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Assessment of Seafarers' Safety Precautions During Dry Docking Operations: A Focus on Safety Signs, PPE, and Hot Works

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ABSTRACT

This research assesses safety precautions awareness among seafarers during dry docking operations at the Dunggo-an Danao City, Cebu facility in 2023. Using a descriptive quantitative method, data was collected through a structured questionnaire distributed among seafarers with dry docking experience. The study profiles respondents based on age, gender, years of service, and rank, then examines their awareness of safety signs, personal protective equipment (PPE), and hot works. Results show that most seafarers were males aged 22-29, with 60% falling into this group. A notable proportion had 1-5 years of service, highlighting the presence of relatively inexperienced seafarers. The most common rank was oiler, representing 30% of the sample.

While respondents showed a high level of awareness regarding PPE and hot works, they demonstrated only moderate awareness of safety signs, classified as "Sometimes Aware." This highlights the need for enhanced training to improve seafarers' understanding of critical safety signs during dry docking.

The study concludes that there is a need for ongoing improvement in safety protocols at the facility to address these gaps and ensure the safety of seafarers. Enhancing safety awareness not only reduces risks but also improves the overall service quality of the facility.

1. Introduction.

Dry docking, a pivotal procedure in the maritime industry, is indispensable for the construction, maintenance, and repair of merchant vessels and boats. This process, involving the docking of a ship in a controlled, dry environment, enables detailed inspections and repairs that are unfeasible while the vessel is in the water. The rigorous examination and maintenance of various submerged components of the ship, including the hull, propeller, and rudder, are crucial for ensuring their operational integrity. To adhere to international maritime regulations, particularly the Safety of Life at Sea (SOLAS) regulations, all merchant vessels must undergo an intermediate survey within 36 months and a comprehensive dry dock inspection twice every five years. Additionally, an annual inspection of the ship's bottom is mandated to ensure ongoing seaworthiness (House, 2015).

Despite being a routine practice, dry docking poses significant risks to seafarers. The tasks performed during this phase, such as working at heights, operating heavy machinery, handling hazardous materials, and performing mechanical repairs, expose workers to a high potential for accidents and injuries. Even with stringent safety protocols in place, dry docking remains one of the most hazardous activities that seafarers face. Therefore, ensuring the safety of personnel during this operation is paramount for the maritime industry. The complex nature of dry docking also has a broader impact, affecting not only the safety of the workers but also the surrounding environment and the reputation of the maritime organizations involved (House, 2015).

The primary objective of this study is to assess the level of awareness among seafarers regarding safety precautions during dry docking. Specifically, it aims to evaluate seafarers' understanding and adherence to critical safety measures in three

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key areas: safety signage, the proper use of personal protective equipment (PPE), and the protocols for conducting hot works. By examining these aspects, the study seeks to identify gaps in safety awareness and highlight areas where further training or reinforcement may be needed to reduce accidents and enhance overall safety during dry docking operations. The results of this study will offer insightful information about the effectiveness of current safety protocols and the extent to which seafarers are equipped to protect themselves in this high-risk environment.

2. Methodology.

This section details the comprehensive methods used in the process of gathering the data from the respondents. The research team utilized a variety of sources, including surveys, journals, internet sources, and other available materials, to ensure a thorough and accurate collection of data.

2.1. Design.

This study determines the safety precautions awareness of seafarers during dry docking of ships. The researchers used descriptive quantitative methods of study, a reliable approach that was used to describe the situation accurately and systematically. By using this design, the researchers were able to determine the level of awareness of seafarers during the dry docking of ships.

2.2. Environment.

The research was conducted in the area of a drydocking facility at Dunggo-an Danao City Cebu. The research environment was chosen since it is the accredited dry dock facility near the campus where the researcher is located. The dry dock facility at Danao City Cebu is known to be one of the best dry dock and port facilities in Cebu. It is one of the best and is known for its good and experienced dry dock at Cebu. It was established on June 07, 1961, and was one of the most popular and considered one of the oldest dry dock facilities in Cebu. The research locale was selected due to the accessibility of the respondents and the researcher.

2.3. Research Respondents.

Purposive sampling was used in this study. This non - probability sampling method is used by researchers to rely on their judgment when choosing the population to participate in this study. It is composed of a survey.

The research respondents of the study were seafarers at the drydocking facility at Dunggo-an Danao City, Cebu. The respondent must be a seafarer. This study comprises 30 selected seafarers at the drydocking facility at Dunggo-an Danao City, Cebu.

Table 1: Distribution of the Respondents.

RESPONDENTS	FREQUENCY	%
Males	30	100%
Females	0	0%
Total	30	100%

Source: Authors.

2.4. Research Instruments.

The researcher used a survey questionnaire as its research instrument. The questionnaire was composed of two major parts. The first part dealt with the personal profile of the respondents in terms of age, gender, number of years onboard, rank, and current position, and the second part dealt with the rate how much they are aware of the potential hazards during their duty, Hufana, D., & Gurat, M. (2023). The questionnaire does not necessarily need an identity; the primary purpose is to give them privacy and gratitude for their participation and attention to the current issues. The questionnaire comprises 15 questions; 5 are related to safety signs, five are related to Personal Protective Equipment, and the other five are connected to safety at hot works.

2.5. Research Procedures.

2.5.1. Gathering of Data.

The data relevant to the study was through primary sources using a survey questionnaire distributed directly to the respondents. Secondary data was taken from books & Internet.

2.5.2. Treatment of Data.

The following statistical tools were used in the study.

Frequency Count and Per Cent were used to summarize, analyze, and interpret the profile of the respondents.

Weighted Mean was used to summarize, analyze, and interpret the responses on the awareness of safety precautions during drydocking to seafarers regarding signs, personal protective equipment, and hot works.

3. Presentation, Analysis and Interpretation of Data.

The presentation, analysis, and interpretation of this chapter's content data gathered from the respondents of this study.

3.1. Profile of the Respondents.

The respondents' profiles are shown in this section in terms of age, gender, rank, number of years onboard, and position.

Table 2: Profile of the Respondents.

Profile	Frequency	Per Cent
Age (Years)		
• 60 years old and above	2	6.67
• 50-59 years old	1	3.33
• 40-49 years old	2	6.67
• 30-39 years old	6	20.00
• 22-29 years old	18	60.00
• 21 years old below	1	3.33
Gender		
• Male	30	100.00
• Female	0	0
Rank		
• Master	2	6.67
• 2nd Mate	1	3.33
• Bosun	3	10.00
• Deck Cadet	5	16.67
• AB (Able Seaman)	5	16.67
• OS (Ordinary Seaman)	2	6.67
• Chief Engineer	1	3.33
• Fitter	1	3.33
• Oiler	9	30.00
• Cook	1	3.33
Current Position		
• Management Level	3	10.00
• Operational Level	1	3.33
• Support Level	26	86.67
No of Years Onboard		
• Less Than a Year	11	36.67
• 1-5 years	15	50
• 6-10 years	1	3.33
• 11 years and above	3	10
Grand Total	**30**	**100**

Source: Authors.

As indicated in Table 2, a majority of the respondents are 22-29 years old (60.00%), all-male (100%), current position is on support level (86.67%), and mostly oiler (30%). Furthermore, most respondents are on board for less than one year (36.67%). These findings imply that most seafarers are younger individuals dominating the workforce; there may be a greater need for ongoing training and development, particularly for advanced positions. This could suggest a high turnover or recruitment emphasis on younger recruits, possibly due to the physically demanding nature of maritime jobs. Gender distribution is highly imbalanced, with (100%) of the participants being male. This aligns with global trends in the marine industry, which is historically male-dominated, though there have been efforts to improve gender diversity in recent years. This highlights an opportunity for greater inclusion of women in maritime careers. The sample's low representation of women could also indicate structural barriers to entry for women or a lower participation rate overall in this field. The dominance of mid-level and entry-level ranks, particularly Oilers, may reflect the structure of the maritime industry, where the workforce consists of a large proportion of support staff with fewer senior officers. The workforce is predominantly composed of individuals with relatively low to moderate experience. The large proportion of workers with 1-5 years of experience could indicate that the industry is bringing in fresh recruits who are gaining knowledge. Still, it may also reflect high turnover rates or limited career longevity for seafarers.

The employment, engagement, or Work of seafarers under 18 is prohibited when such Work is likely to jeopardize their health or safety. The types of such Work shall be determined by national laws or regulations or by the competent authority in consultation with shipowners' and seafarers' organizations by relevant international standards (MLC, 2006, Standard A1.1).

4. Safety Precautions Awareness to Seafarers During Dry Docking.

This section presents seafarers with awareness of safety precautions during drydocking, such as safety signs, personal protective equipment, and hot works. Table 3 shows the Safety signs.

Table 3: Safety precautions for seafarers in terms of Safety Signs.

Questions	Mean	Description	Interpretation
1. How aware are you of the safety signs posted during dry docking operations?	2.53	Sometimes	Less Aware
2. To what extent are you familiar with the safety evacuation signs within your workplace during dry docking?	2.8	Modified	Fairly Aware
3. How confident are you in recognizing and understanding the emergency evacuation signs in your workplace during dry docking?	2.93	Sometimes	Fairly Aware
4. How well can you interpret the various safety signs used specifically during dry docking procedures?	2	Modified	Less Aware
5. Do you consistently follow the safety signs and labels during dry docking operations?	3.07	Sometimes	Very Aware
Total	**2.67**	**Sometimes**	**Sometimes Aware**

Source: Authors.

The data on safety awareness among crew members during dry docking operations reveals crucial insights into their understanding and adherence to safety protocols. The overall mean score of 2.67, categorized as "sometimes aware," reflects a moderate level of safety awareness but also indicates notable gaps that need addressing to ensure a safer working environment. The mean score of 2.53 for awareness of safety signs shows that crew members are "sometimes aware" of these critical safety signals. This level of awareness is concerning, as recognizing safety signs is essential for ensuring quick and effective responses in emergencies. The designation of "less aware" suggests an urgent need for enhanced training and drills focused specifically on safety and identifying safety signs. The scores of 2.80 and 2.93 for awareness of safety and emergency evacuation signs are categorized as "fairly aware." While this shows

a foundational understanding, it is evident that crew members require further education and practical exposure to evacuation procedures and signage. Strengthening awareness through regular training sessions, refreshers, and visual aids could significantly improve responsiveness during emergencies. The score of 2.00 for the ability to interpret different signs used during dry docking is particularly concerning and indicates "less awareness." This gap highlights a critical area that needs immediate attention, as misinterpretation of signs can lead to accidents and unsafe practices. The mean score of 3.07, categorized as "sometimes," suggests that while there is reasonable compliance with following signs and labels during dry docking, it is not yet at an ideal level. Encouraging a safety-first culture through consistent reminders, accountability measures, and integrating safety practices into daily routines can foster greater adherence and proactive engagement with safety protocols. The total mean score of 2.67 indicates the crew's overall awareness of safety precautions during dry docking is moderate, marked as "sometimes aware." The data underscores the importance of enhancing safety awareness and compliance among crew members during dry docking operations. Organizations can significantly elevate the crew's understanding of safety signs and protocols by prioritizing targeted training, improving communication strategies, and actively fostering a culture of safety. This proactive approach will contribute to a safer working environment, reducing the likelihood of accidents and ensuring the well-being of all personnel on board. Continuous monitoring and evaluation of training effectiveness will be essential in sustaining improvements in safety awareness over time.

Safety signs and symbols are extensively used on board ships to alert crew members to working hazards, escape routes, equipment types, and more. These signs serve as pictorial illustrations that help seafarers increase their level of personal safety on ships. Safety signs employ a variety of colors and symbols, which have been standardized and acknowledged by regulatory bodies in the shipping industry to communicate essential aspects related to the operation and maintenance of ships. Seafaring professionals must identify and comprehend these safety signs, as they play a crucial role in reducing the number of accidents on board (Wankhede & Kantharia, 2012).

This section shows the Safety awareness to seafarers in terms of Personal Protective Equipment.

Table 4: Safety awareness to seafarers in terms of Personal Protective Equipment.

Questions	Mean	Description	Interpretation
1. Are you aware of the necessary safety equipment to be used before entering the dry dock?	3.2	Sometimes	Less Aware
2. Has the dock master informed you of potential hazards associated with not wearing safety equipment?	3.6	Sometimes	Fairly Aware
3. Are you familiar with the safety equipment you regularly use during dry docking operations?	3.47	Always	Very Aware
4. Do you routinely check your safety equipment before using it in dry dock operations?	3.47	Always	Very Aware
5. Have you received proper training on the correct use of personal protective equipment (PPE)?	3.47	Always	Very Aware
Total	**3.44**	**Always**	**Very Aware**

Source: Authors.

The overall Mean of **3.44**, interpreted as "**Very Aware**," indicates that most respondents have a solid understanding and adherence to safety precautions, especially regarding the use of personal protective equipment (PPE) during dry docking operations. The results show that respondents are generally well-informed and consistent in applying safety measures, with a particular emphasis on routine checks and familiarity with PPE.

However, there are areas where **awareness could be more robust**. For instance, the respondents show **less awareness** when it comes to the initial identification of necessary safety equipment before entering the dry dock (Mean: 3.2). This gap highlights the need for improved safety briefings or preparatory instructions before drydocking to ensure everyone is fully aware of what equipment is required.

Furthermore, respondents are only **fairly aware** of the potential hazards of not wearing safety equipment (Mean: 3.6). This suggests that communication from dock masters could be enhanced to ensure a more thorough understanding of risks. Strengthening this aspect could help to elevate overall safety awareness to the "Very Aware" level in all categories.

In summary, while there is a high level of awareness and **compliance** in most areas of PPE use, targeted safety briefings and hazard communication improvements can further enhance overall safety during dry docking operations.

Personal Protective Equipment (PPE) is a critical component of workplace safety across various industries, and the international maritime industry is no exception. Seafarers routinely utilize essential PPE items, including overalls, hard hats, safety boots, gloves, and safety glasses. These protective measures are fundamental in safeguarding maritime workers' health and safety (Devereux, H., & Wadsworth, E. (2023).

The importance of PPE extends beyond mere compliance; it plays a significant role in minimizing exposure to hazards that could lead to injuries or health issues. According to the Occupational Safety and Health Administration (OSHA, 2022), the appropriate use of PPE has been shown to impact worker health and safety across industries positively.

Despite the well-documented benefits of PPE, research across various sectors indicates that effective utilization is not always achieved. Several studies have identified many reasons for the inconsistent use of PPE among workers. Lombardi et al. (2009) categorized these reasons into three primary factors influencing PPE usage: perceptions of hazards and risks, enforcement of PPE regulations, and barriers to usage.

Table 5 shows the Safety awareness of seafarers in terms of Hot Works.

The survey results regarding hot works safety awareness during dry docking provide a comprehensive insight into the attitudes and preparedness of workers in this critical area of maritime operations. With a total mean score of **3.36**, categorized as **"Always,"** it is evident that workers generally exhibit high awareness and commitment to safety practices during hot work operations in dry docking. This indicates that safety has become a fundamental aspect of their operational mindset. The mean score of **3.20** for the question regarding the adequacy of safety training reflects a perception of **"Sometimes."** This suggests that while the training provided is rec-

Table 5: Hot Works Safety Awareness.

Questions	Mean	Description	Interpretation
1. Do you believe that the safety training provided adequately prepares you for hot work situations?	3.2	Sometimes	Fairly Aware
2. How often do you actively apply safety awareness while performing hot work tasks?	3.47	Always	Very Aware
3. How confident are you in your ability to safely execute hot work tasks?	3.47	Always	Very Aware
4. In your opinion, are the necessary safety precautions consistently taken before commencing hot work?	3.2	Sometimes	Fairly Aware
5. Do you consistently adhere to best practices for hot work operations during dry docking?	3.47	Always	Very Aware
Total	3.36	Always	Very Aware

Source: Authors.

ognized as beneficial, there may be some gaps in preparation for real-world hot work situations. Workers may require more comprehensive training to confidently address the unique challenges of hot works in dry docking. The response regarding the frequency of applying safety awareness (**3.47**) shows that workers actively engage in safety practices and prioritize safety while performing hot work tasks. This **"Very Aware"** status indicates a proactive approach, suggesting that workers understand the importance of safety measures and integrate them into their routines.

Similarly, the consistent mean score of **3.47** for confidence in safely executing hot work tasks demonstrates that workers feel equipped to manage the risks. This confidence is crucial for fostering a safe work environment, as it empowers employees to make informed decisions and take necessary precautions. The score of **3.20** for the consistency of safety precautions before commencing hot Work indicates a need for improvement. While workers acknowledge the importance of safety measures, there is a perception that these precautions may not always be uniformly applied. This highlights the necessity for organizations to reinforce safety protocols and ensure they are diligently followed. A mean score of **3.47** for adherence to best practices signifies that workers consistently follow recommended safety practices during dry docking operations. This reflects the safety culture positively, suggesting that best practices are well understood and executed. In conclusion, the data reveals a generally **positive safety culture** among workers in hot works during dry docking. While there is a solid commitment to safety practices and confidence in execution, there remains room for improvement in the adequacy of training and the consistency of safety precautions.

Hot Work is any task that generates high temperatures or produces an incentive spark. This includes welding, burning, drilling, chipping, grinding, using mechanical tools, operating equipment powered by internal combustion engines, electrical Work, and utilizing non-intrinsically safe electrical equipment like lamps or torches, which may create incendiary sparks. Hot Work should only be considered if no practical alternative means of repair are available (Ship Management System – Shipping Company A (Europe), 2018; Ship Management System – Shipping Company B (Europe), 2020; Ship Management System – Shipping Company C (Europe), 2015; Ship Management System – Shipping Company D (Asia), 2017).

Before initiating Hot Work, the following precautions must be observed and confirmed:

- The work area must not be subject to vapor release or have combustible vapors present and must be free from any flammable materials.
- The area should be gas-free, and tests using a combustible gas indicator should return readings of no more than 1% of the Lower Flammable Limit (LFL).
- No cargo operations, bunkering, tank cleaning, gas freeing, purging, or inerting activities should be in progress. The vessel must be kept from a terminal or port.
- Adequate fire-fighting equipment must be arranged and ready for immediate use.
- The hopper and nozzle should be electrically bonded to the deck or the equipment being worked on for grit blasting.

The Safety Management System (SMS) should include procedures and guidelines for ensuring the safe management of all operations, tasks, and health measures aboard Company vessels. The SMS applies to everyone on board, including supernumeraries and shore management personnel. Company personnel, whether onboard or ashore, should be committed to achieving safety and environmental excellence. Senior Officers on board and Managers ashore should demonstrate their commitment by providing clear guidance, setting precedents, and displaying leadership to promote safety and environmental excellence (Konwencja SOLAS, 1998; ISM Code, 1998; Standard OHSAS 18001:2007; British Standards No. 4778).

The Shipping Management Company implements the SMS, reinforcing safety and environmental efforts onboard managed vessels (Lloyds Register of Shipping, 2006). According to Beyene et al. (2019), awareness of occupational hazards and safety measures is critical among workers, such as welders, to mitigate risks associated with Hot Work.

5. Discussion.

This study aimed to assess the safety precautions followed by seafarers during dry docking operations. Given the high-risk nature of these procedures, understanding seafarers' adherence to safety protocols is essential to ensure a safer working environment. The study focused on evaluating seafarers' safety awareness and practices in key areas, identifying gaps, and recommending improvements.

Specifically, the study sought to address the following research questions:

1. **What is the profile of the respondents in terms of:**
   1.1. Age
   1.2. Gender
   1.3. Years of service
   1.4. Rank
   1.5. Current Position
2. **What are the safety precautions that seafarers must follow during dry docking in terms of:**
   2.1. **Safety Signs**: How well do seafarers understand and follow safety signs, especially regarding fire and evacuation procedures, and how do they interpret various signs used during dry docking operations?
   2.2. **Personal Protective Equipment (PPE)**: To what extent are seafarers aware of the proper use of PPE, and how consistently do they follow protocols related to PPE during dry docking?
   2.3. **Hot Works**: How aware are seafarers of safety procedures during hot Work?

5.1. Findings.

The following are the salient findings of the study:

1. **Respondents' Profile**: The study identified that most respondents were young (22-29 years old), male, with less than one year of service, and holding support-level positions like oilers. This demographic profile suggests that many respondents might be relatively inexperienced in dry docking, emphasizing the importance of targeted safety training for newer and lower-ranking crew members.
2. **Safety Precautions for;**
   2.1 Signs: The findings revealed gaps in the awareness and interpretation of critical safety signs, including fire and emergency evacuation signs. Despite a foundational understanding, the score for sign interpretation (**??**) highlighted the need for immediate improvement. Training and reinforcement in understanding and following signs could reduce risks, especially during emergencies.
   2.2 PPE Awareness: While there was a generally high level of awareness (mean score: 3.44) regarding PPE use, there was a noted gap in identifying the required PPE before entering the dry dock. This points to the necessity of more thorough safety briefings and better pre-docking instructions, particularly for newer crew members who may be less familiar with procedures.
   2.3 Hot Work Awareness: Awareness of safety during hot work operations was high, with a total mean score of 3.36, reflecting a solid commitment to safety practices. However, training adequacy was rated at 3.20, suggesting that while workers recognize the importance of safety, more comprehensive and scenario-based training is required to prepare them for the complexities of real-world hot work scenarios.

Conclusions and Recommendations.

Conclusion.

The findings indicate that the crew generally exhibits a moderate to high level of safety awareness, particularly in using PPE and compliance with best practices during dry docking and hot work operations. However, there are noticeable gaps, particularly in fire sign awareness, interpretation of safety signs, and consistency in applying safety precautions. While a strong safety culture exists, safety training and communication around potential hazards require strengthening.

Recommendations.

Based on the findings of our study, we offer the following recommendations.

1. Implement Targeted Safety Training for New and Lower-Ranking Crew Members.
2. Enhance Fire Safety and Emergency Evacuation Training.
3. Conduct Pre-Docking Safety Briefings Focused on PPE Requirements.
4. Provide Comprehensive Hot Work Safety Training.
5. Improve Communication and Reinforce Safety Culture.

Nomenclature.

Standards and Codes
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