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The Influence of Behavior Through Safety Culture On Seafarers Performance on Merchant Ship

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Abstract

This study aims to analyze the influence of seafarer behavior on merchant seafarer performance, both directly and indirectly through safety culture as a mediating variable. The background of the study is based on the high contribution of human factors to maritime accidents and the importance of safety culture in improving seafarer operational performance. The study used a quantitative approach involving 100 merchant seafarers as respondents selected through a simple random sampling technique. Data were analyzed using SmartPLS software to test the causal relationship between variables in the structural model. The results showed that behavior significantly influenced seafarer performance, behavior significantly influenced safety culture, and safety culture significantly influenced seafarer performance. In addition, safety culture was proven to significantly mediate the relationship between seafarer behavior and performance by translating behavior into concrete safety actions. These findings reveal that consistent implementation of safety culture can shape positive seafarer behavior, thereby improving operational performance and reducing the risk of accidents in the maritime sector. The conclusion of the study confirms that strengthening safety culture is a key factor in improving seafarer performance and reducing ship accidents. Practical implications, shipping companies and port authorities need to strengthen safety culture through continuous training and effective implementation of regulations.

1. Introduction

Safety culture in the workplace is crucial, especially in the maritime industry, which has a high risk of ship accidents. Good safety behavior includes proactively recognizing potential hazards, reporting risks or damage, and implementing preventive measures. Lack of attention to the human-system relationship is referred to as the role of humans in maritime accidents. Factors such as sophisticated ships, multinational seafarers, lack of competence, inadequate education and training systems, and many others have resulted in an increase in maritime accidents due to human error, necessitating improvements in human performance [1].

Human error can be defined as a deviation from expected human performance, provided the arbitrator does not make a mistake. Errors that occur must have criteria to determine what constitutes an error and what does not. This distinction concerns whether only human behavior is being examined or the system's overall performance.[2]. The close relationship between safety culture and the maritime industry is that the human factor is said to be the main contributor to accidents. The human factor is responsible for many transportation accidents, whether by land, air, or sea, such as human actions contributing to 60.6% of accidents at sea [3].

Communication is a crucial factor in ship safety; a team lacking effective communication increases the risk of errors. Ineffective supervision can be seen in supervisors working alone or in isolation, which presents a risk stemming from workload pressure. Reducing crew size can pose new challenges for assessing navigational risks on board [4].

This research idea is supported by previous research regarding seafarers' performance, which is measured not only by technical ability but also by alertness in emergency situations, reliability in maintaining operational safety, and effectiveness in working according to safety procedures. Safety remains one of the fundamental objectives of the IMO, but the most important challenge is how to further improve maritime safety globally [5].

In this study, the performance of seafarers is based on individual competencies, but it is also necessary to know that the factors that influence the performance of seafarers on board ships in the shipping industry consist of work-related stress factors, physical stress factors, and psychosocial factors in the process of assessing the stress levels of seafarers working on board ships [6].

This research contributes to companies in the shipping sector. First, it aims to improve the performance of seafarers on merchant vessels by paying attention to behaviors related to psychosocial and environmental issues. In the shipping industry,

seafarer performance is crucial for smooth operations, safety, and work efficiency on board. Second, this study seeks to create safety culture on board ships that is integrated with ship operations, minimizes accidents, and ensures the smooth running of watch duties during the voyage.

Human performance in maritime operations shows evidence of a positive correlation between individual factors and behavior [7], [8], the difference analyzes the relationship between seafarer fatigue and the risk of accidents (especially ship grounding) and has implications for making a major contribution to ship operational safety policies and work schedule planning, as well as linking fatigue to real consequences (accidents) [7]. Assessing the level of fatigue and mental disorders of seafarers using subjective psychological measurement instruments. The results of the study indicate that subjective measurements can be used to observe seafarers' conditions, but do not show a significant impact. The implications of the study are diagnostic of seafarers' psychological conditions, relevant for mental health support and improving working conditions from an individual perspective [8].

Various factors such as mental workload, emotions, and fatigue influence human behavior in daily work and decision-making processes.[9].Shipping companies recognize the importance of analyzing seafarers' work performance.[10]. Thus, improving seafarers' work performance is one of the determining factors for the success of shipping companies. Workforce performance can be improved by further enhancing factors that can stimulate employee motivation, creativity, and job satisfaction. Human resources are one of the fundamental elements in an organization which is one of the most effective and important resources in bringing the organization to achieve its goals, so that managing employee attitudes and behavior towards the organization is considered an important phenomenon [11].

Safety culture is a descriptive norm, meaning it is an individual's perception of what others actually do. Safety culture can be defined as part of an organization's culture, which is the result of various interactions between people, behaviors, and the organization [1]. Safety culture at different levels of analysis can influence the types of unsafe behaviors, demonstrating the importance of studying safety culture if one is to understand the influence of culture on safety in transportation. A positive safety culture at one level of analysis (organizational) can mitigate the negative impact of safety culture at other levels of analysis. A positive organizational safety culture can also mitigate the negative impact of challenging working conditions on safety behaviors and workplace accidents [12]. Surveys assessing safety culture, job demands, fatigue, mental health, well-being, and safety performance indicate that while safety culture is perceived positively, a number of factors can negatively impact safety. For example, data shows that high job demands negatively impact seafarers' recovery and long-term well-being.[13].

Violation of procedures is generally identified as an important causal factor in accidents; this illustrates that there is a need to study compliance and non-compliance in a broad context and to explore the factors that influence the tendency to act in accordance with procedures. Safety climate is positively related to safety compliance, shipowners, shipmasters, and stakeholders in the shipping industry must consider a broad multifactorial to improve safety compliance [14].Organizational factors related to leader-member exchange and team-member exchange that influence seafarers' safety behavior. There is a moderating role of safety climate in the relationship between leader-member exchange and team-member exchange and safety behavior to improve safety performance [15]. The operational performance of a shipping company is highly dependent on the performance of its employees. Various factors, both internal and external to the company, influence seafarers' performance on board. Safety culture, along with the work environment, ship specifications, and social impact, are among the determining factors for seafarers' performance [10]. The urgency of this research lies in the limited empirical studies that integrate seafarer behavior, safety culture, and seafarer performance in a single structural model, particularly in the context of merchant ships in Indonesia. Most previous studies position safety culture as an independent or descriptive variable, while this study positions it as a mediating variable that explains the mechanism by which seafarer behavior can translate into better operational performance. The significance of this research findings is not only academic in enriching maritime safety literature, but also practical for shipping companies and port authorities in designing behavior-based safety policies to improve performance and reduce ship accidents.

2. Method

This study uses a quantitative approach to analyze the influence of behavior through safety culture on seafarers' performance on merchant vessels. The quantitative approach was chosen because it can provide an accurate statistical picture of the relationship between variables in a measurable, testable, and generalizable manner. The object of this study is located at Berlian Port, Tanjung Perak, Surabaya, which is one of the main ports in Indonesia with quite heavy commercial ship traffic. The types of vessels that are the focus of this study are commercial vessels such as cargo ships, tankers, and container ships that are berthed at the port. These vessels were chosen because their operational activities reflect the real dynamics of seafarers' work in the context of safety and operational performance.

The population in this study was all seafarers working on merchant ships docked at Berlian Harbor. A sample size of 100 respondents was selected using a simple random sampling method, where each member of the population has an equal chance of being selected. The selection of respondents took into account efficiency of time, effort, and cost, while still ensuring the reliability and representativeness of the data. Data were collected using a questionnaire instrument designed based on the constructs of three main variables: seafarer behavior as the endogenous variable, safety culture as the mediating variable, and seafarer performance as the exogenous variable. Each indicator in the questionnaire was measured using a 5-point Likert scale, and the questionnaires were distributed directly to seafarers on board ships or around port docks. This aimed to obtain actual and contextual data based on field conditions. The following is a flowchart in the stages of this research:

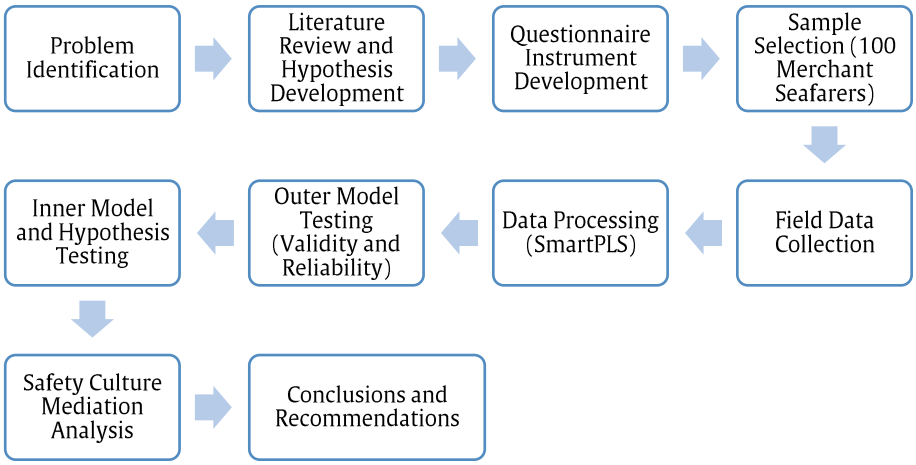

Figure 1. Research Stage Flowchart

Based on the flowchart of the research stages, the work process is carried out in stages as follows: Identification of problems based on the phenomenon of safety and performance of seafarers on merchant ships, Literature study of behavioral theories, occupational safety, and performance in the maritime sector, Formulation of conceptual frameworks and hypotheses based on theories and previous research results, Selection of quantitative research methods and preparation of questionnaires according to variable constructs, Data collection by distributing questionnaires to respondents according to sample characteristics, Data processing and analysis using SmartPLS-based statistical software, Interpretation of analysis results and hypothesis testing to answer research objectives, Preparation of conclusions and strategic recommendations for improving safety culture and seafarers' performance.

The data was analyzed using SmartPLS (Partial Least Squares) software because this method is capable of measuring causal relationships between latent variables and processing models with complex indicators, even with a limited sample size. The analysis process included:

- Convergent validity test (outer loading > 0.7 and AVE > 0.5),
- Construct reliability test (Composite Reliability > 0.7),
- Discriminant validity test (cross loading),
- Test the structural model (inner model) through the R^2, Q^2, and
- Path significance test (path coefficient) based on the t-statistic and p-value.

The final objective of this study is to determine the extent to which seafarer behavior influences performance, both directly and indirectly through safety culture. The second objective is to provide an empirical overview of the importance of safety culture in improving seafarer performance. The third objective is to develop strategic recommendations for shipping companies, port operators, and maritime safety regulators to improve the effectiveness of seafarer management in terms of safety and performance.

3. Results and Discussion

The construction of the path diagram for this study uses partial least square (PLS) which is presented in the Figure 2.

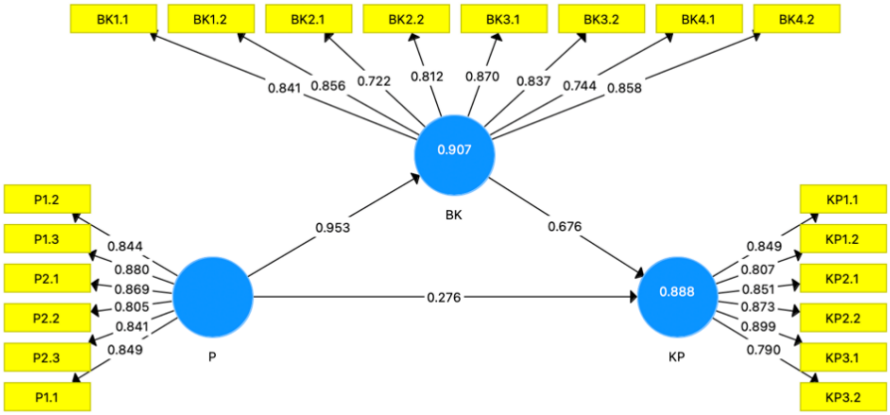

Figure 2. Path Diagram Construction

Figure 2 shows the structural relationship between behavioral variables (P), safety work culture (BK), and seafarer performance (KP). The one-way arrow depicts the causal relationship tested in the Partial Least Square (PLS) model, while the path coefficient value indicates the magnitude of the influence between variables. Seafarer Behavior (P) measured through two main dimensions, namely psychosocial and work environment. The psychosocial dimension includes work

motivation (P1.1), job satisfaction (P1.2), and stress management (P1.3) which describe the mental and emotional condition of seafarers in carrying out operational duties on board. Meanwhile, the work environment dimension includes the work environment (P2.1), safety facilities (P2.2), and work relationships (P2.3) which reflect the physical conditions and social relationships that support seafarers' work behavior.

Safety Culture (BK)measured through four dimensions, namely knowledge, skills, experience, and training. The knowledge dimension includes safety knowledge (BK1.1) and risk awareness (BK1.2) which relate to seafarers' understanding of procedures and potential work hazards. The skill dimension consists of safety skills (BK2.1) and emergency response (BK2.2) which reflect the seafarers' ability to apply safety procedures, especially in emergency conditions. The experience dimension includes work experience (BK3.1) and incident learning (BK3.2) which demonstrates the role of work experience in improving safety awareness and practices. Furthermore, the training dimension includes safety training (BK4.1) and work readiness (BK4.2) as indicators of seafarers' readiness to face operational risks through continuous learning. Seafarer Performance (KP) is measured through three dimensions, namely individual ability, shipowner demands, and safety. The individual ability dimension includes work ability (KP1.1) and work accuracy (KP1.2) which describe the competence and reliability of seafarers in carrying out tasks. The shipowner's requirements include operational standards (KP2.1) and work targets (KP2.2), which reflect performance achievements in line with shipping company expectations. Meanwhile, the safety dimension consists of safety compliance (KP3.1) and accident prevention (KP3.2), which demonstrates seafarers' contributions to maintaining ship operational safety.

Safety culture is positioned as a mediating variable explaining the indirect influence of behavior on seafarer performance. The outer model evaluation of this research is to ensure the validity and reliability of each indicator and construct. Validity is measured using convergent and discriminant validity, while reliability is measured using the R-square value. *Average Variance Extracted* (AVE) is a measure of convergent validity that shows how much variance is captured by a construct compared to the variance caused by measurement error. AVE is calculated using the following equation:

$$AVE = \sum(loading2) \quad (1)$$

Where:

- $\sum$(loading2) is the sum of the squares of all outer loading values on a construct;
- n is the number of indicators of the construct.

A good AVE value is > 0.5, which means that more than 50% of the indicator's variance is explained by the construct it measures. The results of the convergent validity test were assessed based on outer loading > 0.7 and average variance extracted (AVE) > 0.5, which are presented in Table 1.

Table 1. Convergent Validity Test Results

Variables	Indicators of each statement item	Factor loading	Conclusion
Behavior (P)	P1.1	0.849	Valid
	P1.2	0.844	Valid
	P1.3	0.880	Valid
	P2.1	0.869	Valid
	P2.2	0.805	Valid
	P2.3	0.841	Valid
Safety Culture (BK)	BK1.1	0.841	Valid
	BK1.2	0.856	Valid
	BK2.1	0.722	Valid
	BK2.2	0.812	Valid
	BK3.1	0.870	Valid
	BK3.2	0.837	Valid
	BK4.1	0.744	Valid
	BK4.2	0.858	Valid
Seafarer Performance (KP)	KP1.1	0.849	Valid
	KP1.2	0.807	Valid
	KP2.1	0.851	Valid
	KP2.2	0.873	Valid
	KP3.1	0.899	Valid
	KP3.2	0.790	Valid

Based on Table 1, all indicators in the three variables – namely Behavior (P), Safety Culture (BK), and Seafarer Performance (KP) – have a factor loading value above 0.7. For example, the first indicator of the Behavior variable in the third question (P1.3) has a loading of 0.880, the third indicator of the safety culture variable in the first question (BK3.1) is 0.870, and the third indicator of the Seafarer Performance variable in the first question (KP3.1) is 0.899, all of which indicate that these indicators have a strong correlation with the variables they measure. All factor loading values that exceed the threshold indicate that the indicators in this model meet the requirements for convergent validity. This shows that each indicator consistently and significantly reflects the intended latent construct. The convergent validity test was also carried out by determining the average variance extracted (AVE) value presented in Table 2.

Table 2. Average variance extracted (AVE) value

Variables	AVE
Behavior (P)	0.719
Safety Culture (BK)	0.671
Seafarer Performance (KP)	0.715

Based on Table 2 ValuesAVE (shows a value of more than 0.5 for each variable, meaning that the measurement model has met convergent validity, and the indicators used in this study are declared valid in measuring their respective constructs.

Discriminant validity is conducted to ensure that each indicator in the model only reflects the construct (latent variable) it represents and does not have a higher correlation with other constructs. One method to test discriminant validity is to compare the cross-loading value of each indicator against all latent variables in the model. The cross-loading value of each indicator on the formed variable is presented in Table 3.

Table 3. Discriminant Test Results of Cross Loading Values

Variable		Behavior (P)	Safety Culture (BK)	Sailor Performance (KP)
Behavior (P)	P1.1	0.849	0.786	0.800
	P1.2	0.844	0.822	0.756
	P1.3	0.880	0.824	0.772
	P2.1	0.869	0.837	0.807
	P2.2	0.805	0.788	0.752
	P2.3	0.841	0.789	0.790
Safety Culture (BK)	BK1.1	0.803	0.841	0.751
	BK1.2	0.796	0.856	0.798
	BK2.1	0.689	0.722	0.748
	BK2.2	0.791	0.812	0.731
	BK3.1	0.812	0.870	0.835
	BK3.2	0.781	0.837	0.771
	BK4.1	0.728	0.744	0.736
	BK4.2	0.833	0.858	0.774
Seafarer Performance (KP)	KP1.1	0.769	0.824	0.849
	KP1.2	0.702	0.743	0.807
	KP2.1	0.802	0.779	0.851
	KP2.2	0.832	0.824	0.873
	KP3.1	0.835	0.876	0.899
	KP3.2	0.716	0.702	0.790

Based on Table 3 presents the results of the cross-loading test between indicators from three main variables: Behavior (P), Safety Culture (BK), and Seafarer Performance (KP). Based on the Table 1, it is known that each indicator has the highest loading value on the construct it represents, and these values are all above 0.7. This indicates that these indicators have a stronger correlation with their original variables compared to other variables.

Construct reliability test. The aim is to determine the extent to which the indicators of a latent variable consistently measure the construct. One measure used to assess construct reliability in the Partial Least Squares (PLS) approach is Composite Reliability (CR). A good CR value is above 0.70, indicating that the construct has a high level of internal consistency and is reliable. The reliability test in this study uses composite reliability which can be presented in Table 4.

Table 4. Composite Reliability

Variables	Composite Reliability
Behavior (P)	0.922
Safety Culture (BK)	0.931
Seafarer Performance (KP)	0.924

Based on Table 4, it shows that the composite reliability value has a value greater than 0.70. This means that the three variables have excellent reliability and are reliable. Thus, it can be concluded that the indicators of each construct consistently reflect the latent variables being measured. These results strengthen the validity and reliability of the measurement model in this study, allowing the model to be used for further analysis, such as hypothesis testing in the inner model.

Structural model/inner model evaluation is conducted to see the relationship between latent variables. One of the measures used in the Partial Least Square (PLS) approach to assess model fit is Goodness of fit can be known by the Q2 value, the Q2 value can be calculated using the R2 value of each endogenous in the model. The Q2 value is presented in Table 5.

Table 5. Structural model evaluation

Variables	R Square	R Square Adjusted
Safety Culture (BK)	0.907	0.906
Seafarer Performance (KP)	0.888	0.885

Based on Table 5, the R Square can be known as Q2 as follows: Q2 = 1-(1-R12) (1-R22) = 1- (1-0.907) (1-0.888) = 0.9 = 90%. This shows that the model has excellent predictive ability, where 90% of the data variability can be explained by the

model. Specifically, the model can explain the safety culture variable by 90% and the seafarer performance by 88%, while the rest is explained by other factors outside the model. Meanwhile, the hypothesis test in this study can be presented in Table 6.

Table 6. Hypothesis Testing

Influence between variables	Path coefficient	T Statistics(O/STDEV)	P Value	Information
P→KP	0.276	2,160	0.031	Significant Influence
P→BK	0.953	55,376	0.000	Significant Influence
BK→KP	0.676	5,455	0.000	Significant Influence
P→BK→KP	0.644	5,536	0.000	Significant Influence

Based on Table 6, the research hypothesis can be explained as follows:

1. H1: Behavior has a significant influence on sailor performance
   The magnitude of the influence of behavior on seafarer performance is 0.276 with a t statistic of 2.160 > 1.96 and a P Value of 0.031 < 0.05, so it can be interpreted that behavior has a significant influence on seafarer performance. The results of the path coefficient, t-statistic, and P-values obtained indicate that the higher the behavioral value of a seafarer, the higher the seafarer's performance will be. Thus, the first hypothesis stating that behavior has a significant effect on seafarer performance can be accepted (H1 is accepted).
2. H2: Behavior has a significant influence on safety culture
   The magnitude of the influence of behavior on safety culture is 0.953 with a t statistic of 55.376 > 1.96 and a P Value of 0.000 < 0.05, so it can be interpreted that behavior has a significant influence on safety culture.The results of the path coefficients, t-statistics, and P-values obtained indicate that the higher the seafarers' behavioral values, the higher the safety culture. Therefore, the second hypothesis, which states that behavior has a significant effect on safety culture, is accepted (H2 is accepted).
3. H3: Safety culture has a significant influence on seafarer performance.
   The magnitude of the influence of safety culture on seafarer performance is 0.676 with a t statistic of 5.455 > 1.96 and a P Value of 0.000 < 0.05, so it can be interpreted that safety culture has a significant influence on seafarer performance.The results of the path coefficients, t-statistics, and P-values obtained indicate that the higher the safety culture possessed by seafarers, the higher the seafarer performance will be. Thus, the third hypothesis stating that safety culture has a significant effect on seafarer performance can be accepted (H3 is accepted).
4. H4: Safety culture as a mediating variable has a significant influence on the influence of behavior on seafarer performance.
   The magnitude of the influence of behavior on seafarer performance with safety culture as a mediating variable is 0.644.276 with a t statistic of 5.536 > 1.96 and a P Value of 0.000 < 0.05 so that it can be interpreted that safety culture as a mediating variable has a significant influence between behavior on seafarer performance. So, the fourth hypothesis states that safety culture as a mediating variable influential significant relationship between behavior and acceptable seafarer performance (H3 is accepted).

3.1. Discussion

3.1.1. Behavior has a significant influence on sailor performance

According to the hypothesis testing in Table 6, it shows that behavior has a positive and significant influence on sailor performance. (β = 0.276; p < 0.05) This means that to achieve high seafarer performance, it is necessary to pay attention to behavior, especially those related to psychosocial and environmental indicators. In the shipping industry, seafarer performance is crucial for operational smoothness, safety, and work efficiency on board. This finding is consistent with research [16], [17] which states that work behavior and psychosocial conditions play an important role in determining the operational performance of seafarers.

Sailor performance refers to the successful completion of task-related behaviors [18]. In this study, behavioral variables with psychosocial indicators include factors related to the mental and emotional conditions of sailors. Seafarers with stable psychosocial conditions, such as high motivation, job satisfaction, and low stress levels, will be more focused and meticulous in carrying out loading and unloading procedures, arranging ballast, and monitoring the ship's draft and trim. This is crucial for maintaining ship stability, especially when facing changing sea conditions. Motivation and job satisfaction, the enthusiasm and satisfaction of ship crews in carrying out daily tasks in ship operations. Stress and anxiety, the level of mental pressure experienced by ship crews during their duties, especially in challenging work environments.

Workload significantly impacts the reliability of the navigator's behavior on board the ship [19]. Social support, relationships between crew members, and effective communication. The impact on sailor performance is that motivated and psychosocially balanced sailors tend to have the ability to make the right decisions, quickly adapt to emergency situations on board, and complete tasks effectively. Regarding shipowner demands, when psychosocial stress is well managed, sailors will be better able to meet shipowner expectations, because they demonstrate high dedication and commitment to established work standards. Fulfilling safety, a stable psychosocial condition contributes to compliance with safety

procedures. Sailors who are not disturbed by excessive stress will tend to be more vigilant and consistent in carrying out safety procedures. Stress management styles depend on their position in the ship's hierarchy [20].

Environmental indicators relate to the physical and social conditions on board, including facilities and infrastructure. These include the availability or completeness of safety equipment, accommodation conditions, lighting, and ventilation that support seafarers' work. Regarding work comfort, safe and comfortable working conditions will support work productivity, such as ergonomic space arrangement and noise reduction. Physical environmental factors on board can impact seafarers' rest comfort [21]. Meanwhile, social relations and work culture are defined as a conducive work atmosphere and the values and norms applied on board. The influence of environmental indicators on behavioral variables affecting seafarer performance is based on individual capabilities. A supportive onboard work environment can provide space for seafarers to optimize their skills. Adequate facilities and a comfortable environment can improve concentration and accuracy in carrying out tasks. For shipowners who place high demands on seafarers' performance, supported by good environmental conditions, seafarers are better able to meet operational standards set by the shipowner, because they work in conditions that minimize the potential for error. To ensure safety, a safe and well-maintained work environment directly supports safety procedures. The availability of complete safety equipment and conducive physical conditions can play a significant role in reducing the number of ship accidents.

Optimal seafarer performance is achieved when both psychosocial and environmental indicators support each other. Even if seafarers possess good technical skills, without psychosocial support such as motivation and stress management, their performance can decline. Seafarers' behavior, mood, and lifestyle influence performance [22]. Similarly, inadequate work facilities can hinder the application of these skills. Meeting shipowner expectations depends heavily on a combination of mental (psychosocial) readiness and physical working conditions (environment). Training that integrates psychosocial aspects and infrastructure improvements can help seafarers meet stringent operational standards. High safety standards can be met if seafarers work in a stable psychological state and a safe working environment. Mental wellness programs and improvements to safety facilities on board are strategic steps to achieve this goal. A ship's durability is greatly influenced by how consistently and consistently it is operated and maintained. Motivated and stress-manageable sailors tend to demonstrate high levels of dedication to daily inspections, leak checks, and hull maintenance, thereby extending the ship's lifespan and preventing structural damage.

3.1.2. Behavior has a significant influence on safety culture

Safety culture on board a ship is the main foundation in maintaining operational integrity, reducing the risk of accidents, and ensuring the smooth running of tasks during the voyage. Behavioral variables, which include psychosocial and environmental aspects, have a vital role in shaping safety culture on board. The influence of behavior on psychosocial indicators of safety culture, namely on knowledge. Motivated seafarers and those with social support tend to be more open to receiving information and updating their knowledge regarding safety procedures. Furthermore, the skill indicator, good psychosocial conditions can help seafarers in honing technical skills through independent learning and teamwork. Furthermore, the experience indicator, effective stress management allows seafarers to learn from difficult situations and integrate those experiences into safety practices. Types of negative safety compliance behaviors are indicators of a decline in the level of safety culture. Safety culture at various levels of analysis can influence various types of unsafe behaviors which in turn affect the risk of work accidents [23].

The environmental indicator influencing the safety culture indicator is knowledge. A supportive work environment with adequate facilities facilitates access to information sources and documented safety procedures. Skills, safe and comfortable physical conditions allow seafarers to practice and implement technical skills consistently. Experience, a conducive work environment can create opportunities for seafarers to engage in real-life situations that increase practical experience in dealing with potential risks. Training, adequate infrastructure can support the implementation of regular training and emergency simulations, which are important aspects in improving preparedness to face critical situations.

The relationship between psychosocial and environmental factors in building a safety culture on board a ship is through the integrity of knowledge and skills. Seafarers who are psychosocially supported and work in a conducive environment will more quickly absorb safety knowledge and apply it in practice, thereby continuously improving their skills. A characteristic of a safety culture is a commitment to safety [24], another important aspect of safety culture is the culture of information, reporting, and learning and reflecting on practices [25], [26].Prevent major accidents through system management and layered defenses. Leveraging experience, good stress management and a safe environment allows seafarers to reflect on their experiences, so that learning from critical situations can be internalized into work habits [25]. Health risk perception & community resilience based on local wisdom [26]. Optimizing training, motivation and social support encourage active participation in training, while a supportive physical environment can facilitate the practical process, both through simulations and regular exercises.

3.1.3. Safety culture has a significant impact on seafarer performance

A safety culture on board a ship is a key element in effective shipping operations. Implementing a strong safety culture not only increases awareness and adherence to procedures but also impacts the overall performance of seafarers. Seafarer performance is measured by individual capabilities, the extent to which seafarers meet shipowner demands, and success in meeting safety standards.

The impact of safety culture on seafarer performance. Individual capabilities, knowledge integrity, and skills. Adequate knowledge of safety regulations and technical skills honed through training and experience enhance the ability of individual seafarers to perform their duties. The primary objective of the International Safety Management Code is to create a culture of safety in the maritime industry [27]. The right decisions, a strong safety culture equips seafarers with the ability to make quick and correct decisions in emergency situations, which is a key indicator of optimal individual performance.

Shipowners demand high operational standards. Shipowners demand high work standards and strict adherence to safety procedures. A safety culture internalized through knowledge, skills, experience, and training better prepares seafarers to meet these expectations. Trust and reputation: By implementing a consistent safety culture, shipping companies can increase shipowner trust, as seafarers demonstrate commitment and professionalism in every aspect of their operations.

Fulfillment of ship safety through compliance with safety procedures. Good knowledge and training ensure that every seafarer understands and consistently implements safety procedures, thereby ensuring safety standards are met. Regarding risk reduction, skills and experience enable effective risk identification and mitigation, which directly impacts safety compliance on board. In monitoring and evaluation systems, a good safety culture can also create a continuous internal evaluation system to assess and improve the implementation of safety procedures.

The relationship between safety culture and seafarer performance in this study is reflected in the improvement of individual capabilities. Seafarers who are continuously equipped with the latest information and training will be more responsive and reliable in dealing with various situations, both routine and emergency. Meanwhile, in meeting the demands of shipowners, the high standards set by shipowners can be met well because seafarers have adequate competence and readiness. Organizations, companies, and departments largely depend on the skills and knowledge of employees to stay in business [28]. Compliance with safety standards, with a deep understanding and high operational capabilities, seafarers are able to maintain and improve safety on board ships, reduce the risk of accidents, and create a safer working environment.

3.1.4. Safety culture as a mediating variable has a significant influence on the influence of behavior on seafarer performance.

Safety culture on board ships acts as a mediating variable, meaning that safety culture is not only an end result but also a mechanism that strengthens the relationship between seafarers' behavior and their operational performance. The results of this fourth hypothesis, presented in Figure 1 and Table 6, demonstrate that safety culture has a strong mediating role (β = 0.644). The results of this study are in line with thatseafarers' activities are controlled by a planned system [29]. Safety culture in this study is the result of the interaction between knowledge, skills, experience, and training applied on board. The results of this study are in line with the findings of other studies, namely that safety culture has an influence on pro-safety and pro-environmental behavior [30]. The results of this study indicate that safety culture can function to internalize knowledge. Seafarers who continuously receive information and updates regarding safety regulations from shipping company managers will be more aware of potential risks and preventative measures. Seafarers can hone their skills; practical skills acquired through training and experience enable them to respond to emergencies. Optimizing experience, meaning learning from previous experiences allows seafarers to make more informed decisions in the future. Furthermore, strengthening training, meaning that ongoing training programs can ensure that seafarers have the latest knowledge and skills relevant to safety standards. Through behavioral characteristics in decision-making, ship collisions can be avoided [31].

Safety culture as a mediator has a significant influence on the relationship between behavioral variables and seafarer performance, namely by translating behavior into safety actions. Safety culture influences safety behavior [12]. Merchant seafarers with positive psychosocial behavior and a supportive onboard work environment tend to internalize safety values more quickly through a safety culture. This ensures that the knowledge and skills acquired by seafarers are not only retained but also consistently applied. This research, supported by the role of embedded climate and psychological capital in the relationship between perceived psychological well-being and perceived ethical climate, demonstrates positive organizational attitudes and behaviors [32]. Then facilitate the transfer of knowledge and experience. Through systematic training programs and strengthening field experience, safety culture ensures that each seafarer can develop the individual capabilities necessary to meet shipowner demands and safety standards. Safety culture is a way of thinking or acting that is relevant to safety through negotiation with people in a social environment [12]. Next, strengthen the link between theory and practice. A strong safety culture integrates theoretical aspects (knowledge and training) with practical practices (skills and experience), so that positive seafarer behavior is directly reflected in high operational performance.

4. Conclusion

Based on the results of the Partial Least Square (PLS) analysis, this study concludes that seafarer behavior has a significant influence on seafarer performance (β = 0.276), behavior has a very strong influence on safety culture (β = 0.953), and safety culture has a significant influence on seafarer performance (β = 0.676). Safety culture is proven to act as a significant mediating variable with an indirect effect of 0.644. The results of this study confirm that improving seafarer performance depends not only on technical competence, but also on strengthening behavior and systematic internalization of safety culture on board. Safety culture internalizes safety values and ensures that positive seafarer behavior can be translated into concrete actions on board merchant vessels. The commercial vessels in this study are cargo ships, tankers, container ships, and passenger ships. Determining the type of commercial vessel is crucial because each type of vessel has different operational characteristics and levels of safety risks. Safety culture serves as a performance enhancer for seafarers, meaning that a safety culture can help seafarers be more prepared, professional, and consistent in meeting established operational and safety standards. A well-established safety culture on board can mediate the link between behavioral aspects and seafarer performance outcomes. Therefore, shipping companies need to emphasize the development and maintenance of a strong safety culture as a primary strategy to improve seafarer performance and achieve safe and efficient ship operations.

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