Factors Influencing the Implementation of Vehicle Loading Regulations on Ferry Ships

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Abstract. Lashing is carried out to maintain shipping safety while maintaining the stability of the ship from shifting or overturning of vehicles on board, especially large and heavy vehicles, so the government has stipulated Minister of Transportation Regulation number: PM. 115 of 2016 concerning Procedures for Transporting Vehicles on Ships and PM. 30 of 2016 concerning Obligations for Attaching Vehicles to Ferry Transport Vessels. The research aimed to reveal the factors that influence ship crews to implement regulations regarding the obligation to carry out lashing. The research applied a qualitative approach with a Likert scale method to analyze questionnaires distributed to ship crews and a linear regression method to determine the factors that most influence the implementation of regulations. The research findings indicated that activity supervision factors, barriers to implementing Standard Operating Procedure (SOP), and ship crew knowledge influence significantly on the implementation of vehicle loading regulations on ships.
Keywords: Lashing; Loading of vehicles on board; KM. 115 of 2016 and KM. 30 of 2016.

1. Introduction

Efforts to ensure safe ro-ro ferry shipping can be realized by carrying out the correct loading process based on Minister of Transportation Regulation Number: PM. 115 of 2016 concerning Procedures for Transporting Vehicles on Ships and PM. 30 of 2016 concerning Obligations for Fastening Vehicles on Ferry Transport Ships, which states that vehicles on board must be tied (lashed) and have a distance between the vehicle and/or the ship's walls. Vehicle tie-downs are intended to ensure that the vehicle does not move when the ship is sailing due to waves or strong winds, so that the ship and its cargo can sail safely to their destination. Several ship accidents occurred as a result of the vehicles on board not being lashed, namely the sinking of KM. Senopati Nusantara, which is operated by shipping company PT. Prisma Vista. This ro-ro ferry weighs 2,718 GT and has a passenger capacity of 1.250 people. The initial suspicion was that the sinking of this ship was due to bad weather and loose lashings of vehicles, especially large trucks, so that the vehicles were thrown over the maximum limit, causing the ship to capsize (Z Ariani, A Hendra, S Febriary, 2018), KMP seluang which overturned at Ayak River – Asam River crossing pier, Sungai Ayak Village, Belitang Hilir District, Sekadau Regency. On February 22nd, 2019, the capsizing of KMP. Bili which occurred on February 20th, 2021 which resulted in all four-wheeled vehicles and 34 motorbikes sinking (Rizqi and Amalia, 2022), the most recent incident occurred in July 2023 in Ketapang waters, a truck loaded on a KMP. Dharma

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Ferry 1 capsized due to bad weather and high waves hitting the ship, and in August 2023, a truck loaded with soybeans overturned while sailing from the Ketapang ferry port which was going to the Gilimanuk ferry port using KMP. Nusa Makmur, resulted in the wrecking of 6 motorbikes because they were hit by trucks that overturned due to not being lashed (detikbali, 2023).

This research was conducted on a ferry operating at the Bajoe - Kolaka crossing. The Bajoe – Kolaka crossing was chosen as the research location because this crossing is one of the main commercial crossings connecting South Sulawesi with Southeast Sulawesi. There are 9 (nine) ships operating on this route, with operating hours from 10.00 to 21.00. The results of observations regarding the loading of vehicles on ships show that not all aspects of the regulations are implemented, such as the distance between the vehicle and the ship's walls. There should be a minimum distance of 60 cm used for people's access, but on one of the ships this was not enforced.

It is hoped that by knowing the factors that influence the implementation of lashing of vehicles on ships, priority government programs can be adopted to overcome ship accidents due to not lashing vehicles on ships. It is also hoped that this research can increase the body of knowledge for the government, seafarers, academics, and other parties related to shipping safety, especially for ferry transportation using ro-ro ferries in Indonesia.

2. Research Method

The research was carried out with a quantitative approach using multiple linear regression methods. The linear regression method is used to determine the linear correlation between two or more independent variables and one dependent variable (Priyatno, 2017). The correlation is analyzed to assess and find out how much influence the independent variables, which are grouped into 3 (three) variables, namely activity supervision, barriers to implementing regulations, and ship crew knowledge, have on the dependent variable, namely factors that influence the implementation of vehicle loading regulations on Ferry ships.

The sample for this research was 7 (seven) ships and all the crew who worked on these ships with the number of respondents as follows:

Table 1. Number of Respondents as Research Sample

No.	Name of the Ferrying Ship	Number of Respondents
1	KMP. Masagena	17 People
2	KMP. Mishima	15 People
3	KMP. Kota Bumi	16 People
4	KMP. Mandala Nusantara	16 People
5	KMP. Perdana Nusantara	15 People
6	KMP. FAIS	16 People
67	KMP. Muna City	19 People
	Total	114 People

The dependent and independent variables of this research are as follows:

Table 2. Dependent Variable and Independent Variable

No	Variable	Variable Indicator	Total	Scale
1	Activity Supervision (X1)	1. Make sure you get information about the weight of the vehicle. 2. Ensure vehicles are weighed before loading. 3. Ensure the vehicle is equipped with load information. 4. Ensure that the vehicles loaded onto the ship are appropriate. 5. Ensure vehicles are placed according to the loading plan. 6. Ensure the vehicle is tied up in all conditions while on board. 7. Ensure the vehicle is placed in a position according to regulations.	7	Intervals
2	Inhibitors of SOP Implementation (X2)	1. Friction occurs 2. Long and complicated organizational management or coordination flow 3. The organization's ties to existing regulations 4. Increased consumer needs 5. Bad weather or natural conditions 6. There is no control 7. Perceived SOPs complicate or make work inflexible	7	Intervals
3	Crew Knowledge (X3)	1. Don't understand the purpose and benefits 2. Limited knowledge of existing regulations or systems 3. Insufficient abilities and competencies	3	Intervals
4	Implementation of Vehicle Loading System (Y)	1. Instructions for calculation techniques 2. Loading limitations 3. Time limits for submitting information 4. Instructions for exact time for loading 5. Possible load that is too large and inefficient 6. Appropriate HR placement	6	Intervals

The variables have been determined and then hypothesis testing is carried out, namely with the dependent coefficient (R2) which aims to measure the extent of the model's ability to explain variations in the dependent variable. The coefficient of determination value is between 0 (zero) and 1 (one). A small R^2 value means that the ability of the independent variables to explain the dependent variable is very limited. A value

close to 1 (one) means that the independent variables provide almost all the information needed to predict variations in the dependent variable. If the coefficient of determination value is equal to 0 (Adjusted R2= 0), it means that the variation in Y cannot be explained by X at all. Meanwhile, if Adjusted R2 = 1, it means that the variation of Y can be explained by X. In other words, if Adjusted R2 = 1, then all observation points are exactly on the regression line. Then a partial test (the T Statistical Test) is carried out which aims to find out whether partially the independent variable has a significant effect on the dependent variable or not. This research proposes four hypotheses to find out and analyze the influence of the three independent variables on the dependent variable, and finally the F statistical test aims to determine the joint or simultaneous influence of independent variables on the dependent or dependent variable. The criteria used are that if the calculated F value > F table, then H0 is rejected and consequently H1 is accepted, and vice versa.

3. Results and Discussion

Factors influencing the implementation of the vehicle loading system on ships were analyzed using the linear regression method and calculated using the Statistical Product and Service Solutions (SPSS) 25 for Windows program tool. The variables in this research were factors that influence the implementation of vehicle loading regulations on ro-ro ferries determined based on regulations and the results of in-depth interviews with ship crew. These factors were activity supervision, obstacles to implementing regulations and ship crew knowledge as independent variables, while the implementation of the vehicle loading system is the dependent variable.

The objects of this research were 7 (seven) ro-ro ferry ships operating on the Bajoe - Kolaka route and the respondents in this research were the crew members who worked on these ships. The characteristics of respondents from the questionnaires they have filled out and can be processed are as shown in Table 3.

3.1 Results of descriptive statistical analysis

The descriptive statistical results of this research can be seen in Table 4 below.

Table 4 Results of Descriptive Statistical Analysis

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
X1	144	20	28	24.43	2,300
X2	144	21	28	24.47	2,262
X3	144	8	12	10.07	1,217
Y	144	17	24	19.65	2,285
Valid N (Listwise)	144				

Table 3. Respondent Characteristics

No.	Information	Amount	Percentage (%)
1.	**Gender**		
	1. Man	114	100
	2. Woman	0	0
	Total	**114**	**100**
2.	**Level of education**		
	1. High school/equivalent	44	38.6
	2. Diploma (D3)	57	50
	3. Strata 1 (S1)	13	11.4
	4. Strata 2 (S2)	0	0
	5. Strata 3 (S3)	0	0
	Total	**114**	**100**
3.	**Position**		
	1. Skipper	7	6.1
	2. Commander	16	14
	3. Machinist	23	20.2
	4. Wireless operator	2	1.8
	5. Attack	4	3.5
	6. Helmsman	16	14
	7. Oilman	18	15.8
	8. Wipers	2	1.8
	9. Sailor	20	17.5
	10. Chef	6	5
	Total	**114**	**100**
4.	**Length of work**		
	1. 1 to 5 years	16	14
	2. 6 to 10 years	29	25.4
	3. 11 to 15 years	36	31.6
	4. 16 to 20 years old	15	13.2
	5. > 21 Years	18	15.8
	Total	**114**	**100**

Based on Table 4, it is known that the number of data is 114, the explanation of each data is as follows:

1) Activity Supervision (X1) has a minimum value of 20, a maximum value of 28, and an average value (mean) of 24.43 with a standard deviation of 2.300. The average value and standard deviation value of this activity supervision indicate that there is a good distribution of data because the value of the average is greater than the standard deviation.
2) Inhibitors of Standard Operating Procedure Implementation (X2) has a minimum value of 21, a maximum value of 28 and an average value (mean) of 24.47 with a standard deviation of 2,262. The average value and standard deviation value inhibiting the implementation of this SOP show that there is good distribution of data because the average value is greater than the standard deviation.

3) Ship Crew Knowledge (X3) has a minimum value of 8, a maximum value of 12 and an average value (mean) of 10.07 with a standard deviation of 1,217. The average value and standard deviation value of the crew's knowledge show that there is a good distribution of data because the average value is greater than the standard deviation.
4) Implementation of the Vehicle Loading System (Y) has a minimum value of 17, a maximum value of 24 and an average value (mean) of 19.65 with a standard deviation of 2.285. The average value and standard deviation value for the implementation of this vehicle loading system show that there is a good distribution of data because the average value is greater than the standard deviation.

3.2 Data Quality Test Results

Data quality testing is carried out in several stages, namely:

1) Data Validity Test

A question is said to be valid if the calculated r is greater than the r table, n = 114 with a significance level of 5%, and the r table value is 0.184. This test was carried out to find out whether the measuring instrument designed in the form of a questionnaire could carry out its function. The following are the results of the validity test for each questionnaire statement shown in Table 5.

Table 5. Data Validity Test

Research variable	Statement items	Calculated *r* value	R table value (*n* = 114)	Information
Activity Supervision	X1.1	0.290	0.184	Valid
	X1.2	0.700	0.184	Valid
	X1.3	0.837	0.184	Valid
	X1.4	0.836	0.184	Valid
	X1.5	0.593	0.184	Valid
	X1.6	0.489	0.184	Valid
	X1.7	0.785	0.184	Valid
Barriers to Standard Operasional Prosedur (SOP) Implementation	X2.1	0.722	0.184	Valid
	X2.2	0.314	0.184	Valid
	X2.3	0.892	0.184	Valid
	X2.4	0.729	0.184	Valid
	X2.5	0.701	0.184	Valid
	X2.6	0.645	0.184	Valid
	X2.7	0.724	0.184	Valid
Ship Crew Knowledge	X3.1	0.705	0.184	Valid
	X3.2	0.846	0.184	Valid
	X3.3	0.634	0.184	Valid
Implementation of	Y.1	0.654	0.184	Valid

Research variable	Statement items	Calculated *r* value	R table value (*n* = 114)	Information
Vehicle Loading System	Y.2	0.482	0.184	Valid
	Y.3	0.862	0.184	Valid
	Y.4	0.844	0.184	Valid
	Y.5	0.319	0.184	Valid
	Y.6	0.796	0.184	Valid

The calculated *r* value for each statement in the Activity Supervision variable (X1) ranges from 0.290 to 0.785, the Inhibitors to Implementation of SOP variable (X2) ranges from 0.722 to 0.724, and the Ship Crew Knowledge variable (X3) ranges from 0.705 to 0.724. 0.634 and the Implementation of the Vehicle Loading System variable (Y) ranges from 0.654 to 0.796. All calculated r values for each statement regarding the variables Activity Supervision (X1), Barriers to SOP Implementation (X2), Ship Crew Knowledge (X3) and Vehicle Loading System Implementation (Y) are greater than the r table (0.184). This means that each statement item in this research has met the validity test or all of the statements are valid and can be used for collecting research data.

2) Reliability Test

Based on the results of the tests carried out, Table 6 shows Cronbach's Alpha for each research variable above 0.60, namely 0.770 for the Activity Supervision variable, 0.800 for the Implementation of SOP Inhibition variable, 0.659 for the Ship Crew Knowledge variable, and 0.741 for the Implementation of the Vehicle Loading System variable so it can be concluded that all variables in this research are declared reliable.

Table 6. Data Reality Test

Variable	Cronbach's Alpha	Conclusion
Activity Supervision (X1)	0.770	Reliable
Inhibitors of SOP Implementation (X2)	0.800	Reliable
Crew Knowledge (X3)	0.659	Reliable
Implementation of Vehicle Loading System (Y)	0.741	Reliable

3.3 Results of Multiple Linear Regression Analysis

In this research, the hypothesis was tested using a multiple linear regression model to obtain a comprehensive picture of the influence of the Activity Supervision variables, Inhibitors of the Implementation of Standard Operating Procedure and Ship Crew Knowledge on the Implementation of the Vehicle Loading System which was carried out with the help of SPSS version 25 for Windows software. The results of the multiple linear regression test can be seen in Figure 1 as follows:

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	16.610	2.902		5.723	.000
	Total_X1	.214	.077	.216	2.799	.006
	Total_X2	.214	.078	.212	2.752	.007
	Total_X3_	.138	.098	.127	2.049	.009

a. Dependent Variable: Total_Y

Figure 1. Results of Linear Regression Analysis

From the analysis above, the following multiple linear regression equation model is obtained:

$$Y = a + b1X1 + b2X2 + b3X3 + e$$
$$Y = 16.610 + 0.216X1 + 0.212X2 + 0.127X3 + e$$

3.4 Hypothesis Test Results

The steps for hypothesis testing results are as follows:

1) **Coefficient of Determination** Test **Results (R2)**

The Determination Coefficient (R2) is used to determine the magnitude of the correlation value between the independent variable (X) which consists of Activity Supervision (X1), Inhibitors to the Implementation of SOPs (X2) and Ship Crew Knowledge (X3) on the dependent variable (Y), namely the Implementation of the Vehicle Loading System. The results of testing the coefficient of determination can be seen in Figure 2 as follows:

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.592[a]	.350	.332	1.867

a. Predictors: (Constant), Total_X3_, Total_X2, Total_X1

Figure 2. Hypothesis Test Results

Based on Figure 2 above, it can be seen that the results of the multiple regression test obtained an R of 0.592, which means that the correlation/relationship between activity supervision (X1), barriers to implementing SOPs (X2) and Ship Crew Knowledge (X3) has a relatively strong relationship of 59 .2%. Meanwhile, the R Square value or coefficient of determination value was obtained at 0.350. This means that variable The adjusted R Square value of 0.332 or 33.2% shows the large contribution of the influence of the independent variable to the dependent variable.

2) **Test results Partial Significance (Test)**

The results of the partial significance test (t test) can be seen in Figure 3 below.

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	16.610	2.902		5.723	.000
	Total_X1	.214	.077	.216	2.799	.006
	Total_X2	.214	.078	.212	2.752	.007
	Total_X3_	.138	.098	.127	2.049	.009

a. Dependent Variable: Total_Y

Figure 3. Results of the Partial Significance Test (t Test)

The results of hypothesis testing through partial tests (t tests) will be explained as follows:

a) The Activity Supervision Variable (X1) t value is 2.799 which is greater than the t table value of 1.982 with a significance level of 0.006 which is smaller than 0.05, so H1 is accepted and Ho is rejected. Therefore, it can be concluded that the Activity Supervision variable (X1) partially has a positive and significant effect on the Implementation of the Vehicle Loading System.

b) Variable Inhibiting of the Implementation of the standard operating procedure (SOP) (X2), the calculated t value is 2.752, which is greater than the t table value of 1.982 with a significance level of 0.007, which is smaller than 0.05, so H2 is accepted and Ho is rejected. Therefore, it can be concluded that the variable Barriers to the Implementation of standard operating procedure (SOP) (X2) partially has a positive and significant effect on the Implementation of the Vehicle Loading System.

c) The Ship Crew Knowledge variable (X3) has a calculated t value of 2.049, which is greater than the t table value of 1.982 with a significance level of 0.009 which is smaller than 0.05, so H2 is accepted and Ho is rejected. Therefore, it can be concluded that the Ship Crew Knowledge variable (X3) partially has a positive and significant effect on the Implementation of the Vehicle Loading System.

3) Simultaneous Significance Test Results (F Test)

The results of the Simultaneous Significance Test (F Test) can be seen in Figure 4 below

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	206.568	3	68.856	19.755	.000[b]
	Residual	383.397	110	3.485		
	Total	589.965	113			

a. Dependent Variable: Total_Y

b. Predictors: (Constant), Total_X3_, Total_X2, Total_X1

Figure 4. Simultaneous Significance Test Results (F Test)

Based on Figure 4, it can be seen that the calculated F value is 19.755 and the significance is 0.000. This means that the calculated F of 19.755 is greater than the F table of 2.69. Therefore, it can be stated that simultaneously the independent variables (Activity Supervision (X1), Inhibitors to the Implementation of standard operating procedure (SOP) (X2) and Ship Crew Knowledge (X3)) influence the variables dependent, namely the Implementation of the Vehicle Loading System (Y).

The significance level of 0.000 is less than 0.05 or 5%, so it can be concluded that overall Activity Supervision, Inhibitors of the Implementation of Standard Operating Procedure (SOP) and Ship Crew Knowledge have a significant influence on the dependent variable, namely Implementation of the Vehicle Loading System, so that the research hypothesis is that Activity Supervision, Inhibitors of Implementation SOP and Ship Crew Knowledge influence the Implementation of the Vehicle Loading System (H4) to be acceptable.

4. Conclusion

The factors that influence the implementation of the vehicle loading system on ro-ro ferries based on established regulations are as follows: the factors of Supervision activities, Inhibitors of the Implementation of standard operating procedure (SOP) and Ship Crew Knowledge influence significantly the implementation of the vehicle loading system on ro-ro ferries. The higher of the supervision of activities, the prevention of obstacles to standard operating procedure (SOP) and the knowledge of the crew, the higher of the implementation of the vehicles loading system on ro-ro ferries. Future researchers who are interested in researching the same problem are encouraged to do research in different places such as other ferry ports. Managers of the Bajoe ferry port and ro-ro ferry crossing vessels across Bajo'e - Kolaka that are in operation are able to carry out proper supervision of loading activities, and then ensure the factors of the inhibition of the implementation of vehicle loading regulations on ships can be avoided so that the safety and shipping security can be achieved.

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