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Vessel Operational Impact and Generator Operation Toward Electrical Power Load in Mv. Dk-02

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Abstract. Electrical Power Load is everything that beared and occurred by electrical power. The purpose of this research is to analyze the operational condition of vessel and generator operation toward electrical power load on board. The research used quantitative method with application program to analyze the correlation and the impact between independent variable and dependent variable from the electrical power load data. The result of the research done by the researcher on board is X1 (operational condition of vessel) took negative effect toward Y (electrical power load) for 4.2 %. X2 (generator operation) took positive impact toward Y (electrical power load) for 1,1 %. Together, it created positive impact for 4.4 %.
Keywords: Vessel operational condition, generator operation, electrical power load, SPSS.

1. Foreword

Operational is the border and guideline to do an activity. Vessel is a moda to carry the cargos, passengers, or bulks such as coal in order to industrial needs. Vessel operational is a vessel activity in a various condition when the vessel is on sea.[1] Generator operation is an interconnection between several generators in a unit, single or together to carry the burden. The generator will be paralleled to be manually synchronized or automatic, in order to get a bigger power. [2]

The definition of AC generator is a machine that converse mechanic energy (kinetic) to be electric energy with the help of magnetic induction. The energy transformation happened because the change of the maget medium to the coil/anchor (the place where the voltage risen toward generator). [2]

Electicity load is everything which burdened and need electrical power. Electricity load is a electric motor, lighting and the equipment that connect to the source. Electrical Power is a energy accumulation that absorbed or resulted in a circuit. The energy source such as electrical voltage will result electric power, while the connected load will be absorbed with that voltage. The electric power is an energy consumption level in the electric circuit. [3]

When the vessel anchor, the condition of a generator is fully loaded 200kW, therefore, it will experience overloaded capacity and probably cause a blackout. In other chance, 2 generator parallelically and fully loaded for each generator 160 kW for the discharging process and using 4 crane in order to finish it quickly. Those 3 generators will be operated together with the load for each generator is between 160 kW until 240 kW. When the crane operated, the watt meter shows the number that always move. To anticipate anything, the awareness is needed by the engineers, to order the deck department to use 3 cranes. The fuel usages will be increased if the loading discharge delayed and the operational time of the diesel generator. The condition of Vessel Operation and Generator Operation toard Electrical Power Load in MV. DK-02 is a subject to be studied.

2. Literature Review

2.1. Literature Review

Vessel operation is the implementation from the vessel activity plan when operated, in order to reach the purpose as a sea transport moda that have implemented based on the Regulation. [1] There are several conditions in the vessel operation of MV. DK-02, which are:

1. Berthing is a condition when the vessel berth on the port to do the loading and discharging activity.
2. Maneuver is a vessel ability to bend and turn around when sailing in the limited water area around the port.
3. Sailing is a vessel condition when doing a voyage from the departure port toward the arrival port from the finished maneuver until the maneuver on the destination port.
4. Drop anchorage is a vessel condition when the anchor drop on the sea to wait for the berthing line-up on the port.

AC Generator is a power generator or called alternator that has function to convert the mechanical energy (kinetic) to electric energy with magnet induction as the medium. [2]

Generator operation is a generator condition that operated to be resulted voltage and power need to the electrical load used. [2] There are 2 modes on generator operation to generator operation on board to electric resources and power load used to machining aids, which are:

1. Operation mode single generator

   Operation mode single generator is a 1st operation generator to the needs of electric load needed by the generator. The usage of single generator operation is when the vessel anchor or without overload.
2. Operation mode pararel generator

   Irving (1991) stated that parallel generator operation is a condition of two or more generators, so each of the current flow to the load. [2] The advanteage of parallel generator on board is:

   1) To gain greater power.
   2) The certainty of power capacity.
   3) To guarantee the continuity of electrical power availability.
   4) To contain the developed load.

Electricity load is anything that needs electricity power. Eclectricity load is a electric motor, lighting and the equipment connected with the source. Electrical power is the energy about absorbed and resulted in the circuit with energy consumption level of electric circuit.

2.2. Framework

Framework is the relation between the variables arranged by several described theories. The framework made by the position based on the relevant theories so the problem in the research will be solved.

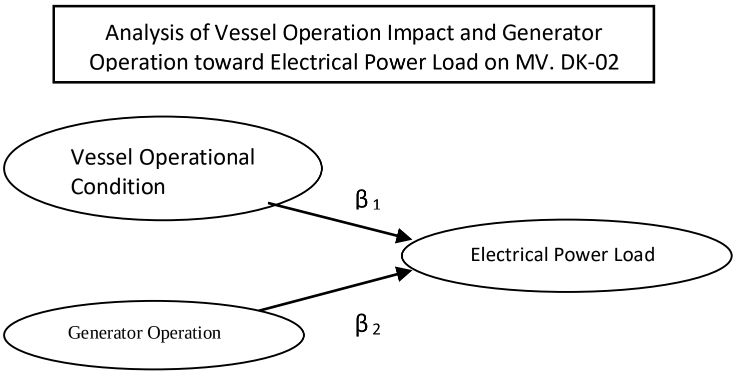

Figure 1. Framework of the Research

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3. METHODS

3.1. Research Methods

Research method is the scientific way to gain the data with certain purposes and usages. Based on the definition, there are 4 keywords that need to be considered, which are scientific, data, purpose and usage. [4]

Quantitative method with descriptive analysis to strengthen the findings, data analysis and descriptive will help to test the relation between independent variable wich are vessel operational condition and generator operation toward related variable wich is electrical power load

3.2. Time and Place for the Research

The research done when on MV DK-02. It is one of the Bulk Carrier vessel on PT. Karya Sumber Energi.

3.3. Data Needed

Information gained toward certain measurement, order to be base on arranging logical argumentation to become fact. The fact is the truth tested empirically, which is from data analysis.

1. Primary data is data gained directly from the first source through the interview result, inspected and the characteristics were noted toward the research object.
2. Secondary data is the data provided by the writer, gained by the writer, other than the subject of the research.

3.4. Data Gained Method

1. Observation is an inspection done by the available situation, spontaneous and scientifically, and the result of the inspection will be summarized and the data gained will be objective.
2. Interview is a process to gain of the research purpose with interviewing between the researcher and the stakeholders. [5]
3. Documentation is gaining with learning the archives and letters inside the engine room, especially about diesel generator journal in the section of electrical power load.

3.5. Data analysis technic

Data analysis is a process of find and arranging the data systematically from the interview, field note, and other material, so it will be easier to be understood and the founding will be informed to other persons. [6]

1. Descriptive analysis
   Quantitative method is used to tell the problem is SPSS.
2. Validity Indicator Test
   Validity test is used to know the properness of the questios to define a variable. The test technic for validity test is using Bivariate Pearson correlation and Corrected Item-Total Correlation. [7]
3. F Test
   F test is used to test the truth of alternative hypothesis; is the model choosen by the researcher correct. Goodness of Fit is all of the independent variable's impact toward the dependent variable.
   Ho: $p = 0$ (weak relation)
   Hi: $p \neq 0$ (not-weak relation)
   If the significant value (p-value) is < 0.05 (the significant is 5%) and or the F value > F table, the summary is Ho denied and Ha accepted. Meanings, there is the same effect of independent variable toward dependent.
4. Multiple Linear Regression Analysis
   Multiple Linear Regression Analysis is used to predict something, where in the model there iis a dependent variable and independent variable. [8] The impact of independent variable toward the dependent variable is the similar regression used as below:

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$$Y = \alpha + \beta 1\ X1 + \beta 2\ X2,$$

Where:

Y : Electrical Power Load
X1 : Vessel operation condition
X2 : Generator operation
β1... β2 : Standard coefficient regression
α : Constant

Hypothesis formula:

- Ho: $\beta 1 = 0$; there is no independent impact toward dependent variable
- Ha: $\beta 2 = 0$; there is independent variable impact toward dependant variable

4. Discussion

4.1. Research Result

This descriptive variable to explain variable data "Y" which is electrical power load. X1 dan X2 Variable is the ordinal data from the operational condition.

a. Mean, Median, Modus, Maximum dan Minimum

Tabel 1. Electrical Power Load

Mean	132,29
Median	140,00
Mode	140
Minimum	80
Maximum	180

The usage of electrical power load in MV. DK-02 gained by the mean result 132.29 kW. While the median from the total electrical power load that oftenly used is 140 kW. The mode of electrical power load above is 140 kW.

The maximum value gained is 180 kW is the biggest load usage when doing the research. The minimum electrical power load gained is 80 kW which the usage is barely used when the generator operated.

b. Frequent

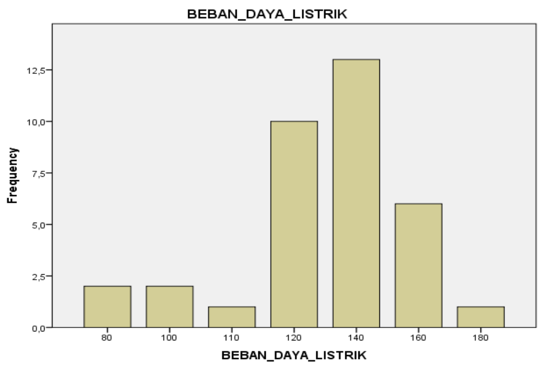

Figure 2. Frequent Diagram

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The usage of electrical power load oftenly shown in the usage of electrical power load, which is 140 kW. Followed 120 kW, 80 kW, dan 100 kW, in usage ussualy of the load 110 kW and 180 kW with frequent 1.

4.2. Test the quality of the validity test electrical power load

Table 2. KMO and Barlett's electrical power load

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.	0,552

Gained KMO value for the indicator test used to measure the variable of electrical power load is 0.552 because the value > 0.5 for the contentment of the sample is fulfilled.

Tabel 3. Component matrix

KON_OPE_KAPAL	,633
OPE_GENERATOR	,680
BEBAN_DAYA_LISTRIK	,582

The indicators used to arrange the variable stated valid because in the table matrix component the value is >0.5 and the load factor is not < 0.5.

4.3. Model Fit Test

a) The correlation vessel operational condition analysis with electrical power load

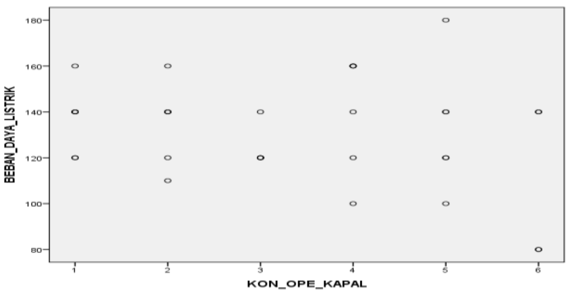

Figure 3. Scatter Graphic with Correlation Plot X1 with Y

Table 4. Correlations Variabel X1 dengan Y

		KON_OPE_KAPAL	BEBAN_DAYA_LISTRIK
KON_OPE_KAPAL	Pearson Correlation	1	-,205
	Sig. (2-tailed)		,238
	N	54	35
BEBAN_DAYA_LISTRIK	Pearson Correlation	-,205	1
	Sig. (2-tailed)	,238	
	N	35	35

Gained the Vessel Operational Condition (X1) with the Electrical Power Load (Y) in the scater plot to the left means "negative". The result of Pearson Sig correlation = 0.238 (23.8%) > 5% meanings Ho accepted and Hi denied. There is the relation between Vessel Operational Condition (X1) and

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Electrical Power Load (Y) that makes it weak. In order to strengthen the statement, it is gained the empirict correlation value (p1) = -0.205. The value shows the correlation between X1 and Y is negative.

b) The correlation of generator operation (X2) analysis with electrical power load (Y)

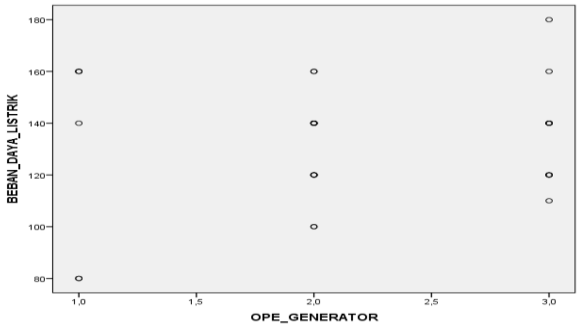

Figure 4. Scatter Graphic Correlation Plot X2

Table 5. Correlations Variabel X2 with Y

		OPE_GENERATOR	BEBAN_DAYA_LISTRIK
OPE_GENERATOR	Pearson Correlation	1	,104
	Sig. (2-tailed)		,552
	N	54	35
BEBAN_DAYA_LISTRIK	Pearson Correlation	,104	1
	Sig. (2-tailed)	,552	
	N	35	35

Generator Operation (X2) with Electrical Power Load (Y) in scater plot on the right side with 'positive' value. The result of Pearson Sig Correltion = 0.552 (55.2%). The value of 55.2% > 5 % means that Ho accepted and Hi denied. The connection between X2 and Y is weak. To strengthen that statement, gained the empirict correlation value (p2) = 0.104 the value shows the correlation between X2 and Y positive.

4.4. Regression analysis

Linear regression analysis is the relation between one independent variable (X) with dependent variable (Y). The positive value or negative to predict the value from dependent value if the independent variable value experience ascension or downgrade. The data used has interval scare or ratio.

The formula of simple linear regression is: $\mathbf{Y = \alpha + \beta X}$

Hypothesis 1: Electrical Power Load (Y) affected by Vessel Operational Condition (X1).

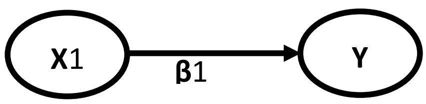

Figure 5. Hypothesis X1 toward Y

Ho: $\beta1 = 0$; (Non linear equality or X1 is not impactful toward Y)
Hi: $\beta1 \neq 0$; (Linear equality or X1 impactful toward Y)

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Table 6. Coefficeints X1 and Y

		Unstandardized Coefficients		Standardized Coefficients		
Model		B	Std. Error	Beta	t	Sig.
1	(Constant)	5,351	1,720		3,111	,004
	BEBAN_DAYA_LISTRIK	-,015	,013	-,205	-1,201	,238

Unstandardized Coefficients (B) gained value α = 5,351 and β1 = -0.015. The equity formed: Y = 5,351 – 0.015 X1.
To test the equity above whether accept or deny the hypothesis told, there is a distribution 'F' toward output table ANOVA.

Table 7. ANOVA X1 and Y

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	4,083	1	4,083	1,442	,238[b]
	Residual	93,460	33	2,832		
	Total	97,543	34			

F value = 1,442 and Sig = 0,238 (23,8%) > 5 % meanings Ho accepted and Hi denied. The equity is linear or X1 have negative impact toward Y (negative sign taken from regression coefficient).
To know how valuable the impact X1 toward Y, you could see Determination Coefficient (R Squere) toward Model Summary.

Table 8. Model Summary X1 dan Y

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,205[a]	,042	,013	1,683

Value R^2=0.042 or 4,2% shows that Operational Condition variable of Vessel (X1) contributes toward the Electrical Power Load (Y) for 4.2 %. There are 95,8% is still there electrical power load (Y) affected by other variable.

Hypothesis 2: The result of electrical power load (Y) affected by generator operation (X2) of vessel

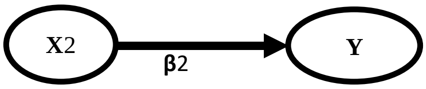

Figure 6. Hypothesis X2 toward Y

Ho: β2 = 0; (Non-linear equity or X2 is not related toward Y)
Hi: β2 ≠ 0; (Non linear equity or X2 is not having impact toward Y)

Table 9. Coefficeints X2 dan Y

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	1,739	,729		2,385	,023
	BEBAN_DAYA_LISTRIK	,003	,005	,104	,601	,552

Unstandardized Coefficients (B) obtained α = 1.739 and β2 = 0.003. The equity formed is: Y = 1.739 + 0.003 X2.
To test the equity, whether accept or deny the hypothesis told, the F distribution determined on output table ANOVA as follow:

Table 10. ANOVA X2 and Y

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	,184	1	,184	,362	,552[b]
	Residual	16,787	33	,509		
	Total	16,971	34			

Value F=0.362 and Sig=0.552 (55.2%). Sig value 55.2% > 5%, meanings Ho accepted and Hi denied. The equity is not linear or X2 have positive impact toward Y (positive sign taken from regression coefficient).
To know how big the value of X2 toward Y, it could be seen from Determination Coefficient (R Squere) toward Model Summary as follow:

Table 11. Model Summary X2 and Y

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,104[a]	,011	-,019	,713

Value R^2 = 0.011 or 1,1%, show that the variable of Generator Operation (X2) contribute toward the data of Electrical Power Load (Y) for 1.1%. There are 98.9% data of electrical power load (Y) affected the other variable.

4.5. Multiple Linear Regression Analysis

Hypothesis 3: Result of Electrical Power Expense data (Y is affected vessel operational condition (X1), and generator operation (X2)

Y = a + β1X1 + β2X2

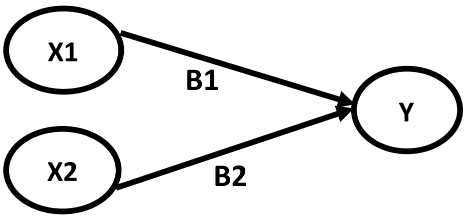

Figure 7. Hypothesis X1 and X2 to Y

Ho: β = 0; (Equation is not linear or X1, X2, is not affecting Y)
Hi: β ≠ 0; (Equation linear or X1, X2, affecting Y)

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Table 12. Coefficients X1, X2 and Y

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	136,989	16,831		8,139	,000
	KON_OPE_VESSEL	-2,529	2,383	-,190	-1,061	,296
	OPE_GENERATOR	1,694	5,712	,053	,297	,769

Unstandardized Coefficients (B) is obtained value α = 136,989 and β1 = -2,529; β2 = 1,694. Equation that is formed is: Y = 136,989 – 2,529X1 + 1,694X2.
For examining the equation whether accepting or rejecting hypothesis which is mentioned calculation ‘F” districution is conducted on output table ANOVA.

Table 13. ANOVA X1, X2, and Y

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	765,947	2	382,973	,745	,483[b]
	Residual	16451,196	32	514,100		
	Total	17217,143	34			

Value F = 0.745 and Sig = 0.483 (48,3%). Value Sig 48,3% > 5%, which means Ho is accepted and Hi is rejected. That equation is not linear or X1, X2, is not affecting Y.
For figuring out how much X1, X2 contibute on Y we can see Determination Coefficient (R Square) on Summary Model.

Table 14. Model Summary X1, X2, dan Y

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,211[a]	,044	-,015	22,674

Value R^2 = 0,044 or 4,4%. That value showing us that variable of Vessel operational condition (X1), Generator operation (X2) contributes simultaneously on Electrical power expense result (Y) of 4,4 %. With that result there is still 95,6% of Electrical power expense data (Y) which is affected by another variable.

4.6. Summary

X1 variable is an ordinal data which is not valuable and description from each condition of a operational condition vessel when is a berthing condition for cargo operation, manuevering, when sea passage (sailing), anchoring for cargo loading. X2 variable is an data from each generator operation which is a single operation (run 1), parallel (run 2), and parallel (run 3). Electrical power expense for finding averae value, middle value, and expense value that almost has the same result and often noted on expense which is used from all vessel operational conditions, and all generator operation condition in every operating electrical generator. The use of electrical power expense obtain an average (mean) 132,29 kW, middle value (median) from overall 140 kW, often-appear value (mode) 140 kW, maximum value 180 kW and minimum value 80 kW expense usage of generator. Usage frequency of electrical power expense with using often appear 140 kW, 160 kW, 120 kW, 80 kW and 100 kW expense is ussualy found for 110 kW and 180 kW with frequency 1 for each expense.

4.6.1. Correlation between variable
Correlation coefficient value person sig X1 of 0.238 vessel operational condition affect toward electrical power expense of 23,8 %. Thus it can be concluded that vessel operational condition toward electrical power expense is weak (afected).

Correlation coefficient value person sig X2 of 0.552 generator operation affect toward electrical power expense of 55,2%. Thus it can be concluded that operation of generator affect the electrical power expense, which is not weak.

4.6.2. Regresion between variable
Regression equation value is Y = 5,351 – 0.015 X1. Then X1, *R Square* value is 0.042, condition of operational vessel (X1) affect the variable related to electrical power expense (Y) up to 4,2 % while the rest 95,8 % affected by another variable.

Regression equation value is Y = 1.739 + 0.003 X2. Then X2, *R Square* value is 0.011, generator operation (X2) affect variable related to electrical power expense (Y) up to 1,1 % while the rest 98,9 % affected by another variable.

Value (X1 dan X2) *R Square* is 0.044, independent variable of operational vessel condition (X1) and independent variable of generator operation (X2) can affect variable related to electrical power expense (Y) up to 4,4 %, while the rest 95,6 %. Thus operational vessel condition and generator operation toward electrical power expense has a low impact. And the rest 95,6% affect another independent variable.

From the calculation related is 95,6%. The use of electrical power expense may affected by independent variable, for instance electrical flow, generator expense, inductive expense. Another expense is electrical motor, transformator, relay and all wire coil expense that can cause electical power unstable. Electrical motor which has been used for a long time and cause the expense to change not according to name plate on expense usage, power factor or the flow entering electrical motor. Can be caused also by loss volt that flowing from electrical generator to the active electical equipment.

5. Conclusion

5.1. Conclusion
Based on analysis result and summary can be taken conclusion as follows:
1. X1 (vessel operational condition) affects (negative) toward Y (electrical power expense) regression equation Y = 5,351 – 0.015 X1. Value of R *square* is 4,2 %
2. X2 (generator operation) affect (positive) toward Y (electrical power expense) regresion equation Y = 1.739 + 0.003 X2. Value of R *square* is 1,1 %
3. X1 (vessel operational condition) and X2 (generator operation) affect (positive) toward Y (electrical power expense) regression equation Y = 136,989 – 2,529X1 + 1,694X2. Valueof R *square* is 4,4%. And the rest 95,6% affect another variable which related to the usae of electrical power expense.

5.2. Suggestion
Based on the result of the conducted analysis, thus the suggestion from the experiment done as follows:
1. If the condition of operational vessel ehen sailing only need less power by using only one generator to save the fuel and also *runninghour* from the generator diesel engine.
2. When on cargo operation the veesel need extra power then 2 or 3 generators are needed, and in watchkeeping time the communication between engine room and bridge watchkeeper should be maintained. So that the engine room watchkeeper can rest the diesel generator when cargo opeation to decrease the power consumption.
3. For the next author, the author is suggested to examine other variable than X1 and X2 for figuring out whether it would be support or weaken the examination that the author did.

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