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Analysis of the Effectiveness of Technical Personnel Management on Main Engine Damage During Extreme Weather Conditions at Sea

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Abstract: This study aims to analyze the effectiveness of technical personnel management in handling main engine failures during extreme weather conditions at sea. The main focus of this study is to assess the extent to which technical competence, communication, coordination, and preparedness of technical personnel contribute to the effectiveness of damage management. The method used is a descriptive quantitative approach with data collection through a closed-ended questionnaire based on a Likert scale. A total of 100 respondents who are ship engineering officers currently studying at a maritime campus were sampled. The results of the analysis show that the four independent variables (technical competence, communication, coordination, and preparedness) simultaneously have a significant effect on the effectiveness of handling main engine failures. From the results of the multiple linear regression test, the coefficient of determination (R^2) value of 0.897 indicates that 89.7% of the variation in damage management effectiveness can be explained by these four variables. This finding indicates that good technical personnel management plays a significant role in reducing the risk of engine system failure during extreme weather.

Keywords: Damage Management; Extreme Weather; Personnel Preparedness; Ship Engineering; Technical Competence

1. INTRODUCTION

The main engine is one of the most crucial components in a ship's propulsion system, ensuring smooth operations at sea. In this context, extreme weather conditions such as storms, high waves, and strong winds can significantly impact the performance of the main engine. According to data released by the International Maritime Organization (IMO), approximately 40% of main engine failures on ships are due to unfavorable weather conditions (IMO, 2020). This demonstrates that effective management of engineering personnel is crucial to minimizing the risk of damage and maintaining the safety of ship operations.

Field experience shows that good coordination between engineering personnel can improve response to damage. For example, a study by Sutrisno (2017) found that ships with regular training programs for engineering personnel tended to have a higher success rate in resolving engine problems compared to ships without such programs. In this regard, good engineering personnel management focuses not only on technical aspects but also on developing effective interpersonal and communication skills.

Extreme weather conditions require swift and precise handling to prevent further damage to the main engine. In these situations, the role of engineering personnel becomes crucial.

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They must have adequate skills and knowledge to perform rapid diagnosis and repairs. Research by Dharma (2018) shows that good management can improve response to damage and reduce repair times. For example, in the case of a tanker experiencing engine failure due to a storm, a well-trained and experienced engineering team can identify the problem more quickly and carry out repairs in a shorter time, thereby reducing downtime and associated economic losses.

Good engineering personnel management also involves the use of information technology to monitor engine and weather conditions in real time. Turban (2016) explains that efficient information systems can help engineering personnel make better and faster decisions. For example, the use of sensors and monitoring software can provide accurate data on engine and environmental conditions, allowing personnel to respond more appropriately when problems occur. Therefore, this study aims to explore how effective management can contribute to reducing main engine failures under extreme weather conditions.

2. PROPOSED METHOD

This study uses a descriptive quantitative approach, which aims to provide a systematic and objective overview of the effectiveness of engineering personnel management on main engine failures in extreme weather conditions at sea. In this study, data were collected using a standardized instrument in the form of a Likert-based questionnaire. This method was used to measure the perceptions and attitudes of engineering officers towards engineering personnel management practices and their impact on main engine failures. The population in this study were ship engineering officers currently studying at the Banten Maritime Polytechnic Campus. This population was selected because they have relevant academic backgrounds and technical experience, particularly in the operation and maintenance of ship main engines. The research sample consisted of 100 engineering officers, selected using a purposive sampling technique.

3. RESULTS AND DISCUSSION

The respondents were ship technical officers currently studying at a maritime university. Respondent selection was based on specific criteria relevant to the research objective, which was to analyze the effectiveness of technical personnel management in dealing with main engine failures during extreme weather conditions at sea. The age distribution of respondents shows that the majority of respondents are between 31 and 40 years old, with a percentage of 44.60%. This indicates that most respondents have sufficient experience in the field, which may influence their ability to handle machine failures. Meanwhile, respondents aged ≤ 30 and

> 40 years old accounted for 36.60% and 18.80%, respectively. This data indicates a balanced proportion between the younger generation and those with more experience.

Respondents' final positions varied, with Engineer 2 being the most common position (36.60%). This indicates that most respondents held strategic and responsible positions in the management of the ship's main engine. The positions of Chief of the Engine Room (KKM) and Engineer 3 also accounted for significant percentages, at 20.50% and 21.40%, respectively. This diversity of positions is important because it provides different perspectives on managing technical personnel. 66.10% of respondents had more than 6 years of experience. This reflects that most respondents have been involved in various situations and challenges at sea, including dealing with extreme weather conditions. This experience is invaluable in the context of this research, as long-term work experience often correlates with the ability to handle engine failures.

The majority of respondents had ATT-IV (42.00%) and ATT-III (40.20%) education, indicating that they had received adequate technical training to handle issues related to ship engines. Good education is crucial for improving technical competence and preparedness in emergency situations. Most respondents (89.30%) had experienced engine failure, and 71.40% of them had participated in engine emergency training. This data indicates that respondents not only have practical experience but also received relevant training to improve their skills in handling engine failures, especially in extreme weather conditions. This is an important indicator in analyzing the effectiveness of technical personnel management on board ships.

Validity and Reliability Test

Validity testing was conducted to ensure that the research instrument used in the questionnaire measured what it was intended to measure. In this study, 60 questionnaire items were tested using Pearson correlation analysis. The test results showed that all items had Pearson correlation values greater than the r-table (0.361), indicating that all items were valid. This high level of validity provides confidence that the data collected from respondents is reliable for further analysis.

The reliability test was conducted using the Cronbach's Alpha method. The results showed a Cronbach's Alpha value of 0.948, indicating that this research instrument is highly reliable. According to Kline (2011), a Cronbach's Alpha value above 0.9 indicates that the instrument is highly reliable. Therefore, the data obtained from the questionnaire can be considered consistent and can be used to analyze the effectiveness of technical personnel management.

The results of validity and reliability tests indicate that this research instrument meets the standards required to conduct an in-depth analysis of the effectiveness of technical personnel management in dealing with main engine failures at sea. Future research can use this instrument to further explore the factors influencing effectiveness in different contexts.

Correlation Test

The results of the correlation test indicate that all independent variables have a significant and positive relationship with the effectiveness of handling main engine failures.

Table 1. Correlation test.

Variabel X	Variabel Y(Effectivenes)	Correlation Value (r)	Sig.(p-value)	Interpretation
Competence Technical	effectiveness of treatment	0,849		Strong, signifikan 0
Communication	effectiveness of treatment	0,94		Very strong, sig-0nifikan
Coordination	effectiveness of treatment	0,897		Very strong, sig-0nifikan
Preparedness	effectiveness of treatment	0,898		Very strong, sig-0nifikan

All correlation values obtained were greater than 0.80, indicating a very strong relationship between the independent variables and the effectiveness of main engine failure management. Furthermore, all significant p-values ($p < 0.01$) indicate that these relationships did not occur by chance, but rather were the result of good technical personnel management on board

Multiple Linear Regression Test

A multiple linear regression analysis was conducted to test the simultaneous influence of the independent variables (competence, communication, coordination, and preparedness) on the dependent variable, namely the effectiveness of main engine failure management. The analysis results showed an R^2 value of 0.897, meaning that 89.7% of the variation in the effectiveness of main engine failure management can be explained by the four independent variables. This indicates that the regression model successfully explains the relationships between the variables. The Durbin-Watson test showed a value of 2.077, which is within the normal range (1.5–2.5), indicating no autocorrelation in this regression model. In other words, the residuals from the regression model do not exhibit a systematic pattern, which is an important requirement in regression analysis.

Simultaneous testing showed that all four independent variables collectively had a significant effect on the effectiveness of main engine failure management, with an F-value of

233.385 and a p-value of 0.000. This indicates that the developed regression model can be used to effectively predict the effectiveness of main engine failure management. Next, a t-test was conducted to determine the partial effect of each independent variable on effectiveness. The results showed that only communication (β = 0.747; Sig = 0.000) and preparedness (β = 0.306; Sig = 0.001) had a significant effect. Meanwhile, competence (β = 0.058; Sig = 0.478) and coordination (β = 0.014; Sig = 0.886) did not show a significant effect on the effectiveness of handling main engine failures.

The VIF values for competence and coordination were above 5, indicating multicollinearity, although still acceptable. This indicates potential overlap between independent variables, which could influence the analysis results. However, communication and preparedness remained the most influential variables in improving the effectiveness of main engine failure management. Overall, the multiple linear regression analysis shows that good technical personnel management, particularly in terms of communication and preparedness, significantly influences the effectiveness of handling main engine failures at sea. These results provide important insights for ship managers to focus on improving communication and preparedness within technical teams to address the challenges posed by extreme weather conditions.

4. CONCLUSIONS

It can be concluded that the research instrument used in the questionnaire has been proven valid and reliable. This validity indicates that all question items are able to measure the intended variables effectively, while high reliability ensures that the data obtained is consistent and reliable for further analysis. This aligns with the findings of Kline (2011), who stated that a Cronbach's Alpha value above 0.9 indicates a highly reliable instrument. Respondents in this study demonstrated high perceptions of all variables studied, namely competence, communication, coordination, and preparedness. Data obtained from descriptive statistical analysis showed that all these variables had average scores above 3.8, indicating that respondents felt positive about their ability to manage technical personnel, particularly in dealing with main engine failures during extreme weather. This supports previous research by Sutrisno (2017), which emphasized the importance of technical competence for operational effectiveness in the field.

Furthermore, there was a positive and significant relationship between the independent variables (competence, communication, coordination, and preparedness) and the dependent variable, namely the effectiveness of main engine failure management. The Pearson correlation test results showed that all independent variables had a significant relationship with failure

management effectiveness, with a high correlation value. Research by Dharma (2018) also supports this finding, stating that good management can improve overall operational effectiveness.

Multiple linear regression analysis showed that the independent variables collectively had a significant effect on the effectiveness of technical personnel management in dealing with main engine failures during extreme weather. The R^2 value of 0.897 indicates that 89.7% of the variation in effectiveness can be explained by these four variables. This indicates that the regression model successfully explains the relationships between the variables and can be used as a reference for developing future management strategies.

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