs, namely comfortable use of the car (Kirkizoğlu

& Karaer, 2022). After-sales service can be defined from several perspectives; for example Chen et al., (2017) explained that after-sales service is carried out to encourage product sales transactions. Additionally, from retail literature (Potluri & Hawariat, 2010), company titled services and after-sales service, are considered an added value to customers. In contrast, companies as producers of physical or tangible products state after-sales service as services provided free of charge to customers through their own distribution chain until it is time for the customer to make a repeat purchase (Kurata & Nam, 2013). In addition, Kurata and Nam (2013) also explained that after-sales service is used as technical support for customers and products. Even though many researchers have defined the concept of after-sales service differently due to the breadth of the role of the entire value chain, it is stated that this after-sales service has the following general characteristics:

1. After-sales service is a customer-oriented process designed to meet customer needs and maintain customer satisfaction.
2. The concept of after-sales service is a cross-functional process carried out by different actors.

Over the past decade, after-sales service utilizing technology-based concepts has become the primary source of income for hybrid and environmentally friendly car manufacturers. Furthermore, the company will focus on maintaining customer satisfaction among those who are willing to buy the product rather than acquiring customers because of higher costs. As a result, this concept becomes a strategic source of differentiation and a sustainable competitive advantage in the future (Li et al., 2014).

There are several elements used as indicators of after-sales service (Kurata & Nam, 2010); after-sales service elements are as follows:

1. A guarantee convinces customers that the product will be in good condition or free from damage, resulting from inaccuracy in artistry or using poor materials that are

valid for a certain period.

2. Provision of accessories or spare parts is commonly implemented as part of the after-sales service; it is essential to provide accessories and spare parts as without these, damaged products will not function properly, and even these products will be damaged.

3. Advanced consulting maintenance services (periodic) are needed if a product has a long consumption period and requires regular maintenance to function correctly.

Repeat Purchases

Several studies state that emotional and affective ties affect the intention to repurchase a product (Ferguson & Mohan, 2020). However, in many studies of social relations as a dynamic factor, there has been little increase in buying interest. Hajli et al., (2017) states that there are several psychological situations that can lead and motivate consumers to make repeat purchases. Therefore, belief in the satisfaction created will stimulate the company to develop a solid intention to achieve repeat purchases by its customers. Service quality can be interpreted as providing benefits as long as consumers use them (Zhang et al., 2021). In this case, the services provided can encourage and become a determining factor for consumers' desire to buy, especially for repeat purchases (Yuan et al., 2021). Identification of repeat purchases can be made based on the service center provided and guarantees that the brand can deliver the expectations consumers want. This identification makes it easier for companies to increase repeat purchase intentions and set strategies for the future (Yuan et al., 2021).

Customer Satisfaction

Satisfaction can be defined as "the difference in taste between previous expectations and perceived performance after the goods are consumed or worn; performance is different from expectations, leading to dissatisfaction" (Xu, 2022). Darko &

Liang, (2022) explain the meaning of customer satisfaction as a person's subjective evaluation, resulting in a positive emotional response. This customer satisfaction is a condition in which customer expectations are met by the desire to have a product (Kotler, 2021). Customer satisfaction is a psychological response to exceeding expectations based on their evaluative consumption of expectations and perceptions (Littlechild, 2021). Customer satisfaction is also obtained when customer feelings are represented by adding new features that have not previously been felt when using other products. It is decisive in customer purchase behavior (Bhardwaj et al., 2021).

Customers are satisfied if their expectations are met and will be very satisfied if customer expectations are exceeded. According to Matsuoka (2022), there are five main dimensions of customer satisfaction, namely:

1. Price, usually low, is an essential source of pride for sensitive customers because they will get a high value for their money. This price component is relatively unimportant for those who are not price sensitive.

2. Service quality depends on three things: systems, technology, and people. Customer satisfaction with service quality is usually difficult to imitate because forming an attitude and behavior in line with the company's wishes is not an easy job. Improvements must be made to the recruitment process, training, and work culture.

3. Product Quality: Customers feel satisfied if they feel the quality is good after purchasing and using the product.

4. Emotional Factors are shown by consumers for the satisfaction they get in using a product/service; this includes creating a sense of pride or self-confidence.

5. Efficiency: The ease of obtaining the product or service and the ease of payment can make customers more satisfied if it is relatively easy, comfortable, and efficient to get the product or service.

A company should hope to increase its market share, sales, and number of customers

through a customer satisfaction strategy. Customer satisfaction can be applied to service companies, according to Kiran (2017), Woo et al. (2021), and Woo et al. (2021):

1. Customer Expectations Management Strategy: Customer expectations are formed and based on several factors, such as past shopping experiences, the opinions of friends and relatives, and the information and promises of the company and its competitors.
2. Relationship Marketing and Management: Relationship marketing and management is a way of thinking about customers, marketing, and value creation, not just a set of tools, techniques, and tactics. In other words, relationship marketing and management is an integrative or holistic approach that strengthens the company's marketing competence.
3. After-sales Marketing: This stage emphasizes the importance of marketing and communication activities after the purchase transaction. In particular, to provide confidence after the purchase stage (so that consumers are sure that the purchasing decisions are sensible) and to build brand loyalty.
4. Customer Retention Strategy: This focuses on the techniques used to retain customers so that customers do not switch to other suppliers or service companies.
5. Superior Customer Service: Excellent customer service is realized by offering better service than competitors.
6. Technology Infusion or Infusion Strategy Technology can be used effectively to improve and satisfy the customer, generating customer satisfaction in the service experience.
7. Effective Complaint Handling Systems: Both in industry and engagement in the service sector, it is obligatory to respond to customer complaints to know the level of customer satisfaction. In essence, there are two primary purposes for customers to submit complaints. The first is to cover economic losses, and the second is to improve self-image.

Hypothesis Development

In many types of marketing research, it is stated that service quality increases each day by considering the intangible aspects (S. Woo et al., 2021). However, tangible products require a form of service related to service quality. The concept of after-sales service includes the quality of services which support customer satisfaction, becoming a strong reason for customers to choose particular products (Abbas, 2020). The quality of service, especially the after-sales service, is vital in purchasing a new car with an integrated internet system as it is today. With this service encouragement, the company can maintain good relationships with customers in the long-term (Murali et al., 2016). This agrees that tangible product services are intangible values continuously offered to customers (Gligor et al., 2019; Omar et al., 2021; and Blut, 2016). Previous studies have noted service quality as an essential factor in consumer-focused companies, while Kim (2021) has shown that service quality is a dynamic factor in shaping customer satisfaction. Many previous studies have theoretically established that service quality significantly affects customer satisfaction, but this also applies dynamically in different countries from the measurement scale (Eboli & Mazzulla, 2021). Thus, this study proposes the following hypothesis:

H1: The service quality of the automotive industry affects customer satisfaction.

Several recent studies have studied the impact of after-sales service on customer satisfaction and customer retention in several industrial sectors (Kurata & Nam, 2013; Blut, 2016; and Arabi et al., 2018). Parasuraman et al. (1994) revealed that service quality in the service industry is essential in encouraging customer satisfaction. Woo et al., (2021) also explained that the quality of service must begin to be improved at the retail level as it can directly meet customer needs, and recognize their satisfaction and loyalty. In a study by Quy Nguyen-Phuoc et al. (2021), air travel services were determined by safety

assurance, reliability, and empathy, while the actual dimensions of these services were found to predict customer satisfaction. Rebelo et al. (2021) provided an overview of after-sales service from manufacturers by directly identifying the physical product, such as product defects, employee competence and experience, and the existence of a replacement warranty period according to customer expectations. The service center approach is a determining factor for improving the service experience, which has been found to include response time, repairs, the price-performance ratio, service contracts, spare parts availability, and the general behavior of technicians, as the main factors for customer satisfaction and customer intensions to make repeat purchases (Levesque & Boeck, 2017). Thus, this study proposes the following hypotheses:

H2: After-sales service in the automotive industry affects customer satisfaction.

H3: The service quality in the automotive industry affects future repeat purchase decisions.

H4: After-sales service in the automotive industry affects future repeat purchase decisions.

H5: Customer satisfaction mediates the effect of service quality and after-sales service on future repeat purchase decisions.

RESEARCH METHODS

This study utilized quantitative methods to analyze samples from a specific population using purposive sampling (Ahrholdt et al., 2019). Using a non-probability sampling method does not provide equal opportunities or opportunities for all elements of the population (Siegel & Wagner, 2022), and is suitable for this study as the study has several criteria for selecting respondents. The measurements of this study were adapted from primary and secondary data, which were taken from several literary sources as well as previous research that considered impacts on the use of cars with new technologies.

Another research method used in this study is the cross-sectional survey design. Data were collected from 100 respondents who had bought and used a car with incorporated IoT technology. Structural Equation Modeling (SEM) using AMOS software was used to test the research hypotheses. The study examined the direct and indirect effects of service quality and after-sales service on repeat purchases through customer satisfaction as a mediating variable. The measurement model was evaluated for reliability and validity using Cronbach's alpha, composite reliability, convergent validity, and discriminant validity. Path analysis was used to test the hypotheses and the significance of the direct and indirect effects. The results showed that service quality and after-sales service had a significant positive impact on customer satisfaction, while customer satisfaction also had a significant positive impact on repeat purchases.

The sampling carried out in this study used the Isaac and Michael formula (Siegel & Wagner, 2022) as follows:

$$S = \frac{\lambda^2.\, N.\, P.\, Q}{d^2(N-1)+^2.\, P,\, Q}$$

λ^2 with dk = 1, Refractive Error Rate 1%, 5%, 10%, P = Q = 0,5. d = 0,05.

Keterangan:

S : Total Sample

λ^2: Chi-squared, whose value depends on the degrees of freedom and the error rate. To DF = 1, Error = 10%, Chi-squared = 2,706 (Chi-squared *Table)*

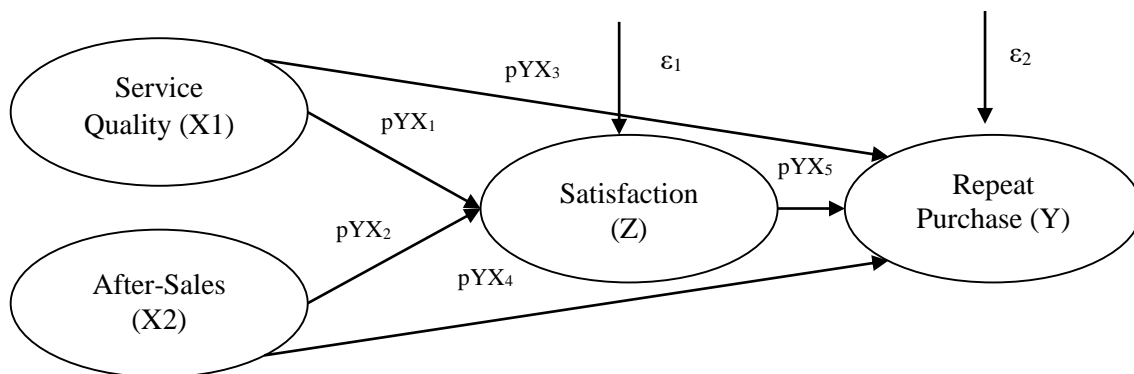N : Total Population

P : True Chance (0.5)

Q : False Chance (0.5)

d: Difference between the sample mean and the population mean

Table 2 Protocol of Power Analyses

Input Parameters		Output Parameters	
Effect size (ρ)	0.3	Critical t	1.5689
A err Prob	0.05	DF	109
Total Sample Size	111	Power (1-β err prob)	0.95

Figure 2 Relationship Model Between Variables

Using a population of 231,309 in Sidoarjo City, East Java Province, Indonesia, this study determined an error tolerance limit of 10% and a value of d = 0.05. Accordingly, the size of the research sample was defined in Table 2.

Path analysis was used as the regression method, as it is suitable for analyzing the causal relationship between one variable and another.

The following equations express this analysis:
$$Z = pZx1 + pZx2 + pZY + \varepsilon1$$
$$Y = pYx1 + pYx2 + \varepsilon2$$

Path analysis was used, taking into account both direct and indirect effects.

Path analysis is a statistical technique used to examine causal relationships among a set of variables. It is an extension of multiple regression, which allows for the modelling of direct and indirect effects among variables. In the given model, the dependent variable Z is influenced by three independent variables: X1, X2, and Y, while the variable Y is influenced by two independent variables, X1 and X2.

In path analysis, direct and indirect effects are of particular importance. Direct effects refer to the influence of one variable on another without any mediating variable. Indirect effects, on the other hand, refer to the influence of one variable on another through one or more mediating variables.

In the given model, the direct effects are represented by the path coefficients (pZx1, pZx2, pZY, pYx1, and pYx2). These coefficients indicate the strength and direction of the relationships between the variables. For example, pZx1 represents the direct effect of X1 on Z, while pYx1 represents the direct effect of X1 on Y.

Indirect effects are calculated by multiplying the direct effects along the paths connecting the variables. For example, the indirect effect of X1 on Z through Y would be calculated as the product of pYx1 (direct effect of X1 on Y) and pZY (direct effect of Y on Z).

The errors, $\varepsilon1$ and $\varepsilon2$, represent the unexplained variance in the dependent variables (Z and Y), which may be due to measurement errors or other variables unaccounted for in the model.

In summary, path analysis is a useful method for disentangling complex relationships among variables and allows researchers to investigate both direct and indirect effects

in a single model. This method helps to better understand the causal structure of the relationships and provides insights into potential interventions or policy implications.

RESULTS

This study used Structural Equation Modeling (SEM) based on Partial Least Square (PLS-SEM) analysis with the assumption that all data obtained were not normally distributed, the sample size was not too large, randomization of the sample selection was not required, indicator measurements were carried out reflectively and formatively, the latent variables were dichotomous, interval scales were used, residual distribution was not needed, and that the model could act as theory development with a linear regression approach. Data were collected by distributing research questionn-aires directly, visiting respondents, conducting interviews, and filling out questionnaires. A total sample of 100 questionnaire responses was collected, with the questionnaires being distributed from February to June 2021. The profile of respondents who participated in this study showed that the sex of the respondents was mostly male, (65.5%) while the remainder were female (34.4%). Meanwhile, the average age of 20 to 35 years, accounted for 69 respondents (72.1%). Regarding the number of purchases, students or young people accounted for 40 respondents (44.4%). At the same time, most respondents had made only a one-time purchase, accounting for 42 people (45.6%). Respondents already held sufficient knowledge about the products from the respondent data, so respondents already knew about service quality, after-sales service, and purchasing decisions well.

Table 3 shows that this study is feasible with all Cronbach's alpha values > 0.7, the values of composite reliability > 0.7 and all rho_A values > 0.7; thus, all latent variables of service quality (X1), after-sales service (X2), satisfaction (Z), and repeat purchase intensions (Y) were reliable and valid.

The results presented show the performance of the PLS-SEM model in terms of its predictive accuracy using the PLS prediction technique. Table 4. contains the Root Mean Squared Error (RMSE), Mean Absolute Error (MAE), and Q^2_Predict values for each of the model's constructs (Service Quality, After-Sales, Satisfaction, and Purchase).

Root Mean Squared Error (RMSE): This metric represents the average squared difference between the predicted and actual values. Lower RMSE values indicate better predictive accuracy. In this study, the RMSE values for the constructs were:

Service Quality: 0.950
After-Sales: 1.078
Satisfaction: 0.998
Repeat Purchases: 0.954

Table 3 Construct Reliability and Validity

Construct	Cronbach's Alpha	rho_A	Composite Reliability
Service Quality (Kp/X1)	0.773	0.792	0.822
After-Sales (Lpj/X2)	0.789	0.787	0.821
Satisfaction (Kpm/Z)	0.835	0.846	0.899
Purchase (Kpl/Y)	0.883	0.879	0.901

Table 4 Prediction Summary

	RMSE	MAE	Q^2_Predict
Service Quality (Kp/X1)	0.950	0.741	0.155
After-Sales (Lpj/X2)	1.078	0.837	0.126
Satisfaction (Kpm/Z)	0.998	0.821	0.134
Repeat Purchase (Kpl/Y)	0.954	0.775	0.146

Mean Absolute Error (MAE): This metric represents the average absolute difference between the predicted and actual values. Lower MAE values indicate better predictive accuracy. In this study, the MAE values for the constructs were:

Service Quality: 0.741
After-Sales: 0.837
Satisfaction: 0.821
Repeat Purchases: 0.775

Q^2_Predict: This is an alternative to the traditional Q^2 value used in PLS-SEM for model validation. It is calculated using the out-of-sample prediction errors (RMSE or MAE) and indicates the model's predictive relevance. Higher Q^2_Predict values (>0) indicate that the model has predictive relevance, while values close to or below 0 suggest the model may not have predictive relevance. In this study, the Q^2_Predict values for the constructs were:

Service Quality: 0.155
After-Sales: 0.126
Satisfaction: 0.134
Repeat Purchases: 0.146

Based on these results, the PLS-SEM model shows some predictive relevance for all constructs, as indicated by Q^2_Predict values greater than 0. However, it is important to consider the context of the research and compare these values with other models or benchmarks to better assess the model's predictive performance. Additionally, RMSE and MAE values can be used to identify areas where the model's predictions may need improvement or further investigation.

The results of the HTMT test show that all construct pairs have values below the threshold of 0.90, indicating good discriminant validity. More specifically, the HTMT value between Service Quality and After-Sales Service is 0.82, while between Service Quality and Satisfaction it is 0.77, and between Service Quality and Repeat Purchases it is 0.81. For After-Sales Service and Satisfaction, the value of HTMT is 0.79, while for After-Sales Service and Repeat Purchases it is 0.83. Finally, the HTMT value between Satisfaction and Repeat Purchases is 0.85. Thus, it can be concluded that each construct in this model is different and differentiates itself adequately from the other constructs.

Table 6 explains that there is no collinearity or very high correlation between independent variables because the VIF values are less than 10.

The results of the VIF test show that all variables have VIF values below the boundary fence of 3.3, indicating no significant multicollinearity problem. More specifically, Service Quality has a VIF of 1.467,

Table 5 HTMT Test

Pair of Constructs	HTMT
Service Quality - After-Sales Service	0.82
Service Quality - Satisfaction	0.77
Service Quality – Repeat Purchases	0.81
After-Sales Service - Satisfaction	0.79
After-Sales Service – Repeat Purchases	0.83
Satisfaction – Repeat Purchases	0.85

Table 6 Collinearity Statistics (VIF)

	VIF
Service Quality (Kp/X1)	1.467
After-Sales (Lpj/X2)	1.369
Satisfaction (Kpm/Z)	1.562
Purchase (Kpl/Y)	1.522

After-Service has a VIF of 1.369, Satisfaction has a VIF of 1.562, and Repeat Purchase has a VIF of 1.522.

Based on these results, it can be concluded that Common Method Bias does not appear to be a problem in this study. Furthermore, various tests and other controls were carried out to ensure the validity and refinement of the research results.

In Table 7, the path coefficient of 0.222 refers to the magnitude of the influence of the latent variables X1 and X2 with their indicators on variable Z with its indicators. The path coefficient of 0.473 refers to the significant influence of the latent variable Z with its indicators on Y with its indicators.

The calculation of the path analysis model was carried out by removing any indicators with a factor loading value below 0.6. As can be seen in Figure 3, the model reveals that all factor loading values are above 0.7, indicating that the construct is valid for all variables.

Table 7 Path Coefficients

	Y	Z
X1	0.222	0.473
X2	0.145	0.495
Z	0.585	
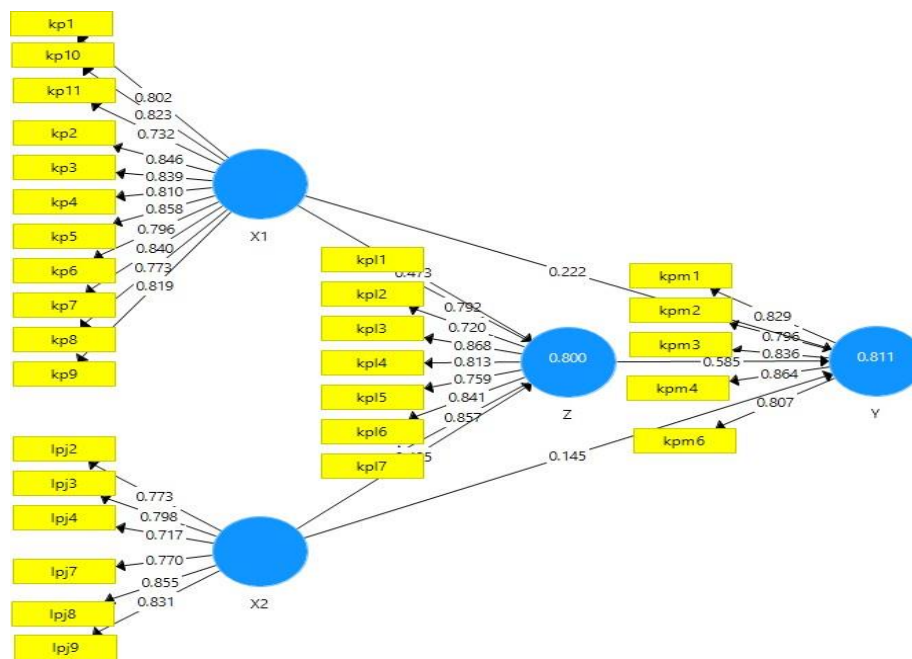
Figure 3 Results of the PLS Algorithm

Table 8 R Square and PLS Predict

Variable	R-Square	RMSE	MAE	Q²_Predict
Satisfaction (Z)	0.638	0.998	0.821	0.134
Repeat Purchases (Y)	0.702	0.954	0.775	0.146

Table 9 F-Square

Path	f-Square
Service Quality → Satisfaction	0.182
After-Sales Service → Satisfaction	0.213
Satisfaction → Repeat Purchases	0.276

Regarding the structural model in Table 8, the R-square values for Satisfaction and Repeat Purchases were 0.638 and 0.702, respectively, indicating that the model explains 63.8% of the variation in Satisfaction and 70.2% of the variation in Repeat Purchases. Regarding effect size in Table 9, the f-square results show that Service Quality and After-Sales Service have a moderate effect on Satisfaction with f-square values of 0.182 and 0.213. Meanwhile, Satisfaction has a more significant effect on Repeat Purchases, with an f-square of 0.276.

Additionally, the RMSE and MAE values for Satisfaction were 0.998 and 0.821 respectively, while for Repeat Purchases, they were 0.954 and 0.775. The Q^2_Predict values for Satisfaction and Repeat Purchases were 0.134 and 0.146 respectively, indicating reasonably good predictive validity of the model. Therefore, based on the R-square, f-square and PLSpredict results, the structural model appears to be of good quality and a good fit.

In Table 10, service quality was shown to have an indirect positive effect on repurchases through satisfaction. Meanwhile, after-sales service has an indirect positive effect on repurchasing through satisfaction.

Mediation Role Elaboration

The results of the study indicate that satisfaction acts as an essential mediator in the relationship between service quality and after-sales service and repeat purchases.

In particular, the findings support the hypothesis that service quality and after-sales service have an indirect positive affect on repeat purchases through increased satisfaction levels. This shows that although service quality and after-sales service can directly encourage repeat purchases, their effect can be enhanced through increased customer satisfaction.

Theoretically, these results suggest that understanding and managing customer satisfaction is essential to a resale strategy. It also shows that while service quality and after-sales service are essential, an effective strategy to increase repeat purchases must involve efforts to increase customer satisfaction.

From a practical perspective, these findings suggest that companies should invest in improving service and after-sales service quality and ensuring that customers are satisfied with their experience. This may involve training staff to provide superior customer service, ensuring that products and services match customer expectations, and that customer problems or complaints are responded to effectively and promptly.

In Table 11, the path coefficient value for X1 is 0.591, while for X2 it is 0.488, reflecting the influence of latent variables X1 and X2, namely service quality and after-sales service, along with their indicators, on variable Z, satisfaction, with its indicators. Meanwhile, the path coefficient value of

Table 10 Indirect Effects

Route	Indirect Effect Estimation	SE	t-Value	p-Value
Service Quality → Satisfaction → Repeat Purchases	0.276	0.043	6.420	0.000
After-Sales → Satisfaction → Repeat Purchases	0.289	0.046	6.304	0.000

Table 11 Total Effect

	Y1	Z	P-Value
X1	0.497	0.591	0.001
X2	0.502	0.488	0.000
Y			0.000
Z	0.714		0.002

0.714 indicates the magnitude of the influence of the satisfaction variable (Z) on the purchase variable (Y).

The convergent validity of the model uses reflective indicators based on the factor loading of the indicators measuring the construct. There were four constructs in this study, each with 1 to 3 indicators, and each indicator having 2 to 3 statements, measured on a scale of 1 to 5. The results of the measurement model testing, can be explained as follows:

1. The service quality construct was measured using Kp1-Kp12. All indicators had factor loading values above 0.7, an AVE above 0.6, and commonality above 0.6.
2. The after-sales service construct was measured using Lpj1-Lpj9. All indicators had factor loading values above 0.7, an AVE above 0.6, and commonality above 0.6.
3. The construct of consumer satisfaction was measured using Kpl1-Kpl7. All indicators had factor loading values above 0.7, an AVE above 0.6, and commonality above 0.6.
4. The consumer purchase construct was measured using Kpm1-Kpm6. All indicators had factor loading values above 0.7, an AVE above 0.6, and commonality above 0.6.

Based on the results of the factor loading values described above, it can be concluded that the construct has good convergent validity.

The data provided contains the results of a bootstrapping test, which includes the original sample (O) path coefficients, sample mean (M), bias, and confidence intervals (2.5% and 97.5%). A brief description of the partial data for each relationship follows:

X1 → Y:

The path coefficient in the original sample is 0.222, while the sample mean is 0.234, resulting in a positive bias of 0.012. The 95% confidence interval ranges from 0.021 to 0.388. This indicates a positive bias in the relationship between X1 and Y, while the confidence interval suggests that the actual path coefficient could fall within a wide range.

X1 → Z:

The path coefficient in the original sample is 0.473, while the sample mean is 0.483, resulting in a positive bias of 0.010. The 95% confidence interval ranges from 0.356 to 0.577. This suggests a positive bias in the relationship between X1 and Z, while the confidence interval indicates a moderate range for the actual path coefficient.

X2 → Y:

The path coefficient in the original sample is 0.145, while the sample mean is 0.149, resulting in a positive bias of 0.004. The 95% confidence interval ranges from -0.019 to 0.355, indicating a minimal positive bias in the relationship between X2 and Y.

Table 12 AVE and Communality

Indicator	AVE	Communality
Kp (X1)	0.661	0.661
Lpj (X2)	0.627	0.627
Kpm (Z)	0.684	0.684
Kpl (Y)	0.654	0.654

Table 13 Confidence Bias-Corrected Intervals

	Original Sample (O)	Sample Mean (M)	Bias	2.5%	97.5%
X1 → Y	0.222	0.234	0.012	0.021	0.388
X1 → Z	0.473	0.483	0.010	0.356	0.577
X2 → Y	0.145	0.149	0.004	-0.019	0.355
X2 → Z	0.495	0.487	-0.008	0.353	0.617
Z → Y	0.585	0.572	-0.013	0.341	0.782

Nevertheless, the confidence interval includes positive and negative values, implying that the actual path coefficient is uncertain.

X2 → Z:

The path coefficient in the original sample is 0.495, while the sample mean is 0.487, resulting in a negative bias of -0.008. The 95% confidence interval ranges from 0.353 to 0.617, suggesting a slight negative bias in the relationship between X2 and Z. The confidence interval indicates a moderate range for the actual path coefficient.

Z → Y:

The path coefficient in the original sample is 0.585, while the sample mean is 0.572, resulting in a negative bias of -0.013. The 95% confidence interval ranges from 0.341 to 0.782. This indicates a slight negative bias in the relationship between Z and Y, while the confidence interval suggests that the actual path coefficient could fall within a relatively wide range.

The biases in the data indicate minor deviations between the original sample path coefficients and their sample means. The confidence intervals provide insight into the range within which the accurate path coefficients could lie, representing the uncertainty in the relationships between variables.

Based on the bootstrapping results provided, here is an interpretation of the path coefficients for each relationship in the research, where X1 is Service Quality, X2 is After-Sales Service, Z is Satisfaction, and Y is Repeat Purchases:
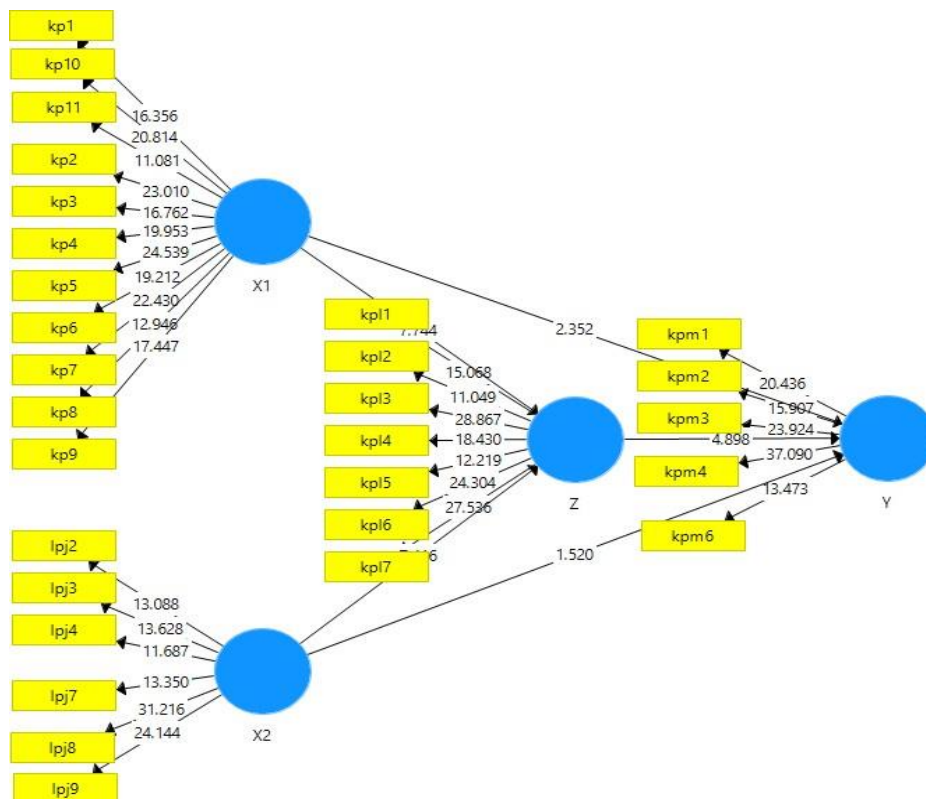
X1 (Service Quality) → Y (Repeat Purchases)

Path coefficient: 0.222

p-value: 0.019

The path coefficient of 0.222 indicates the positive and significant direct effect of Service Quality on Repeat Purchases (p-value < 0.05). This means that as Service Quality improves, customers are more likely to make repeat purchases.

X1 (Service Quality) → Z (Satisfaction)

Figure 4 PLS Bootstrapping

Path coefficient: 0.473
p-value: 0.000

The path coefficient of 0.473 signifies the positive and significant direct effect of Service Quality on Satisfaction (p-value < 0.05). This suggests that better Service Quality leads to higher levels of customer satisfaction.

X2 (After-Sales Service) → Y (Repeat Purchases)

Path coefficient: 0.145
p-value: 0.129

The path coefficient of 0.145 shows a positive but non-significant direct effect of After-Sales Service on Repeat Purchases (p-value > 0.05). This means that there is insufficient evidence to conclude that better After-Sales Service directly leads to increased repeat purchases.

X2 (After-Sales Service) → Z (Satisfaction)

Path coefficient: 0.495
p-value: 0.000

The path coefficient of 0.495 indicates the positive and significant direct effect of After-Sales Service on Satisfaction (p-value < 0.05). This suggests that better After-Sales Service contributes to increased customer satisfaction.

Z (Satisfaction) → Y (Repeat Purchase)
Path coefficient: 0.585
p-value: 0.000

The path coefficient of 0.585 represents the positive and significant direct effect of Satisfaction on Repeat Purchases (p-value < 0.05). This indicates that higher levels of satisfaction are associated with a higher likelihood of customers making repeat purchases.

In summary, these results suggest that both Service Quality and After-Sales Service have a significant positive effect on customer Satisfaction. However, only Service Quality has a significant direct effect on Repeat Purchases. The positive and significant relationship between Satisfaction and Repeat Purchases implies that improving customer satisfaction can lead to increased repeat purchases.

The table above shows that the original sample estimate of service quality (KP) is 0.473 with a significance below 5%, as indicated by the t-statistic value of 7.744, which is greater than the t-table value of 1.984. This means that service quality has a positive influence on customer satisfaction. Based on the regression results, it can be concluded that the first hypothesis (H1) should be accepted. The second test was conducted to see whether after-sales service positively affected customer satisfaction (KPM). The test results can be seen in table 4 above. After-sales service obtained an original sample estimate value of 0.487 with a t-statistic value of 7.416, greater than the t-table value of 1.984. This means that product quality positively affects purchasing decisions with a significance level below 5% (significant). Based on the test results, it can be concluded that the second hypothesis (H2) should be accepted. The third test revealed an original sample estimate for service quality (KP) of 0.499 with a significance below 5%, as indicated by the t-statistic value of 6.262, which is greater than the significant t-table value of 1.984. This shows that service quality positively affects purchase decisions (KPL). Based on the regression results, it can be (H3) should be accepted. Testing of the fourth hypothesis was used to see the effect of

Table 14 Path Coefficients (Mean, STDEV, T-Value)

	Original sample estimate	Mean of Subsamples	Standard deviation	T- Statistic
KP→KPM	0.473	0.483	0.061	7.744
LPJ→KPM	0.495	0.487	0.067	7.416
KP→KPL	0.499	0.510	0.080	6.262
LPJ→KPL	0.434	0.426	0.089	4.855
KPM→KPL	0.585	0.572	0.119	4.898

after-sales service (LPJ) on purchasing decisions (KPL). Based on the results of the service quality test, the original sample estimated a value of 0.434 with a t-statistic value of 4.855, which is greater than the t-table value of 1.984, indicating that after-sales service has a positive effect on purchasing decisions with a significance value below 5% (significant). From the results of the hypothesis regression, it can be concluded that the fourth hypothesis (H4) should be accepted. The fifth hypothesis was tested to determine the effect of consumer satisfaction (KPM) on purchasing decisions (KPL). The results of the consumer satisfaction test, revealed an original sample estimate value of 0.585 with a t-statistic value of 4.898, which is greater than the t-table value of 1.984, indicating that consumer satisfaction has a positive effect on consumer decisions to make repeat purchases with a significance level below 5% (significant). From the results of the hypothesis regression, it can be concluded that the fifth hypothesis (H5) should be accepted.

DISCUSSION

Based on the results of the first test, the original sample estimate value between service quality and customer satisfaction is quite significant at 47.3%. This suggests that most respondents believe that the Company has carried out the production process well, producing quality goods for use by consumers, in addition to management performance. The high number of positive customer responses received by some companies is one observable effect of this belief, and consequently leads to the value of shares moving up, with the company being seen to be in great demand by investors. The level of trust of respondents has also been proven from frequency data which shows that 67% of the respondents had used IoT technology and android network systems in their cars. Car products with environmentally friendly innovations and renewable energy sources, such as electric power, are in great demand. In Indonesia, this is also supported by many government policies which have encouraged

the acceleration of carbon emission reductions. Therefore, this research proves once again that the performance of car manufacturers which have applied IoT and environmentally friendly technology in their products and services can continue to grow. The second hypothesis explains that the after-sales service variable has an effect of 49.5% on car customer satisfaction with the IoT technology system. Support for this assessment is obtained from respondents who have responded that the manufacturer has provided an extended guarantee in case of problems or damage to the car with 24-hour service and connected to the internet network and maps. Customers no longer need to worry about their car because any problem will be detected wherever the car stops and the issue will be taken over by the manufacturer for repair. Some manufacturers also provide extra services for car accessories that can be ordered online to add to the car's aesthetic value. With the value of quality service and after-sales service growing, it was found that 49.9% of customers are likely to make repeat purchases for the same type of car; this is supported by their level of satisfaction with the services provided and the application of technology which makes it easier for them to shop and drive, including the use of an autonomous car feature that has been added to many cars and which can be used while on a freeway. The fourth hypothesis is also proven by path analysis, indicating that 43.4% of customers can buy this new product directly without thinking about previous customer satisfaction. Interestingly, this is because they have also felt the impact on the environment of the after-sales service after seeing other people—users of the same product. After-sales service has also given new customers confidence to buy this product; for example, with IoT services such as insurance, customers will feel protected if they use the product. The fifth hypothesis showed the highest influence value on customer decisions to make repeat purchases; this can be confirmed because of changes in business models that have occurred in the automotive industry at the same time, as has been said by Kurata &

Nam (2013) and Arabi et al. (2018). Changes in business models like this will develop quickly along with the speed of information and communication media with the internet network system. This research has found several things about future customer behavior and how the automotive industry can respond to changes. Customers hope in the future is the creation of a future car that is interconnected and environmentally friendly, which will reduce the risk of excessive gas emissions, and reduce the number of road accidents that can cause death.

CONCLUSION

Based on the research conducted and the explanation of the research results, several conclusions can be drawn:

The service quality variable has a positive and significant effect on customer satisfaction. It can be seen that the estimated value of the original sample is 0.473 with a significance below 5%, which is indicated by the t-statistic value of 7.744, which is greater than the t-table value of 0.1984. The proof of the first hypothesis is carried out by obtaining a significance value of <0.05. It is proven that the quality of service with IoT technology and the development of information technology for customers is in great demand. It is hoped that in the future, there will be significant developments to support efficiency and renewable energy as a result of higher user mobility. The second is that the after-sales service variable significantly affects customer satisfaction. Based on the test results, the original sample estimate value is 0.495 with a t-statistic value of 7.416, which is greater that the t-table value of 0.1984, indicating that the after-sales service variable positively affects customer satisfaction with a significance below 5% (significant). With this test, it has also been proven that the services provided by using IoT in insurance are starting to align with the customer's desire for the efficiency and effectiveness of the vehicles used, to support daily activities.

Third, the service quality variable positively and significantly affects repurchase decisions. The original sample estimated value of 0.499 with a t-statistic value of 6.262 (t-table value = 0.1984), indicates that service quality positively affects purchasing decisions with a significance level below 5% (significant). This also proves that analyzing the path through customer satisfaction can encourage customers to make purchases of similar products repeatedly so that the product life cycle will be longer; therefore, in the future, it is hoped that this research can be a reference material for developing the quality of services provided to maintain a good relationship with customers. This study also answers the fourth problem formulation: the after-sales service variable has a positive and significant effect on repeat purchase decisions. The test results can be seen in Table 4. The quality of service obtained an original sample estimate value of 0.434 with a t-statistic value of 4.855 (t-table value = 1.984). This indicates that the services provided through the after-sales service network for an indefinite period will foster trust in customers, prompting them to make repurchases in the future. Good long-term cooperation grows between producers and customers. The last conclusion is that consumer satisfaction has a positive and significant effect on repeat purchases. Based on the test results, the original sample estimate value is 0.585 with a t-statistic value of 4.898 (t-table value = 1.984) and a significance below 5% (significant). This shows that a massive level of satisfaction in using cars with innovations and technologies will motivate customers to make further purchases in the future. Therefore, a continuous system is needed to monitor every movement and mobility of every customer using the new product to continue to feel served in the future.

The practical implication of this research is that the findings of this study show that the quality of sales service before and after buying a car with an online network can contribute to increasing customer satisfaction and encouraging repeat purchases in the future. This phenomenon reveals that the service process provided, effectively and

efficiently impacts buying behavior significantly. Ease in providing services for customer complaints and upholding professionalism can significantly impact the purchase of this product. Besides that, the office's physical existence can signal that the company still exists. The existence of long-term guarantees for consumers in caring for and reselling products that have been used at competitive prices will provide a sense of comfort for consumers. The practical implication of this research is to show the importance of developing digital technology that must be used to approach consumers because it is very effective in quickly measuring consumer wants and needs in the future.

LIMITATIONS

While this study provides valuable insights into the relationship between service quality, after-sales service, customer satisfaction, and repeat purchases in the context of IoT technology-based cars in Indonesia, it is essential to acknowledge the limitations of this study. These limitations present opportunities for future research to expand and improve upon the findings:

1. Generalizability: The findings of this study are based on a specific sample of IoT technology car users in Indonesia. Therefore, caution should be exercised when generalizing the results to other contexts or populations. Future research could replicate this study in different countries or cultures to enhance the external validity of the findings.
2. Cross-sectional design: This study employed a cross-sectional survey design, which limits the ability to establish causality between the variables. Future research could use longitudinal or experimental methods to provide more robust evidence of the causal relationships among service quality, after-sales service, customer satisfaction, and repeat purchases.
3. Self-report measures: The data collected in this study relied on self-report measures, which may be subject to biases

such as social desirability and recall bias. Future research could consider incorporating objective measures or observational methods to enhance the validity of the findings.
4. Mediating and moderating variables: This study focused on the mediating role of customer satisfaction in the relationship between service quality, after-sales service, and repeat purchases. However, other mediating or moderating variables may not be considered in this study. Future research could explore additional factors influencing the relationship between service quality, after-sales service, and repeat purchases.

SUGGESTIONS FOR FUTURE RESEARCH

1. Comparative studies: Conducting comparative studies between different brands or models of IoT technology-based cars could provide valuable insights into the specific factors that drive customer satisfaction and repeat purchases in the context of other car brands.
2. Long-term customer behavior: Investigating the long-term effects of service quality and after-sales service on customer loyalty and repurchase intentions would contribute to a better understanding customer behavior in the IoT technology car market.
3. Service recovery strategies: Exploring effective service recovery strategies in the event of service failures in the IoT technology car industry could help companies enhance customer satisfaction and retention.
4. Technology adoption and acceptance: Studying the factors influencing customers' adoption and acceptance of IoT technology in cars, such as perceived usefulness and perceived ease of use, would provide insights into the drivers of customer satisfaction and repeat purchases.

By addressing these limitations and pursuing the suggested avenues for future

research, scholars can further advance the understanding of service quality, after-sales service, and customer satisfaction in IoT technology-based cars, benefiting the automotive industry and enhancing customer experiences.

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