



Application of Structural Equations Modeling Partial Least Square at the Comparison of the Niveau of Responsibility From Cs and DigiCS

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Abstract

Banking is an institution that plays a role in increasing economic development and also increasing equitable development. People who are serving users will be more selective in choosing banks so that many banks strive to be superior and more satisfying than other banks. Customer satisfaction can be seen from the role of CS and DigiCS. Customer Service (CS) is all actions intended to meet needs and activities by providing services so that each customer's needs are met. Digital Customer Service (DigiCS) is BNI digital banking automation that provides customers with immediate experience when carrying out digital transactions at BNI. The aim of this research is to determine the factors that influence the level of CS and DigiCS customer satisfaction with several variables, namely product quality (X_1), service quality (X_2), time (X_3), convenience/efficiency (X_4), and customer satisfaction (Y). The method used in this research is structural equation modeling partial least squares with the help of Microsoft Excel and SmartPLS software with the application of SEM - PLS to analyze the relationship between endogenous latent variables and exogenous latent variables. The results of this research are that for CS customer satisfaction it is found that only the exogenous variable product quality (X_1) with its influences indicators customer satisfaction (Y) while for DigiCS customer satisfaction the results are that only the exogenous variable product quality (X_1) and the exogenous variable convenience/efficiency (X_4) with indicators that influence customer satisfaction (Y).

Keywords: Customer Satisfaction, CS, DigiCS, Structural Equation Modeling Partial Least Square (SEM - PLS)

1. Introduction

Banking is an institution that plays a role in increasing economic development and also in increasing equitable development (Paparang, 2016). Banking functions to connect parties who have excess funds and will produce them to parties who experience a lack of funds (Wijayanto, 2015). People who are service users will be more selective in choosing a bank to store their money or valuable assets. Many banks strive to be superior and more satisfying than other banks (Imelda, 2018).

satisfaction is the main point in maintaining banking reputation in order to gain added value in the wider community, so customer satisfaction needs to be increased (Febriana, 2016). How to increase customer satisfaction can be done with various strategies that are seen from several factors including product quality (effectiveness), service quality, convenience (efficiency) and time. These four factors will be used to see the level of customer satisfaction of PT. Bank Negara Indonesia Tbk Payakumbuh City Branch (Lestari and Iskandar, 2021; Anggraeni, 2021; Oktaviani, 2014; Wijayanto, 2015).

Satisfaction is the level of someone's feelings that arise after comparing the performance of the product received against their expectations. The level of satisfaction is based on the difference between perceived results and expectations. Customers will be very satisfied if the results meet expectations, and if the results do not meet expectations then customers will be disappointed (Kotler and Keller, 2006).

Dr. Cashmere. MM (Customer Service Ethics) states that Customer Service (CS) are all actions intended to meet needs and activities by providing services so that each customer's needs are met. The role of customer service very important for companies and banks because their duties are the basis of all operations in the banking world. Digital Customer Service (DigiCS) is BNI's digital banking automation that provides customers with direct experience when carrying out digital transactions at BNI.

Structural equation modeling (SEM) is analysis method statistics to solve problems and phenomena that arise with a structural approach (Byrne, 2013). Factor analysis, path analysis, and regression is part of SEM. There are two types of SEM methods, namely covariance based structural equation modeling (CB-SEM) and structural equation modeling partial least squares (SEM-PLS) (Hair Jr et al., 2014). This research uses SEM with the SEM-PLS approach.

Several studies that have been carried out are taken as related references, research conducted by Aurelia and Perdana, (2020) regarding the application of SEM-PLS to public satisfaction with police public services in West Kalimantan by taking into account several aspects including law enforcement aspects, aspects of maintaining security and order, aspects public services, and aspects of public trust, research results show that the variables aspects of maintaining social security and order and aspects of public services influence public trust.

Then the results of research by Marliana, (2019) regarding the application of PLS-SEM on the relationship between student satisfaction levels and the quality of Google Classroom by taking into account several aspects, namely information quality, service interaction quality, user interface quality, and usability, the results showed that usability has a significant effect on the level of student satisfaction.

Next is research by Ursule et al., (2022) regarding a systematic PLS-SEM approach for assessing unemployment among university graduates in Madagascar by taking into account several aspects including lack of awareness, lack of opportunities, lack of appropriate skills, overqualified, unemployment, weak GDP, obtained that lack of opportunities, lack of appropriate skills, overqualified, unemployment, weak GDP have a significant influence on the causes of unemployment. Then research by Suhriani & Abdurakhman, (2019) regarding the component-based SEM approach using GSCA by taking into account the relationship between the quality of attitudes towards lecturers and student motivation, it was found that the quality of attitudes towards lecturers had a positive effect on student motivation.

Furthermore, research by Ravand and Baghaei, (2019) regarding partial least squares structural equation modeling with R by taking into account the relationship between reading comprehension, motivation, vocabulary and strategy use, showed that motivation had a significant effect on strategy use. Next was research by Sumargo and Novalia, (2018) regarding structural equation modeling to determine the subjective well-being factors of poor children in bad environments by taking into account the relationship between family socio-economic conditions and children's social-emotional health on children's subjective well-being, it was found that family socio-economic conditions have a significant effect on social emotional health as well as social health. Emotions have a significant effect on children's subjective well-being.

This research will discuss the comparison of customer satisfaction levels with CS and DigiCS using the application of partial least squares structural equation modeling. There are five variables used, namely, product quality, service quality, time, convenience/efficiency, and customer satisfaction. Each variable has two indicators whose relationship will later be analyzed.

2. Structural Equation Modeling Partial Least Square

Structural Equation Modeling (SEM) is a statistical method that is useful for testing statistical models that evaluate cause and effect. Factor analysis, path analysis, and regression are part of SEM (Byrne, 2009). SEM in its two types consists of covariance based structural equation modeling (CB-SEM) and structural equation modeling partial least squares (SEM-PLS). Partial east square structural equation modeling (PLS-SEM) is a nonparametric statistical approach that does not require data distribution assumptions. PLS-SEM can be applied to data that is not normally distributed by utilizing the central limit theorem, so it can be used even on data with limited and small samples (Hair Jr et al., 2014). SEM-PLS testing begins with the initial stages of designing the inner model and outer model.

Structural models or inner models are used to predict cause-and-effect relationships or causality between latent variables. The structural model describes the correlation between latent variables in accordance with the substantial theoretical basis (Ghozali and Latan, 2015). Structural models can be based on underlying theories, previous research findings, and the process of exploring relationships between variables (Wati, 2018).

The measurement model or outer model aims to determine how the latent variables and indicators relate to each other. The relationship between indicators must be highly correlated with each other because the model is reflective between the indicators (Ghozali and Latan, 2015). The next stage is to construct and convert the path diagram to inner model and outer model equations.

Falk and Miller (1992) suggested the use of the reticular action modeling (RAM) nomogram procedure in the path diagram construction stage. Next, convert the path diagram to the outer model equation with model equation (1) as follows:

$$\eta = (1 - \beta)^{-1}(\Gamma\xi + \zeta) \quad (1)$$

η states the vector of endogenous latent variables, β states the coefficient matrix of endogenous latent variables, Γ states the coefficient matrix of exogenous latent variables, ξ denotes a vector of exogenous latent variables, and ζ represents the residual vector. PLS designed for recursive model (a model that has one direction of causality), so connection between variable exogenous latent to endogenous latent variables is often called causal chain system with the following equation:

$$\eta_j = \sum_i \beta_{ji} \eta_i + \sum_i \gamma_{jb} \xi_b + \zeta_j \quad (2)$$

γ_{jb} states the path coefficient that connects the endogenous variable (η) as a predictor with the variable exogenous (ξ), β_{ji} states the path coefficient that connects the endogenous variable (η) as a predictor with the variable endogenous (η), ζ_j states the error or level of measurement error, while the conversion of the path diagram to the inner model equation with model equation (3) is as follows:

$$\begin{aligned} x_{nx1} &= \Lambda_{x_{nxq}} \xi_{nx1} + \delta_{nx1} \\ y_{mx1} &= \Lambda_{y_{mxp}} \eta_{mx1} + \varepsilon_{mx1} \end{aligned} \quad (3)$$

x states the manifest indicator variable for the exogenous latent variable (ξ), y states the manifest indicator variable for the endogenous latent variable (η), Λ_x states the loading matrix which shows the coefficient between the exogenous latent variable and the indicator variable, Λ_y loading matrix which shows the coefficient between the endogenous latent variable and the indicator variable, δ states the residual measurement error or noise from exogenous variable indicators, ε states residual measurement error or noise from endogenous variable indicators.

The next stage is estimating and evaluating the outer model and inner model. Evaluate the outer model with convergent validity, discriminant validity, and composite reliability.

1. Convergent Validity

Convergent validity is evaluated based on the values or factor loads formed by the relationship between the indicator variables and the latent variables (Ghozali and Latan, 2015). The factor loading value is said to be valid if it is > 0.7 so it meets the criteria (Hair et al., 2019).

2. Discriminant Validity

Validity is assessed based on the Fornell-Lacker Criterion and cross loading values. The Fornell-lacker criterion test meets the criteria if the AVE root value of the latent variable is greater than the correlation value between the latent variable and other latent variables. The cross-loading test meets the criteria if the cross-loading value of each indicator variable with its latent variable is higher than the cross loading value of the other latent variables (Ghozali and Latan, 2015).

3. Composite Reliability

Composite reliability is a value that is used to indicate the level of consistency of a measuring instrument. The composite reliability of the indicator group has a value equal to 0.7, so it is said to have good composite reliability (Ghozali and Latan, 2015). Calculation of composite reliability (pc) can be done using the formula:

$$pc = \frac{(\sum \lambda_i)^2}{(\sum \lambda_i)^2 + \sum_i var(\varepsilon_i)} \quad (4)$$

λ_i states factor ε_i loading, states measurement error of indicator variables. Composite reliability also provides an evaluation value using Average Variance Extracted (AVE). AVE is said to be reliable if the AVE value is greater than 0.5, which means the variable has the ability to explain at least half or more of the variation in the items. The AVE calculation formula is as follows:

$$AVE = \frac{\sum \lambda_i^2}{\sum \lambda_i^2 + \sum_i var(\varepsilon_i)} \quad (5)$$

First evaluation of the inner model looks at the R-square value by paying attention to the appropriateness of the endogenous latent variable which will then be explained by the exogenous latent variable. Testing is carried out with R-square using the following formula calculation (Dillon and Goldstein, 1984):

$$R^2 = 1 - \frac{\sum_{i=1}^z (y_i - \hat{y}_i)^2}{\sum_{i=1}^z (y_i - \bar{y})^2} \quad (6)$$

Next, evaluate the predictive Q-square value of relevance. Observation value resulting from the model and its parameter estimates are shown by Q-square. Testing is carried out using Q-square with the following calculations:

$$Q^2 = (1 - R^2) \quad (7)$$

R^2 is R-square of the endogenous latent variable contained in equation (6). Value range Q^2 is in the range $0 < Q^2 < 1$, where if the value gets closer to 1 it indicates the goodness of the model.

bootstrap resampling hypothesis testing. Bootstrap is a method used to estimate all original samples with subsequent resampling (Efron and Tibshirani, 1993). The bootstrap procedure here produces test statistical values for each relationship path in hypothesis testing.

statistical hypothesis in the outer model is as follows:

$H_0: \lambda_i = 0$ (there is no significant influence between the indicator variables on the latent variables)

$H_1: \lambda_i \neq 0$ (there is a significant influence between the indicator variables on the latent variables)

hypothesis in the inner model are as follows:

$H_0: \gamma_i = 0$ (There is no significant influence between exogenous latent variables on endogenous latent variables)

$H_1: \gamma_i \neq 0$ (There is a significant influence between exogenous latent variables on endogenous latent variables)

The resampling method allows data to be distributed Independently, this indicates that no normal distribution assumptions or large sample sizes are required (Davison and Hinkley, 1997). Testing this hypothesis uses the t test with the criterion of a p- value < 0.05 (alpha 5%). The p-value < 0.05 is H_0 rejected, which means there is a significant influence and vice versa.

satisfaction is the main point in maintaining banking reputation in order to gain added value in the wider community, so customer satisfaction needs to be increased (Febriana, 2016).

Factors that influence customer satisfaction include:

1. Product quality

Product quality has an important part in the success of a bank. Along with technological developments, companies are required to continue to develop product quality so as to provide superior products. Product quality is a characteristic of a product or service that is capable of satisfying customer needs (Kotler and Armstrong, 2018).

2. Service quality

One important factor in customer satisfaction is service quality. Customers will feel satisfied if the services provided can make customers feel comfortable and safe in transactions. Service quality is defined as everything that focuses on efforts to fulfill consumer needs and desires as well as accuracy in providing service information so as to create conformity with consumer expectations (Sulistyowati, 2018).

3. Service time

Time also affects customer satisfaction, because if transactions are faster then customers do not need more time to queue.

4. Convenience/ efficiency

5. The convenience (efficiency) factor also influences the level of customer satisfaction because it can fulfill customer needs quickly, precisely and safely in carrying out transactions. Convenience is an attitude that does not make it difficult for users to carry out the process transactions (Turban et al., 2015).

3. Methodology Study

This research uses primary data obtained from the results of a survey of customers using an online questionnaire. The sampling method uses quota sampling where the respondents are customers who carry out transactions on CS and DigiCS at PT. Bank Negara Indonesia Tbk Payakumbuh City Branch. The variables used are product quality, service quality, time, and convenience/efficiency which are exogenous variables and customer satisfaction which is an endogenous variable.

As for steps in study This is as following:

1. Carrying out data collection through the use of online questionnaires which are distributed according to previously determined criteria within a certain time frame;
2. Conduct data exploration using descriptive analysis which is useful for knowing the general characteristics of respondents;
3. Testing research instruments using validity and reliability tests which are useful for seeing whether the questionnaire is valid or not and its consistency;
4. Designing the inner model and outer model;
5. Carrying out the stages of path diagram construction and conversion of path diagrams to inner model and outer model equations;
6. Estimating and evaluating the inner model and outer model using convergent validity, discriminant validity and composite reliability tests for the outer model equation, while for the inner model equation using the coefficient of determination (R Square) test and bootstrap resampling hypothesis testing.
7. Obtain results and draw conclusions based on the results of hypothesis testing.

4. Application of Structural Equation Modeling Partial Least Square in Comparison of Customer Satisfaction Level Towards Cs and DigiCs

This research uses data from BNI customers who make transactions on CS and DigiCS with the criteria of customers who are of productive age and who made transactions in the last 3 months. The sampling technique in this study used quota sampling with the distribution of questionnaires starting from July 10 2023 to August 1 2023 which was carried out using Google Forms. The interpretation obtained is as below:

For CS data, the results can be seen with the initial stage of looking at the convergent validity value which is useful for finding out whether the correlation is valid or not indicator variables against variables latent. Convergent validity can be seen through the loading value factors with a criteria value greater than 0.7 and if they do not meet the criteria they will be removed from the model, then re-estimation will be carried out to re-check the loading factor value for each indicator.

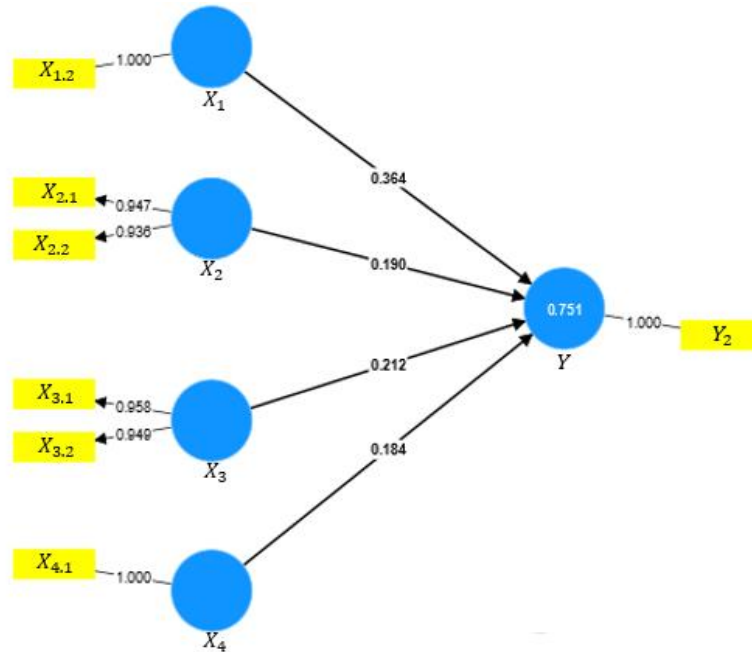


Figure 1: CS re-estimation path diagram output

Figure 1 shows that there are no longer any indicators that have a loading factor value below 0.7 and the loading factor value of each indicator variable increases because several indicators have been removed from the model.

Next, a discriminant validity test will be carried out, a test that is useful in determining the level of accuracy of an indicator variable for measuring the latent variable. The discriminant validity test is assessed based on the cross loading and Fornell-Lacker criterion values.

Table 1: Output cross loading

Variable	X_1	X_2	X_3	X_4	Y
$X_{1.2}$	1,000	0.840	0.698	0.768	0.813
$X_{2.1}$	0.859	0.947	0.678	0.737	0.781
$X_{2.2}$	0.718	0.936	0.673	0.757	0.713
$X_{3.1}$	0.698	0.713	0.958	0.734	0.746
$X_{3.2}$	0.629	0.652	0.949	0.786	0.679
$X_{4.1}$	0.768	0.793	0.796	1,000	0.783
Y_2	0.813	0.795	0.749	0.783	1,000

Table 1 shows that the indicators are said to be suitable for explaining the association variables because the correlation coefficient value of each indicator variable is greater for the association variable than the correlation between the indicator variables and other variables. Discriminant validity value with the Fornell-lacker criterion presented as follows:

Table 2: Fornell-lacker criterion values

Variable	X_1	X_2	X_3	X_4	Y
X_1	1,000				

X_2	0.840	0.941		
X_3	0.698	0.717	0.953	
X_4	0.768	0.793	0.796	1,000
Y	0.813	0.795	0.749	0.783
				1,000

Table 2 shows that the AVE root value of the latent variable is greater than the correlation value between the latent variable and other latent variables. Next, look at the reliability test, which is a test that is measured by Cronbach's value Alpha , Composite Reliability and AVE values are presented as follows:

Table 3: Cronbach's alpha, composite reliability, and AVE values

Variable	Cronbach's Alpha	Composite Reliability	AVE
Service quality	0.872	0.940	0.886
Time	0.899	0.952	0.908

Table 3 shows Cronbach's values alpha and value composite reliability meets the criteria because the value is greater than 0.7, and the AVE value also meets the criteria because the value is greater than 0.5, then the coefficient of determination value shows how much contribution the exogenous latent variable makes to the endogenous latent variable . The coefficient of determination value obtained was 0.751 or 75.1%. This shows that the variables product quality, service quality, time, and convenience/efficiency contribute 75.1% to the customer satisfaction variable, while the remaining 24.9 % is the contribution of other variables which were not studied.

The final stage of hypothesis testing is useful in determining the influence of exogenous latent variables on endogenous latent variables. After observations are made using predetermined criteria, the results of the value calculation test are obtained p-value with the help of smartpls and presented as follows:

Table 4: Path coefficients hypothesis test results

Path Diagram	Original samples	T statistics	P value	Information
Product quality -> Customer satisfaction	0.364	2,701	0.007	H_0 rejected
Service quality -> Customer satisfaction	0.190	1,521	0.128	H_0 accepted
Time -> Customer satisfaction	0.212	1,738	0.082	H_0 accepted
Convenience/ efficiency -> Customer satisfaction	0.184	1,282	0.200	H_0 accepted

Table 4 shows that only the product quality variable has a significant effect on customer satisfaction because it has a t statistics value of 2.701 with a p-value of $0.007 < 0.05$ so H_0 it is rejected. The structural equation model formed is as follows:

$$Y = 0.364X_1 + \zeta$$

In DigiCS data, the results can be seen using the same initial stages as CS data, namely looking at the convergent validity value which is useful for finding out whether the correlation between indicator variables against variables latent. Convergent validity can be seen through the loading value factors with a criteria value greater than 0.7 and if they do not meet the criteria they will be removed from the model, then re-estimation will be carried out to re-check the loading factor value for each indicator.

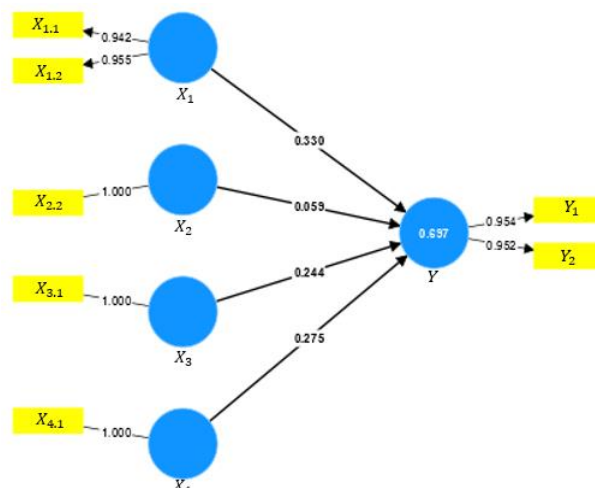


Figure 2: CS Re-estimation path diagram output

Figure 2 shows that there are no longer any indicators that have a loading factor value below 0.7 and the loading factor value of each indicator variable increases because several indicators have been removed from the model.

Next, a discriminant validity test will be carried out, a test that is useful in determining the level of accuracy of an indicator variable for measuring the latent variable. The discriminant validity test is assessed based on the cross loading and Fornell-Lacker criterion values.

Table 5: Output cross loading

Variable	X ₁	X ₂	X ₃	X ₄	Y
X _{1.1}	0.942	0.677	0.736	0.700	0.691
X _{1.2}	0.955	0.756	0.780	0.738	0.783
X _{2.2}	0.758	1,000	0.789	0.803	0.724
X _{3.1}	0.800	0.789	1,000	0.761	0.765
X _{4.1}	0.760	0.803	0.761	1,000	0.760
Y ₁	0.755	0.673	0.757	0.718	0.954
Y ₂	0.731	0.707	0.700	0.730	0.952

Table 5 shows that the indicators are said to be suitable for explaining the association variables because the correlation coefficient value of each indicator variable is greater for the association variable than the correlation between the indicator variables and other variables. Discriminant validity value with the Fornell-lacker criterion presented as follows:

Table 6: Fornell-lacker criterion values

Variable	X ₁	X ₂	X ₃	X ₄	Y
X ₁	0.948				
X ₂	0.758	1,000			
X ₃	0.800	0.789	1,000		
X ₄	0.760	0.803	0.761	1,000	
Y	0.780	0.724	0.765	0.760	0.953

Table 6 shows that the AVE root value of the latent variable is greater than the correlation value between the latent variable and other latent variables. Next, look at the reliability test, which is a test that is measured by Cronbach's value Alpha , Composite Reliability and AVE values are presented as follows:

Table 7: Cronbach's alpha, composite reliability and AVE values

Variable	Cronbach's Alpha	Composite Reliability	AVE
Product quality	0.888	0.947	0.899
Customer Satisfaction	0.899	0.952	0.908

Table 7 shows the values Cronbach's alpha and value composite reliability meets the criteria because the value is greater than 0.7, and the AVE value also meets the criteria because the value is greater than 0.5. Next, the value of the coefficient of determination shows how much contribution the exogenous latent variable makes to the endogenous latent variable. The coefficient of determination value obtained was 0.697 or 69.7%. This shows that the variables product quality, service quality, time, and convenience/efficiency contribute 69.7% to the customer satisfaction variable, while the remaining 30.3 % is the contribution of other variables which were not studied.

The final stage of hypothesis testing is useful in determining the influence of exogenous latent variables on endogenous latent variables. After observations are made using predetermined criteria, the results of the value calculation test are obtained p-value with the help of smartpls and presented as follows:

Table 8: Path coefficients hypothesis test results

Path Diagram	Original Samples	T statistics	P value	Information
Product quality -> Customer satisfaction	0.330	2.653	0.008	H ₀ rejected
Service quality -> Customer satisfaction	0.059	0.434	0.664	H ₀ accepted
Time -> Customer satisfaction	0.244	1.717	0.086	H ₀ accepted

Convenience/ efficiency -> Customer satisfaction	0.275	2.049	0.041	H_0 rejected
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Table 8 shows that only the product quality variable has a t statistics value of 2.653 with a p-value of $0.008 < 0.05$ so it is H_0 rejected and the convenience variable has a t statistics value of 2.049 with a p-value of $0.041 < 0.05$ so it is also H_0 rejected. It was concluded that there is a significant influence between product quality and convenience/efficiency

$$Y = 0.330X_1 + 0.275X_4 + \zeta$$

5. Conclusion

Based on the results of the discussion, it was concluded that the level of CS customer satisfaction shows that of the four exogenous variables X_1 , product quality (X_2), service quality (X_3), time (X_4), and convenience/efficiency (X_5) which influence the customer satisfaction process (Y), only the exogenous variable is product quality (X_1). with the indicators significantly and a structural equation model is formed as follows: $Y = 0.364X_1 + \zeta$

Meanwhile, the results of the DigiCS customer satisfaction level analysis show that of the four exogenous variables product quality (X_1), service quality (X_2), time (X_3), and convenience/efficiency (X_4) which influence the customer satisfaction process (Y) only the exogenous variable product quality (X_1) has indicators. -the indicators and the exogenous variable convenience/efficiency (X_4) with the indicators are significant and a structural equation model is formed as follows: $Y = 0.330X_1 + 0.275X_4 + \zeta$.

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