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| **The Impact of Sedimentation on the Perak River Shipping Channel on Shipyard Operations***1Nafhan Iqbal, 2Intan Sianturi, 3Dyah Ratnaningsih, 4Trisnowati Rahayu**1Politeknik Pelayaran Surabaya**2Politeknik Pelayaran Surabaya**3Politeknik Pelayaran Surabaya**4Politeknik Pelayaran Surabaya**Correspondence email of author: nafhaniqbal1510@gmail.com* |
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***Abstract***

*Siltation of shipping channels is a problem that can increase shipping safety and security risks and hinder economic activities. One of the causes of siltation is sedimentation, which is the process of deposition solid particles in the form of sand and rocks so that it requires regular maintenance. Especially in the Perak River shipping channel that has occurred quite significantly over the past few years and there has been no dredging until now. The occurrence of sedimentation has a great impact on the operational activities of shipyard companies located along the Perak River shipping channel. The purpose of this study is to find out what are the impacts caused by the sedimentation of the Perak River on shipyard operations. This type of research is a Quantitative research using the SPSS application. The sample of this research is an employee at the shipyard company PT. Dumas Tanjung Perak Shipyard and Pelni Surya Shipyard. In this study, a simple linear regression data analysis technique was used, then the result of the equation Y = 5.943 + 1.112X was obtained. The results of this study show that the impact of sedimentation of shipping channels has a positive and significant effect on shipyard operations. The impact of siltation such as a reduction in the number and size of vessels that can pass through the channel and also increased operational costs for shipyard companies and ship owners due to process delays when waiting for the waters to be independent in the highest tide conditions.*

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| ***Keywords:*** *Sedimentation, Shipping Channels, Shipyards*  |

# INTRODUCTION

A port is a place that is used in activities related to the delivery of goods/cargo, people by sea (Ratnaningsih & Rizqina, 2024). Sea transportation is a means of transportation that has a very vital role as a means of transportation that can reach all regions through waters (Rahayu & Febriansyah, 2024). The port includes the ocean where ships dock and dock, as well as the land used for the loading and unloading process, boarding and disembarking passengers, etc. In addition, ports are also places that can be the key to the development of an area (Bagus, 2024). In the delivery of cargo or passengers with a large number of passengers, many expedition companies do it by sea because of cost efficiency.

Tanjung Perak Port is one of the many ports in Indonesia with a fairly high level of busyness because it is a first-class port. Of course, in supporting the smooth running of every activity carried out at the Port, ideal Port facilities are needed. One example is the shipping flow which is the entry in/out of the ship to the Port must be paid great attention to its safety and security.

Just like on land in the waters also has a route that can be passed by transportation, in this case it is a ship and is referred to as a shipping channel, it is also a basic facility that must be in every port. According to Law No.17 of 2008 "Shipping channels are waters that in terms of depth, width, and other shipping impediments are considered safe and safe to sail" it can be concluded that in designing shipping channels must meet existing provisions such as sufficient width and depth to ensure safety and security for various types and sizes of ships that will cross the channel. One of the things that can cause a reduction in the depth and width of the shipping channel is the occurrence of sedimentation in the waters.

Sedimentation is the event of transporting rock materials through hydropower which then settles in a certain area. The sedimentation process is a siltation process that includes the process of erosion, transportation, *deposition* and compactionof the sedimentation itself (Rifardi, 2012). The process starts from the flow of water that causes the erosion process. Furthermore, sediment material resulting from erosion rolls and moves to a lower area or follows the direction of water flow or also called the sediment transport process. After that, the sedimentary material will settle and solidify over time. This process eventually causes siltation in rivers or shipping channels. As a result of the sedimentation process, which causes siltation in the shipping channel, to overcome siltation in the shipping channel and port pool, dredging activities are needed to carry out maintenance every year, even if the soil sedimentation is large enough, it can be carried out several times in one year.

Dredging is the work of altering or shaping the bottom of the waters to reach a certain depth and width according to the desire. In this study, dredging must be carried out immediately to restore the depth of the shipping channel according to the needs of interested parties because the channel has not been maintained for a long time in the form of dredging. Dredging is very necessary because good service must be supported by adequate facilities (Magdalena et.al, 2021).

The Port of Tanjung Perak has several shipping channels, one of which is the Perak River shipping channel which is currently experiencing quite significant sedimentation. The channel connects from the western shipping channel of Surabaya (APBS) to several shipyards. Of course, it will have a great impact if the shipping channel of the Silver River is not in optimal condition because the maintenance or maintenance of the ship is an important thing and is also carried out regularly by every ship that will sail to be able to maintain the condition of the ship in accordance with the ship's seaworthiness standards. Therefore, of course, the shipyard was affected by sedimentation which caused siltation of the Perak River shipping channel, thereby hampering and reducing the operational performance of the shipyard. The operation in question is in a shipyard company, operational activities in the form of a process starting from the receipt of the ship from the ship owner to the shipyard company to be repaired in the shipyard until the ship is repaired until it leaves the shipyard and returns to the owner. In this case, several parties are involved such as shipyard companies, ship owners, *marine inspectors* from the Kesyahbandaran office as supervisors and inspectors of activities.

The siltation of the silver river shipping channel is evidenced by the Port Director's Letter number PP20/11/12/DP-17 stating that the silver river shipping channel must be immediately dredged by the Port operator. In addition, the letter also shows that the sealing of the Perak River shipping channel has been happening for a long time when the letter was issued, but according to information from the shipyard company, until now there has been no dredging activity on the Perak River shipping channel, making it difficult to access the shipyard for ships that will carry out maintenance and repairs.

Based on the explanation above, in this study, the formulation of the problem as a guideline in carrying out the research was determined, namely whether there is an influence between sedimentation in the Perak River shipping channel on shipyard operations and how the impact due to the sedimentation of the Perak River on shipyard operations. Therefore, based on the existing formula, this study aims to find out whether there is an influence between the sedimentation of the Perak River on shipyard operations and also to find out the impact resulting from the sedimentation of the Perak River on shipyard operations.

# METHOD

The type of research in this study uses a quantitative approach, which is a systematic investigation of a phenomenon or event by collecting data that can be measured and analyzed using statistical, math, or computational methods (Sianturi, 2024). The time used by the author in this study is carried out during field work practice (PRADA), which is from August 1, 2023 to August 1, 2024 which is located at PT. Dumas Tanjung Perak Shipyard and Pelni Surya Shipyard which are shipyard companies located in the Perak River shipping channel which is the focus of research. The data collection technique is carried out by distributing questionnaires according to the sugiyono theory (Sugiyono, 2008). The questionnaire was distributed in the form of a google form with a likert scale (1-4), interviews, documentation and literature studies. Primary data is in the form of the results of questionnaires obtained from 80 respondents from the two companies and interviews with employee representatives of each Company. The sampling technique used by the author uses the slovin formula with a margin of error of 5% with a total population of 336 which is the number of employees from the two companies and found a sample of 80 respondents which were then divided using  *the Proportionate Stratified Random Sampling* formula and a sample of 66 respondents from PT. Dumas Tanjung Perak Shipyard and 14 respondents from Pelni Surya Shipyard. Secondary data is in the form of documentation. The tool used in this study is the SPSS for windows version 21 application. The data analysis techniques used by the author are data quality tests using validity and reliability tests, classical assumption tests using normality tests and simple linear regression analysis.

# RESULTS AND DISCUSSION

**Data Presentation**



Fig 1. Perak River Sounding Results 2022

Source: Pelni Solar Shipyard Company Archives

Figure 1 shows that the bathymetric data is the latest data that researchers can obtain, considering that the flow of shipping is not measured regularly. Based on figure 1, it shows that the depth of the silver river in 2022 is only around 1 meter below the water level for the deepest point, while at the edge of the waters the bottom of the water can be seen, of course this is not a size for ships to pass through at any time. In fact, the Perak River shipping channel is the main access for ships to enter 6 shipyard companies.

**Questionnaire**

The researcher used 2 research variables, namely Sedimentation of Shipping Channel (X) and Shipyard Operations (Y). The data collection technique is by distributing questionnaires to as many as 80 respondents who have been selected by the researcher according to the criteria for the research sample that has been determined. The following is the presentation of the data from the questionnaire results of each variable.

Table 1. Respondents' Answers to Variable X

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Item | Respondent's Answer | Total Score | Presentase | Category |
| **SS** | **S** | **TS** | **STS** |
| X.1.1 | 53 | 25 | 2 | 0 | 291 | 90,9375 | Very High |
| X.1.2 | 29 | 39 | 12 | 0 | 257 | 80,3125 | Tall |
| X.1.3 | 38 | 40 | 2 | 0 | 276 | 86,25 | Very High |
| X.1.4 | 32 | 38 | 5 | 5 | 257 | 80,3125 | Tall |
| X.1.5 | 39 | 31 | 9 | 1 | 268 | 83,75 | Very High |
| X.1.6 | 43 | 33 | 3 | 1 | 278 | 86,875 | Very High |
| X.1.7 | 46 | 32 | 2 | 0 | 284 | 88,75 | Very High |
| X.1.8 | 48 | 29 | 3 | 0 | 285 | 89,0625 | Very High |
| X.1.9 | 45 | 31 | 4 | 0 | 281 | 87,8125 | Very High |
| X.1.10 | 41 | 35 | 4 | 0 | 277 | 86,5625 | Very High |
| X.1.11 | 44 | 36 | 0 | 0 | 284 | 88,75 | Very High |
| Average | **86,3068182** | Very High |

Source : Researcher questionnaire data processing (2025)

Table 1 is a description from the respondents of the Shipping Channel Sedimentation variable (X) to 80 respondents with 11 statements that raise 4 Dimensions in 1 Silver River sedimentation impact indicator on shipyard operations.

Table 2. Respondents' Answers to Variable Y

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Item | Respondent's Answer | Total Score | Presentase | Category |
| **SS** | **S** | **TS** | **STS** |
| Y.1.1 | 45 | 34 | 1 | 0 | 284 | 88,75 | Very High |
| Y.1.2 | 43 | 33 | 4 | 0 | 279 | 87,1875 | Very High |
| Y.1.3 | 42 | 31 | 7 | 0 | 275 | 85,9375 | Very High |
| Y.1.4 | 39 | 36 | 4 | 1 | 273 | 85,3125 | Very High |
| Y.1.5 | 47 | 29 | 4 | 0 | 283 | 88,4375 | Very High |
| Y.1.6 | 46 | 30 | 4 | 0 | 282 | 88,125 | Very High |
| Y.1.7 | 35 | 40 | 4 | 1 | 269 | 84,0625 | Very High |
| Y.1.8 | 44 | 35 | 1 | 0 | 283 | 88,4375 | Very High |
| Y.1.9 | 39 | 39 | 2 | 0 | 277 | 86,5625 | Very High |
| Y.1.10 | 43 | 33 | 3 | 1 | 278 | 86,875 | Very High |
| Y.1.11 | 41 | 35 | 3 | 1 | 276 | 86,25 | Very High |
| Y.1.12 | 34 | 36 | 7 | 3 | 261 | 81,5625 | Very High |
| Y.1.13 | 34 | 34 | 8 | 4 | 258 | 80,625 | Tall |
| Y.1.14 | 40 | 37 | 3 | 0 | 277 | 86,5625 | Very High |
| Average |  | **86,0491071** | Very High |

Source : Researcher Questionnaire Data Processing (2025)

Table 2 is a description of the Shipyard Operational variable (Y) to 80 respondents with 14 statements that raise each of the 2 Dimensions in 4 Indicators of the impact of silver river siltation on shipyard operations.

**Interview**

1. **Interview Results with Resource Person 1 (PT. Dumas Tanjung Perak Shipyard)**

 According to the information from the 2nd respondent who is an employee of the PT. Dumas Tanjung Perak Shipyard stated that sedimentation has been occurring for a long time and is very troublesome for the Company. In addition, sedimentation occurs along the channel, making it difficult for ships to enter the shipyard. The PT. Dumas always guides the ship that will enter for the safety of the ship so that it does not run aground at the location of the channel at a very low depth, even if it has to wait when the water conditions are at high tide. For now, the Company only limits ships with a maximum draft of 3 meters to be served, this certainly makes the Company refuse if it is not in accordance with the provisions that make the service users reduced.

1. **Interview Results with Resource Person 2 (Pelni Surya Factory)**

 According to the statement from the source, sedimentation has been happening for a long time. The company can currently only accept a maximum ship draft of 2.8 meters due to the low depth of the groove. In addition, ships can only enter and exit the channel only when the water conditions are at the highest tide. Related to this, the ship also has to wait at the highest tide, increasing the ship's operational costs due to delays. If the ship enters late at high tide, it will be able to cause the ship to run aground and this also often happens. This also makes the Company often reject ships of sufficient size that will carry out repairs.



Fig 2. Condition of the Perak River

Source : Researcher Documentation

**Validity Test**

In this study, the variable used, namely the independent variable (X) is Sedimentation of the Shipping Channel, which has indicators, namely: Erosion Activity, Transportation, Sedimentation, Compaction. While the dependent variable (Y) is Shipyard Operations, with indicators, namely: Operations, Marketing, Finance, Human Resources.

The validity test was carried out by comparing the value of r calculated with the r table. In deciding the feasibility of an item or questionnaire, a significance test of the correlation coefficient is carried out at a significance level of 0.05 which means that it is said that an item or questionnaire is valid if there is a significance correlation with the total score. It is declared valid if r is calculated > r table and has a positive value, it is not said to be valid if r calculates< r table.

Table 3. Validity Test Results

|  |  |  |  |
| --- | --- | --- | --- |
| Nomor | Corrected Item Total Correlation (Rhitung) | Rtabel | Information |
| X.1.1 | 0,618 | 0,220 | Valid |
| X.1.2 | 0,519 | Valid |
| X.1.3 | 0,593 | Valid |
| X.1.4 | 0,601 | Valid |
| X.1.5 | 0,596 | Valid |
| X.1.6 | 0,73 | Valid |
| X.1.7 | 0,67 | Valid |
| X.1.8 | 0,724 | Valid |
| X.1.9 | 0,689 | Valid |
| X.1.10 | 0,558 | Valid |
| X.1.11 | 0,603 | Valid |
| Y.1.1 | 0,653 | 0,220 | Valid |
| Y.1.2 | 0,539 | Valid |
| Y.1.3 | 0,754 | Valid |
| Y.1.4 | 0,732 | Valid |
| Y.1.5 | 0,76 | Valid |
| Y.1.6 | 0,686 | Valid |
| Y.1.7 | 0,724 | Valid |
| Y.1.8 | 0,72 | Valid |
| Y.1.9 | 0,642 | Valid |
| Y.1.10 | 0,776 | Valid |
| Y.1.11 | 0,633 | Valid |
| Y.1.12 | 0,566 | Valid |
| Y.1.13 | 0,391 | Valid |
| Y.1.14 | 0,697 | Valid |

Source : Data processed by SPSS (2025)

**Reliability Test**

Measure reliability with the Cronbach Alpha *statistical test*, so a variable is said to be reliable if:

* 1. It can be said to be reliable if *the Cronbach Alpha* number > 0.60,
	2. And it is called unreliable if *the Cronbach Alpha* number < 0.60.

Furthermore, the results of the reliability test can be seen, namely in table 4 for the results of variables X and 4. for the result of the variable Y.

Table 4. Variable X Reliability Test Results

|  |
| --- |
| Reliability Statistics |
| Cronbach's Alpha | N of Items |
| ,839 | 11 |

Source : Data processed by SPSS (2025)

Based on the results of data processing in table 4, it is known that  *the Cronbach Alpha* value is 0.839 > 0.60, so the Shipping Channel Sedimentation Variable (X) can be said to be reliable so that it is suitable as a research instrument.

Table 5. Results of Variable Y Reliability Test

|  |
| --- |
| Reliability Statistics |
| Cronbach's Alpha | N of Items |
| ,894 | 14 |

Source : Data processed by SPSS (2025)

Based on the results of data processing in table 5, it is known that the *value of Cronbach Alpha* is 0.894 > 0.60, so the Shipyard Operational Variable (Y) can be said to be reliable so that it is suitable as a research instrument.

**Uji Normalitas**

According to Ghozali (2018), before the data was processed using the regression formula, previously the two variables, namely free and bound, must be declared to be normally distributed or close to normal using the normality test. The normality test is to use the Kolmogorov-Smirnov test.

When Asymp. Sig is greater than 0.05, then the residual data is distributed normally, but if Asymp. Sig is less than 0.05 then the data is not distributed normally. The results of the normality test can be seen in Table 6, as below.

Table 6. Data Normality Test Results

|  |
| --- |
| One-Sample Kolmogorov-Smirnov Test |
|  | Unstandardized Residual |
| N | 80 |
| Normal Parametersa,b | Mean | ,0000000 |
| Std. Deviation | 3,28298798 |
| Most Extreme Differences | Absolute | ,145 |
| Positive | ,083 |
| Negative | -,145 |
| Kolmogorov-Smirnov Z | 1,296 |
| Asymp. Sig. (2-tailed) | ,069 |

Source : Data processed by SPSS (2025)

Based on table 6 it can be seen that the value of Asymp. Sig is 0.069 > 0.05, so it can be concluded that the processed data is normally distributed and the model is suitable for further research analysis.

**Coefficient of Determination**

Table 7. Determination Test

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate |
| 1 | .821a | ,673 | ,669 | 3,304 |
| a. Predictors: (Constant), Sedimentasi Alur Pelayaran |

Source : Data processed by SPSS (2025)

The value of R is the symbol of the coefficient. Table 7 has a correlation value of 0.673. The value can be interpreted that the two research variables have a relationship in a strong category. Through the table above, the R Square value or Coefficient of Determination (KD) is also obtained which shows how good the regression model formed by the interaction of free variables and bound variables is. The KD value obtained was 67.3%. So it can be interpreted that the independent variable (X) has a contribution effect of 67.3% on the dependent variable (Y).

**Simple Linear Regression Analysis**

According to Riduwan (2016), simple linear regression analysis is to predict how far the value of dependent variables will change, if the value of independent variables is manipulated/altered or lowered. This analysis was used to determine the functional relationship or causal relationship of the independent variable X (Shipping Channel Sedimentation) on the bound variable Y (Shipyard operations).

Table 8. Simple Regression Coefficients

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Model | Unstandardized Coefficients | Standardized Coefficients | t | Sig. |
| B | Std. Error | Beta |  |  |
| 1 | (Constant) | 5,943 | 3,352 |   | 1,773 | ,080 |
| Sedimentasi Alur Pelayaran | 1,112 | ,088 | ,821 | 12,679 | ,000 |
| a. Dependent Variabel: Operasional Galangan Kapal |

Source : Data processed by SPSS (2025)

Based on table 8, the results of the calculations carried out by the researcher on the SPSS *version* 21.0 *for Windows* program obtained a (constant value) of 5.943 and b of 1.112. The form of a simple linear regression equation is as follows:

Y = a + βX

Y = 5,943 + 1,112X

Based on the regression equation above, the meaning of the above equation is as follows:

* + - 1. The value of the coefficient a (Constant) is 5.943 which means that if there is no Sedimentation of the Shipping Channel (X = 0), it is estimated that the Shipyard Operations (Y) has a value of 5.943.
			2. It can be seen that the impact of Shipping Channel Sedimentation (X) on Shipyard Operations (Y) is unidirectional (positive), this is shown in the Regression Coefficient of X or the value of b in the regression equation which shows a positive number of 1.112 which means that every increase in the supervision of 1 unit will be followed by an increase in ship safety and security which is 1.112.
			3. Likewise, if the Sedimentation of the Shipping Channel decreases by 1 unit, the Shipyard Operations will tend to decrease, namely a decrease of 1,112.

**Analysis of Interview Results**

Based on the results of interviews conducted by researchers with the two companies that were used as research samples, it can be concluded that sedimentation on the Silver River has occurred for quite a long time and has not even been routinely monitored by Port operators, so that the depth of the Silver River shipping channel will decrease day by day. For now, based on existing data, the depth of the silver river is only 1 meter below sea level in the middle of the channel, this certainly makes the ship tidal able to enter the shipping channel of the silver river, the only way for the ship to get out and enter only when the water conditions are experiencing the highest tide, therefore the ship has to wait first so that it will increase the operational costs of the ship and also the shipyard company. If the ship is forced to enter when the water has not yet risen, it will result in the ship running aground.

In addition, sedimentation causes ships that can be served to be limited by the Company, namely only ships that have a maximum draft of 3 meters, this causes the Company to reject many prospective service users because they exceed the specified standards. So because the refusal causes a reduction in the number of ships served by the Company which can automatically reduce revenue for the Company.

**Discussion**

Based on the results of data analysis obtained through interviews and questionnaires by researchers about the influence of the sedimentation of the silver shipping channel on shipyard operations in the significance test, a significance value of 0.000b < 0.05 was obtained so that there was an influence on the Sedimentation of the Shipping Channel (X) on the dependent variable of Shipyard Operations (Y). Meanwhile, judging from the determination test, a coefficient of 67.3% was obtained and a simple linear regression analysis test with a constant that has a value of 1.112 which has a positive value so that it can be concluded that the Shipping Channel Sedimentation variable (X) has an effect of 67.3% on the Shipyard Operational variable (Y) and the Shipping Channel Sedimentation variable (X) has a positive value, then the value of the Shipyard Operational variable (Y) will increase.

Judging from the results of the hypothesis test that has been carried out previously, it is known that the value of the Shipping Channel Sedimentation variable (X) has a coefficient value not equal to zero, which is 5.943 which means that Ha is accepted, which states that the Shipping Channel Sedimentation variable (X) has a significant influence on the Shipyard Operational variable (Y). While judging from the T test, the tcount is greater than the ttable (12.679>1.990) thus Ha is accepted, from the results of the study show that the independent variable of Shipping Channel Sedimentation (X) affects the dependent variable of Shipyard Operations (Y).

Furthermore, answering the problem formulation of the impact of sedimentation on the shipping channel of the Silver River on shipyard operations based on the results of interviews and questionnaires by the researcher are as follows:

1. Sedimentation causes siltation in the Silver River shipping channel, where the Silver River shipping channel is a channel that connects to several shipyards. Thus, the siltation of the Perak River shipping channel hinders the process of exiting/entering the ship to the shipyard.
2. The low depth of shipping channels causes large ships to not be able to pass through the channel, reducing market potential. In addition, it can also reduce the number of ships that can be served by the shipyard, causing a decrease in revenue for the shipyard.
3. Because of the low depth of the shipping channel, the ship can only cross when the water conditions are at the highest tide, so the ship has to wait longer in the port pool which can cause an increase in the ship's operational costs, because if forced to cross before the highest tide, it can cause the ship to run aground on the silver river shipping channel.

# CONCLUSION > T.N Roman 11 Bold

The conclusion that can be drawn by the researcher based on the results of data analysis and discussion in this study on "The Impact of Sedimentation on the Perak River Shipping Channel on Shipyard Operations" is that there is an influence with the explanation of the shipyard operational variable (Y) positively influenced by the sedimentation variable of the shipping channel (X), then it can be said that the higher the sedimentation in the Perak River shipping channel, the lower it will be for operations shipyards that can be done. This is evidenced by the constant that has a positive value of 1.112. The influence value can also be seen from the simple linear regression determination test, there was an influence of the Shipping Channel Sedimentation variable (X) of 67.3% on the Shipyard Operational variable (Y).

If viewed from the results of the hypothesis test (T test), the tcount is greater than the ttable (12.679 > 1.990), and the significance value has a low value compared to the alpha value of 0.000b < 0.05 so that the significance value is in the rejection area of Ho (crisis area), thus Ho is rejected and Ha is accepted which states that Sedimentation of the Shipping Channel (X) affects Shipyard Operations (Y).

The impact caused by the sedimentation of the Silver River is that it has an impact on the effectiveness and operational efficiency of shipyards such as a reduction in the number of ships that use shipyard services, an increase in the operational costs of the shipyard and also ships that carry out docking, often late activities because they have to wait for the highest tide for ships to be able to enter/exit the shipyard. In addition, it also eliminates the market potential for large ships because it cannot pass through the channel.

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