EFFECT OF PRODUCT QUALITY AND SERVICE PURNA SELLING ON LOYALTY MEDIATED BY CUSTOMER SATISFACTION IN. ACCURACY CORE QUANTUMS

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Abstract - *This study aims to determine and analyze the effect of product quality and after-sales service products for measuring health products on customer satisfaction and loyalty at PT. Quantum Inti Akurasi.*

The strategy used in this study is a quantitative associative research strategy and the research method used is a survey. The population in this study were all customers of PT. Quantum Inti Akurasi. Researchers used the Moe formula with a sample of 97 customers.

Based on the results and discussion shows that product quality has a significant positive effect on customer satisfaction; after-sales service of medical devices has a significant positive effect on customer satisfaction; Product quality has a significant positive effect on customer loyalty received; after-sale service of medical device products has a significant positive effect on customer loyalty received; satisfaction has a significant positive effect on customer loyalty received; Product quality has a significant positive effect on customer loyalty received through customer satisfaction and after-sales service of medical equipment products has a significant positive effect on loyalty received through customer satisfaction at PT. Quantum Inti Akurasi.

Keywords: Product quality, after sales service, satisfaction, customer loyalty

Abstrak– Penelitian ini bertujuan untuk mengetahui dan menganalisis pengaruh kualitas produk dan layanan purna jual terhadap kepuasan dan loyalitas pelanggan pada PT. Quantum Inti Akurasi.

Strategi yang digunakan dalam penelitian ini adalah strategi penelitian asosiatif kuantitatif dan Metode penelitian yang digunakan adalah survei. Populasi dalam penelitian ini adalah seluruh pelanggan PT. Quantum Inti Akurasi. Peneliti menggunakan rumus Moe dengan sampel sebanyak 97 pelanggan.

Berdasarkan hasil dan pembahasan menunjukkan bahwa kualitas produk berpengaruh positif signifikan terhadap kepuasan pelanggan ; layanan purna jual produk alat kesehatan berpengaruh positif signifikan terhadap kepuasan pelanggan ; kualitas produk berpengaruh positif signifikan terhadap loyalitas pelanggan diterima ; pelayanan purna jual produk alat kesehatan berpengaruh positif signifikan terhadap loyalitas pelanggan diterima ; kepuasan berpengaruh positif signifikan terhadap loyalitas pelanggan diterima ; kualitas produk berpengaruh positif signifikan terhadap loyalitas diterima melalui kepuasan pelanggan serta layanan purna jual produk alat kesehatan berpengaruh positif signifikan terhadap loyalitas diterima melalui kepuasan pelanggan pada PT. Quantum Inti Akurasi.

Kata kunci : Kualitas produk, layanan purna jual, kepuasan, loyalitas pelanggan

I. PRELIMINARY

Health is an important factor that must be developed by every country. Indonesia even defines health as a human right as stated in Article 8 of the 1945 Constitution which reads "Every citizen has the right to health services". Hospitals are a very important part of a health system. The hospital is the main thing that functions as a referral center. Hospitals can be government implementing units in providing public services or as private service institutions. In Indonesia, most of the hospitals are owned and operated by the central government and local governments. The existence of a hospital, both private and government owned, is needed by the community,

Seeing the number of suppliers of medical devices in Jakarta that continue to emerge, companies must strive to lead their companies in order to retain customers well in the market. Even today, entrepreneurs are competing to be at the forefront of their fields. This has spurred business actors, especially in medical devices, to determine customer satisfaction as their main goal to maintain the continuity of the company. Suppliers of medical devices compete to keep each customer from moving to similar competing companies, therefore companies are competing to be able to satisfy service, product quality, and compete in terms of price so that customers continue to buy products at PT. Quantum Core Accuracy.

Table 1.1 List of health equipment suppliers in Jakarta based on rating

No.	Perusahaan	Rating
1.	PT. Cipta Karunia Mandiri	5.00
2.	SaTurtle Medical & Dental Laboratory	4.9
3.	PT. Core Medika Sarana Medical equipment center	4.9
4.	PT. Quantum Core Accuracy	4.5
5.	CV. Central Jakarta Raya	4.3
6.	Sam Medical Center for medical equipment	4.00
7.	CV.Central Jakarta Raya	4.00
8.	Central Medical Devices	4.00
9.	Advance	3.8
10.	Genesis - Medical device	3.5

Sumber:www.klikalamat.com

Ber based on Table 1.1 above, it can be seen that there are several lists of suppliers of medical devices in Jakarta based on their rating. At the highest rating is PT. Cipta Karunia Mandiri and the fourth place is occupied by PT. Quantum Core Accuracy.PT Quantum Inti Accuracy is a company engaged in the supply and calibration of tools. Since 2003, PT Quantum Inti Accuracy (QIA) has been specialized in supplying Biomed, Radiology and Industrial tools and calibrations. Where currently PT Quantum Inti Accuracy is the sole distributor of various leading brands of equipment and calibration such as Fluke Biomedical (USA), Unfors RaySafe (Sweden), Leeds Test Object (UK), Shielding International (USA), Andilog (France), Larson Davis (USA), Sun Nuclear (USA) and of course also received various kinds of awards both domestically and internationally. There is also a lot of work or collaboration carried out by PT Quantum Inti Accuracy with government institutions and also with other leading private companies. Furthermore, the motto of PT Quantum Inti Accuracy is Support Your Quality System. Where this motto indicates that this company seeks to provide or support partners or consumers to support a quality system for them.

Based on the background of the problems described above, the authors are interested in researching "The Effect of Product Quality and After Sales Service on Loyalty Mediated by Customer Satisfaction at PT. Quantum Core Accuracy"

1.1. Formulation of the problem

Based on the background that has been stated above, the main problems of this study are:

1. Does product quality have a direct effect on customer satisfaction at PT. Quantum Core Accuracy?
2. Does after-sales service have a direct effect on customer satisfaction at PT. Quantum Core Accuracy?
3. Does product quality have a direct effect on customer loyalty at PT. Quantum Core Accuracy?
4. Does after-sales service have a direct effect on customer loyalty at PT. Quantum Core Accuracy?
5. Does customer satisfaction have a direct effect on customer loyalty at PT. Quantum Core Accuracy?
6. Does product quality have an indirect effect on customer loyalty through customer satisfaction at PT. Quantum Core Accuracy?
7. Does after-sales service have an indirect effect on customer loyalty through customer satisfaction at PT. Quantum Core Accuracy?

1.2. Research purposes

Based on the formulation of the problem above, this research was conducted to determine whether there are:

1. Direct effect of product quality on customer satisfaction at PT. Quantum Core Accuracy
2. The direct effect of after-sales service on customer satisfaction at PT. Quantum Core Accuracy
3. Direct influence of product quality on customer loyalty at PT. Quantum Core Accuracy
4. The direct effect of after-sales service on customer loyalty at PT. Quantum Core Accuracy
5. Direct influence of customer satisfaction on customer loyalty at PT. Quantum Core Accuracy
6. The indirect effect of product quality on customer loyalty through customer satisfaction at PT. Quantum Core Accuracy.
7. The indirect effect of after-sales service on customer loyalty through customer satisfaction at PT. Quantum Core Accuracy.

II. LITERATURE REVIEW

2.1. Marketing Management

Management is broadly defined by Usman (2016: 6) as planning, implementing, and supervising (P3) organizational resources to achieve goals effectively and efficiently. Management is a process of planning, organizing, managing resources, communicating, leading, motivating and controlling the implementation of tasks and the use of resources to achieve organizational goals effectively and efficiently. (Ulber, 2015: 6).

2.2. Product quality

According to Kotler and Keller (2016: 347) product quality is the ability of a product to perform its functions, these capabilities include durability, reliability, accuracy produced by the product as a whole.Meanwhile, according to Kotler and Armstrong (2015: 27) Product quality is the ability of a products to carry out their functions, including reliability, durability, accuracy, ease of operation, and product improvement, as well as other valuable attributes.

2.3. Activity Performance or Management Assets

Meanwhile, according to Gitman (2012: 73), the activity ratio measures the speed of conversion of various accounts into sales or cash inflows or outflows. In a sense, the

activity ratio measures how efficiently a company operates along various dimensions such as inventory management, expenses and collections. A number of these ratios are available to measure the most important current account activities including inventories, accounts receivable and accounts payable. The efficiency with the total assets used can also be assessed

2.4. After sale service

Layanan After-sales service has emerged as a major source of competitive maneuver, so that companies are trying to create a competitive advantage by creating a portfolio of after-sales services with different offers from competitors (Ruben, 2016). Rigopoulou et.al (2008) describe that after-sales service is a service provided to customers after the product is delivered. Cavalieri et.al (2007) see after-sales service as an activity that occurs after a product purchase and is intended to support customers in the use and utilization of goods.

2.5. Customer satisfaction

According to Hasan (2015: 89) Customer satisfaction is a concept that has long been known in marketing theory and application, customer satisfaction is one of the essential goals for business activities and is seen as the best indicator for earning profits in the future, triggering efforts to increase customer satisfaction

2.6. Customer loyalty

Hurriyati (2016: 35) states that: "Customer loyalty has an important role in a company, maintaining them means improving financial performance and maintaining the company's survival, this is the main reason for a company to attract and retain customers. Efforts to make loyal customers cannot be done directly, but through several stages, from finding potential customers to acquiring partners

2.7. Relations between Research Variables

2.7.1. Direct effect of product quality on customer satisfaction

Customer satisfaction is the feeling of pleasure or disappointment a person experiences after comparing the perceptions of the performance or results of a product with its hopes. Customer satisfaction is a phenomenon after purchase, which means that customer satisfaction occurs after purchase, where the customer after making a purchase will then evaluate the product whether it is in accordance with their expectations or not. If the performance of the product is in line with expectations, the customer will be satisfied. Conversely, if the product's performance does not match expectations, the customer will feel dissatisfied. Product quality is one of the factors that affect customer satisfaction.Product quality is the ability of a product to carry out its functions, including durability, reliability, accuracy, ease of operation and improvements, as well as other valuable attributes. Product quality and customer satisfaction are closely related. Product quality is the most strategic weapon with the potential to beat competitors. So, only the company with the best product quality will grow rapidly. Customers definitely want to get a product that suits their needs and wants. A quality product will encourage customers to repurchase the product and this indicates customer satisfaction with the product. This is in accordance with previous research conducted byIshaq et al. (2016), Djumarno, Sjafar and Djamaluddin (2017), andNafiseh Masoudinezhad (2018) which states that product quality affects customer satisfaction.

2.7.2. The direct effect of after-sales service on customer satisfaction

ToCustomer satisfaction = f (expectations, perceived performance). From the above equation, it can be seen that there are two main variables that determine customer satisfaction, namely expectations and perceived performance. If the perceived performance

exceeds expectations, the customer will feel satisfied, but if on the contrary, the customer will feel dissatisfied. The effect of perceived performance is stronger than expectations in determining customer satisfaction. Can maintain customer satisfaction and trust in a brand, the company must provide service to customers, both aftersales and product purchases. This service is known as after sales service. After-sales service is the seller's responsibility for the quality of the goods he sells and can be provided in the form of further consultation or warranty in the form of replacement of damaged goods (spare parts) and repairs. The role of after-sales service aims to provide services of a good standard and quality to increase customer trust. In carrying out after-service the company must know what exactly the customer wants, because the customer will be satisfied with the product purchased as well as the good service and relationship from the company, and encourage loyalty, customer loyalty to the product and the company. No matter how good the products sold by the company, If the service from the company cannot satisfy the customer, then the customer easily turns away from other products and companies. Based on the notion of after-sales service, it is that a company can satisfy its customers or customers after buying goods or services from the company. So, after-sales service to guarantee customers the use of the product or service.This is in accordance with previous research conducted by Didik Wahjudi, Timoticin Kwanda, Rianthi Sulis (2018), Irini D. Rigopoulou (2018), Mohammad Ali Hajizadeh Gashti (2015), Alireza Fazlzadeh, Fatemeh Bagherzadeh, and Pegah Mohamadi (2015), Nafiseh Masoudinezhad (2018) and Oko, AE Ndu (2015) who say that after-sales service affects customer satisfaction.

2.7.3. Direct effect of product quality on customer loyalty

"The product concept proposes that customers favor products offering the most quality, performance, or innovative features" which means that the product concept states that customers will prefer or be attracted to products that offer the most quality, high-performance, and innovative features. With good product quality, customers will feel their needs are fulfilled and become loyal to the product. Product quality is closely related to customer loyalty. If the goods and services purchased match what the customer expects, there will be satisfaction or loyalty and vice versa. Product quality is a dynamic condition associated with goods and services, people, processes from the environment that meet or exceed expectations. This is in accordance with previous research conducted by Ishaq et al. (2016), Djumarno, Sjafar and Djamaluddin (2017), andNafiseh Masoudinezhad (2018) which states that product quality affects customer loyalty.

2.7.4. The direct effect of after-sales service on customer loyalty

Service quality can be interpreted as an effort to fulfill customer needs and desires as well as the accuracy of its delivery in balancing customer expectations. The relationship between service quality and loyalty "Reported a positive relationship between service quality and the two forementioned loyalty indicators". Zeithaml says there is a positive relationship between service quality and indicators of loyalty, namely loyalty in varying pricing and a willingness to pay higher fees and being loyal even if prices go up. Therefore, service quality must be the main focus of company attention because it can create loyalty. This is in accordance with previous research conducted by Didik Wahjudi, Timoticin Kwanda, Rianthi Sulis (2018),Mohammad Ali Hajizadeh Gashti (2015) and Nafiseh Masoudinezhad (2018) who say that after-sales service affects customer loyalty.

2.7.5. Direct effect of customer satisfaction on customer loyalty

When a customer has made a decision, the after-purchase evaluation is described as an individual customer feedback. During the evaluation, customers will learn from experience and can change the pattern of obtaining information, evaluate brands, and choose brands. "Consumtion experience will directly influence whether the consumer will buy the same brand again". After purchasing, the customer will evaluate the performance

of the brand. Satisfaction will encourage customers to make repeat purchases. Dissatisfaction prompts customers to reassess choices and will reduce repurchase intentions. Dissatisfaction prompts not to make repeat purchases, informs the negative and for the company lost sales opportunities. With regard to the outcome "..., post purchase evaluation is a learning process that provides feedback to the consumer and is stored as information for the future reference ". Satisfaction occurs when product performance matches or exceeds customer expectations, and purchasing decisions will be strengthened. Strengthening purchasing decisions as feedback from after evaluation. Purchasing is psychological in nature. Relates to feedback on satisfaction and dissatisfaction: "Satisfaction reinforces positive attitudes toward the brand, leading to a greater likelihood that the same brand will be purchased again. Dissatisfaction is likely to lead to negative brand attitudes and lessens the likelihood that the consumer will buy the same brand again ". Customer satisfaction is the main factor in assessing service quality, where the customer assesses the performance of the service received and is felt directly on the product of a service. Service quality is determined by how the level of conformity between the services provided and those expected by customers. The higher the quality of service that is felt, the higher the level of user / customer satisfaction, the more positive the behavior of one's intention in responding to the service. This is in accordance with previous research conducted by furthermore, it will increasingly have a positive impact on one's intention behavior in responding to these services. This is in accordance with previous research conducted by furthermore, it will increasingly have a positive impact on one's intention behavior in responding to these services. This is in accordance with previous research conducted byIshaq et al. (2016), Djumarno, Sjafar and Djamaluddin (2017),Chang Eun Kim et al (2017), Didik Wahjudi, Timoticin Kwanda, Rianthi Sulis (2018), Mohammad Ali Hajizadeh Gashti (2015) and Nafiseh Masoudinezhad (2018) who say that satisfaction affects customer loyalty.

2.7.6. The influence of product quality on customer loyalty through customer satisfaction

In buying a product, customers will compare one product to another and will pay more attention to products that provide benefits. This is because in looking for a product, customers do not only want to fulfill their needs, but also satisfy their desires. Therefore the company must have good product quality, so that customers like the products issued by the company. Quality is an advantage possessed by these products. Quality in the view of the customer is something that has its own scope that is different from the quality in the view of the manufacturer when issuing a product that is usually known for its true quality. Quality products have an important role in shaping customer satisfaction. The more quality the products and services provided, the more satisfaction the customer feels, the more quality the products and services provided, the higher the satisfaction felt by the customer, it can lead to benefits for the product. Likewise, if there is no satisfaction, it can result in customers moving to other products because product quality is closely related to customer loyalty. If the goods and services purchased match what the customer expects, there will be customer satisfaction or loyalty and vice versa. If the enjoyment obtained by customers exceeds their expectations, then customers will truly feel satisfied and it is certain that they will continue to make repeat purchases. Product quality is closely related to customer loyalty. If the goods and services purchased match what the customer expects, there will be satisfaction or loyalty and vice versa. This is in accordance with previous research conducted byIshaq et al. (2016), Djumarno, Sjafar and Djamaluddin (2017),Chang Eun Kim et al (2017), Didik Wahjudi, Timoticin Kwanda, Rianthi Sulis (2018), Mohammad Ali Hajizadeh Gashti (2015) and Nafiseh Masoudinezhad (2018) who say that product quality affects customer loyalty through satisfaction.

2.7.7. The effect of after-sales service on customer loyalty through customer satisfaction

Customer satisfaction is the focus of attention by almost all companies in Indonesia, companies are required to know the shifting needs and desires of customers that change almost every time. this is due to the better understanding of customers on the concept of customer satisfaction as a strategy to win the competition in the business world. Customer satisfaction is important for a provider of goods or services, because customers will spread their satisfaction to other potential customers. Customer satisfaction plays a very important role in a highly competitive industry because there is a huge difference in loyalty between customers who are simply satisfied and those who are truly satisfied or happy. So it can be concluded that good after-sales service activities to internal and external customers are carried out after the buying and selling process of a product. If a company has a policy to provide after-sales service facilities to customers, service can be a form of guarantee which is a supporting factor for the perfection of customer satisfaction in maintaining loyalty.This is in accordance with previous research conducted by Ishaq et al. (2016), Djumarno, Sjafar and Djamaluddin (2017),Chang Eun Kim et al (2017), Didik Wahjudi, Timoticin Kwanda, Rianthi Sulis (2018), Mohammad Ali Hajizadeh Gashti (2015) and Nafiseh Masoudinezhad (2018) who say that after-sales service affects customer loyalty through satisfaction.

2.8. Research Hypothesis Development

The hypothesis is a temporary answer to the research results. It is said temporarily because the answers given are only based on relevant theories, not based on empirical facts obtained through data collection, with the following hypothesis:

H1 It is suspected that there is a direct effect of product quality on customer satisfaction

H2 It is suspected that there is a direct effect of after-sales service on customer satisfaction

H3 It is suspected that there is a direct effect of product quality on customer loyalty

H4 It is suspected that there is a direct effect of after-sales service on customer loyalty

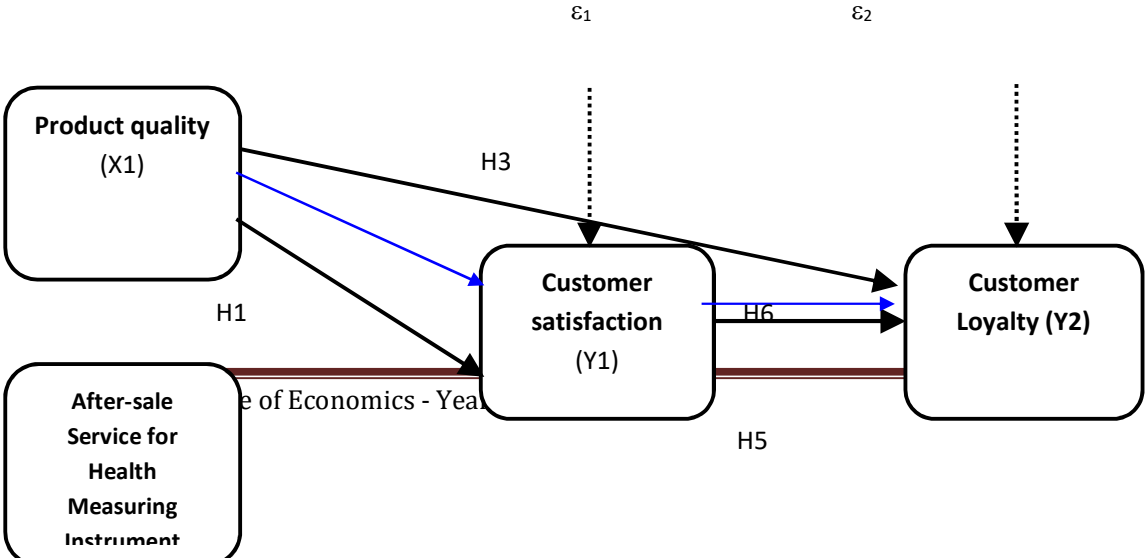
H5 It is suspected that there is a direct effect of customer satisfaction on customer loyalty

H6 It is suspected that there is an indirect effect of product quality on customer loyalty through customer satisfaction as a variable *mediation*

H7 It is suspected that there is an indirect effect after sales service has an effect on customer loyalty through customer satisfaction as a variable *mediation*

2.9. Research Conceptual Framework

In accordance with the research topic, the variables of this study use a structural model, that is, if each dependent / endogenous variable is determined by a set of independent / exogenous variables. The following is the research conceptual framework as follows:



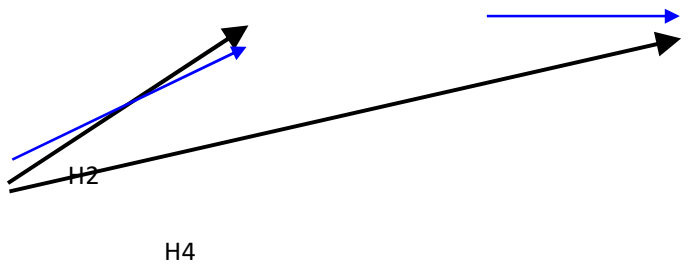


Figure 2.1. Conceptual framework influences product quality and after-sales service on customer loyalty through customer satisfaction

Information:

Exogenous Variable:	X_1	: Product quality
	X2	: After sale service
Mediating variable (Y1)		: Customer satisfaction
Endogenous Variable (Y2)		: Customer loyalty
→		: Direct effect
→		: Indirect effect

This conceptual framework explains the direct and indirect effects between the variables studied and the hypotheses that will occur in this study. In this research, there is a direct influence of the variables of product quality and after-sales serviceon the variable of customer satisfaction, there is a direct influence of the variable product quality, after sales service and customer satisfaction on customer loyalty and there is an indirect effect of the variable quality of products and after sales service on the variable customer loyalty through the variable customer satisfaction.

III. RESEARCH METHOD

3.1. Research Strategy

The research method is a scientific way to get data with specific purposes and uses, scientifically meaning that research activities are based on scientific characteristics, namely rational, empirical, and systematic (Sugiyono 2017: 58). Based on the objectives and form of the research conceptual framework, the approach used in this research is quantitative research and the strategy used in this study is an associative strategy. The associative strategy is a research strategy that aims to determine the influence between two or more variables (Sugiyono, 2017: 59). In this research, a theory can be built that can function to explain, predict and control a symptom

3.2. Population and Sample Research

Population is a comprehensive collection of an object which is the researcher's concern. Research objects can be in the form of living things, objects, systems and procedures, phenomena and others (Sugiyono, 2015: 116). In population research, there are two types of population, namely the general population and the target population. The target population is the population that is the target of applying our research conclusions (Sukmadinata, 2016: 80). The population in this study were all customers of PT. Quantum Inti Accuracy, with limited customer population, the target population, namely customers of PT. Quantum Core Accuracy which spreads in 34 provinces in Indonesia as many as 97 people

Based on this research, because the total population is not greater than 100 respondents, the authors take 100% of the total population at PT. Quantum Core Accuracy as many as 97 respondents. Thus the use of the entire population without having to draw a sample of researchers as a unit of observation is called a census technique

3.3. Data Analysis Methods

The statistical analysis of this research data uses path analysis to see the direct and indirect effects between variables. Researchers use path analysis in this study because path analysis allows researchers to test theoretical propositions regarding causal relationships. The analysis is carried out using correlation and regression so that it can be seen that to arrive at the last dependent variable, it must go through direct channels or through mediation. The model is depicted in the form of a circle and arrow, where a single arrow shows the cause because each variable in a model is the dependent variable (the respondent) while the others are the cause. Riduwan and Kuncoro (2016: 115)

3.3.1. Data processing methods

In this research, this data management uses a program *SPSS Ver. 25.00*. This was done to make it easier to manage statistical data more quickly and accurately.

3.3.2. Method of presenting data

In this study, the data that has been collected will be presented in tabular form which is expected to facilitate research in analyzing and understanding the data, so that the data presented is more systematic.

3.3.3. Instrument Test

A questionnaire depends on the quality of the data used in the test. Research data will not be useful if the instrument that will be used to collect research data does not have high validity and reliability. These tests and measurements each show the consistency and accuracy of the data collected (Sugiyono, 2017: 125).

1. Validity test

   The validity test is carried out to ascertain how well an instrument is used to measure the concept that should be measured. According to Sugiyono (2017: 128) to test the validity is done by correlating the score of the questions with the total score. The total score is the sum of all statement scores. The data that has been obtained is tabulated and factor analysis is carried out using the Construck Validity method using a simple correlation method. If the result is 0.3 (critical) or more, then the factor is a strong construction or has good construction validity.

   The formula used to test the validity of this instrument is Karl Pearson's Product Moment, as follows:

$$r_{xy} = \frac{n\sum X\ Y - (\sum X)(\sum Y)}{\sqrt{\{n\sum X^2 - (\sum X)^2\}\{n\sum Y^2 - (\sum Y)^2\}}} \quad \text{..... (3.2)}$$

   Information:

   r_{xy} = The coefficient of the validity of the question items being sought
   n = Number of respondents sought (sample)
   X = Score obtained by subjects from all items
   Y = The total score obtained from all items

   Then the results of rxy are compared with the critical value of the product moment (rcritical), if the results obtained rxy> 0.3, then the instrument is valid. In practice, to test the validity of the questionnaire, Microsoft Office Excel software and Statistical Product and Service Solution (SPSS) are often used.

2. Reliability test

   Reliability test is a tool for measuring a questionnaire which is an indicator of a variable or construct. A questionnaire is said to be reliable or reliable if someone's answer to a statement is consistent or stable over time. The method used to test the reliability of the questionnaire in this study is to measure the reliability with the Cronbach Alpha statistical test. To find out that the questionnaire is reliable, it will be tested the reliability of the questionnaire with the help of the SPSS computer program. The instrument used in these variables is said to be reliable if it has a Cronbach Alpha of more than 0.60 (Duwi Priyatno, 2016).

Cronbach's Alpha Coefficient: $\alpha_{it} = \left(\frac{k}{k-1}\right)\left(1 - \frac{\Sigma S_i^2}{S_t^2}\right)$

Information :

k = number of questionnaire items

α_{it} = coefficient of reliability of the questionnaire items

∑Si2 = the number of valid item score variances

St2 = variance of the total item score

To find the variance of the questionnaire items and the variance of the total item score, the following formula is used:

$$S_i^2 = \frac{\Sigma X_i^2}{n} - \left(\frac{\Sigma X_i}{n}\right)^2$$

Information :

∑Xi = total score of each item

∑Xi2 = the sum of the squares of each item's score

According to Sekaran (2015), the basis for making this reliability test decision is as follows:

If the Cronbach's Alpha coefficient ≥ 0.6 → then Cronbach's Alpha is acceptable (construct reliable).

If Cronbach's Alpha <0.6 → then Cronbach's Alphapoor acceptable (construct unreliable).

3.3.4. Classic assumption test

The classic assumption test must be done first to find out whether the data is suitable for analysis. The aim is to avoid biased estimates, because not all data can be applied regression. The classical assumption test used is the normality test, multicolonierity test, autocorrelation test, and heteroscedasticity test.

1. Normality test

   Normality test is used to test whether in a regression model the dependent and independent variables (confounders) or both have a normal distribution (Ghozali, 2015: 160). A good regression model is to have normal distribution data or close to normal. If the residual value is not normally distributed, the statistical test will be invalid for a small sample.

   PeThis study conducted a normality test by performing a simple statistical test by looking at the Kalmogorov-Smirnov (KS) significance value. The KS test is carried out by looking at the profitability value, provided that if the profitability value is ≥ 0.05, the residual is normally distributed. Meanwhile, if the profitability value is ≤ 0.05, the residual is not normally distributed.

2. Multicollinearity Test

   The multicollinearity test aims to test whether there is a relationship between independent variables in the regression model (Ghozali, 2015). Because a good regression model is that there is no correlation between the independent variables. To determine the presence or absence of multicollinearity in the regression of this study are as follows:

   a. Independent variables correlation matrix.

      JIf there is a high enough correlation between variables (above 0.95), then this is an indication of multicolonierity (Ghozali, 2015).

   b. Tolerance value and variance inflation factor (VIF)

      These two measures indicate each independent variable described by other independent variables. The cutoff that is commonly used to indicate multicolonierity is a tolerance value ≤ 0.10 or a VIF value ≥ 10 (Ghozali, 2015).

3. Autocorrelation Test

   The autocorrelation test aims to test whether there is a correlation between the confounding error in period t and the disturbing error in period t-1 (before) (Ghozali, 2015). If there is a correlation, it is called an autocorrelation problem. Meanwhile, a good regression model is a regression model that does not have autocorrelation problems. In this study the autocorrelation test was performed using the Durbin Watson (DW) test.

4. Heteroscedasticity Test

   The heteroscedasticity test aims to test whether in the regression model there is an inequality of variance from the residuals of one observation to another. Imam Ghozali (2015) states that a way to detect the presence or absence of heteroscedasticity is to look at the scatter plot graph between the predicted values of the dependent variable, namely ZPRED with the residual SRESID, park test, white test, and jet serge. In this study, heteroscedasticity was detected by looking at the Scatter plot graph, including the prediction of the dependent variable (ZPRED) and its residual (SRESID).

3.3.5. Statistical analysis of data

The statistical analysis used in this research is path analysis. The main analysis carried out is to test the path constructs whether it is empirically tested or not. Further analysis is carried out to look for direct and indirect effects by using correlation and regression so that it can be seen that to arrive at the last dependent variable, it must go through the direct path or through the mediating variable.

Based on the opinion of Riduwan and Kuncoro (2016: 116-118), there are several steps for path analysis testing, namely as follows:

1. Formulate a hypothesis in the structural equation for structure 1:

$$Y1 = \rho zx1X1 + \rho zx2X2 + \varepsilon_1$$

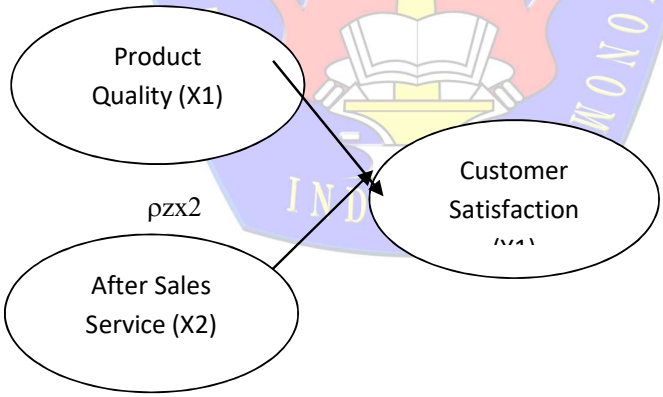


Figure 3.1 Substructure 1 Path Analysis

a. Effect of X1 on Y1

   Ho: $\rho y1x1 = 0$ (there is no significant direct effect of product quality on customer satisfaction at PT Quantum Inti Accuracy)

   Ha: $\rho y1x1 \neq 0$ (there is a significant direct effect of product quality on customer satisfaction at PT Quantum Inti Accuracy)

b. Effect of X2 on Y1

   Ho: $\rho y1x2 = 0$ (there is no significant direct effect of after-sales service on customer satisfaction at PT Quantum Inti Accuracy)

   Ha: $\rho y1x2 \neq 0$ (there is a significant direct effect of after-sales service on customer satisfaction at PT Quantum Inti Accuracy)

To test the effect of each change in endogenous variables on changes in exogenous variables, it is seen from the significance t compared to the real level α (5% = 0.05) with the following criteria:

1) Ho is rejected, Ha is accepted if significance t <0.05
2) Ho is accepted, Ha is rejected if the significance t> 0.05

c. To calculate error 1 (ε_1), then it will test the hypothesis of the influence of X1 and X2 on Y1

Ho: $\rho y1\varepsilon_1 = 0$ (there is no significant effect of product quality and after-sales service on customer satisfaction at PT Quantum Inti Accuracy)

Ha: $\rho y1\varepsilon_1 \neq 0$ (there is a significant influence on product quality and after-sales service on customer satisfaction at PT Quantum Inti Accuracy)

To test the effect of changes in endogenous variables simultaneously on changes in exogenous variables, it is seen from the significance F compared to the real level α (5% = 0.05) with the following criteria:

1) Ho is rejected, Ha is accepted if significance F <0.05
2) Ho is accepted, Ha is rejected if the significance F> 0.05

2. Formulate a hypothesis in structural equation 2:

$$Y2 = \rho yx1X1 + \rho yx2\ X2 + \rho y2y1Y1 + \varepsilon_2$$

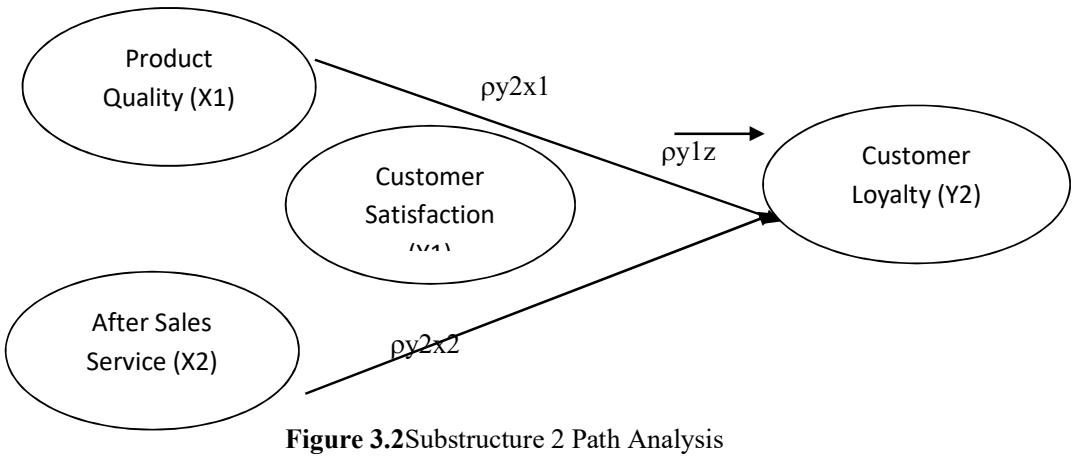


Figure 3.2 Substructure 2 Path Analysis

3. Formulate a hypothesis in structural equation 2:

a. Effect of X1 on Y2

Ho: $\rho y2x1 = 0$ (there is no significant direct effect of product quality on customer loyalty at PT Quantum Inti Accuracy)

Ha: $\rho y2x1 \neq 0$ (there is a significant direct effect of product quality on customer loyalty at PT Quantum Inti Accuracy)

b. Effect of X2 on Y2

Ho: $\rho y2x2 = 0$ (there is no significant direct after-sales service influence on customer loyalty at PT Quantum Inti Accuracy)

Ha: $\rho y2x2 \neq 0$ (there is a significant direct effect of after-sales service on customer loyalty at PT Quantum Inti Accuracy)

c. Effect of Y1 on Y2

Ho: $\rho y2y1 = 0$ (There is no significant direct effect of customer satisfaction on customer loyalty at PT Quantum Inti Accuracy)

Ha: $\rho y2z1 \neq 0$ (there is a significant direct effect of customer satisfaction on customer loyalty at PT Quantum Inti Accuracy)

To test the effect of each change in endogenous variables on changes in exogenous variables, it is seen from the significance t compared to the real level α (5% = 0.05) with the following criteria:

1) Ho is rejected, Ha is accepted if significance t <0.05
2) Ho is accepted, Ha is rejected if the significance t> 0.05

d. To calculate error 2 (ε_2), then it will test the hypothesis of the effect of X1 X2 Y1 on Y2

Ho: $\rho y2\varepsilon_2 = 0$ (there is no significant effect of product quality, after-sales service, and customer satisfaction on customer loyalty at PT Quantum Inti Accuracy)

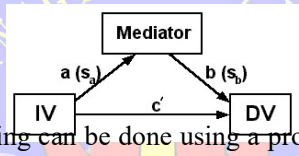
Ha: $\rho y2\varepsilon_2 \neq 0$ (there is a significant influence on product quality, after-sales service, and customer satisfaction on customer loyalty at PT Quantum Inti Accuracy)

To test the effect of changes in endogenous variables simultaneously on changes in exogenous variables, it is seen from the significance F compared to the real level α (5% = 0.05) with the following criteria:

1) Ho is rejected, Ha is accepted if significance F <0.05
2) Ho is accepted, Ha is rejected if the significance F> 0.05

4. Sobel test

To determine the effect of X1 on Y2 through Y1, as well as the effect of X2 on Y2 through Y1, the Sobel Test concept will be used.



This mediation hypothesis testing can be done using a procedure developed by Sobel (1982) and is known as the Sobel test (Sobel test). The sobel test is carried out by testing the strength of the indirect effect X to Y through M. The indirect effect of X to Y through M is calculated by multiplying the path X □ M (a) by the path M □Y (b) or ab.

So the coefficient ab = (c - c '), where c is the effect of X on Y without controlling M, while c' is the coefficient of influence of X on Y after controlling for M. Standard error coefficients a and b are written as sa and sb and the magnitude of the standard error for the indirect effect is described as follows:

The Sobel test is calculated using the formula below:

Sat = √ b2sa2 + a2sb2 + sa2sb2

Information: Sa = standard error coefficient aSb = standard error coefficient bb = coefficient of mediasia variable = independent variable coefficient

To test the significance of the indirect effect, it is necessary to calculate the t value of the ab coefficient with the following formula:

$$t = \frac{ab}{sab}$$

This calculated t value is compared with the t table value. If the t value is greater than the t table value, it can be concluded that there is a mediation effect. The assumption of the sobel test requires a large number of samples, if the number of samples is small, then the sobel test will be less conservative (Ghozali, 2015: 248-249).

IV. RESULTS AND DISCUSSION

4.1. Description of Research Object

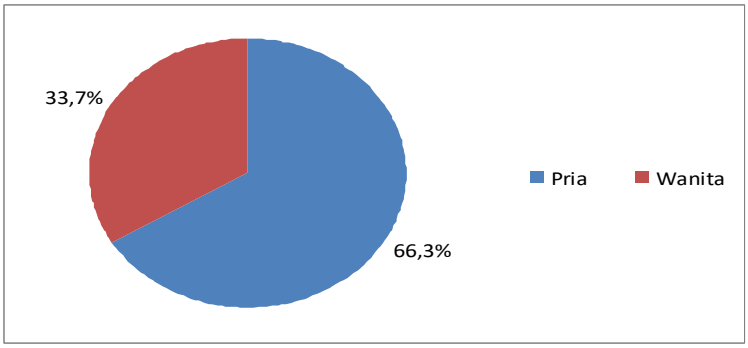
PT. Quantum Inti Accuracy specializes in Biomedical, Radiology and HVAC / R Testing and Calibration instruments business. As part of our mission, we provide

comprehensive application training for end users, product assurance and after sales service and support for every product that is procured through us or our dealers. We hold several free technical seminars and live demonstrations in the testing and calibration of medical equipment as a contribution to the improvement of QA skills and calibration of Indonesian human resources, For such seminars, we work closely with technical experts from our principals and our customers such as hospitals

4.2. Respondent Description

PeneThis litian took samples of customers at PT. Quantum Core Accuracy. Sample selection is done by first verifying the customer sample. In the following, we will provide an overview of the characteristics of the respondents which are stated in the form of tabulation of the identity of the respondents, as many as 97 samples of respondents in which the questionnaire statement is given using the google form application which is sent via whatsapp web. Presentation of data regarding the identity of the respondent to provide an overview of the respondent's condition.

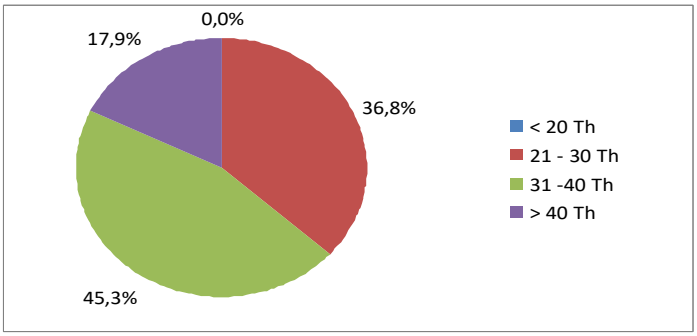
PePresentation of data on the identity of the respondent to provide an overview of the respondent's condition.



Source: SPSS processed data (2020)

Figure 4.1. Data on the Characteristics of Research Respondents Based on Gender

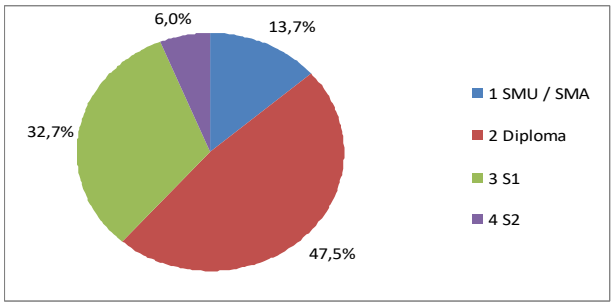
BerBased on Figure 4.1 above, it shows that male gender has a larger number than female as much as 66.3% of respondents for men compared to 33.7% of respondents for women. This condition indicates that PT. Quantum Core Accuracy is widely used by men than women.



Source: SPSS processed data (2020)

Figure 4.2. Data on the Characteristics of Research Respondents by Age

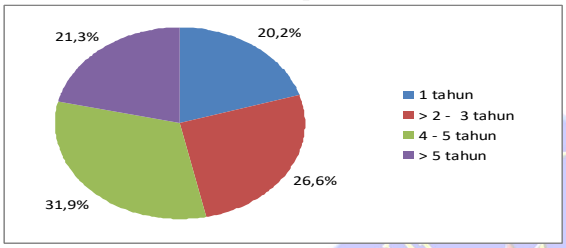
BerBased on Figure 4.2, the age group of respondents, it was found that the most respondents aged 31-40 years were 45.3%. And the least is the respondent aged <20 years, as many as 0% of respondents. Thus the age of the customers of PT. Quantum Core Accuracy is classified as productive age.



Source: SPSS processed data (2020)

Figure 4.3. Data on the Characteristics of Research Respondents Based on Last education

In this study, the highest number of respondents was diploma education as much as 47.5 %%. The lowest respondent is high school / high school education as much as 6%.



Source: SPSS processed data (2020)

Figure 4.4. Data on the Characteristics of Research Respondents Based on How long does it take to use the product that PT. Quantum Core Accuracy

In this study, the highest number of respondents with a length of time using products with 4-5 years agent as much as 31.9%. The lowest respondent is 1 year as much as 20.2%.

4.3. Instrument Testing Results

This study uses primary data. The data were collected using a questionnaire distribution technique, namely by providing written statements to the respondents. Furthermore, the respondent responded to the statement given. This questionnaire is closed in nature where the answers are readily available. It is hoped that this questionnaire will be completed quickly. Before the questionnaire was distributed to the research sample, it was first carried out a trial test on 30 respondents outside the research sample. to measure the validity and reliability of these measuring instruments.

4.3.1. Validity test

Testing the validity of the instrument is to determine the degree of accuracy of the instrument to collect research data. This test is conducted to determine whether all statements (instruments) of research proposed to measure the research variables are valid. The type of validity used in this research is construct validity, which includes understanding the theoretical arguments that underlie the measurements obtained. To test the validity of this study it was calculated by computer using the Statistical Product and Service Solutions (SPSS) program, the result for making a decision was to compare rcritical with rcritical. Rhitung value can be obtained by using the Product Moment Correlation Coefficient value. If the Product Moment Correlation Coefficient> critical, the statement item is said to be valid or if r count is positive, and rcount> critical, then the item or variable is valid. If r count is not positive, and rcount <critical, then the item or variable is invalid. Where is critical using rtabel with a sample of 30 andα= 5% then it is obtained 0.361. The results of

the validity test for each statement can be seen in the table below (the results of the SPSS instrument validity test are in the attachment):

Table 4.1. Overall Results of the Validity Test

No.	Statement	rhitung Variable X1	rhitung Variable X2	rhitung Variable Y1	rhitung Variable Y2	critical	Information
1	Q1	0.831	0.891	0.887	0.818	0.361	Valid
2	Q2	0.612	0.763	0.758	0.859	0.361	Valid
3	Q3	0.826	0.683	0.759	0.816	0.361	Valid
4	Q4	0.575	0.827		0.624	0.361	Valid
5	Q5	0.774	0.683		0.805	0.361	Valid
6	Q6		0.536			0.361	Valid
7	Q7		0.891			0.361	Valid

Source: SPSS processed data (2020)

Based on the results of the validity test, it was concluded that all the items tested had rcritical values greater than 0.361. Based on these results it can be said that all statement items in this study are valid.

4.3.2. Reliability test

Reliability test is used to determine the consistency or stability of the measuring instrument, whether the tool used is reliable and remains consistent if the measurement can be repeated. In this reliability test, the SPSS program was used with the Cronbach's Alpha method. To test the reliability of the same instrument used the Cronbach's Alpha formula. This formula is used to see the extent to which the measuring instrument can give relatively no different results when re-measuring the same symptoms at different times. So the measurement of reliability is concerned with the consistency and accuracy of the measurement. The results of the reliability test for the research variables (the results of the SPSS instrument reliability test are in the attachment):

Table 4.2. Overall Results of Reliability Test

Variable	*Alpha Cronbach*	> / <	Constant	Information
Product Quality (X1)	0.775	>	0.60	*Reliable*
After Sales Service Price (X2)	0.869	>	0.60	*Reliable*
Satisfaction (Y1)	0.722	>	0.60	*Reliable*
Customer Loyalty (Y2)	0.844	>	0.60	*Reliable*

Source: SPSS processed data (2020)

From the output table of the reliability test results above, it can be seen that the Cronbach Alpha value for the three variables used in this study is greater than 0.60. So it can be concluded that all variables in this study are reliable.

4.1. Statistical Analysis of Data

Before analyzing path analysis, we first describe the classical assumption test, then continue testing for sub structure 1 and sub structure 2.

4.1.1. Classic assumption test

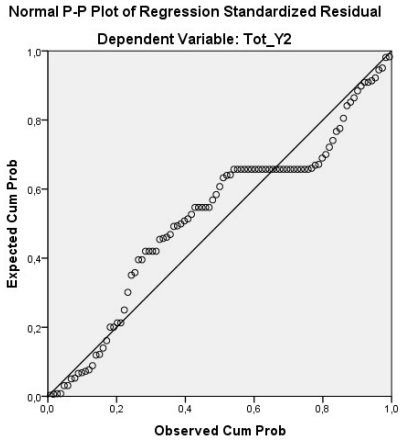
The classic assumption test is a prerequisite test if you use linear regression analysis. These tests include the normality test, multicollinearity test, heteroscedasticity test, and autocorrelation test. If these assumptions are violated, for example the regression model is not normal, multicollinearity occurs,

heteroscedasticity occurs or autocorrelation occurs. The following will discuss each classical regression assumption test as follows:

1. **Normality test**

The normality test is useful for knowing whether the dependent variable, independent or both is normally distributed, close to normal or not. A good regression model should be normally distributed or close to normal. To detect whether the data is normally distributed or not, it can be seen by describing the distribution of data through a graph. After analyzing the research variables, the data obtained will be used to analyze and test the research hypothesis formulation based on the structure of the model between the research variables.

Hypothesis testing is used to test the effect of product quality (X1), after-sales service (X2), customer satisfaction (Y1) and customer loyalty (Y2). The normality test aims to test whether in the regression model the dependent variable (namely customer loyalty) and the independent variable (namely product quality, after-sales service and customer satisfaction) both have a normal or near normal distribution. To test whether the data distribution is normal or close to normal can be done with graphs (Ghozali, 2015), the way is to look at the normal plot graph. In this study the data normality test was carried out by graphical analysis using the SPSS version of the software tool.24.



Source: SPSS processed data (2020)

Figure 4.9 PP Plot Normal Data Normality Test Histogram

The normal plot graph shows the distribution of the points (data) around the diagonal line, and the distribution follows the direction of the diagonal axis. This graph shows that the regression model is feasible because it meets the assumption of normality.

The normality test is used to test the observation data whether the data is normally distributed or not. In this study, the normal data distribution test was performed using the Kologorov-Smirnov test. The results of the Normality Test with Kolomogrov-Smirnov are as follows:

Table 4.3. Kolmogorov-Smirnov test results

One-Sample Kolmogorov-Smirnov Test

		Unstandardized Residual
N		97
Normal Parametersa, b	Mean	0E-7
	Std. Deviation	1.24856725
Most Extreme Differences	Absolute	, 140
	Positive	, 120
	Negative	-, 140
Kolmogorov-Smirnov Z		1,383

Asymp. Sig. (2-tailed)	, 144

a. Test distribution is Normal.
b. Calculated from data.

Source: SPSS processed data (2020)

The assumption of normality of the residual value needs to be tested to prove whether the residual value is around zero. The Kolmogorov-Smirnov test results do prove that the residual value follows the normal distribution due to Asymp. Sig (2-tailed)> 0.05.

2. Multicollinearity test

The results of the multicollinearity test are used to determine whether or not there are deviations from the classic multicollinearity assumption, namely the existence of a linear relationship between the independent variables in the regression model. The condition that must be met in the regression model is the absence of multicollinearity. There are several test methods that can be used, including (1) by looking at the value of the inflation factor (VIF) at the regression, (2) by comparing the value of the individual determinant coefficient (r2) with the determinant value simultaneously (R2) and (3) by looking at the value eigenvalue and condition index.

Table 4.4. Multicollinearity test results

Coefficientsa

Model		Collinearity Statistics	
		Tolerance	VIF
1	(Constant)		
	Product Quality X1	, 351	2,849
	After Sales Service_X2	, 246	4,066
	Customer Satisfaction_Y1	, 383	2,612

a. Dependent Variable: Customer Loyalty_Y2

Source: SPSS processed data (2020)

Multicollinearity testing can be seen with the VIF value and the t value (tolerance) of each predictor. If the VIF value of each predictor does not exceed 5 and the t value is far from the number 1, it can be concluded that there is no multicollinearity between the independent variables in this study. From table 4.4 it can be seen that the VIF value of all variables does not exceed 5. While the tolerance value for all variables is not more than 1. From the results of the table above, it can be concluded that there is no multicollinearity between the independent variables in this study.

3. Autocorrelation test

This test is used to determine the extent of the influence of the independent variable on the dependent variable. For the purposes of this test, it is adjusted to Durbin Watson's criteria, namely that if the Durbin Watson is -2 to 2 there is no autocorrelation.

There is a correlation among observational data where the existence of a data is influenced by previous data (time series data which are interconnected), so that the correlation coefficient obtained is less accurate. Autocorrelation is a condition in which there is a correlation or relationship between observations, either in the form of time series observations or cross-section observations. In regression estimation it is necessary to detect whether or not there is autocorrelation in the model being built. In addition, it should be noted that although autocorrelation can occur in cross-sectional data, autocorrelation problems are usually more common in time series data. The autocorrelation test is a test of assumptions in regression where the dependent variable is not correlated with itself. The purpose of correlation with oneself is that the value of the dependent variable is not related to the value of the variable itself, either the value of the previous variable or the value of the period after (Santosa & Ashari, 2015: 240). According to Widayat and

Amirullah (2016: 108) if there is autocorrelation, the consequence is that the estimator is still inefficient, therefore the confidence interval is wide. Another consequence if the autocorrelation problem is left unchecked, the variants of the confounding error become underestimated, which in the end, the use of the t test and the F test can no longer be used to detect the presence of autocorrelation, is from the Durbin Watson scale the basis for making decisions is as follows: either the value of the previous variable or the value of the period afterwards (Santosa & Ashari, 2015: 240). According to Widayat and Amirullah (2016: 108) if there is autocorrelation, the consequence is that the estimator is still inefficient, therefore the confidence interval is wide. Another consequence if the autocorrelation problem is left unchecked, the variants of the confounding error become underestimated, which in the end, the use of the t test and the F test can no longer be used to detect the presence of autocorrelation, is from the Durbin Watson scale the basis for making decisions is as follows: either the value of the previous variable or the value of the period afterwards (Santosa & Ashari, 2015: 240). According to Widayat and Amirullah (2016: 108) if there is autocorrelation, the consequence is that the estimator is still inefficient, therefore the confidence interval is wide. Another consequence if the autocorrelation problem is left unchecked, the variants of the confounding error become underestimated, which in the end, the use of the t test and the F test can no longer be used to detect the presence of autocorrelation, is from the Durbin Watson scale the basis for making decisions is as follows:

DW number below -2 means there is positive autocorrelation
DW numbers between -2 to +2 mean there is no autocorrelation
DW numbers above +2 means that there is negative autocorrelation

Table 4.5. Autocorrelation Test

Model Summary b

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	, 845a	, 714	, 705	1.26855	2,118

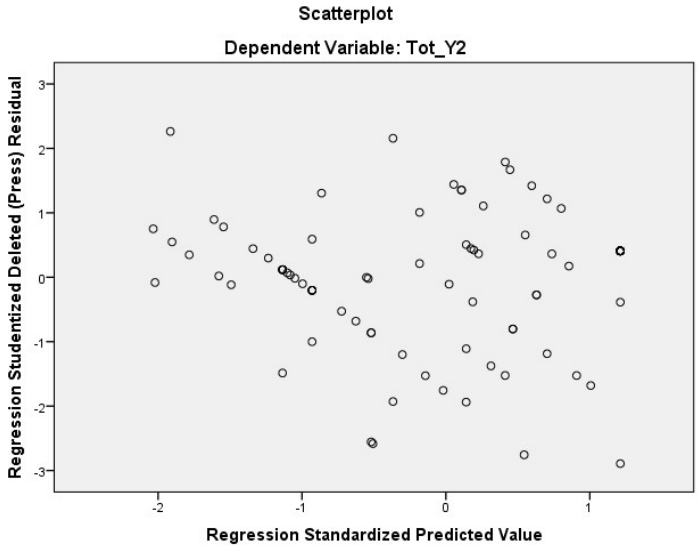
a. Predictors: (Constant), Customer Satisfaction_X1, Product Quality_X1, After Sales Service_X2
b. Dependent Variable: Customer Loyalty_X2

Source: SPSS processed data (2020)

Based on the predetermined criteria, the DW count is between -2 and 2, namely $-2 \leq 2.118 \leq 2$, this means that there is no autocorrelation. So the conclusion is that the Autocorrelation Test is fulfilled.

4. Heteroscedasticity Test

Heteroscedasticity detection can be done by using the scatter plot method by plotting the ZPRED value (prediction value) with SRESID (its residual value). Y axis. Based on these results it can be concluded that there are no symptoms of heteroscedaticity in the regression model.



Source: SPSS processed data (2020)

Figure 4.10 Heteroscedasticity Test with Scatterplot

4.1.2. Testing the effect of product quality and after-sales service on satisfaction (Sub structure 1)

Based on data processing for sub structure 1, the following results were obtained:

Table 4.6. Coeficient Sub Structure 1

Coefficientsa

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1,287	, 777		1,656	, 101
	Product Quality X1	, 076	, 071	, 113	2,058	, 000
	After Sales Service_X2	, 319	, 049	, 692	6,459	, 000

a. Dependent Variable: Customer Satisfaction Y1

Source: SPSS processed data (2020)

The results of the calculation (output) of the structural equation in the sub-structure chapter 1 are as follows:

$Y1 = 0.113\ X1 + 0.692\ X2 + \varepsilon 1$

Based on the structural equation in sub structure 1 above, it can be interpreted as follows:

a. The direct effect of product quality on satisfaction based on the table above is 0.113
b. The direct effect of after-sales service on satisfaction based on the table above is 0.692

The magnitude of the simultaneous influence of product quality and after-sales service on satisfaction, the data processing results obtained can be seen in table 4.7 below:

Table 4.7. Coefficient of Determination

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	, 786a	, 617	, 609	, 92871

a. Predictors: (Constant), After Sales Service_X2, Product Quality X1

Source: SPSS processed data (2020)

The magnitude of the Rsquare (R2) number is 0.617. This figure shows that the effect of product quality and after-sales service simultaneously on satisfaction is 61.7%. The remaining 38.3% is influenced by other factors. In other words, the satisfaction variable can be explained using the

variable product quality and after-sales service of 61.7% while the effect of 38.3% is explained by other variables outside of this research model.

4.1.3. Testing the effect of product quality, after-sales service and satisfaction on customer loyalty (Sub structure 2)

Based on data processing for sub-structural 2, the following results were obtained:

Table 4.9. Coeficient Sub Structure 2

Coefficientsa

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	, 944	1,077		, 876	, 383
	Product Quality X1	, 405	, 098	, 386	4,129	, 000
	After Sales Service_X2	, 300	, 081	, 414	3,705	, 000
	Customer Satisfaction_X1	, 170	, 141	, 108	2,205	, 000

a. Dependent Variable: Customer Loyalty_X2

Source: SPSS processed data (2020)

The results of the calculation (output) of the structural equation for pasa sub structure 2 are as follows:

$$Y2 = 0.386\ X1 + 0.414\ X2 + 0.108\ Y1 + \varepsilon 1$$

Based on the structural equation in sub structure 2 above, it can be interpreted as follows:

a. The effect of product quality on customer loyalty based on the table above is 0.386
b. The effect of after-sales service on customer loyalty based on the table above is 0.414
c. The effect of satisfaction on customer loyalty based on the table above is 0.108.

The magnitude of the simultaneous influence on product quality, after-sales service and satisfaction on customer loyalty results in data processing which can be seen in the following table 4:10:

Table 4.10. Coefficient of Determination

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	, 845a	, 714	, 705	1.26855

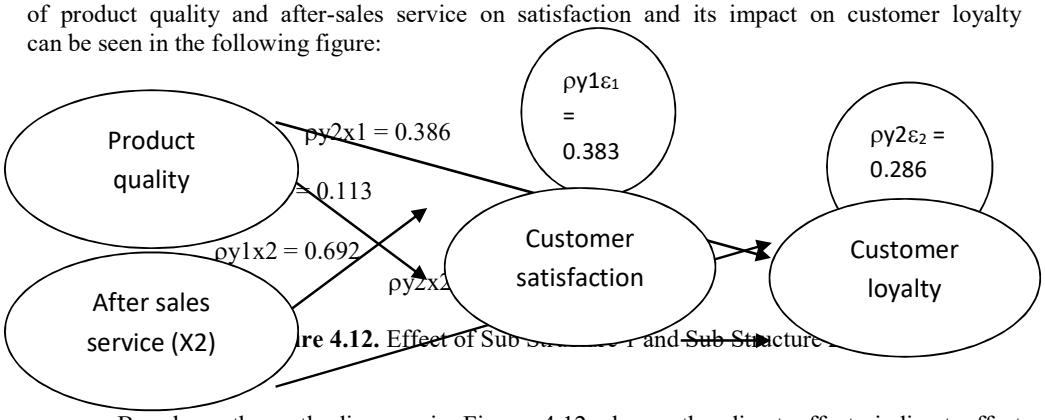
a. Predictors: (Constant), Customer Satisfaction_X1, Product Quality_X1, After Sales Service_X2

Source: SPSS processed data (2020)

The magnitude of the Rsquare (R2) number is 0.714. This figure shows that the effect of using product quality, after-sales service and satisfaction simultaneously on customer loyalty is 71.4%. The remaining 28.6% is influenced by other factors. In other words, the variable customer loyalty can be explained using variables of product quality, after sales service and satisfaction of 71.4%, while the influence of 28.6% is explained by other variables outside this research model.

4.2. Research Findings

Based on the results of the path coefficient on sub structure 1 and sub structure 2, there can be described as a whole which illustrates the path analysis diagram of the effect of product quality and after-sales service on satisfaction and its impact on customer loyalty can be seen in the following figure:



re 4.12. Effect of Sub Structure 1 and Sub Structure 2

Based on the path diagram in Figure 4:12 above, the direct effect, indirect effect and total effect can be explained as follows:

1. Direct effect
a. The effect of product quality on satisfaction is equal to ρy1x1 = 0.113
b. The effect of after-sales service on satisfaction is equal to ρy1x2 = 0.692
c. The effect of product quality on customer loyalty is equal to $\rho y_2 x1$ = 0.386
d. The effect of after-sales service on customer loyalty is equal to ρy2x2 = 0.414
e. The effect of satisfaction on customer loyalty is equal to ρy2y1 = 0.108
2. Indirect effect
a. The effect of product quality on customer loyalty through satisfaction is ρy1x1 (0,113) xρy2y1 (0.108) = 0.012
b. The effect of after-sales service on customer loyalty through satisfaction is ρy1x2 (0.692) xρy2y1 (0.108) = 0.075
3. Total effect
a. The effect of total product quality on satisfaction is equal to ρy1x1 0.386. The indirect effect of product quality on customer loyalty through satisfaction is 0.012, so the total effect is 0.398 (0.386 + 0.012 = 0.398)
b. The effect of total after-sales service on satisfaction is equal to ρy1x2 0.414. The indirect effect of after-sales service on customer loyalty through satisfaction is 0.075, so the total effect is 0.489 (0.414 + 0.075 = 0.489).

Table 4.14. Interpretation of Research Results Sub Structure 1 and Sub Structure 2

Independent variable - dependent	**Direct Influence**
Product quality - Customer satisfaction	0.113
After sales service - Customer satisfaction	0.692
Product quality - Customer loyalty	0.386
After sales service - Customer loyalty	0.414
Customer satisfaction - Customer loyalty	0.108
Independent variable - dependent	**Indirect Influence**
Product quality - customer satisfaction - customer loyalty	0.012
After sales service - Customer satisfaction - Customer loyalty	0.075
Direct Effect + Indirect Effect	**Total Effect**
(Product quality - customer satisfaction) + (product quality - customer satisfaction - customer loyalty)	0.398
(After sales service - Customer satisfaction) + (After sales service - Customer satisfaction - Customer loyalty)	0.489

Source: Processed data (2020)

Table 4.15. Research Hypothesis Summary Results

Independent Variable - Dependent	**Direct Influence**	**Sig.**
Product quality - Customer satisfaction	There is a Direct Effect	0,000
After sales service - Customer satisfaction	There is a Direct Effect	0,000
Product quality - Customer loyalty	There is a Direct Effect	0,000
After sales service - Customer loyalty	There is a Direct Effect	0,000
Customer satisfaction - Customer loyalty	There is a Direct Effect	0,000
Independent Variable - Mediation - Dependent	**Indirect Influence (Mediation)**	
Product quality - customer satisfaction - customer loyalty	There is a Mediation Effect	0,000
After sales service - Customer satisfaction - Customer loyalty	There is a Mediation Effect	0,000

Source: Processed data (2020)

Based on the research results, it is described as follows:

1. The influence of product quality on customer satisfaction PT. Quantum Core accuracy is 0.113 and partially there is a significant direct effect of product quality on customer satisfaction at PT.

Quantum Core Accuracy where the significance of t variable X1 is 0.000 smaller than the real level or 0.000 <0.05 so that Ho is rejected or Ha.This is in accordance with previous research conducted by Ishaq et al. (2016), Djumarno, Sjafar and Djamaluddin (2017), andNafiseh Masoudinezhad (2018) which states there is an effect of product quality on customer satisfaction.This means that changes in product quality improvement are positive and real towards increasing customer satisfaction. Customers who come to the company get good quality products and quality fromPT. Quantum Core Accuracy, of course, will feel satisfaction with product quality. This shows that the customer PT. Quantum Core Accuracywant product quality from existing dimensions. If the customer receives the value of benefits according to or even exceeds his expectations, this will increase customer satisfaction.

2. Great influence after sales service on customer satisfaction PT. Quantum Core accuracy is 0.692 and partially there is a significant direct effect of after-sales service on customer satisfaction at PT. Quantum Core Accuracy where the significance of t variable X2 is 0.000 smaller than the real level or 0.000 <0.05 so that Ho is rejected or Ha. This is in accordance with previous research conducted by Didik Wahjudi, Timoticin Kwanda, Rianthi Sulis (2018), Irini D. Rigopoulou (2018), Mohammad Ali Hajizadeh Gashti (2015), Alireza Fazlzadeh, Fatemeh Bagherzadeh, and Pegah Mohamadi (2015), Nafiseh Masoudinezhad (2018) and Oko, AE Ndu (2015) which stated there is an effect of after-sales service on customer satisfaction. The meaning after sale service can increase customer satisfaction in a positive and real way towards increasing customer satisfaction. Customers who come to the company get good and quality service fromPT. Quantum Core Accuracy, of course, will feel that after sale service so real that the customer will feel satisfaction. This shows that after-sales service is an important factor in the industry in relation to the services the company provides to customers after making a purchase. So thatPT. Quantum Core Accuracy must pay attention to the after-sales service aspects in order to increase customer satisfaction.
3. The direct influence of product quality on customer loyalty of PT. Quantum Core Accuracy is 0.386 and partially there is a significant direct effect of product quality on customer loyalty at PT. Quantum Core Accuracy where the significance of t variable X1 is 0.000 smaller than the real level or 0.000 <0.05 so that Ho is rejected or Ha. This is consistent with previous research conducted by Ishaq et al. (2016), Djumarno, Sjafar and Djamaluddin (2017), andNafiseh Masoudinezhad (2018) whichstates that there is a relationship between product quality and customer loyalty.This means that changes in product quality increase in the direction of positivity, significantly towards increased customer loyalty. Customers who come to the company get good products because customers get good products fromPT. Quantum Core Accuracy, of course, customers will feel comfortable and in the end make loyal to PT. Quantum Core Accuracy. If customers still get product quality according to expectations or even exceed their expectations, this will increase customer loyalty.
4. Great influence of direct after sales service on customer loyalty PT. Quantum Core accuracy is 0.414 and partially there is a significant direct effect of after-sales service on customer loyalty at PT. Quantum Core Accuracy where the significance of t variable X2 is 0.000 smaller than the real level or 0.000 <0.05 so that Ho is rejected or Ha.. This is supported by previous research by Didik Wahjudi, Timoticin Kwanda, Rianthi Sulis (2018), Mohammad Ali Hajizadeh Gashti (2015) and Nafiseh Masoudinezhad (2018) stated there is an effect of after-sales service on customer loyalty. By providing good after-sales service, it will have an impact on the sustainability of the company, because customers do not switch to other companies or competitors so that it indirectly provides benefits for the company that after-sales service is an activity that provides revenue, profit and competitive advantage for the company. even after sales service in the health industry will provide a profit four or five times greater than the sale of a new product.
5. The influence of satisfaction on customer loyalty of PT. Quantum Core accuracy is 0.108 and partially there is a significant direct effect of satisfaction on customer loyalty at PT. Quantum Core Accuracy where the significance of t variable X1 is 0.000 smaller than the real level or 0.000 <0.05 so that Ho is rejected or Ha. This is supported by previous research by Ishaq et al. (2016), Djumarno, Sjafar and Djamaluddin (2017),Chang Eun Kim et al (2017), Didik Wahjudi, Timoticin Kwanda, Rianthi Sulis (2018), Mohammad Ali Hajizadeh Gashti (2015) and Nafiseh Masoudinezhad (2018)which states that there is an effect of satisfaction on customer loyalty. This significant influence means that the better and the increase in customer satisfaction given to customers, then customer loyalty will increase. Conversely, the lower customer satisfaction

given to customers, the lower customer loyalty. This shows that customer satisfaction is an important factor that must be considered by PT. Quantum Core Accuracy to maintain customer loyalty in accordance with the statement Tjiptono said that customer satisfaction will encourage customer loyalty.

6. The indirect influence of product quality on customer loyalty through customer satisfaction at PT. Quantum Core Accuracy is (0.113) x (0.108) = 0.012 and the calculation results obtained a p-value of 0.000 smaller than the real level or 0.000 <0.05. So it can be concluded that there is a mediating effect between product quality on customer loyalty through satisfaction. The indirect effect of product quality on loyalty through satisfaction is not greater than the direct effect, meaning that the satisfaction variable is effective as a mediating variable between product quality and loyalty. This shows that high product quality tends to create high customer loyalty through the satisfaction of each customer. Conversely, if customers feel that the quality of the company's products is low, far from their expectations (low customer satisfaction), then the customer will tend to have a low level of loyalty to the company.
7. Great influence not after sales service on customer loyalty through customer satisfaction at PT. Quantum Core Accuracy is (0.692) x (0.108) = 0.075 and the calculation results obtained a p-value of 0.000 smaller than the real level or 0.000 <0.05. So it can be concluded that there is a mediating effect between after-sales service on customer loyalty through satisfaction. The indirect effect of after-sales service on loyalty through satisfaction is not greater than the direct effect, which means that the effective satisfaction variable is the mediating variable between the after-sales service and loyalty variables.This means that if the company gives after sale service good for each customer, the customer tends to be satisfied. Furthermore, it is also proven thatafter sale service will automatically affect customer loyalty seen from the results of that data analysis after sale service direct positive effect on customer loyalty. The results of further analysis indicated thatafter sale servicehas a significant effect on customer loyalty through customer satisfaction. The meaningafter sale servicewill increase the loyalty of each customer if they feel satisfaction. Changes in the level of customer satisfaction are proven to affect the level of customer loyalty. The influence provided by customer satisfaction on customer loyalty is positive and significant. That is, if the level of satisfaction felt by customers is high, the resulting customer loyalty will increase. Conversely, if customers feel low satisfaction, the resulting level of loyalty will be low or reduced.
8. The results of this study indicate that customer satisfaction can be said to be a mediating variable on product quality and after-sales service on customer loyalty PT. Quantum Core AccuracyIt can be seen from the magnitude of the total effect compared to the direct effect arising from product quality on customer loyalty and after-sales service on customer loyalty. This means that by improving product quality and after-sales service, customer satisfaction will also increase which will be followed by increased customer loyalty.

V. CONCLUSIONS AND SUGGESTIONS

Conclusion

Based on the hypothesis testing carried out in the previous chapter, it can be concluded that:

1. Partially, there is a positive and significant direct effect of product quality on customer satisfaction at PT. Quantum Core Accuracy where Ho is rejected or Ha.
2. Partially there is a significant positive direct effect after sales service on customer satisfaction at PT. Quantum Core Accuracy where Ho is rejected or Ha.
3. Partially there is a significant positive direct effect of product quality on customer loyalty at PT. Quantum Core Accuracy where Ho is rejected or Ha.
4. Partially there is a significant positive direct effect after sales service on customer loyalty at PT. Quantum Core Accuracy where Ho is rejected or Ha.
5. Partially there is a positive and significant direct effect of satisfaction on customer loyalty at PT. Quantum Core Accuracy where Ho is rejected or Ha.
6. There is a mediating effect between product quality on customer loyalty through customer satisfaction at PT. Quantum Core Accuracy.
7. There is the effect of mediation between after-sales service on customer loyalty through customer satisfaction at PT. Quantum Core Accuracy.

5.2. Suggestion

Ber based on the conclusions above, the following suggestions can be proposed:

1. Product quality affects customer satisfaction, so to increase satisfaction can be done by increasing the quality of the product that is more reliable and for measurement so that it can be more varied in one product.
2. After-sales service has an effect on customer satisfaction, to be able to increase customer satisfaction by further improving it, such as the existence of a more complete calibration laboratory.
3. Product quality affects customer loyalty, so to increase loyalty, it can be done by increasing the quality of the product, especially in this case responding faster to claims for damaged or incomplete products.
4. After sales service affects customer loyalty so that to increase loyalty can be done by improving service, especially in terms of the company retains more of its old customers, with new customers the company can help customers to explain the function of the tool and provide solutions when new customers need consultation.

5.3. Limitations and Further Research Development

The limitations of this study are:

1. This research was conducted at PT. Quantum Core Accuracy so that it is necessary to add a wide object of research.
2. This study uses exogenous and endogenous variables, namely product quality and after-sales service and one mediating variable, namely satisfaction. In addition, the research indicators used in research can be added with other indicators outside of this research that are relevant to the research to be carried out.

REFERENCE LIST

Alireza, Fazlzadeh. Fatemeh Bagherzadeh. and Pegah Mohamadi. 2015. How after-sales service quality indicators affect customer satisfaction. Full Length Research Paper. African Journal of Business Management Vol. 5 (17). pp. 7658-7664. 4 September. 2015. ISSN 1993-8233 © 2015 Academic Journals

Alma, Buchari. 2016. Marketing Management and Marketing Services. CV Alfabeta. Bandung.

Amir, M. 2016. Strategic Management Concepts and Applications. Eagle. Jakarta.

Arikunto, Suharsimi. 2016.*Research Procedure A Practice Approach*. Rineka Cipta. Jakarta

Cavalieri et.al. 2007.Blanching of Foods. Encyclopedia of Agricultural. Food. and Biological Engineering. pp. 1-5. USA

Dharmesta. 2016.Customer loyalty. A Conceptual Study As A Guide For Researchers. Journal of Indonesian Economics and Business, Vol. 14 No.3.pp73 88

Djumarno, Sjafar and Djamaluddin. 2017. The Effect of Brand Image. Product Quality. and Relationship Marketing on Customer Satisfaction and Loyalty. International Journal of Business Marketing and Management (IJBMM) Volume 2 Issue 10 November 2017. PP15-24 ISSN. 2456-4559

Fagirl. 2016.Hospital Image. Study customer satisfaction and loyalty at PKU Yogyakarta Hospital. Utilities Journal. vol. 12 no. 2. July

Ferdinand. 2015.*Structural Equation Modeling in Management Research*. Edition 2. Key Library Series 03 / BP UNDIP. Semarang.

Broon. 2016.*Organizational Behavior. A Managerial and Organizational Perspective*. Little Brown and Company. Boston-Toronto.

Gashti, Mohammad Ali Hajizadeh. 2015. Study of the Effects of Customer Service and Product Quality on Customer Satisfaction and Loyalty. International Journal of Humanities and Social Science Vol. 1 No. 7; [Special Issue –June 2015].

Ghozali, Imam. 2015. Application of Multivariate Analysis with the IBM SPSS Program. Edition 7. Diponegoro University Publisher. Semarang.

Giese and Cote. 2016. Academy of Marketing Science Review. Defining Consumer Satisfaction. Vol 2000 No.

Griffin, Jill. 2015.*Customer Loyalty. Growing and Maintaining Customer Loyalty (Revised Edition).*Erlangga. Jakarta.

Hasan, Ali. 2015.*Marketing.*Medpress. Yogyakarta.

Hasibuan, Malayu SP. 2016. Human Resource Management. Edition. Revision. Publisher PT Bumi Aksara. Jakarta.

Hindle and Thomas. 2015.*Marketing Management Essence Series*. Translate. Damiano Q. Roosmin. Gramedia. Jakarta.

Hurriyati. 2016. B*Marketing rules and Consumer Loyalty*. Alfabeta. Bandung.

Irawan. 2016. Modern Marketing Management 2nd Edition. Liberty Offset. Yogyakarta.

Irini D. Rigopoulou. 2018. After-sales service quality as an antecedent of customer satisfaction The case of electronic appliances. Managing Service Quality Vol. 18 No. 5. 2018 pp. 512-527 q Emerald Group Publishing Limited 0960-4529

Ishaq et al. 2016. Role of Corporate Image. Product Quality and Customer Value in Customer Loyalty. Mediation Effect of Customer Satisfaction J. Basic. Appl. Sci. Res .. 4 (4) 89-97. 2016 © 2016. TextRoad Publication ISSN 2090-4304 Journal of Basic and Applied Scientific Research

Jeon. 2017. The impact of brand concept on brand equity. Asia Pacific Journal of Innovation and Entrepreneurship. 11 (2) 233-245. Retreived from Emerald Insight

Cashmere. 2016 Introduction to Management. PT Raja Grafindo Persada. Jakarta .

Kim, Chang Eun. Joon-Shik Shin. Jinho Lee. Yoon Jae Lee. Dear Kim. Areum Choi. Ki Byung Park. Ho-Joo Lee and In-Hyuk Ha. 2017. Quality of medical service. patient satisfaction and loyalty with a focus on interpersonal-based medical service encounters and treatment effectiveness. a cross-sectional multicenter study of complementary and alternative medicine (CAM) hospitals. Kim et al. BMC Complementary and Alternative Medicine (2017) 17.174 DOI 10.1186 / s12906-017-1691-6

Koontz and Weihrich. 2015 *Management; A Global Perspective*. Tenth Edition. Mcgraw Hill Inc. USA.

Kotler, Philip. 2016. Marketing Management. Millennium Edition. Prenhallindo. Jakarta

Kotler, Philip. and Armstrong 2015. Marketing Management. Analysis. Planning. Implementation. and Control. Volume 1. Indonesian Edition of the Principles of Marketing 9e. Publisher PT. Prenhalindo. Jakarta

Kotler, Philip. and Keller. 2016. Marketing Management. 12th edition. Erlangga. Jakarta

Lupiyoadi, Rambat and Madani. 2015.Service Marketing Management. Theory and Practice First Edition. Jakarta. Four Salemba

Masoudinezhad, Nafiseh. 2018. The Relationship Between The Quality Of After-Sales Service And Customer Satisfaction. Customer Retention And Customer Loyalty. Volume-5. Issue-1. June-2018 ISSN No. 2349-5677

Eghra. 2016. Subway customer loyalty and evaluating marketing strategies. Journal of Business Management & Social Science Research. Vol. 2 No.11. pp. 17-30

Mukti, Dawn. 2015.*MSMEs in Indonesia Economic Law Perspective.*Learning Library. Yogyakarta.

Nasution. 2015. Qualitative Naturalistic Research Methods. Tarsito. Bandung.

Oko, AE Ndu. 2015. After-Sales Services and Consumers' Perception of Quality. A Study of Refrigerator Users (Consumers) in South East Nigeria. 2015. Vol. 1. No. 2 Business and Management Horizons ISSN 2326-0297

Priyatno, Duwi. 2016. The Flash Way to Learn Data Analysis with SPSS 20. Andi Offset. Yogyakarta.

Rangkuti, Freddy. 2016.*SWOT analysis. Techniques of Dissecting Business Cases*. PT Gramedia Pustaka Utama. Jakarta.

Riduwan and Kuncoro. 2016 Path Analysis. The sixth edition. Alfabeta. Bandung.

Riduwan. 2015 Research Methods for Thesis. Alfabeta. Bandung.

Rigopoulou et.al. 2008After-sales service quality as an antecedent of customer satisfaction. The case of electronic appliances. Managing Service Quality. Vol. 18. No. 5. p. 512–527.

Robbins and Coulter. 2016 Management. 11th. Prentice Hall. USA

Reuben. 2016. Communication and Human Behavior. PT. RajaGrafindo Persada

Rudika. H. 2016. Analysis of the Influence of Overall Customer Satisfaction Variables on Consumer Loyalty in Aqua Bottled Drinking Water Products in Semarang City. Journal of STIE Semarang. Vol. 6. No. 2. June 2016 Edition (ISSN. 2252-7826

Saccani. et.al. 2015 Management. Prentice Hall. USA.

Saeed. 2015.Impact of Service Quality on Customer Loyalty in Islamic Banking Sector of Pakistan. A Mediating Role of Customer Satisfaction. Journal of Basic and Applied Scientific Research. Vol. 4. No. 2

Saidani. 2016 The Effect of Product Quality and Service Quality on Customer Satisfaction and Purchase Intention at Ranch Market. Indonesian Science Management Research Journal (JRMSI). Vol. 3. No. 1

Saladin, Djaslim. 2015.*Marketing Management (First Edition).*CV. Linda Karya. Bandung.

Samboro. et al. 2016The Effect of Service Quality and Advertising on Purchasing Decisions at Bandoeng Guest House Malang. Journal of E-ISSN. 2407-5523 Vol. 3. No. 1

Santoso, Singgih. 2016. Parametric Statistics Revised Edition. Elex Media. Jakarta.

Now, Uma. 2016.*Research Methodology For Business.*Four Salemba. Jakarta.

Now, Uma. and Bougie. 2015.*Research Methods for Business. A skill. Building Approach.*5th edition. John Wiley. New York.

Sharifi. 2015.The Relationship between Internet Addiction and Social Support and Hopefulness. World Scientific News Journal. 1

Sugiyono. 2017.*Qualitative and Quantitative Research Methods R&B*. Alfabeta. Bandung.

Sukmadinata, Nana. 2016. Educational Research Methods. PT. Tarsito. Bandung.

Supranto, J. 2015. *Multivariate Analysis. Meaning and interpretation*. PT. Rineka. Create. Jakarta.

Suryani and Hendryadi. 2015.*Quantitative Research Methods Theory and Application of Research in Management and Islamic Economics*. Prenadamedia Group. Jakarta.

Susanty and Adisaputra. 2016 The Influence of Telkom Speedy Brand Image on Customer Loyalty in Banyumanik District, Semarang. Semarang. Diponogoro University

Sutisna. 2016. *Consumer Behavior and Marketing Communications*. Second edisis .. Youth Rosdakarya. Bandung

Ulber, Silalahi. 2015 Quantitative Social Research Methods. PT. Refika. Bandung.

Usman. 2016. Complete Guide to Structural Equation Modeling Levels. Basic. The Lantern of Science. Semarang

Wahjudi, Didik. Timoticin Kwanda. Rianthi Sulis. 2018. The Impact of After-sales Service Quality on Customer Satisfaction and Customer Loyalty of Middle-upper Class Landed Housings. Journal of Industrial Engineering. Vol. 20. No. 1. June 2018. 65-72 DOI. 10.9744 / jti.20.1.65-72 ISSN 1411-2485 print / ISSN 2087-7439 online

5.1. Zeitahml and Bitner. 2016.*Service Marketing.*Irwin McGraw Hill. Boston. New York. USA