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Analysis of the Influence of Infrastructure, Costs, and Services for the Crew's PT. PELNI on Customer Satisfaction Using Principal Component Analysis (PCA) Method

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ABSTRACT

The presence of efficient port infrastructure is of utmost importance in ensuring the seamless functioning of both cargo and passenger operations. In addition to infrastructure, providing high-quality service by a ship's crew is equally important to derive from the infrastructure. Another factor to consider is whether the cost levied for services and infrastructure meets the community's expectations, as excessive costs without adequate infrastructure and services will result in dissatisfied customers. Therefore, customer satisfaction cannot only be assessed from one aspect but must be seen from various aspects, which in this study will be seen from the infrastructure, costs, and crew services. This research focuses on ships owned by PT. PELNI because this company is one of the largest in Indonesia, leading in great demand for sea transportation services. The research on infrastructure aspects, costs, and crew services includes supporting aspects to link them to customer satisfaction with PT. PELNI will be analysed using the Principal Component Analysis (PCA) method. The principal component (PC) can be utilised for feature selection and variable interpretation for data with several variables and a correlation. The results found that infrastructure (X1) can explain the factor variance of 45.309%.

Keywords: *Cost, Customer Satisfaction, Infrastructure, Principal Component Analysis*.

1. INTRODUCTION

PT. Indonesian National Shipping, better known as PT. PELNI is a state-owned shipping company with reliable and professional ship transportation services. PT PELNI operates a fleet of passenger ships, fast ferries, and freight ships that serve domestic travel routes and stops at more than 94 ports throughout the archipelago [1]. To support success and achieve its main vision, namely to become a leading maritime shipping and logistics company in Southeast Asia, PT. PELNI is aggressively improving ship facilities and infrastructure, as currently, PT PELNI has 26 passenger ships, 5 Sea Highway freighters, one cattle ship, and seven commercial cargo ships. In addition, PT. PELNI also has seven commercial cargo ships that can be chartered by other parties with a cooperation scheme (1) Voyage Charter (2) Time Charters [2].

To ensure the maintenance and governance of existing infrastructure, PT PELNI (Persero) applies the principles of Good Corporate Governance (GCG) by establishing a Compliance function under the Risk Management & Compliance Division by enforcing the Good Corporate Governance (GCG) soft structure guidelines, which consist of Manual Board Guidelines, Corporate Governance Guidelines, Code of Conduct, Gratification Guidelines, Gratification Control Unit Guidelines (UPG) and Whistleblowing System Guidelines (WBS) to ensure that all matters related to infrastructure and service governance can run properly according to the rules and under the wishes of the customer [3].

The facilities provided by PT. PELNI on board consists of public facilities, such as places of worship and cleaning facilities. Then, there are food supply facilities, safety facilities, security and order, reliability, comfort, convenience, and equality, and there are events on board that are made for entertainment purposes to customers during the trip [4]. Due to ongoing service and infrastructure improvements, in 2021, the overall volume of PT PELNI (Persero) ship usage will be 2.28 million passengers with the achievement of 102.23%; freight transport 100,287 tons/m^3 with the achievement of 144.15%; container transportation 24,387 TEUs with the achievement of 131.42%; transportation of 10,870 vehicles with the achievement of 114.40% and transportation of livestock 6,608 with achievement of 92.18% [4]. In the same year, PT PELNI (Persero) recorded a direct economic value of IDR 4.44 trillion, an increase of 4.18% or IDR 178.20 billion compared to the direct economic value obtained in 2020, which amounted to IDR 4.26 trillion. The direct economic value distributed in 2021 was recorded at IDR 4.85 trillion,

an increase of 7.03% or IDR 318.87 billion compared to the direct economic value distributed in 2020, which amounted to IDR 4.53 trillion. The direct economic value stored in 2021 was negative at IDR 414.02 billion due to the direct economic value distributed being greater than the direct economic value obtained by the Company in 2021 [4]. Another thing that is no less important is the concern of PT. PELNI are employees and ship crew who deal directly with customers and determine customer satisfaction with PT. PELNI. Throughout 2021, PT PELNI (Persero) has implemented an employee recruitment process by providing equal and equal opportunities to each prospective employee.

The employee recruitment policy is open, without discriminating against gender, religion, race, ethnicity, class, or political affiliation. The Company also provides competency development facilities for employees through various training programs and provides equal and equal opportunities for each prospective employee. Throughout 2021, 3,808 employees have been enrolled in education and training programs consisting of seminars, workshops, and certification. Regarding OHS performance, the Company continues to carry out its commitment to always maintain zero fatality performance by conducting regular OHS audits to create a safe, healthy, and conducive work climate. In addition, the company continues to provide work safety training to employees who have direct contact with risk areas. Through several activities and training provided, PT. PELNI hopes that the services provided by employees, especially crew members, can satisfy PT. PELNI [4]. All

Efforts made by PT. PELNI, from repairing and upgrading infrastructure to paying attention to employees. so that they can provide the best service to customers does not always get customer satisfaction because the benchmarks and factors influencing customer satisfaction vary in the field. Therefore, this study will analyse customer satisfaction PT. PELNI looks at various supporting aspects of infrastructure, costs, and crew services using the Principal Component Analysis (PCA) method. In general, the principal component (PC) can be useful for feature selection and interpretation of variables. It can be used on data that has a large number of variables and has a correlation between the variables [5]. After the analysis has been carried out and it is known that the components that have a major contribution to customer satisfaction will then be used as material for evaluation and input related to aspects that must be improved on the facilities, costs, and services provided by PT. PELNI to meet customer satisfaction.

2. METHODOLOGY

In this research, many variables are used to consider customer satisfaction. However, because many factors influence it, it must be reduced first to get the factors that significantly influence customer satisfaction. The appropriate method is the Principal Component Analysis (PCA) method. The PCA method does not initialise variables, meaning this research has no terms response and predictor variables. PCA method has an advantage because the factors that will be reduced next have nothing to do with other variables, so it can provide objective results regarding factors that majorly contribute to determining customer satisfaction.

2.1 Principal Component Analysis (PCA)

PCA is a linear combination of the initial variables, which geometrically this linear combination is a new coordinate system obtained from the rotation of the original system. The PCA method is excellent to use if the existing data has a large number of variables and has a correlation between the variables [6]. In general, the principal component (PC) can be helpful in variable selection and interpretation. The variable resulting from the selection is called the principal component. PCA is used to describe the structure of the variance-covariance matrix of a set of variables through a linear combination of these variables. In general, there are two main stages in PCA, namely,

1. Variable Dimension Reduction Stage
   a. Define var(x) and cov(x) or cov(z) matrices

$$Var(x) = \sigma^2 = \frac{1}{n}\sum_{i=1}^{n}\left(Z_{ij} - \mu_j\right)^2 \text{ and}$$
$$Cov(x,y) = \frac{1}{n-1}\sum_{i=1}^{n}\left(x_{ij} - \mu_{xj}\right)\left(y_{ij} - \mu_{yj}\right) \quad (1)$$

   The Cov (x,y) is a matrix in which the covariance value in each cell is obtained from the sample values [6].
   b. Determine the p eigen value of cov(x) or cov(z)
   c. Determine m PC based on specific criteria
   d. Obtains a m eigen-vector of size px1 from the same m eigen-value
   e. Determine m equations or linear combinations of the original PC variables
2. Interpretation Stage
   a. The proportion of cumulative viability explained by m PC of the total original variables where the number of PC variables is less than the number of original variables
   b. Comparing the importance of variables in each PC with other variables
   c. Determination of m groups of dominant variables and independence among existing PCs

2.2 Data Quality Test

To analysis the data further, it is necessary to test the instrument used to collect data using validity and reliability tests.

1. Validity test

Validity testing is needed to determine whether a research variable can measure the desired answer and appropriately reveal data from the variable. The higher the level of validity of a research variable, the better it is in showing what is being measured. Validity testing will be conducted by comparing the calculated r values (correlated item-total correlations) with the r table values. The indicator is declared valid if the calculated r value exceeds the r table value and is positive [7]. Conversely, if the r count value is negative and less than the r table value, the question indicator can be removed from the research instrument. The following is the equation used to calculate the level of validity of the variables used in the analysis.

$$r_{xy} = \frac{n\left(\sum xy\right)\left(\sum x\right)\left(\sum y\right)}{\sqrt{\left\{n\sum x^2 - \left(\sum x\right)^2\right\}\left\{n\sum y^2 - \left(\sum y\right)^2\right\}}} \quad (2)$$

Where,

r_{xy} = the results of the correlation between the two variables that are connected

x = Selected statement item score

y = total score of statement items

$\sum x$ = total score on the x distribution

$\sum y$ = total score on the y distribution

$\sum x^2$ = squared results in the x distribution of scores

$\sum y^2$ = squared results in the y-score distribution

n = number of respondents

2. Reliability Test

The reliability test was carried out to determine the reliability of the research instrument. The reliability test was carried out to find out whether a research instrument can be said to be reliable and reliable in terms of consistent and stable respondents' answers from time to time. Do Cronbach's Alpha calculations with the formula to determine whether the instrument is declared reliable.

$$r_{xy} = \frac{n\left(\sum xy\right)\left(\sum x\right)\left(\sum y\right)}{\sqrt{\left\{n\sum x^2 - \left(\sum x\right)^2\right\}\left\{n\sum y^2 - \left(\sum y\right)^2\right\}}} \quad (3)$$

Where,

r^n = coefficient value

k = total statement items

$\sum \sigma \frac{2}{b}$ = the total variance of statement item scores

$\sigma \frac{2}{i}$ = total variance

If Cronbach's Alpha value calculation results are above 0.6, the research instrument can be declared reliable and reliable [7].

2.3 Assumption Testing

In this study, the assumptions that must be met before analysing with PCA are as follows,

1. Data Adequacy Assumptions

The Kaiser Meyer Olkin (KMO) measure of sampling adequacy tests whether the partial correlation among variables is small [8]. The method used to test the data adequacy assumption is the Kaiser Meyer Olkin (KMO) method with hypotheses,

H_0: The amount of data is sufficient to be analysed

H_1: The amount of data is not enough to be analysed

Mathematically, the formula for calculating KMO is,

$$KMO = \frac{\sum_{j=1}^{p}\sum_{k=1}^{p} m_{jk}^2}{\sum_{j=1}^{p}\sum_{k=1}^{p} m_{jk}^2 + \sum_{j=1}^{p}\sum_{k=1}^{p} n_{jk}^2} \quad (4)$$

Where,

J = 1,2,3,…,p and k= 1,2,3,…,p.

m_{jk} = correlation coefficient between variable j and variable k

n_{jk} = partial coefficient between variable j and variable k

If the resulting KMO > 0.5, then the data was sufficient to be analysed [9].

2. Multicollinearity Assumptions

The Barlett test will be used in this study to test the occurrence of multicollinearity between the data used and the hypothesis,

$H_0 : \rho \neq 1$ (no correlation)

$H_1 : \rho = 1$ (There is a correlation)

If $p - value < \alpha$ so, it can be concluded that H0 should be rejected, which means there is no correlation between the research variables.

2.4 Data Source

The data used in this study is primary data from a survey of 50 people who have used or frequently used ships from PT. PELNI is on the go to measure PT. PELNI. Customer satisfaction in this study was measured using three variables, namely infrastructure (X1), costs (X2), and service (X3),

with each variable having the Table 1 assessment indicators.

Table 1. Indicator for each variable

Variable	Indicator
Infrastructure (X_1)	There are cleaning facilities (Q_1)
	There are prayer facilities (Q_2)
	There are health facilities (Q_3)
Costs (X_2)	Low cost (Q_4)
	There is a discount (Q_5)
	Fees according to infrastructure and services (Q_6)
Service (X_3)	Friendly crew (Q_7)
	The crew is quick to respond (Q_8)

3. RESULT AND DISCUSSION

3.1 Data Characteristics

The characteristics of the data in this study are presented in the form of a distribution map of the origin of the community that has and often uses ships owned by PT. PELNI uses survey data, as shown in Figure 1.

Figure 1. Map of the distribution of PT. PELNI

Based on Figure 1, it is known that the majority of people who have used ships owned by PT. PELNI originates from the province of West Nusa Tenggara, followed by East Nusa Tenggara. The colours in Figure 1 show the number of people; the more transparent the colours produced, the more people will use ships owned by PT. PELNI for traveling.

3.2 Data Quality Test

Testing the data quality consists of testing the validity and reliability of the components of the research variables along with the indicators of each variable used.

1. Validity Test

A validity test relates to testing the validity of survey data consisting of variables and indicators to determine whether they are feasible to be used as material for analysis. Concerning the importance of validity tests, adequate research is impossible or even "worthless" without validity [10]. Table 2 shows the results of the validity test of the research variables along with their respective indicators.

Table 2. Validity Test

Variable	Indicator	r Indicator	r Variable	r table
Infrastructure (X_1)	Q_1	0.375	0.474	0.235
	Q_2	0.337		0.235
	Q_3	0.353		0.235
Costs (X_2)	Q_4	0.349	0.267	0.235
	Q_5	0.343		0.235
	Q_6	0.378		0.235
Service (X_3)	Q_7	0.384	0.373	0.235
	Q_8	0.510		0.235

The information obtained based on Table 2 is that it is known that all variables and indicators used in this study are valid and can be used in the analysis because they have a greater r value than the r table.

2. Reliability Test

Reliability is essential because evidence of reliability is the first step in establishing a test's scientific acceptance and usefulness [11]. Cronbach's Alpha was used in this study to test data reliability after it was known that the data was valid, as shown in Table 3.

Table 3. Reliability Test Result

Cronbach's Alpha Indicator	Cronbach's Alpha Variable	N
0.696	0.727	11

Apart from being valid, the variables and indicators in this study are also reliable or suitable for analysis because the Cronbach's Alpha value for these variables and indicators is already greater than 0.6, so it can be concluded that the data used is valid and reliable.

3.3 Assumption Testing

1. Data Adequacy Assumptions

Based on the analysis results, the KMO value was obtained for the customer quality measurement data of PT. PELNI is 0.512, which means the data is sufficient for further analysis because it has a KMO value greater than 0.5.

2. Multicollinearity Assumptions

The researcher uses the Barlett test to assume multicollinearity apart from using the VIF value. This study will use the Barlett test with a hypothesis,

$H_0 : \rho \neq 1$ (no correlation)

$H_1 : \rho = 1$ (There is a correlation)

In the multicollinearity test using the Barlett test, if the resulting p-value is < 0.05, the conclusion will be drawn to reject H_0, which means there is a correlation between the variables and the indicators used. The results obtained are that the resulting p-value is 0.114, which means that this value is more significant than 0.05, so it is concluded that it fails to reject H_0, which means that there is no correlation

between variables and indicators in the research or the assumption of multicollinearity has been fulfilled.

3.4 Principal Component Analysis

In PCA, if a variable tends to group and form a factor, that variable will have a reasonably high correlation with other variables. This test is carried out by entering all existing variables and then testing these variables. Communalities values show the significant variance that can be explained by the factors formed in Table 4.

Table 4. Communalities

Variable	Extraction
X_1	0.648
X_2	0.089
X_3	0.622

Table 4 provides information that the extraction value for the infrastructure variable (X_1) is 0.648, which means that 64.8% of the infrastructure variable (X_1) can explain the factors formed. Then, the cost variable (X_2) has an extraction value of 0.089, meaning that this variable can explain 8.9% of the factors formed. Furthermore, the service variable (X_3) has an extraction value of 0.622, which means that this variable of 62.2% can explain the factor formed by the variance. Further information can be seen in Table 5 regarding the factoring results obtained from the eigenvalues.

Table 5. Eigen Value

	Initial Eigen values		
Component	**Total**	**% of variance**	**Cumulative %**
X_1	**1.359**	**45.309**	**45.309**
X_2	0.977	32.570	77.879
X_3	0.664	22.121	100.000

In Table 5, there is an infrastructure variable (X_1) with an eigenvalue more significant than one and provides a cumulative proportion of diversity of 45.309%, meaning that 1 factor can absorb information in the data of 45.309%. Thus, the infrastructure variable (X_1) has a role in determining customer satisfaction using the services of PT. PELNI. Guidelines for table and figure format and arrangement are described in the following sub-sections.

4. CONCLUSIONS

Customer satisfaction in this study was measured using three variables, namely infrastructure (X_1), costs (X_2), and service (X_3), with each variable having an assessment indicator where it is known that the majority of people who have used ships owned by PT. PELNI originates from West Nusa Tenggara province, followed by East Nusa Tenggara province, where in this study, the data used is valid and reliable and meets the data adequacy assumptions and multicollinearity assumptions. It is found that the infrastructure variable (X_1) can explain the factor variance of 45,309%. Therefore, for the PT. PELNI, to maintain and increase customer satisfaction, can pay attention to infrastructure related to the indicators used in this study, namely cleaning facilities, worship facilities, and cleaning facilities. Further research is expected to be able to add indicators and other relevant variables and increase the amount of data to be analysed so that they can know more deeply and the data can represent the population well.

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