

# Development of Customer Loyalty Measurement Application Using R Shiny with Structural Equation Model Partial Least Square Method, Customer Satisfaction Index, and Customer Loyalty Index

Cintika Oktavia, Budi Warsito, Vincensius Gunawan

Information Systems Department, Faculty of Graduate Schools, Universitas Diponegoro, Semarang 50241, Indonesia

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## ABSTRACT

One of Indonesia's well-known e-commerce platforms, Shopee, relies on information technology to run its business. The information technology used by Shopee is considered unable to meet customer satisfaction. Customer reviews are dissatisfied with the facilities provided by Shopee, and some customers compare Shopee with other e-commerce sites. The research contribution is the understanding that the proper use of information technology can positively impact customer experience, improve operational efficiency, and support business growth in the e-commerce industry. Research with a quantitative approach will build a website-based application as a statistical tool for data processing using R shiny so that the application results have high interactivity, dynamic visualization, and better explanation. The research will collect 100 data provided to customers who have transacted at Shopee and distributed through the telegram application, which is distributed to particular groups and channels for Shopee users. Data processing for this study will use the Structural Equation Model Partial Least Square, Customer Satisfaction Index, Net Promoter Score, and Customer Loyalty Index. The study results show that electronic service quality and security seals positively and significantly affect customer satisfaction. Electronic service quality has a moderate effect on customer satisfaction, while electronic security seals have a slightly lower effect on customer satisfaction ( $t=5.584$ ,  $p<0.001$ ). Additionally, a significant correlation between customer loyalty and satisfaction was discovered ( $t=14.764$ ,  $p=0.001$ ). Research proves the need to improve service quality and security aspects to increase customer satisfaction on e-commerce platforms and the importance of maintaining customer satisfaction as a strategy to increase customer loyalty.

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### Corresponding Author:

Cintika Oktavia, Universitas Diponegoro, Jl. Imam Bardjo SH No. 5, Semarang 50241, Indonesia  
Email: [cintikaoktavia@undip.ac.id](mailto:cintikaoktavia@undip.ac.id)

## 1. INTRODUCTION

The online trading industry is a digital revolution driven by advances in information technology. These advances have provided inventive e-commerce platforms and changed how people shop and interact with products and services [1]. Technological developments enable e-commerce businesses to operate more quickly and efficiently. Customers can easily access online stores through applications and websites. Data analytics, automated logistics delivery systems, and secure digital payments enhance the customer experience [2]-[4].

Information technology enhances transaction security to prevent fraud and cyber attacks [5]. With automated support systems and chatbots, information technology can improve customer service [6]. One of the top Indonesian e-commerce platforms, Shopee, depends on technology to run its business [7]. By combining information technology and business innovation, Shopee has become one of Indonesia's most successful and well-known e-commerce platforms [8]. Shopee has created a pleasant, comfortable, and safe online shopping experience through a reliable transaction security system, a safe and practical payment process, and efficient customer service [9], [10]. A study revealed that Shopee still needs to improve in meeting customer satisfaction so that customers show less loyalty to Shopee from customer reviews who are unsatisfied with the facilities provided by Shopee [11], [12]. There are still many customers who compare

Shopee with other e-commerce [13]. As a result of deficiencies in meeting customer satisfaction, many customers feel hesitant and unsure about continuing to use Shopee as their platform of choice. For e-commerce platforms like Shopee, customer satisfaction is paramount because it can create customer loyalty, a good brand reputation, good product ratings, and reviews, and differentiate Shopee from its competitors [14]. In addition, customer satisfaction impacts increasing retention, repeat purchases, and word-of-mouth [15]. Shopee can create a sustainable environment for business growth by placing customer satisfaction as a top priority [16]. Electronic services quality and security affect customer satisfaction in electronic platforms such as e-commerce [17]. Electronic service quality includes system description, access speed, user interface responsiveness, and ease of use [18]. Quality of information, readability, clarity of product descriptions, and availability of customer reviews are also included in service quality [19]. Platforms offering electronic security seal services take measures to safeguard customers' personal and financial data against identity theft, fraud, and cyberattacks [20]. One of the main priorities is the security of payment transactions, including encryption technology. To safeguard confidential details like credit card information, precautions must be taken. Data An electronic security seal service is essential to establish because it creates customer trust and provides assurance that their information is safe when they make online transactions [21]. Customer satisfaction directly impacts loyalty; customers who are satisfied with their shopping experience on electronic platforms will tend to return to transact in the future because customer loyalty increases customer retention, reduces the cost of purchasing new customers, and increases the long-term perception of the platform [22].

This study aims to measure customer loyalty and customer satisfaction by involving the influence of electronic service quality and electronic security seal services. This study focuses on service factors that influence customer satisfaction which can create customer loyalty. The research results can be used as a business and management learning case study. Measuring customer satisfaction and loyalty using the structural modeling method of partial least squares, customer satisfaction index, net promoter score, and customer loyalty index, to perform data processing, a website-based application will be built with the help of R studio software and the R shiny package. The research contribution is to see how much customer satisfaction and loyalty is towards Shopee, how well electronic platforms such as e-commerce use information technology, and how important it is to apply information technology as needed.

## 2. METHODS

Customer loyalty will be measured using a quantitative approach. Quantitative approaches develop and use mathematical models, hypotheses, and theories to examine issues or events. There are seven stages in the process to measure customer loyalty that are utilized to address the issue. The stages involved include resource and equipment research, variable determination, system planning, application development, data processing, application testing, and evaluation and analysis. Fig. 1 depicts the performance flow of customer loyalty measurement.

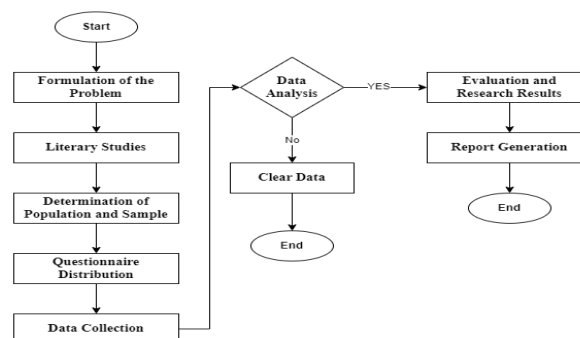


Fig. 1. Research methodology

## 2.1. Research Resources and Equipment

The data used in this study comes from customers who have made purchases on the Shopee application. The data to be analyzed is the proportion of answers from Shopee application users. Demographic characteristics of Shopee users include gender and age, while data on user characteristics includes the age range of Shopee application users. The Google Form application will create a questionnaire and distribute it online via the Telegram application to 100 people. To ensure that the data collected is numerical, respondents give responses using a Likert scale from 1 to 5 with the categories strongly agree, agree, entirely agree, disagree, and strongly disagree. Application developers require a laptop or desktop computer with an Intel Core i5 processor, a minimum of 8GB RAM, and a 250GB hard drive. Microsoft Excel and R studio, which come with the R shiny package, are additional hardware.

## 2.2. Variable Determination

The latent variables for measuring loyalty are electronic service quality, electronic security seal services, customer satisfaction, and customer loyalty. The electronic service quality variable has seven indicators, namely responsiveness (ESQ1), affirmation (ESQ2), user interface (ESQ3), customization (ESQ4), transaction efficiency (ESQ5), access (ESQ6), and empathy (ESQ7). The electronic security seal service variable has four indicators, namely security (SSS1), trust (SSS2), transaction protection (SSS3), and convenience (SSS4). The customer variable has four indicators, namely product quality satisfaction (KEP1), service quality (KEP2), price (KEP3), and emotional (KEP4), while customer loyalty has four indicators of repurchase (LOY1), recommendation (LOY2), fault tolerance (LOY3), and attractiveness (LOY4).

## 2.3. System Planning

Research framework and system flow diagrams will be used to explain system design. Fig. 2 shows the research framework, which consists of three main parts: input, process, and output. The Input section collects data from customer questionnaires covering customer satisfaction, customer loyalty, e-service quality, and e-security seal services. Part Process analysis of the smallest quarter's merchandise characteristics, net promoter score, customer satisfaction index, and customer loyalty index. The value of the level of customer loyalty to the company is the output of the research.

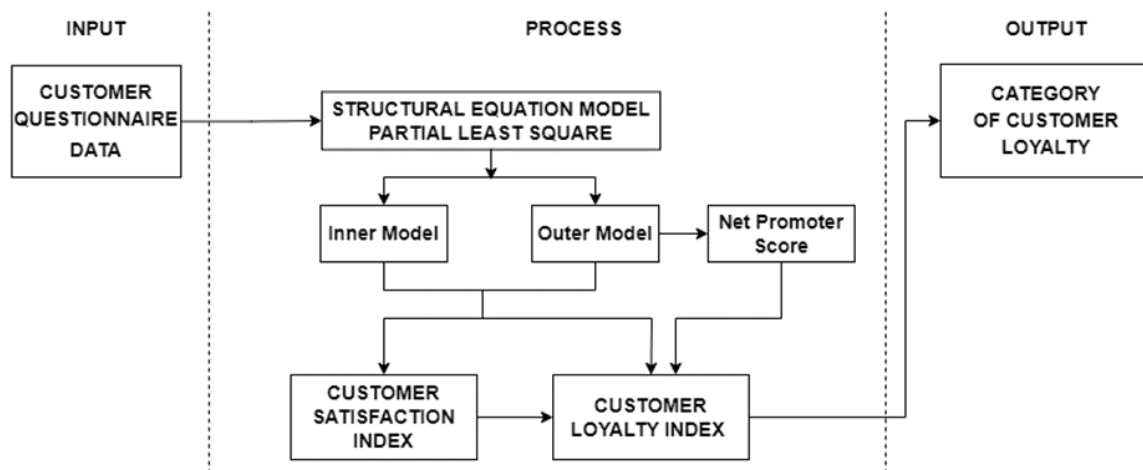


Fig. 2. System planning

Fig. 3 shows a flowchart of a customer loyalty system that begins with collecting data from a customer questionnaire. First, the data will be tested for validity and reliability. Validity was tested by a content validity test, and reliability was tested by an internal reliability test. If the results are unsatisfactory, the customer will be asked to enter a new questionnaire to obtain more accurate and valid data. After the validity and reliability tests are completed, data adjustments will be made for the calculation of the outer model. After that, the system checks whether the outer model criteria values are met. If the outer model value does not match, the data that does not match will be deleted. The training process evaluates the causal relationship between constructs in measuring the inner model after reaching the criteria for the outer model. Furthermore, the system calculates customer satisfaction and loyalty through the satisfaction index, promoter net score, and loyalty index.

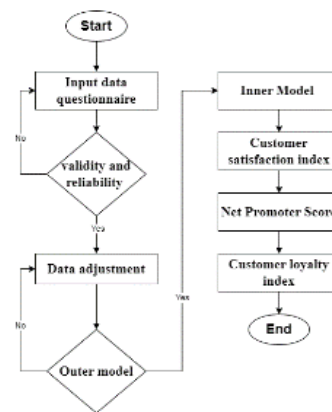


Fig. 3 System flow chart

## 2.4. Application Development

R Shiny is a web platform that creates interactive applications based on R Studio. Since R Shiny is based on a reactive programming model, its development consists of the user interface and the server. This section separates the logical mandates between data processing and user interface displays. The R Shiny application development process starts with creating the user interface. After the user interface is complete, a server will be built to handle data processing logic and respond to user input. Finally, the UI and server are combined into a single application using shiny functions to ensure the application is operational and responsive.

### 2.4.1. User Interface Design

The R shiny user interface has a section structural equation model, net promoter score, customer satisfaction index, and customer loyalty index. The structural equation modeling section of the user interface includes features such as CSV file upload, measurement of input and structural models, and a process button to start analysis. By displaying the results of statistical summary values, loading, bootstrap paths, HTMT indexes, bootstrap loading, and structural model plots. Customer satisfaction index section of the user interface that allows users to upload CSV data, select variables to analyze, and perform customer satisfaction index calculations. An interactive table displays the analysis results, which includes the variable name, load value, construct coefficient value, major influence value, weight value, percentage customer satisfaction index, and indicator customer satisfaction index. The analysis description also displays the value of the customer satisfaction index, the highest, lowest, total, and categories of customer satisfaction index.

The glossy R user interface net promoter score section allows users to upload CSV data, perform promoter net score calculations, and visualize the results as bar graphs. This function makes it simple for people to understand the level of customer satisfaction from the net promoter score generated, as well as view the "Promoters", "Passives", and "Detractors" score categories. A plot download feature is also available to make the analysis results more practical. The customer loyalty index section allows users to analyze the customer loyalty index based on CSV data. Uploading customer data, selecting relevant variables, and entering customer satisfaction index values and net scores. After the analysis, the interactive table displays the results of variable names, loading values, major influence values, weight values, customer loyalty indexes, and indicator customer loyalty index values. The analysis description also displays the value of the customer loyalty index, the lowest, the total, and the highest customer loyalty index category.

### 2.4.2. Server Design

The R shiny application depends on the server to manage the interaction between the user and the application. The server used in this study begins with uploading data files, which are read and displayed in tabular form. Using the structural equation modeling method, users can select and analyze measurement and structural models. Tables and graphs are used to show the analysis' findings. In addition, the application can calculate the customer satisfaction index by using the data uploaded by users and entering their values. The calculation results are displayed in the form of a table that describes the categories of customer satisfaction. Next, the app calculates the net promoter score based on the uploaded data and shows the results in text and bar graphs. Finally, the application also calculates the customer loyalty index and shows the results in a table form and a description of the level of customer loyalty.

## 2.5. Processing Data

Data processing with structural equations using the partial least squares method is processed in 2 stages of measurement, namely the analysis of the outer and inner models. Value factor loading, extracted mean-variance, configuration configurations, and Cronbach's Alpha were calculated in the outer model measurements. Factor loading shows the item's relationship to the factor being measured, and a minimum factor loading value of around 0.7 is usually considered sufficient to maintain the item in the factor [23]. Average Variance Extracted (AVE) indicates the extent to which factors can explain variation within items. The desired AVE value is usually more than 0.5, which indicates that the factor represents approximately part of the item variation [24]. Composite reliability measures the consistency of internal factors in the exact construction, and a minimum value of 0.7 is considered good. Cronbach's Alpha is also used to measure internal consistency; a minimum score of 0.7 is considered good [25].

Inner model calculations get Ori Sample, Average Sample, Standard Deviation, T statistics, and P values [26]. Evaluation of a quality model is the first step in principal component or factor analysis. The Ori Sample value indicates the amount of data used for analysis. The average sample is the average sample data value. The data distribution is measured by a standard deviation different from the average. The T statistic is a statistical test used to measure the significance of each component or factor in the analysis [27]. The T statistic corresponding probability value is the value that indicates how significant the result of the statistical test is. Statistical T-values and P-values are often used to determine whether a component or factor significantly contributes to an analysis [28]. A p-value of less than or equal to 0.05 must be reached [29].

After calculating the inner and outer models, the customer satisfaction value is processed using the customer satisfaction index method using a structural equation model; the partial least square value is taken from the factor load value and the construct coefficient value, where this value will be added up and will get the value of the significant influence, weight value, and the value of the indicator customer satisfaction index [30], [31]. The customer level in the customer satisfaction index method has satisfaction criteria where the value is generated if the value is 0.00 - 24.99 very dissatisfied, 25.00 - 49.99 dissatisfied, 50.00 - 74.99 satisfied, and 75.00 - 100.00 very satisfied [32], [33]. Equation (1) the values obtained will be added up to get the total value of the customer satisfaction index by adding up using the formula in.

Further measurements measure the net promoter score in measuring customer loyalty to a particular product, service or brand. This approach aims to clarify consumer willingness to recommend a good or service to others [34]. The steps in calculating the promoter net score are giving questions, classifying respondents, and calculating the promoter net score [35]. Customer loyalty value management with the customer loyalty index method to obtain the level of loyalty from customers by adding the value of the partial least square structural equation model method and the value of the customer satisfaction index method [36]. The value of the partial least square structural equation model method used is the factor loading value which will be processed to display the value of the significant influence, the weight, and the value of the indicator customer loyalty index. The customer level in the customer loyalty index method has satisfaction criteria where the value is generated if the value is 0.00 - 24.99 very disloyal, 25.00 - 49.99 disloyal, 50.00 - 74.99 loyal, and 75.00 - 100.00 very loyal [37]. Equation (2) the values collected will be processed using the customer loyalty index method using the formula in.

$$\sum_{i=1}^n (\text{Weight} \times \text{Percentage of responses that were satisfied}) \quad (1)$$

$$\frac{[\sum_{i=1}^n (\text{Weight} \times \text{Percentage of loyal responses}) + (\text{promoter net score} - \text{Customer Satisfaction Index})]}{2} \quad (2)$$

## 2.6. Evaluation and Analysis

The research hypothesis will be tested using the t-test to measure the statistical significance of the path coefficient between latent variables in the inner model. The t-test determines whether the path coefficient differs significantly from zero, indicating whether the hypothesis is valid. The statistical technique used is a bootstrap-based t-test. Bootstrap is a statistical technique that produces resampled distributions from the original data to obtain more accurate estimation of confidence intervals. The path coefficient between the inner model variables has statistical significance at the 0.05 (or lower) significance level [38]. The critical value is often used for a significance level of 0.05 in the t distribution is  $\pm 1.96$ . The t-statistic value greater than 1.96 in the context of the t-test indicates that the path coefficient between the variables in the inner model has statistical significance at the 0.05 significance level [39]. This study has three hypotheses, namely.

Hypotheses 1 : Customer satisfaction is directly impacted favorably by the quality of electronic services.  
 Hypotheses 2 : Customer satisfaction is directly impacted favorably by the seals of electronic security.  
 Hypotheses 3 : Customer loyalty is directly influenced by customer satisfaction.

### 3. RESULTS AND DISCUSSION

#### 3.1. Application Development

The customer loyalty measurement application built with R studio utilizes the r shiny package. Application testing has been carried out by black box testing with five tests. The functionality test proves that the application for measuring customer loyalty functions by the desired or expected features. The accuracy and performance tests prove that the application is consistent, accurate, responsive, and has a fast response time without excessive lag. User and integration tests give users good feedback, and applications interact properly with data sources or systems.

The customer loyalty measurement application has five main pages. Fig. 4 is an image of the structural equation model application page to help users analyze quickly and effectively. Users can enter measurement models and structural models that they want to test via this interface and upload CSV files containing data to be used in the analysis. This page aims to give users the ability to perform analysis without understanding the technical complexities behind it. Users can analyze and see the results in conciliation text, factor loading, bootstrap path, bootstrap HTMT values, and structural model visualization. Therefore, this page allows users to access relevant information about the relationship between variables, model validity, and SEM-PLS analysis results without having sufficient technical knowledge.

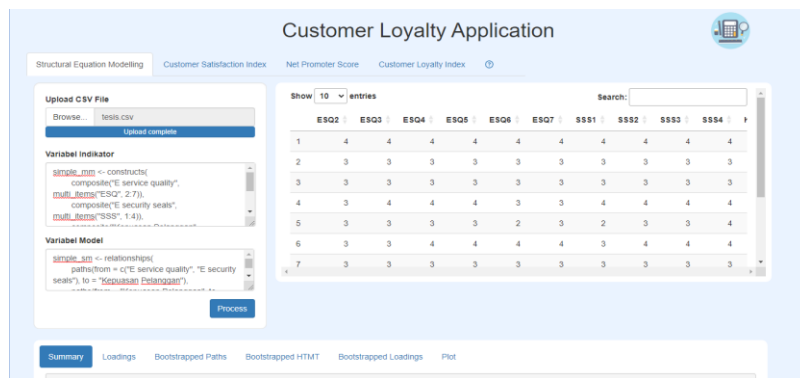


Fig. 4. SEM PLS application page

Fig. 5 is a customer satisfaction index application page designed to facilitate the analysis of the customer satisfaction index. Users can upload data in CSV format, select variables to be analyzed, enter data via data upload, select variables, and customize other inputs. The application generates an interactive table containing the results of the analysis. This page aims to provide an easy and effective user interface to access and analyze customer satisfaction index data in a more practical and easy-to-understand way.

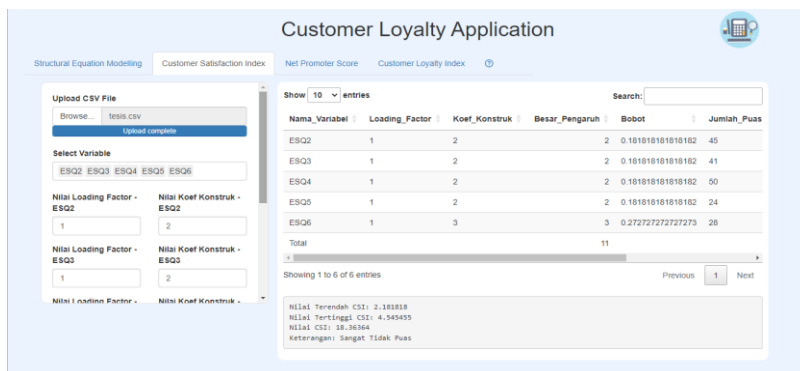


Fig. 5. Customer satisfaction index application page

Fig. 6 is a net promoter score application page designed to facilitate the analysis of customer satisfaction measures. Users can upload data in CSV format to generate promoter net scores in text form. This page aims

to help users understand customer satisfaction based on the net promoter score and provide a business or organization with valuable insights on improving the quality of their service or product. This page also allows the user to download the plot visualization as a report or further analysis.

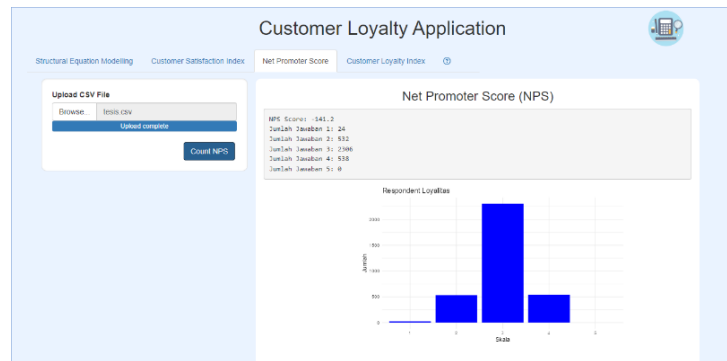


Fig. 6. Net promoter score application page

Fig. 7 is the customer loyalty index application page. This application is designed to make analysis of the customer loyalty index easier. Users can upload data in CSV format, select variables to analyze, and enter Customer Loyalty Index and Net Promoter Score values. Results in an interactive tabular format and verbatim text are displayed about the analysis results. This page aims to help users measure and understand customer loyalty levels more efficiently and provide valuable insights for businesses or organizations on improving service quality and understanding their customer loyalty levels.

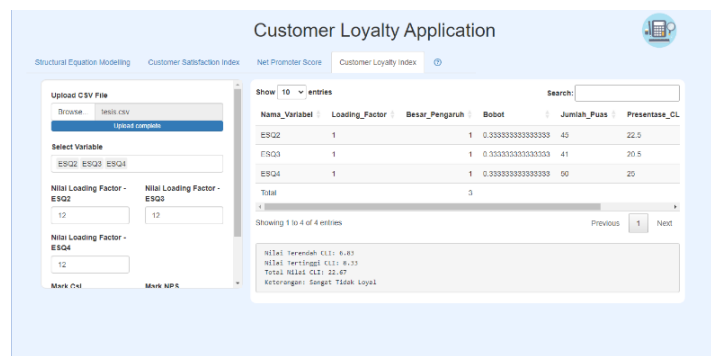


Fig. 7. Customer loyalty index application page

Fig. 8 is an information page to provide users with complete information about methods and procedures for measuring customer loyalty which is divided into two pages. The first part briefly explains how services and facilities impact measuring customer loyalty. The second part explains the calculation steps, including advanced access to watch videos that support user understanding. With this information in mind, this page aims to provide comprehensive guidance on understanding, analyzing and accounting for customer user loyalty.

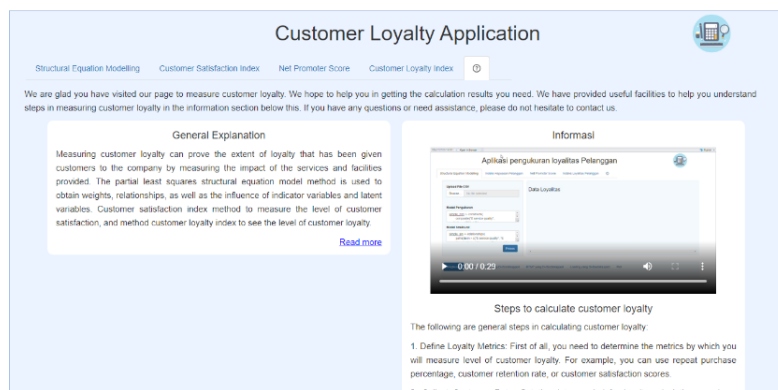
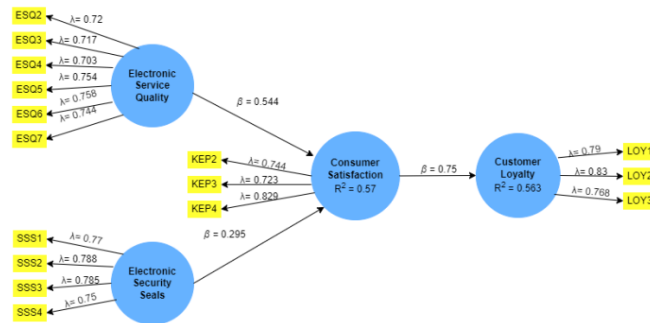


Fig. 8. Information application page

**3.2. Evaluation and Calculation Results**

The assessment of the outer model and the evaluation of the inner model are the two key phases of the PLS-SEM model evaluation. The purpose of evaluating the measurement model is to ensure that the indicators in the model can explain the construct being measured and that each indicator is separated from its measurement. The initial outer model evaluation results show that the ESQ1, KEP1, and LOY4 indicators must meet the standards because their loading factor values are less than 0.7. To improve the quality of the model, these inappropriate indicators were removed, and a new calculation model was created. Fig. 9 shows the measurement evaluation results after cleaning the 6 indicators and changing models.



**Fig. 9.** Measurement evaluation results

Table 1 displays the calculations' outcomes of the outer model and the calculation values of the outer model, namely the values of Factor Loading, AVE, Composite Reliability, and Cronbach Alpha. The results of the factor loading analysis show that the indicators for each of the four variables studied have factor loading values between 0.720 and 0.846. The AVE values range between 0.537 and 0.642, indicating that these indicators can adequately describe the variation of the concept measured in each variable [40]. Composite Reliability achieved high values, ranging between 0.838 and 0.874, indicating a substantial degree of consistency in measuring the variables [41]. The Cronbach Alpha value for each variable also shows a high level of internal reliability, ranging between 0.719 and 0.831. These values indicate that the questionnaire has the exact measurement and concept. Overall, the factor analysis results show that the measuring instrument used in this study has good validity and reliability in describing the relationship between the variables measured: electronic service quality, electronic security seals, customer satisfaction, and customer loyalty [42].

**Table 1.** Outer model calculation

Variables	Indicators	Factor Loading	AVE	Composite Reliability	Cronbach Alpha
Electronic Service Quality	ESQ2	0.720	0.537	0.874	0.831
	ESQ3	0.717			
	ESQ4	0.703			
	ESQ5	0.754			
	ESQ6	0.758			
	ESQ7	0.744			
Electronic Security Seal	SSS1	0.770	0.598	0.856	0.776
	SSS2	0.788			
	SSS3	0.785			
	SSS4	0.750			
Customer Satisfaction	KEP2	0.846	0.642	0.843	0.721
	KEP3	0.723			
	KEP4	0.829			
Customer Loyalty	LOY1	0.790	0.634	0.838	0.719
	LOY2	0.830			
	LOY3	0.768			

Table 2 is the result of calculating the inner model to determine the research hypothesis. The analysis results of e-service quality and customer satisfaction show a moderate positive relationship between the two variables, with a correlation coefficient of 0.544 in the initial sample and 0.552 in the average sample [43]. Variation in sample responses to this relationship is indicated by a standard deviation value of 0.097. This relationship shows an extreme significance, according to the t-statistic value of 5.584 and the p-value of 0.000, which is far below the significance threshold (0.05) [44]. These results indicate a moderate positive relationship



between the two variables. Therefore, the findings of this analysis support hypothesis (1). It is proven that electronic service quality has a positive effect on customer satisfaction. The analysis of the relationship between Electronic Security Seals and Customer Satisfaction shows that the relationship coefficient between these two variables is 0.259 in the initial sample and 0.260 in the average sample. A standard deviation of 0.101 indicates variation in the sample's response to this relationship. The t-statistic is 2.565, and the p-value is 0.010, indicating that this relationship has a vital statistical significance [45]. The results show that the relationship between perceptions of electronic security seals and customer satisfaction has a positive direction [46]. Still, the impact is weaker than the relationship in the previous hypothesis. Therefore, the findings of this analysis support hypothesis (2) that electronic security seals positively affect customer satisfaction, although the effect is lower. Customer loyalty and customer satisfaction have a strong correlation, with a coefficient of 0.760 in the average sample and 0.750 in the first sample, according to the examination of this connection. Consistency in sample responses to this relationship is indicated by a low deviation value (0.051). This relationship is very significant, according to the statistical t-value of 14.764 and the p-value of 0.000 [47]. According to the analysis's findings, a strong positive correlation exists between customer loyalty and degree of customer pleasure. Therefore, the findings of this analysis support hypothesis (3). It is proven that customer satisfaction has a positive effect on customer loyalty.

**Table 2.** Inner model calculation

Relation and Hypotheses	Ori Sample	Average Sample	Standard Deviation	T Statistic	P Value
Electronic Service Quality -> Customer Satisfaction	0.544	0.552	0.097	5.584	0.000
Electronic Security Seal -> Customer Satisfaction	0.259	0.260	0.101	2.565	0.010
Customer Satisfaction -> Customer Loyalty	0.750	0.760	0.051	14.764	0.000

**Table 3** results from the Customer Satisfaction Index (CSI) Parameters used for customer satisfaction. Each variable has a relevant component. This includes the Great Influence and the weight that influences the CSI calculation, the construct coefficient, which indicates the impact of the variable on the construct, and the Load Value, which indicates the extent to which the variable is related to the measured construct [48]. The analysis results show differences in the influence and weight of each variable. The Electronic Service Quality (ESQ) variable positively influences customer satisfaction, with a Great Influence value of 0.382 to 0.412 [49]. In contrast, the Electronic Security Seal (SSS) variable has a lower influence, with a Great Influence value of 0.194 to 0.204 [50]. Customer Satisfaction Variable (KEP), especially KEP4, has a significant influence, with a Great Influence value of 0.621. The analysis results show that Shopee's services have met customer expectations and needs, with CSI values ranging between 0.817 and 3.114, with an overall CSI value of 60.246 [51]. Overall there is significance in assessing customer satisfaction where the total cost and total CSI reached 4.991 and 24.257 [52]. Therefore, the analysis results provide significant evidence about the impact of the variables involved in increasing the level of customer satisfaction and confirm that the level of customer satisfaction is very high on the "Satisfied" scale.

**Table 3.** Measurement results of customer satisfaction

Variable	Loading Value	Construct Coef	Great Influence	Weight	Number Satisfied	CSI Percentage	Nilai CSI
ESQ3	0.720	0.544	0.391	0.078	31	31	2.432
ESQ4	0.717	0.544	0.390	0.078	29	29	2.266
ESQ5	0.703	0.544	0.382	0.076	23	23	1.762
ESQ6	0.754	0.544	0.410	0.082	22	22	1.808
ESQ7	0.758	0.544	0.412	0.082	19	19	1.569
ESQ2	0.744	0.544	0.404	0.081	25	25	2.027
SSS1	0.770	0.259	0.199	0.039	28	28	1.118
SSS2	0.788	0.259	0.204	0.040	28	28	1.144
SSS3	0.785	0.259	0.203	0.040	31	31	1.262
SSS4	0.750	0.259	0.194	0.038	21	21	0.817
KEP2	0.846	0.750	0.634	0.127	20	20	2.542
KEP3	0.723	0.750	0.542	0.108	22	22	2.390
KEP4	0.829	0.750	0.621	0.124	25	25	3.114
Total			4.991				24.257

Fig. 10 is the result of the Net Promoter Score (NPS) analysis diagram, which is 236.8, reflecting the level of customer awareness to recommend a product or service on a scale of 1 to 5. Data on the number of answers shows variations in customer perceptions of the brand: there are ten answers in the score category 1 (Very Not Satisfied), 359 answers in category score 2 (Not Satisfied), 1056 answers in category score 3 (Neutral), 420 answers in category score 4 (Satisfied), and 55 answers in category score 5 (Very Satisfied). The NPS scale from 1 to 5 gives an idea of the customer's perception and tendency to recommend, where there is an opportunity to increase satisfaction and get more positive recommendations from customers [53].

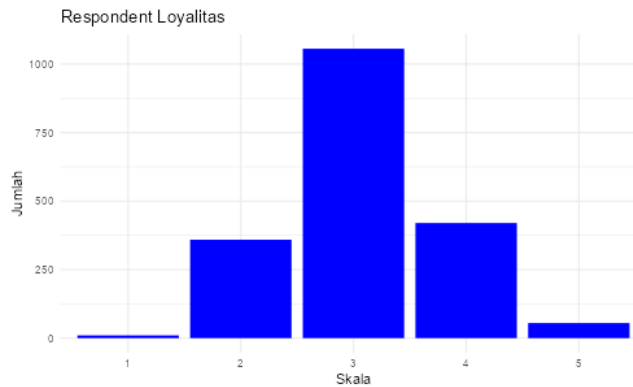


Fig. 10. Net Promoter Score analysis diagram

Table 4 is the result of calculating the Customer Loyalty Index (CLI) parameter used to measure customer loyalty. Each variable has a relevant component in the CLI calculation, including loading value, significant influence, weight, number of loyal customers, and the CLI and CLI value proportion [54]. The analysis results show that each customer loyalty variable has a significant influence which is in line with its value loading value, which is between 0.703 and 0.72 [55]. The LOY2 variable has the highest influence, indicated by the high loading value and Great Influence, and has the highest CLI value, which is 10.051. This shows the highest level of loyalty in the LOY2 variable, while the LOY1 and LOY3 variables show a slightly lower level of loyalty but are still positive. Overall, this analysis provides an overview of the level of customer loyalty to Shopee, where the CLI values and related parameters provide essential insights into assessing and increasing customer loyalty [56]. The analysis results provide significant evidence about the impact of the variables involved in increasing the level of customer loyalty and confirmation that the level of customer loyalty is very high on the "Loyal" scale.

Table 4. Measurement results of customer loyalty

Variable	Loading Value	Great Influence	Weight	Number Satisfied	CLI Percentage	Nilai CLI
LOY1	0.72	0.72	0.336	24	24	8.074
LOY2	0.717	0.717	0.335	30	30	10.051
LOY3	0.703	0.703	0.328	28	28	9.198
Total		2.14				27.324

### 3.3. Discussion

The evaluation results of the Partial Least Squares (PLS) Structural Equation Modeling (SEM) model were in two stages: evaluating the outer and inner models. There are corrective actions taken after initial findings show that some indicators are not up to standard. Removing non-conforming indicators and changing the model improves the quality of the measurement model. The updated outer model evaluation results confirm the validity and reliability of the model. The inner model analysis supports the hypothesis that electronic service quality positively impacts customer satisfaction, while electronic security seals also positively impact customer satisfaction. However, it is lower, and customer satisfaction positively impacts customer loyalty. The Parameters of the Customer Satisfaction Index show that Electronic Service Quality and Customer Satisfaction positively affect satisfaction, while Electronic Security Seals have a lower influence. The Net Promoter Score analysis results show variations in customer perceptions of the brand, with opportunities to increase positive recommendations. The Composite Loyalty Index describes the level of loyalty, with LOY2 having the highest influence and loyalty. These results confirm high satisfaction levels and intense loyalty to Shopee's services.

Research using the Partial Least Squares (PLS) Structural Equation Modeling (SEM) model differed from previous research. Such as research entitled "A model of online food delivery Service quality, customer satisfaction, and customer loyalty: A combination of PLS-SEM and NCA approaches" focuses on the effect of the service quality dimension on customer satisfaction using the adequacy logic approach [57]. This study dissects the "must have" factors in service quality and is based on findings through the PLS-SEM method. While ongoing research examines the influence of service quality dimensions on customer satisfaction using the logic of needs and applying various analytical methods such as PLS-SEM, CSI, NPS, and CLI. The current research is more comprehensive by identifying the factors needed to achieve higher satisfaction levels through various approaches and analytical methods.

This research has several limitations that need to be considered: too small sample size and external factors. Changes in market trends or social situations can significantly affect the relationship between the variables studied, where the current research results need to be seen as a representation of the conditions when the research was conducted and may not always apply to different conditions in the future. Therefore, it is recommended to involve a larger sample size. In the framework of future research, it can be explored further in larger sample sizes and external factors that can affect the relationship between variables. For future research, it would be helpful to deepen the exploration of external factors that affect the relationship between the variables studied. This can involve monitoring market trends, regulatory changes, or broader societal factors influencing customer perceptions and behavior. Additionally, taking into account the inclusion of pertinent factors might offer a more thorough comprehension of complicated dynamics.

#### 4. CONCLUSION

The evaluation results of the Structural Equation Modeling Partial Least Squares have shown the quality of the method used. This finding is proven through a positive and significant interaction between the indicators and the variables studied. The analysis results show that electronic service quality and security seals are essential in achieving customer satisfaction and loyalty. Electronic service quality and security seals significantly shape positive customer perceptions of online trading platforms. Good service quality and a sense of security in transactions increase customer satisfaction. Customer loyalty is significantly and positively influenced by customer satisfaction. Therefore, online trading platforms like Shopee must prioritize improving service quality and security to ensure a positive customer experience and build strong loyalty. This implication also emphasizes the role of information technology in online business success and the importance of focusing on the overall customer experience. By taking these steps, platforms can achieve higher satisfaction levels and strengthen customer bonds in the long term.

This study has research limitations, namely sample size and potential data bias. Nonetheless, recognition of these limitations suggests a realistic approach within its limitations. Therefore, it is advisable to continue research focusing on improving e-service quality and e-security measures and exploring additional factors that influence customer satisfaction and loyalty. These findings provide valuable guidance for the online trading industry's challenges and opportunities. The industry can identify best practices and effective strategies through a deeper understanding of Shopee's position in terms of customer satisfaction and loyalty compared to its competitors. This research also underlines the critical role of information technology in forming positive relationships with customers in an increasingly dynamic era of online commerce.

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## BIOGRAPHY OF AUTHORS



**Cintika Oktavia**, Master of information systems, Diponegoro University postgraduate school. Email: [cintikaokavia@students.undip.ac.id](mailto:cintikaokavia@students.undip.ac.id).



**Budi Warsito**, Lecturer majoring in information systems at Diponegoro University. Have an interest in the field of data mining and information systems. Email: [budiwarsitoundip@gmail.com](mailto:budiwarsitoundip@gmail.com).



**Vincensius Gunawan Slamet Kadarrisman**, Lecturer majoring in physics at Diponegoro University. Have an interest in the field of material physics. Email: [goenangie@lecturer.undip.ac.id](mailto:goenangie@lecturer.undip.ac.id). Orcid: 0000-0003-2189-2610.