DIJDBM: Dinasti International Journal of Digital Business Management
E-ISSN: 2715-4203
P-ISSN: 2715-419X
https://dinastipub.org/DIJDBM dinasti.info@gmail.com +62 811 7404 455
DINASTI PUBLISHER
DOI:https://doi.org/10.38035/dijdbm.v7i4

Examining the Role of Equipment Conditions and Worker Competence in Accident Risk Prevention and Ship-To-Ship Transfer Performance

Ridho Agung Prihutomo[1], April Gunawan Malau[2], Erwin Ferry Manurung[3].
[1]Sekolah Tinggi Ilmu Pelayaran, Jakarta, Indonesia, dhotomo@gmail.com.
[2]Sekolah Tinggi Ilmu Pelayaran, Jakarta, Indonesia, aprilgunawan22@gmail.com.
[3]Sekolah Tinggi Ilmu Pelayaran, Jakarta, Indonesia, ferry.ginanjar92@gmail.com.

Corresponding Author: dhotomo@gmail.com[1]

Abstract: This study is motivated by key issues, including the suboptimal performance of Ship-to-Ship (STS) operations, as indicated by declining equipment readiness, inconsistent implementation of standard operating procedures (SOPs), and the persistence of accident risks due to technical failures and human error. In addition, gaps in worker competency and the limited availability of backup equipment pose challenges that may disrupt operational efficiency. Therefore, this study aims to analyze the influence of equipment condition and worker competence on accident risk prevention and their implications for STS performance. This research adopts a quantitative approach with a cross-sectional survey design. The population consists of 265 respondents, including operational port workers and ship crews, using a saturated sampling technique. Data were collected through Likert-scale questionnaires and field observations. The data analysis technique employed Structural Equation Modeling–Partial Least Squares (SEM-PLS) using SmartPLS software to examine both direct and indirect relationships among variables. The results indicate that equipment condition and worker competence have a positive and significant effect on accident risk prevention and STS performance. Accident risk prevention also serves as a significant mediating variable between independent variables and operational performance. Worker competence is identified as the most dominant factor in improving STS performance. Based on these findings, it is recommended that companies enhance equipment maintenance and availability, strengthen training and certification programs for workers, and implement an integrated risk-based safety management system to improve safety and operational performance of STS activities sustainably.

Keyword: Equipment Condition, Worker Competence, Accident Risk Prevention, Ship-to-Ship Performance.

INTRODUCTION

Maritime transportation plays a strategic role in supporting economic development and strengthening Indonesia's vision as a global maritime axis. As an archipelagic country,

Indonesia relies heavily on maritime transportation systems to facilitate logistics distribu-tion, industrial activities, and international trade. Shipping companies therefore hold signifi-cant responsibilities in ensuring the safety of vessels, crews, cargoes, and operational pro-cesses. Safe and efficient transportation activities depend heavily on vessel seaworthiness and compliance with established maritime standards and regulations (Lasse et al., 2016; Ri-cardianto et al., 2021).

The maritime industry is also highly regulated through international standards estab-lished by the International Maritime Organization (IMO). The organization plays a vital role in maintaining shipping safety, security, and environmental protection by developing inter-national conventions and operational guidelines. Indonesia actively participates in these ini-tiatives to strengthen maritime governance and operational safety standards. Such regula-tions are especially important in high-risk maritime activities, including cargo transfer op-erations involving hazardous materials and large vessels (Sagala, 2021).

The oil and gas industry is considered one of the sectors with the highest occupation-al health, safety, security, and environmental risks. In this industry, risk management sys-tems are integrated into operational activities to minimize workplace hazards and ensure operational continuity. Among maritime oil and gas operations, Ship-to-Ship (STS) transfer activities represent one of the most critical and complex operational processes because they involve transferring cargo between vessels under varying environmental and technical con-ditions. Effective safety management therefore becomes essential to prevent operational failures and maintain performance quality.

Pertamina Marine STS Teluk Semangka serves as one of the strategic operational terminals supporting Ship-to-Ship transfer activities, particularly for Liquefied Petroleum Gas (LPG) and crude oil transportation. The terminal is designed to accommodate large ves-sels such as Very Large Crude Carriers (VLCC) and operates continuously to facilitate cargo movement efficiently. However, STS operations involve numerous operational challenges requiring careful planning, coordination, and strict safety implementation. The complexity of these activities increases the importance of maintaining operational reliability and mini-mizing accident risks.

Operational performance at Pertamina Marine STS Teluk Semangka has shown sev-eral challenges in recent years. Although safety indicators such as pilot qualification readi-ness and safe berthing consistently achieved operational targets, equipment readiness expe-rienced a significant decline from 100% in 2023 to 69% in 2024 before improving to 85% in 2025. Limitations in essential equipment such as Pneumatic Rubber Fenders (PRF) and hos-es created potential operational risks and increased the possibility of operational failures. These findings indicate that equipment conditions play a substantial role in influencing the effectiveness and continuity of STS operations.

In addition to equipment conditions, accident prevention has emerged as another crit-ical concern affecting operational sustainability. Records of operational incidents showed recurring problems including PRF rope failures, hose leakage, PRF sinking incidents, and tugboat breakdowns. Although major accidents were successfully avoided, these incidents caused delays, operational disruptions, and increased safety concerns. Such occurrences demonstrate that accident prevention measures, including hazard identification, risk control procedures, routine inspections, and safety monitoring systems, require continuous im-provement to reduce operational risks effectively.

Worker competence also represents an essential factor influencing operational safety and performance. Employees involved in STS operations are expected to possess adequate technical knowledge, practical skills, and safety awareness to perform tasks effectively. Pre-liminary survey findings indicated that perceptions regarding workers' competencies re-mained inconsistent, particularly in terms of technical skills, training adequacy, and work experience. Since STS activities involve high-risk operational environments, insufficient competencies may

contribute to operational errors and negatively affect safety performance. Therefore, continuous training and competency development programs become increasingly important in maintaining operational reliability.

Previous studies have demonstrated that equipment quality and crew competence significantly influence maritime safety and accident prevention. Studies by Glykas et al. (2021), Tokić et al. (2021), Sriyanti et al. (2025), and Mursidi (2023) emphasized the im-portance of safety standards and human resource competence in maritime operations. How-ever, limited studies specifically investigate the relationship among equipment conditions, worker competence, accident risk prevention, and operational performance within Ship-to-Ship activities, particularly in Indonesian maritime environments such as Pertamina Marine STS Teluk Semangka. This research therefore aims to address this research gap by examin-ing how equipment conditions and worker competence influence accident risk prevention and its implications for Ship-to-Ship operational performance.

METHOD

This study employed a quantitative research approach using a survey methodology to examine the relationships among research variables. Quantitative research is considered an objective approach characterized by collecting and analyzing numerical data through statis-tical techniques (Sugiyono, 2019). The research applied a cross-sectional design in which both independent and dependent variables were measured at a single point in time. Data col-lection was conducted using structured questionnaires distributed to respondents, while the analytical process utilized path analysis through Structural Equation Modeling–Partial Least Squares (SEM-PLS) using SmartPLS software.

This study used both primary and secondary data sources. Primary data consisted of respondents' perceptions regarding equipment condition, worker competence, accident risk prevention, and Ship-to-Ship performance variables collected through questionnaires. Sec-ondary data were obtained from books, scientific journals, regulations, and supporting doc-umentation relevant to the research topic. Data collection techniques included field research through surveys and direct observations, as well as library research to obtain supporting the-oretical and empirical references. A Likert scale with five response categories ranging from strongly disagree to strongly agree was employed to measure respondents' perceptions.

The population of this study consisted of 265 individuals involved in port and Ship-to-Ship operations at Pertamina Marine Region II Teluk Semangka, including 45 port opera-tional workers and 220 ship officers from 22 vessels. Since the population size was relative-ly limited and accessible, this research applied a saturated sampling or census sampling technique, where all population members were used as research respondents. The study in-cluded independent variables consisting of equipment condition (X1) and worker compe-tence (X2), an intervening variable represented by accident risk prevention (Y), and a de-pendent variable represented by Ship-to-Ship performance (Z). Data analysis was performed using SEM-PLS, including validity testing, reliability testing, structural model analysis, hy-pothesis testing, and mediation analysis.

RESULTS AND DISCUSSION

Statistical analysis in this study was conducted using the Partial Least Square (PLS) approach to examine the relationships among research variables. The statistical analysis process consisted of outer model testing and inner model testing, each aiming to evaluate the quality of the measurement model and structural model.

Outer Model Analysis Results

Outer model analysis was conducted to evaluate the validity and reliability levels of indicators in measuring the latent constructs used in this study.

Convergent Validity

Based on the data, the highest dimension of the Equipment Condition variable (X1) was Availability and Readiness with a loading factor value of 0.951, indicating that equipment readiness and availability are the most dominant aspects supporting equipment condition. The indicator with the highest value was X1.5 (0.925), making it the strongest indicator in reflecting equipment readiness in supporting operational activities. Meanwhile, the lower dimension was Technical Safety Compliance with a loading factor value of 0.908 and indicator X1.11 (0.830). Although it remains within the very strong category, this dimension still requires improvement to optimize compliance with technical safety standards.

Based on the data, the highest dimension of the Worker Competence variable (X2) was Work Knowledge with a loading factor value of 0.956, indicating that workers' knowledge levels are the most dominant factor in forming competence. The indicator with the highest value was X2.1 (0.919), making it the strongest indicator in reflecting workers' mastery of work-related knowledge. Meanwhile, the lower dimension was Work Attitude and Behavior with a loading factor value of 0.849 and indicator X2.9 (0.866). Although categorized as strong, this dimension can still be improved to ensure that positive work behavior further supports overall competence improvement.

Based on the data, the highest dimension of the Accident Risk Prevention variable (Y) was Hazard Identification with a loading factor value of 0.936, indicating that the ability to identify potential hazards is the most dominant aspect in accident prevention efforts. The indicator with the highest value was Y3 (0.935), making it the strongest indicator in representing the effectiveness of hazard identification in the workplace. Meanwhile, the lower dimension was Monitoring and Evaluation with a loading factor value of 0.829 and indicator Y12 (0.847). Although categorized as strong, this dimension still needs improvement to optimize supervision and evaluation processes in preventing accidents.

Based on the data, the highest dimension of the Ship-to-Ship Performance variable (Z) was Time and Resource Efficiency with a loading factor value of 0.952, indicating that efficiency in utilizing time and resources is the most dominant aspect in determining Ship-to-Ship operational performance. The indicator with the highest value was Z4 (0.913), making it the strongest indicator in reflecting operational efficiency. Meanwhile, the lower dimension was Operational Safety with a loading factor value of 0.906 and indicator Z9 (0.834). Although it remains within the very strong category, this dimension still requires optimization to ensure operational safety is balanced with achieved efficiency.

The results of SmartPLS data processing indicate that the outer model values, or correlations between indicators and latent constructs, all have loading factor values greater than 0.70. This indicates that all indicators (48 indicators) met the convergent validity criteria, meaning that all indicators for each variable are valid and suitable for further analysis. The outer model results are presented through the PLS algorithm structural model.

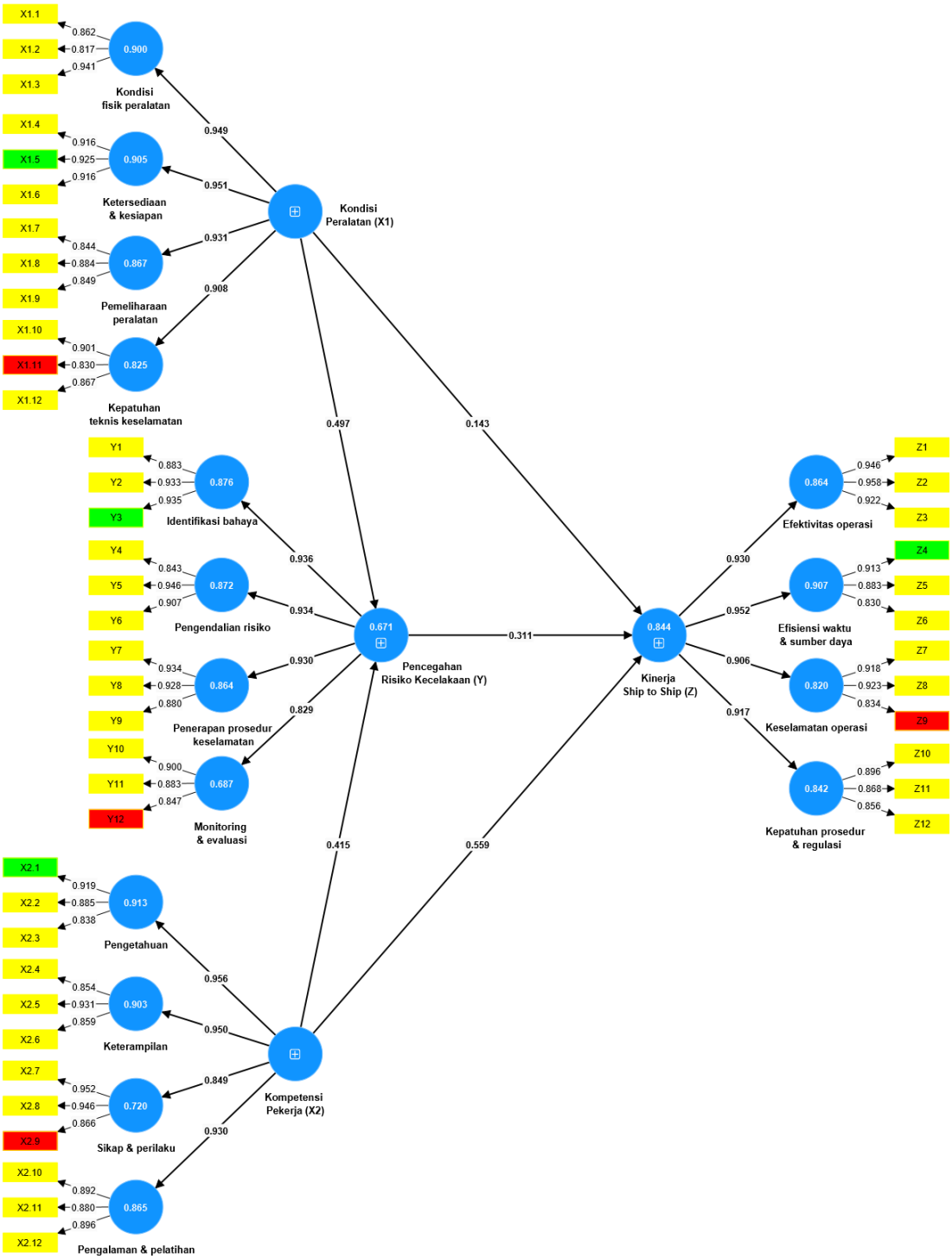

Figure 2. Outer Model Structural Model

Based on the SmartPLS results shown above, all indicators for each latent variable had loading factor values above the minimum threshold of 0.70, thereby satisfying convergent validity criteria. Therefore, both the measurement and structural models are considered suitable for further hypothesis testing.

Discriminant Validity

Discriminant validity testing was conducted to ensure that each latent construct within the research model had clear distinctions and measured different concepts from one another.

Table 1. Discriminant Validity and Construct Reliability Results

Variables	AVE	Cronbach's Alpha	Composite Reliability	Rule of Thumb	Description
Equipment Condition (X1)	0.678	0.956	0.962	AVE > 0.5; CR & CA > 0.7	Valid and Reliable
Worker Competence (X2)	0.676	0.956	0.961	AVE > 0.5; CR & CA > 0.8	Valid and Reliable
Accident Risk Prevention (Y)	0.673	0.955	0.961	AVE > 0.5; CR & CA > 0.9	Valid and Reliable
Ship-to-Ship Performance (Z)	0.689	0.959	0.964	AVE > 0.5; CR & CA > 0.7	Valid and Reliable

The results indicate that all variables have Average Variance Extracted (AVE) values greater than 0.50, demonstrating that each construct possesses sufficient discriminant validity. Furthermore, Cronbach's Alpha and Composite Reliability values for all variables exceeded 0.70, indicating that all constructs are reliable and internally consistent. Thus, the measurement model satisfies both validity and reliability requirements.

Fornell–Larcker Criterion

Table 4.9 Fornell–Larcker Criterion among Variables

Variables	STS Performance (Z)	Worker Competence (X2)	Equipment Condition (X1)	Accident Risk Prevention (Y)
STS Performance (Z)	0.830			
Worker Competence (X2)	0.822	0.870		
Equipment Condition (X1)	0.719	0.612	0.823	
Accident Risk Prevention (Y)	0.820	0.719	0.751	0.820

The Fornell–Larcker Criterion results show that the square root values of AVE for each construct were greater than the correlations among constructs. Therefore, all latent variables met the discriminant validity requirements.

Cross Loadings

Cross-loading results indicate that each indicator has the highest loading value on its respective construct compared to other constructs. This demonstrates that all indicators appropriately represent their respective latent variables and possess satisfactory discriminant validity.

Inner Model Analysis Results

Inner model analysis was performed to examine causal relationships among latent constructs and assess the structural model's capability in explaining endogenous variables.

R-Square Test and Q-Square Test

Table 3. R-Square Values

Variables	R-Square
Accident Risk Prevention (Y)	0.671
Ship-to-Ship Performance (Z)	0.844

The R-Square value for Accident Risk Prevention was 0.671, meaning that Equipment Condition and Worker Competence explained 67.1% of the variance in Accident Risk Prevention, while the remaining 32.9% was influenced by other factors outside this study. The R-Square value for Ship-to-Ship Performance was 0.844, indicating that Equipment Condition, Worker Competence, and Accident Risk Prevention explained 84.4% of Ship-to-Ship performance variance, while the remaining 15.6% was influenced by other variables.

Predictive relevance (Q^2) was calculated as follows:

$Q^2 = 1 - (1 - 0.671)(1 - 0.844)$

$Q^2 = 1 - (0.329 \times 0.156)$

$Q^2 = 1 - 0.051$

$Q^2 = 0.949$

The Q^2 value of 0.949 (>0 and close to 1) indicates that the structural model has excellent predictive relevance and adequately explains 94.9% of the endogenous variable variation.

Goodness of Fit Test

Goodness of Fit (GoF) testing was performed to assess the overall model fit.

Table 4 Goodness of Fit Results

	Saturated Model	Estimated Model
SRMR	0.074	0.079
d_ULS	25.514	28.881

The Goodness of Fit results show that SRMR values for both the saturated and estimated models met the acceptable threshold (<0.08), indicating acceptable model fit. Although d_ULS values suggest differences between empirical and estimated correlation matrices, further bootstrap evaluation confirmed acceptable model adequacy.

Overall, the model demonstrated an acceptable level of fit and was considered appropriate for hypothesis testing.

Hypothesis Testing Results

Hypothesis testing in SEM-PLS was performed using bootstrapping procedures to determine the significance of structural path coefficients.

Table 5. Direct Effect and Indirect Effet Analysis

Hypothesis	Direct Effects and Indirect Effects	Original Sample (O)	T Statistics	P Values	Description
H1	Equipment Condition (X1) → Accident Risk Prevention (Y)	0.497	5.758	0.000	Positive and Significant
H2	Worker Competence (X2) → Accident Risk Prevention (Y)	0.415	5.113	0.000	Positive and Significant
H3	Equipment Condition (X1) → STS Performance (Z)	0.143	2.769	0.006	Positive and Significant
H4	Worker Competence (X2) → STS Performance (Z)	0.559	7.411	0.000	Positive and Significant
H5	Accident Risk Prevention (Y) → STS Performance (Z)	0.311	5.054	0.000	Positive and Significant
H6	Equipment Condition (X1) → Accident Risk Prevention (Y) → STS Performance (Z)	0.155	3.463	0.001	Positive and Significant
H7	Worker Competence (X2) → Accident Risk Prevention (Y) → STS Performance (Z)	0.129	3.885	0.000	Positive and Significant

Effect of Equipment Condition on Accident Risk Prevention

The test results indicate that equipment condition has a positive and significant effect on accident risk prevention in Ship-to-Ship (STS) operations. The coefficient value of 0.497 indicates that better equipment conditions contribute to a higher level of accident risk prevention. The T-statistics value of 5.758, which exceeds the threshold value of 1.96, confirms that the relationship is statistically significant, while the P-value of 0.000 further strengthens the significance of the effect. Well-maintained equipment reflects optimal operational readiness and demonstrates that technical factors play a dominant role in reducing operational failures. Equipment operating in proper condition minimizes technical errors and supports workplace safety systems.

The findings indicate that equipment condition is not merely a supporting factor but a key determinant of accident prevention effectiveness. Unreliable equipment can increase operational risks and system failures, whereas standardized and properly maintained equipment improves operational reliability and safety performance. These findings are consistent with studies conducted by Liang et al. (2024), Xu et al. (2021), Glykas et al. (2021), Mashartanto et al. (2023), Mursidi (2023), and Rikardo et al. (2023), which emphasized that equipment reliability, condition monitoring systems, and maintenance management significantly contribute to operational safety and risk reduction. Overall, this study strengthens the existing literature by confirming that equipment condition is a critical component in maritime safety systems, particularly in STS operations.

Effect of Worker Competence on Accident Risk Prevention

The analysis results show that worker competence has a positive and significant influence on accident risk prevention. The coefficient value of 0.415 indicates that improving worker competence enhances the ability to prevent workplace accidents. The T-statistics value of 5.113, which is greater than 1.96, indicates statistical significance, while the P-value of 0.000 confirms a highly significant relationship. Worker competence includes knowledge, technical skills, experience, and attitudes in carrying out operational activities. Competent workers are able to identify potential hazards quickly and implement preventive actions effectively, contributing to a safer working environment.

The findings confirm that worker competence plays a strategic role in minimizing accident risks. Workers with sufficient training and experience tend to be more prepared for emergency situations and demonstrate greater compliance with operational procedures. These results support the findings of Wiweko et al. (2015), Fan and Yang (2023), Gundić et al. (2021), Barasa et al. (2024), Hanik et al. (2024), and Permatasari (2023), who emphasized that crew competence significantly influences operational safety and reduces human error. Overall, this study reinforces the importance of worker competence as a key factor in accident risk prevention within STS operational activities.

Effect of Equipment Condition on Ship-to-Ship Performance

The findings indicate that equipment condition has a positive and significant influence on Ship-to-Ship performance. The coefficient value of 0.143 suggests that improved equipment conditions contribute to increased operational performance, although at a relatively lower magnitude compared to other variables. The T-statistics value of 2.769 and the P-value of 0.006 indicate that the relationship is statistically significant. Adequate equipment conditions support operational continuity and facilitate cargo transfer activities effectively and efficiently.

The findings suggest that equipment condition directly contributes to operational performance enhancement by minimizing disruptions and increasing productivity. Equipment failures may negatively affect operational processes and extend operational time, while reliable

equipment improves work efficiency. These findings align with Liang et al. (2024), Xu et al. (2021), Glykas et al. (2021), Mashartanto et al. (2023), Hadijah et al. (2023), and Mursidi (2023), who highlighted the importance of equipment readiness in supporting operational effectiveness. Therefore, maintaining equipment quality through preventive maintenance systems remains essential for improving STS performance.

Effect of Worker Competence on Ship-to-Ship Performance

The results demonstrate that worker competence has a positive and significant effect on Ship-to-Ship performance. The coefficient value of 0.559 indicates a substantial contribution of worker competence toward improving operational performance. Furthermore, the T-statistics value of 7.411 and the P-value of 0.000 indicate a highly significant relationship. Competent workers possess the capability to perform operational tasks effectively, efficiently, and accurately, thereby increasing productivity levels.

The findings reveal that worker competence is the most dominant factor affecting Ship-to-Ship performance compared to other variables. Workers with adequate skills and experience are more capable of utilizing equipment effectively and making decisions under critical conditions. These findings support previous studies conducted by Wiweko et al. (2015), Fan and Yang (2023), Gundić et al. (2021), Hadijah et al. (2023), Permatasari (2023), and Tokić et al. (2021), which emphasized the role of crew competence in improving operational performance. Thus, investment in training and human resource development is essential for achieving optimal STS operational outcomes.

Effect of Accident Risk Prevention on Ship-to-Ship Performance

The findings indicate that accident risk prevention has a positive and significant influence on Ship-to-Ship performance. The coefficient value of 0.311 suggests that increasing accident prevention efforts contributes positively to operational performance improvement. The T-statistics value of 5.054 and the P-value of 0.000 indicate strong statistical significance. Accident risk prevention reflects the effectiveness of workplace safety systems in minimizing operational disruptions.

The findings demonstrate that accident prevention serves as an important factor in enhancing operational performance by creating a safer working environment and reducing operational interruptions. Effective safety systems improve productivity, operational continuity, and employee confidence. These results are consistent with findings from Glykas et al. (2021), Rikardo et al. (2023), Mursidi (2023), Barasa et al. (2024), Sriyanti et al. (2025), and Tokić et al. (2021), which emphasized that safety management practices significantly affect operational performance. Therefore, integrating safety procedures into operational systems is essential for improving STS performance.

Effect of Equipment Condition on Ship-to-Ship Performance through Accident Risk Prevention

The analysis results indicate that equipment condition has a positive and significant indirect effect on Ship-to-Ship performance through accident risk prevention. The coefficient value of 0.155 suggests a meaningful mediation effect, while the T-statistics value of 3.463 and P-value of 0.001 confirm statistical significance. Better equipment conditions enhance the effectiveness of accident prevention mechanisms and support safer operational activities.

The findings indicate that accident risk prevention functions as a mediating variable between equipment condition and operational performance. Reliable equipment enhances safety management systems, which ultimately improve operational performance. These findings support Liang et al. (2024), Xu et al. (2021), Glykas et al. (2021), Mashartanto et al. (2023), Rikardo et al. (2023), and Mursidi (2023), who emphasized the relationship between

equipment condition, safety systems, and performance outcomes. Therefore, organizations should integrate equipment management and safety systems simultaneously.

Effect of Worker Competence on Ship-to-Ship Performance through Accident Risk Prevention

The results indicate that worker competence has a positive and significant indirect effect on Ship-to-Ship performance through accident risk prevention. The coefficient value of 0.129 demonstrates a meaningful mediation contribution, while the T-statistics value of 3.885 and P-value of 0.000 indicate strong statistical significance. Competent workers can identify hazards more effectively and implement preventive measures that improve operational safety.

The findings reveal that accident risk prevention acts as a mediating variable between worker competence and Ship-to-Ship performance. Competent workers are more capable of applying safety procedures and minimizing human error, resulting in improved operational efficiency and effectiveness. These findings are supported by Wiweko et al. (2015), Gundić et al. (2021), Barasa et al. (2024), Sriyanti et al. (2025), Hanik et al. (2024), and Permatasari (2023), who emphasized the relationship among competence, safety awareness, and performance improvement. Overall, this study confirms that accident prevention strengthens the influence of worker competence on operational performance.

CONCLUSION

The results of this study indicate that equipment condition and worker competence have positive and significant effects on accident risk prevention and Ship-to-Ship (STS) per-formance. Equipment condition significantly contributes to accident risk prevention with a contribution value of 49.7%, where equipment availability and readiness become the domi-nant dimensions. Similarly, worker competence significantly influences accident risk pre-vention with a contribution value of 41.5%, indicating that workers' understanding of opera-tional procedures plays an important role in improving workplace safety. In addition, equipment condition directly affects STS performance with a contribution value of 14.3%, while worker competence shows the strongest direct influence on performance with a con-tribution value of 55.9%, making it the most dominant factor in enhancing operational per-formance.

Furthermore, accident risk prevention also has a positive and significant effect on STS performance with a contribution value of 31.1%, indicating that effective safety sys-tems improve operational outcomes. The study also confirms the mediating role of accident risk prevention in the relationship between equipment condition, worker competence, and operational performance. Equipment condition indirectly affects performance through acci-dent prevention with a coefficient of 0.155, while worker competence indirectly affects per-formance with a coefficient of 0.129. Overall, the findings indicate that operational perfor-mance improvement depends not only on technical readiness but also on competent human resources and sustainable safety management systems.

REFERENCE

Barasa, L., Malau, A. G., Hidayat, A., & Purnamasita, L. (2018). Pengaruh penggunaan peralatan bongkar muat terhadap produktifitas bongkar muat di PT. Pelindo II Cabang Pontianak. METEOR STIP Marunda, 11(2).

Barasa, L., Simanjuntak, M., & Syafitra, B. W. (2024). Factors affecting the safety climate of the ship's crew: Empirical evidence from shipping companies in Indonesia. Asian Journal of Shipping and Logistics, 41(5), 75–82.

Barasa, L., Sumali, B., Nancy, P., & Cardiana. (2021). The effect of compensation on ship's crew performance of floating crane Ratu Giok-2. Proceedings of the 1st International Conference on Management, Business, Applied Science, Engineering and Sustaina-bility Development (ICMASES 2019). https://eudl.eu/doi/10.4108/eai.3-8-2019.2290751

Fan, S., & Yang, Z. (2023). Analysing seafarer competencies in a dynamic human-machine system. Ocean and Coastal Management, 240, 106662. https://doi.org/10.1016/j.ocecoaman.2023.106662

Glykas, A., Perissakis, S., & Rudan, I. (2021). A risk assessment methodology as a tool for screening of ship-to-ship (STS) transfer operations. Pomorski Zbornik, 60, 49–63.

Gunawan, T., Hendriono, P., & Arief, M. (2008). Analisis faktor-faktor yang berpengaruh terhadap produktivitas bongkar muat kontainer di dermaga Berlian Surabaya (Studi Kasus PT. Pelayaran Meratus). WIDYA TEKNIK, 7(1), 79–89.

Gundić, A., Vujičić, S., Maglić, L., & Grbić, L. (2021). Reducing a human factor in cruise ships accidents by improving crew competences. International Journal of Marine Navigation and Safety of Sea Transportation, 15(2), 1322–1325. https://doi.org/10.12716/1001.15.02.20

Hadijah, H., Suryana, T., Ardiansyah, A., Porwanti, T., & Aziz, M. A. (2023). Analysis of the effect of working conditions on the welfare and performance of commercial ship crews: A comparative study of domestic and overseas shipping. Jurnal Penelitian Transportasi Laut, 25(1), 23–39.

Hanik, K., Yulianto, A., & Rizqi, N. A. (2024). Pengukuran tingkat kedisiplinan dan kompe-tensi terhadap kecelakaan kerja pada awak kapal. Inland Waterways Journal, 6(1), 46–60. https://doi.org/10.54249/iwj

Lasse, H. (2018). Pengambilan sampel dalam penelitian kuantitatif. Salemba Empat.

Liang, Q., Knutsen, K. E., Vanem, E., Æsøy, V., & Zhang, H. (2024). A review of maritime equipment prognostics health management from a classification society perspective. Ocean Engineering, 301, 117619. https://doi.org/10.1016/j.oceaneng.2024.117619

Malau, A. G. (2023). The Effect of Work-Life Balance on Higher Education Employee Performance: Moderation of Organizational Support and Job Satisfaction Level. Journal of Innovation in Educational and Cultural Research, 4(2), 254–263. https://doi.org/10.46843/jiecr.v4i2.681

Malau, A. G., Barasa, L., & Sumali, B. (2019). Effect of competence and ship crew disci-pline on performance PT. Myclin Express Offshore. International Review of Man-agement and Marketing, 9(5), 39-46.

Malau, A. G., Barasa, L., & Utami, A. P. (2021). Pengaruh kompetensi dan kompensasi ter-hadap kepuasan kerja awak kapal PT Amas Iscindo Utama. International Review of Management and Marketing, 11(3), 56-63.

Malau, A. G., Togatorop, A. L., & Sabpatari, F. (2021). Pengaruh kompetensi dan motivasi karyawan terhadap kinerja pelayanan penerbitan sertifikat kapal di Kantor KSOP Khusus Batam. Management Science & Marketing, 14(2), 123-130.

Mashartanto, A. A., Roselia, F., & Kristian, A. D. (2023). Analisis sistem perawatan safety equipment terhadap keselamatan crew kapal MT. Gas Natuna. Al Qalam: Jurnal Ilmiah Keagamaan dan Kemasyarakatan, 17(1), 78–79. https://doi.org/10.35931/aq.v17i1.1785

Meilinasari, N. H., Febriansyah, C., & Syahdana, R. (2021). Optimalisasi penerapan ISPS Code untuk meningkatkan keselamatan dan keamanan di atas kapal MV. CK Bluebell. METEOR STIP Marunda, 11(2). https://ejournal.stipjakarta.ac.id/index.php/meteor/article/download/196/163/

Mursidi. (2023). Analisis faktor yang mempengaruhi keselamatan pelayaran: Studi pada KSOP Tanjung Emas Semarang. Jurnal Aplikasi Pelayaran dan Kepelabuhanan, 14(1), 94–107.

Palapa, A., Saifudin, I., Jamaan, A., & Kalmareuro, V. U. (2024). Pengaruh fungsi mana-jemen terhadap kompetensi peserta didik dimediasi sistem informasi terintegrasi pa-da diklat kemaritiman. Saintara: Jurnal Ilmiah Ilmu-Ilmu Maritim, 8(2).

Permatasari, C., Noreng, R., & Saraswati, I. (2023). The influence of crew skills on the use of navigation equipment and its impact on shipping safety: A case study at PT Al Jazeera Shipping Company. Journal of Maritime Studies and National Integration, 7(1), 11–17.

Ricardianto, P. (2021). Maritime transportation and logistics management. Prenada Media.
Rikardo, D., Saleh, S., & Nurrahman, M. H. (2023). Optimalisasi penerapan keselamatan kerja dalam upaya pencegahan kecelakaan kru pada saat bekerja di Kapal MV. Ce-pat. Journal Marine Inside, 5(2), 47–63. https://doi.org/10.56943/ejmi.v5i2.67
Sagala, S. (2021). Maritime safety management and shipping regulations. Deepublish.
Selasdini, V., Barasa, L., & Wartono. (2018). Pengaruh ketersediaan utilisasi alat bongkar muat pelabuhan terhadap kinerja produktifitas di Pelabuhan Batu Ampar Batam. METEOR STIP Marunda, 11(2).
Simanjuntak, M. B., Winarno, W., Purnama, C., Simanjuntak, M., Wibowo, T. A., Palapa, A., & Simanjuntak, P. D. (2025). Professional perspectives on smart port cities: In-tegration of urban agriculture and maritime energy networks for sustainable coastal development (Transformative maritime education paradigms). BIO Web of Confer-ences, 199, 03009. https://doi.org/10.1051/bioconf/202519903009
Simanjuntak, M., Herawati, S., & Pangestu Gusti, A. (2024). The analysis of interpersonal communication and basic safety training with organizational policy as an intervening variable. International Journal of Maritime Studies, 5(1), 45–53. https://ejurnal.pip-semarang.ac.id/jdb/article/view/574
Siregar, V. Selasdini., Haryati, S., & Rizq, M. D. (2021). Pengaruh kebijakan perusahaan mengenai penempatan pelaut berijazah kompetensi kelas III sebagai juru mudi dan juru minyak terhadap pengembangan karir pelaut di atas kapal milik PT Tanto Intim Line. Jurnal Ilmu Pelayaran, 3(1), 25-32.
Sriyanti, E. E., Cahyadi, T., Yando, M., & Herawati, S. (2025). The effect of ISM Code im-plementation and crew competence on safety awareness which impacts the prevention of work accidents by ship crew at PT Asia Maritim Temas. Journal of Maritime Stud-ies and National Integration, 7(1), 11–17.
Sugiyono. (2019). Metode penelitian kuantitatif, kualitatif, dan R&D (10th ed.). Alfabeta.
Tokić, T., Frančić, V., Hasanspahić, N., & Rudan, I. (2021). Training requirements for LNG ship-to-ship transfer. Pomorski Zbornik, 60, 49–63.
Wiweko, A., Thamrin, M., & Edi, D. W. (2015). The effect of vessel seaworthiness and crew's competence on marine safety. Jurnal Manajemen Transportasi & Logistik, 2(3), 287–304.
Xu, X., Yan, X., Yang, K., Zhao, J., Sheng, C., & Yuan, C. (2021). Review of condition moni-toring and fault diagnosis for marine power systems. Transportation Safety and En-vironment, 3(2), 85–102. https://doi.org/10.1093/tse/tdab005.