



Regular Research Article

Personal Protective Equipment Compliance During Ship Docking: A Case Study of KM. Pantokrator

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Abstract: This study examines Personal Protective Equipment (PPE) compliance during ship docking activities on board KM. Pantokrator and identifies factors influencing its implementation. A qualitative descriptive approach was employed during a 12-month sea-practice period from August 2024 to August 2025, with primary observations conducted during the vessel's docking and maintenance activities at JMI II Semarang from October to December 2024. Data were collected through direct observation, semi-structured interviews with four informants comprising a Third Officer, Bosun, Able Seaman, and Kasap, and supporting documentation. The data were analyzed through qualitative coding supported by NVivo and validated through triangulation of observation, interview, and documentary evidence. The findings show that PPE compliance was inconsistent across work activities, particularly during maintenance tasks such as chipping, painting, grinding, cleaning, and work at height. PPE use was influenced by personal awareness, comfort, supervision, equipment availability, and work culture. Documentary evidence also indicated limitations in PPE availability and procurement fulfillment. Compliance tended to improve when supervision was present but was less consistent during routine work without direct monitoring. The study concludes that improving PPE compliance requires more than providing equipment; it requires systematic supervision, adequate PPE stock management, timely procurement, and reinforcement of a safety culture in shipboard work practices.

Keywords: Personal Protective Equipment; PPE Compliance; Ship Docking; Occupational Safety; Safety Culture; Maritime Safety

1. Introduction

Maritime transportation plays an important role in connecting regions and facilitating the movement of goods, vehicles, and passengers. In Indonesia, where many regions are separated by sea, commercial shipping forms an important part of the national transportation system. However, maritime operations are inherently complex and involve various occupational hazards that may affect the safety of ship crews [1], [2].

Ship crews may be exposed to hazards arising from working conditions, shipboard operations, machinery and equipment, maintenance activities, noise, vibration, and other operational factors [3], [4]. Maintenance activities, in particular, may involve demanding

working conditions and multiple factors that can increase the potential for human error and occupational risk [3]. Previous research has also documented occupational accidents among personnel working in maritime transportation, indicating the importance of effective safety management and the consistent implementation of safety practices on board ships [2], [5]. Therefore, occupational safety in maritime operations requires not only established safety management systems but also their consistent implementation during shipboard operations [6].

One important component of occupational safety is the use of Personal Protective Equipment (PPE), including safety helmets, gloves, safety shoes, eye protection, hearing

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protection, and other task-specific protective equipment. PPE provides protection against occupational hazards that remain after other risk-control measures have been applied [7]. In maritime operations, however, the availability of PPE does not necessarily ensure its consistent use. Research on PPE use among cadets on board has shown that although personnel may have a good understanding of the importance and function of PPE, its actual use may still be incomplete or inconsistent [8]. Other research has also examined the use of PPE as a means of reducing accident risks among ship personnel [9]. These findings indicate that the effectiveness of PPE in occupational safety depends not only on the availability of equipment but also on its appropriate and consistent use during work activities[8], [9].

PPE compliance can also be influenced by individual and organizational factors. Previous research has identified relationships between personal factors and PPE-use behavior [10], while studies in the maritime sector have emphasized the importance of safety perception, safety behavior, and organizational safety conditions [11]. Safety culture is also an important factor in shaping safety behavior among ship personnel. Previous research has highlighted the relationship between safety culture, working conditions, and personal injuries in maritime transport, while recent research among ship deck officers found that safety culture has a positive relationship with safety behavior[1], [12]. In addition, research conducted in Indonesian shipping companies has examined factors associated with the safety climate of ship crews [13]. These findings suggest that PPE implementation should not be viewed solely as an equipment-related issue but also as part of broader individual and organizational safety practices.

The issue becomes particularly important during ship maintenance and docking activities. Unlike routine voyage operations, docking involves more intensive maintenance activities, including chipping, painting, grinding, cleaning, and work at height. Such activities may expose crew members to several hazards simultaneously and require the use of appropriate task-specific PPE. Maintenance

activities on marine systems have been associated with demanding working conditions and the potential for human error, further emphasizing the importance of effective safety practices during maintenance work [3]. Consequently, the implementation of PPE during maintenance activities provides an important context for evaluating whether established safety requirements are consistently applied under actual shipboard working conditions.

Previous studies have examined PPE use, occupational accidents, safety behavior, and safety culture in maritime and other occupational settings [1], [8], [9], [12], [13]. However, relatively few studies have provided an in-depth examination of how PPE availability, crew understanding, supervision, and actual PPE-use practices are related during intensive maintenance activities on a specific vessel. Existing studies have generally examined individual aspects of PPE use or broader safety behavior, whereas an in-depth examination of PPE implementation under actual shipboard working conditions can provide a more practical understanding of the gap between formal safety requirements and their application in daily operations. This study addresses this gap by examining PPE implementation on board KM. Pantokrator, with particular attention to maintenance activities conducted during the vessel's docking period.

The study was conducted on board KM. Pantokrator during the researcher's sea-practice period from August 2024 to August 2025. The vessel underwent docking and maintenance activities at JMI II Semarang from October to December 2024. During this period, various maintenance activities were performed more intensively, providing an opportunity to observe PPE implementation under actual working conditions. Field observations identified instances of incomplete PPE use during activities such as chipping, painting, grinding, cleaning, and work at height. Interviews with relevant deck personnel were subsequently conducted to explore crew understanding of PPE, factors affecting compliance, supervision, and PPE availability. These observations and interviews provided empirical evidence of differences

between the expected use of PPE and its actual implementation during shipboard work.

The present study therefore aims to analyze the implementation of Personal Protective Equipment (PPE) on board KM. Pantokrator, particularly during ship maintenance and docking activities, by examining crew understanding, PPE availability, actual usage practices, and factors influencing compliance. By combining direct observation, semi-structured interviews, and supporting documentation, this study provides an empirical case of PPE implementation on a Ro-Ro passenger vessel. The findings are expected to contribute to the improvement of shipboard occupational safety through strengthened PPE management, routine supervision, task-specific safety practices, and the development of a more consistent safety culture.

2. Materials and Methods

2.1 Research Design

This study employed a qualitative descriptive approach to examine the implementation of Personal Protective Equipment (PPE) on board KM. Pantokrator. A qualitative approach was selected because the study aimed to describe actual PPE practices, crew understanding, PPE availability, supervision, and factors influencing compliance under real shipboard working conditions. Direct observation, semi-structured interviews, and supporting documentation were used to obtain and triangulate the research data.

2.2 Research Location and Period

The research was conducted during the researcher's sea-practice period on board KM. Pantokrator from August 2024 to August 2025. The vessel operates as a Ro-Ro passenger vessel on the Parepare–Nunukan route, transporting passengers and vehicles between the two ports. The total crew complement consisted of 46 personnel, including deck, engine, security, and catering personnel. This study primarily focused on the deck department because deck personnel are directly involved in deck operations and maintenance activities relevant to PPE implementation.

Particular attention was given to the vessel's docking and maintenance period at JMI II Semarang from October to December 2024. The docking period was selected as an important observation context because maintenance activities were substantially more intensive than those performed during routine voyage operations. During docking, personnel were involved in activities such as chipping, painting, grinding, cleaning, and work at height, which involved different occupational hazards and required appropriate PPE. Personnel from other departments could also assist with maintenance activities when their routine operational duties were less demanding. However, the analysis in this study remained focused on PPE implementation within the deck-related activities observed by the researcher.

2.3 Data Collection

Data were collected through participatory observation, semi-structured interviews, and documentation. Participatory observation was conducted throughout the sea-practice period, with more intensive observation during the docking period at JMI II Semarang from October to December 2024. The observation focused on actual PPE use during work activities, including chipping, painting, grinding, cleaning, and work at height. Particular attention was given to the type of work being performed, associated hazards, PPE required for the activity, PPE actually used, and instances of incomplete or inappropriate PPE use.

Semi-structured interviews were conducted with selected crew members who had direct involvement in shipboard work and PPE implementation. Interviews were conducted during both routine vessel operations and the docking period. The interview questions covered crew understanding of PPE, the purpose and importance of PPE, PPE availability, factors affecting PPE use, supervision, comfort, and experiences related to occupational safety. The semi-structured format allowed the researcher to use predetermined questions while providing flexibility to explore responses that were relevant to the research objectives.

The interview responses were documented

and subsequently organized for qualitative analysis. The interview questions and detailed interview results are provided in the research documentation. Observation records, interview findings, and available documentation were compared to strengthen the credibility of the findings through data triangulation.

2.4 Interview Informants

Table 1. Interview Informants and Their Relevance to PPE Implementation

No.	Position	Role on Board	Relevance to PPE Implementation
1	Third Officer	Deck officer and safety-related supervision	Responsible for monitoring safety practices and reinforcing PPE use during shipboard activities
2	Kasap	Deck work leader who directs and participates in deck operations and maintenance activities; involved in managing maintenance-related stores and PPE	Provides direct work instructions and influences PPE use during deck and maintenance activities; involved in the management of PPE and maintenance supplies
3	Bosun	Senior deck work leader who directs and participates in deck maintenance activities; responsible for managing maintenance stores and PPE inventory	Directly responsible for the storage and management of PPE and maintenance supplies, while also supervising and participating in deck work
4	Able Seaman	Deck crew member who performs deck operations and maintenance tasks under the direction of deck leaders	Direct user of PPE during deck and maintenance activities

2.5 Data Analysis

Qualitative data were analyzed using NVivo to organize, code, and identify patterns within the observation and interview data. The analysis began with familiarization with the interview transcripts, observation records, and supporting documentation. Relevant statements and observations related to PPE implementation were then coded according to their meaning and relevance to the research objectives.

The coding process initially identified descriptive codes representing specific issues emerging from the data, including PPE availability, PPE use, risk perception, comfort, supervision, safety awareness, and procurement. Related codes were subsequently grouped into broader categories and examined for recurring patterns and relationships. Through this process, the analysis developed three major thematic areas: (1) understanding of PPE, (2) implementation practices, and (3) constraints affecting PPE implementation.

The thematic analysis was then interpreted by comparing patterns identified across

The interview informants were selected based on their direct involvement in deck operations, maintenance activities, and PPE implementation. The informants included the Third Officer, Kasap, Bosun, and Able Seaman. Their different responsibilities provided perspectives on PPE use from both supervisory and operational roles.

interviews, observations, and documentation. Particular attention was given to situations in which reported practices differed from observed practices, such as when crew members demonstrated an understanding of PPE requirements but did not consistently use the required equipment during actual work. This comparison supported the interpretation of the gap between safety knowledge and practical implementation.

Coding consistency was supported through repeated review of coded material and comparison of the codes with the original interview and observation data. The final themes were retained when they were supported by sufficient evidence from the collected data. NVivo was therefore used as an organizational and analytical tool to support the qualitative analysis and did not replace the researcher's interpretation of the data.

3. Results

3.1 PPE Implementation During Ship Maintenance Activities

Field observations conducted during the sea-practice period showed that PPE implementation on board KM. Pantokrator was not consistently maintained across different work activities. The most intensive observations were conducted during the docking period at JMI II Semarang from October to December 2024, when various maintenance activities were performed more frequently than during routine voyage operations. These activities included chipping, painting, grinding, cleaning, and work at height.

The observations showed that PPE compliance varied according to the type of work and the level of supervision. In several activities, crew members performed work without complete PPE despite the presence of potential hazards. The observed conditions are summarized in Table 2.

As shown in Table 2, PPE non-compliance occurred in several work activities, particularly through incomplete use of task-specific protective equipment. The findings indicate that PPE implementation was not determined solely by the availability of safety requirements but was also influenced by actual work practices and supervision. During intensive maintenance activities, the combination of multiple hazards and incomplete PPE use increased workers' exposure to occupational risks.

The observations also showed that PPE compliance tended to be higher when officers were actively monitoring the activity. In contrast, PPE use could become less consistent during routine work without direct supervision. This finding was supported by the interview data, which indicated that crew members generally understood the function and

importance of PPE but did not always maintain the same level of compliance during routine activities. This pattern suggests that PPE use has not yet been fully internalized as a consistent work habit.



Figure 1. Example of a work-related injury caused by slipping due to absence of safety shoes

The photographic documentation only shows the injured wrist and does not reveal the crew member's face or identifiable personal information. Informed consent was explicitly obtained from the crew member prior to documenting and presenting the injury photograph for research purposes. A work-related incident documented during the study involved a crew member who sustained an injury to the hand after slipping while performing shipboard work without safety shoes. The incident provides field evidence of the potential consequences associated with inadequate use of appropriate PPE. Although the incident involved a hand injury, the absence of safety shoes is relevant to the circumstances of the slipping event because appropriate footwear is intended to provide protection and improve stability during work. This incident further illustrates the importance of consistent PPE use, particularly during activities involving slippery working surfaces.

Table 2. Observation of PPE Implementation During Shipboard Work Activities

No.	Work Activity	Main Hazard	Required PPE	Actual PPE Used	Non-Compliance Observed	Risk Implication	Recommended Corrective Action
1	Mooring during rain	Slippery working surface and risk of falling	Safety shoes, gloves, helmet	Gloves and helmet were used; safety shoes were not used	Safety shoes were not used	Increased risk of slipping and foot injury	Require safety shoes during mooring and conduct pre-work PPE checks
2	Cargo handling	Falling or shifting cargo and hand injury	Safety shoes, gloves, helmet	PPE was used incompletely	Required PPE was not used completely	Increased risk of hand, foot, and other bodily injuries	Conduct task-specific PPE checks and toolbox meetings before cargo handling
3	Chipping and painting	Dust, flying particles, noise, and exposure to paint-related substances	Appropriate respiratory protection, eye protection, coverall, gloves, and hearing protection according to the task	PPE was incomplete; cloth was used as a substitute for a mask	Respiratory and other task-specific PPE were not used appropriately	Increased exposure to dust, particles, noise, and hazardous substances	Provide suitable PPE and verify PPE use before maintenance work
4	Working at height	Falling from height and falling objects	Safety harness, helmet, safety shoes, and other applicable fall-protection equipment	Helmet was not consistently used	Helmet was not used during the observed activity	Increased risk of head injury and injury from falling objects	Require task-specific PPE and continuous supervision during work at height
5	Safety equipment maintenance	Contact with tools/materials and foot injury	Gloves, coverall, safety shoes	Sandals were worn instead of safety shoes	Safety shoes were not used	Increased risk of foot injury	Prohibit unsuitable footwear and conduct PPE inspection before work

3.2 Availability and Condition of PPE

The availability of PPE on board KM. Pantokrator was assessed based on the vessel's PPE inventory records, observations, and procurement records. The inventory data showed that the quantity and condition of PPE

varied among equipment types. Although several basic PPE items were available, not all equipment was sufficient to meet the needs of the deck crew. The PPE inventory is summarized in Table 3.

Table 3. PPE Inventory and Availability on Board KM. Pantokrator

No.	PPE Type	Total Quantity	Condition	Serviceable Quantity	Availability for 25 Deck Crew
1	Safety helmet	35 units	3 less suitable; 20 good; 12 new and unused	32 units	128%
2	Safety goggles	21 units	Good/new	21 units	84%
3	Earmuff	11 units	Good	11 units	44%
4	Gloves	18 pairs	Good/new	18 pairs	72%
5	Harness	10 sets	6 used and good; 4 new and good	10 sets	40%
6	Mask	12 units	Good/new	12 units	48%

The inventory data indicate that PPE availability varied considerably among equipment types. Safety helmets had the highest availability, with 32 serviceable units for 25 deck crew members, equivalent to 128% of the deck crew requirement. In contrast, safety goggles, ear muffs, gloves, harnesses, and masks were insufficient to provide one serviceable item for every deck crew member. Harnesses had the lowest availability, with only 10 serviceable sets, equivalent to 40% of the deck crew requirement.

Although the inventory records indicate that several PPE items were in good or new condition, three safety helmets were recorded as being in less suitable condition. The presence of new and unused PPE also indicates that the existence of equipment in the inventory did not necessarily mean that all available PPE was actively used during work activities.

In addition to inventory availability, PPE procurement records during the docking period in Semarang were examined. The PPE procurement records provided by the vessel's Captain and Chief Officer documented a PPE request and fulfillment during the researcher's sea-practice period, particularly in preparation for the docking period. Based on the available procurement documentation, PPE replenishment was not documented consistently throughout the observation period. This condition indicates that PPE replenishment

was not consistently aligned with the changing requirements of shipboard maintenance activities.

The procurement records and interview findings further indicate that delays in fulfilling PPE requests could affect the availability of equipment required for shipboard work. Limited or delayed replenishment may encourage crew members to continue using existing equipment for longer periods or, in some circumstances, use inappropriate substitutes. One observed example was the use of cloth as a substitute for a mask during maintenance work. This condition demonstrates that PPE availability is not solely determined by the total number of items recorded in the inventory, but also by their suitability, accessibility, and timely replenishment.

Overall, the findings indicate that PPE availability and condition had not fully supported consistent PPE implementation on board KM. Pantokrator. The problem was particularly evident for PPE items whose quantities were below the number of deck crew members and during maintenance activities requiring task-specific protective equipment. Therefore, PPE management should include routine inventory inspection, monitoring of serviceable stock, timely procurement, and distribution according to the requirements of each work activity.

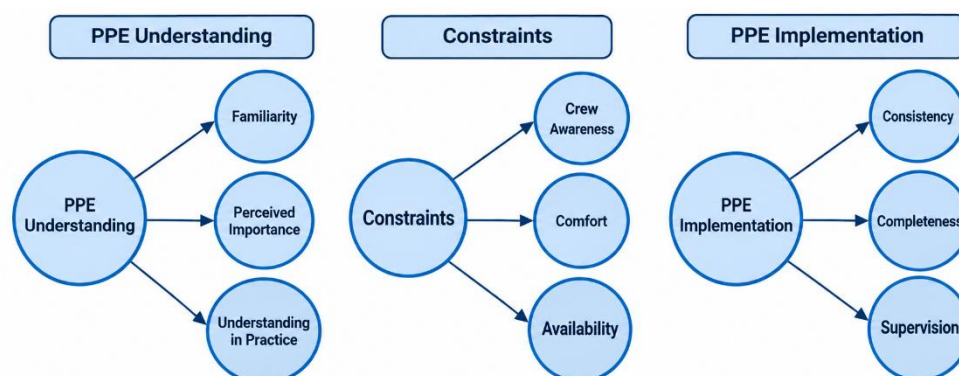


Figure 4. Integrated NVivo thematic clusters of factors influencing PPE compliance on board KM. Pantokrator

Table 4. Themes and Sub-themes Identified from NVivo Analysis

Main Category	Sub-theme	Interpretation
PPE Understanding	Familiarity	Crew members were familiar with the use and function of PPE in shipboard work.
PPE Understanding	Importance of PPE	Crew members recognized PPE as important for protecting themselves from occupational hazards.
PPE Understanding	Understanding in Practice	Understanding of PPE was not always reflected consistently in actual work practices.
Constraints	Crew Awareness	Crew awareness influenced the consistency of PPE use during work activities.
Constraints	Comfort	Discomfort associated with PPE use could affect the willingness to wear PPE continuously.
Constraints	Availability	Limited availability of certain PPE items affected their use during specific work activities.
PPE Implementation	Consistency	PPE use was not consistently maintained across different work activities.
PPE Implementation	Completeness	Some crew members used PPE incompletely and did not always use all equipment required for the task.
PPE Implementation	Supervision	Supervision influenced PPE compliance, with PPE use tending to be more consistent when officers monitored the work.

NVivo analysis of interview data (2026)

Overall, the NVivo analysis demonstrates that PPE implementation on board KM. Pantokrator was influenced by the interaction between crew understanding, practical constraints, and the way PPE was applied during work activities. The findings suggest that improving PPE compliance requires more than providing protective equipment; it also requires strengthening crew awareness, ensuring appropriate and comfortable PPE availability, maintaining complete task-specific PPE use, and strengthening supervision.

3.4 Comparison of PPE Implementation with Maritime Safety Requirements

The observed PPE practices on board KM.

Pantokrator were further compared with relevant maritime occupational safety requirements to identify the gap between established safety standards and their implementation in daily shipboard operations. The comparison focused primarily on the International Safety Management (ISM) Code and the Maritime Labour Convention, 2006 (MLC, 2006), particularly the occupational safety and health provisions under Regulation 4.3 and Standard A4.3. The ISM Code provides a framework for the safe management and operation of ships, including the identification of risks and the establishment of appropriate safeguards. Meanwhile, the MLC, 2006 establishes requirements for occupational

safety and health protection and accident prevention in the maritime workplace [6], [14].

Table 5. Comparison between Maritime Safety Requirements and PPE Implementation on Board KM. Pantokrator

Safety Requirement	Expected Practice	Observed Condition on KM. Pantokrator	Assessment
Safe working environment and risk control	Safety measures should be applied according to identified occupational hazards and the nature of the work	Several work activities were performed with incomplete PPE despite identifiable hazards, particularly during maintenance activities	Partially implemented
Provision of appropriate safeguards	Appropriate safeguards should be provided and applied to control identified risks	Basic PPE was available, but several task-specific PPE items were limited in quantity	Partially implemented
Use of PPE for occupational accident prevention	Appropriate PPE should be applied as part of occupational risk-control measures when required by the work activity	PPE use was inconsistent; some crew members did not use complete PPE during certain activities	Not consistently implemented
Safe shipboard work procedures	Shipboard work should be conducted in accordance with established safety procedures and assigned responsibilities, including appropriate PPE requirements.	PPE compliance was higher when officers actively supervised the work but was less consistent during routine activities	Requires improvement
Inspection and correction of unsafe conditions	Inappropriate PPE use was observed during several activities, but corrective action was not always consistently maintained	Inappropriate PPE use was observed during several activities, but corrective action was not always consistently maintained	Partially implemented
Continuous improvement of occupational safety	Safety practices should be continuously improved through monitoring and corrective measures	The findings identified gaps in PPE availability, supervision, and consistent crew compliance, indicating areas requiring further improvement	Requires improvement

Research findings and comparison with the ISM Code and MLC, 2006

As shown in Table 5, the observed implementation of PPE on board KM Pantokrator was not fully consistent with the maritime occupational safety principles considered in this study. The main gap was not the complete absence of PPE requirements or equipment, but the difference between expected safety practices and their application during actual work activities.

The findings show that basic PPE was available on board, but the availability of several task-specific items was insufficient to support consistent implementation. This condition was particularly relevant during maintenance activities that involved multiple hazards. In addition, observations showed that PPE use was more consistent when officers were directly supervising the work, while compliance tended

to decrease during routine activities. This indicates that the implementation of safety procedures was still influenced by situational factors rather than being consistently applied as part of daily work practices.

The comparison also indicates that PPE implementation should be assessed not only based on the availability of equipment, but also on its suitability for the work activity, condition, and actual use during operations. The observed incomplete PPE use and the use of inappropriate substitutes, such as cloth as a substitute for a mask, indicate that the availability of PPE did not always result in appropriate PPE use during shipboard work.

Overall, the comparison reveals a gap between formal maritime safety requirements and actual PPE practices on board KM.

Pantokrator. Although the vessel had established safety requirements and provided basic PPE, improvements are still required in PPE management, supervision, risk awareness, and the consistent application of task-specific protective measures. These findings provide a basis for the discussion of the behavioral and organizational factors influencing PPE compliance presented in the following section.

4. Discussion

4.1 Gap Between PPE Availability and Actual Implementation

The findings demonstrate that the availability of PPE does not automatically result in consistent PPE use during shipboard activities. Although KM. Pantokrator had a range of PPE available, several types of equipment were insufficient in quantity compared with the number of deck crew, and PPE use remained inconsistent across different work activities. This finding indicates that PPE implementation is influenced by factors beyond the physical availability of protective equipment.

The observations during the docking period at JMI II Semarang provide an important illustration of this gap. Docking involved more intensive maintenance activities, including chipping, painting, grinding, cleaning, and work at height. These activities exposed crew members to different hazards and therefore required PPE appropriate to each task. However, incomplete PPE use was still observed in several activities. Previous research has shown that maintenance activities in marine systems involve conditions in which human error can contribute to safety risks, emphasizing the importance of appropriate safety practices during maintenance work [3]. Research on occupational accidents in maritime transportation has also demonstrated that shipboard personnel may be exposed to various work-related hazards during maritime operations [2].

This finding is consistent with the NVivo analysis, which identified PPE understanding, constraints, and PPE implementation as the three main categories influencing PPE practices. In particular, the analysis showed that

familiarity with PPE and recognition of its importance did not always result in consistent use. Previous research among cadets on board has similarly shown that knowledge and understanding of PPE do not necessarily guarantee complete and consistent PPE use during shipboard activities [8]. Therefore, the problem identified in this study cannot be explained solely by a lack of knowledge among crew members.

From an occupational safety perspective, PPE functions as a protective measure against hazards that remain after other risk-control measures have been applied [7]. Consequently, PPE should not be considered a substitute for other preventive measures but rather as part of an integrated approach to occupational risk control. In the context of KM. Pantokrator, the observed inconsistency indicates that the effectiveness of PPE depends not only on its availability but also on whether the equipment is suitable for the task, correctly used, and consistently monitored.

The findings also have implications for the implementation of the ISM Code. The ISM Code provides a framework for the safe management and operation of ships, including the identification of risks, establishment of safeguards, and implementation of procedures for safe shipboard operations [6]. Therefore, the effectiveness of a safety management system should not be assessed solely from the existence of procedures or PPE inventories. It should also be reflected in the extent to which established safety requirements are translated into actual work practices.

The gap identified in this study is therefore not simply a matter of insufficient PPE stock. Rather, it represents a difference between the availability of protective equipment and its effective implementation during actual shipboard work. The findings indicate that improving PPE implementation requires the availability of appropriate equipment to be accompanied by consistent application, task-specific requirements, and effective supervision.

4.2 Supervision and Safety Culture

The findings indicate that supervision played an important role in influencing PPE

compliance among the crew of KM. Pantokrator. PPE use tended to be more consistent when officers were directly monitoring the work activity, whereas compliance could decrease when crew members performed routine tasks without direct supervision. This pattern was identified from field observations and was also reflected in the interview findings, which indicated that crew members generally understood the importance of PPE but did not always maintain consistent use during routine activities.

This finding suggests that PPE compliance was not fully internalized as an individual work habit. Instead, compliance was partly influenced by the presence of external supervision. Such a condition indicates that safety procedures may be followed more strongly when crew members perceive that their work is being monitored. Therefore, supervision should not be limited to responding to violations but should function as a continuous mechanism for reinforcing safe working practices.

The role of supervision can be understood within the broader concept of safety culture. Nævestad (2017) reported that safety culture and working conditions are associated with personal injuries in maritime transport, indicating that safety-related outcomes are influenced by conditions within the working environment rather than by individual behavior alone [1]. Similarly, Xi et al. (2025) found that safety culture has a positive relationship with safety behavior among ship deck officers, demonstrating the importance of organizational safety conditions in shaping how safety practices are implemented on board [12].

The findings from KM. Pantokrator are also consistent with the study by Barasa et al. (2025), which examined factors affecting the safety climate of ship crews in Indonesian shipping companies. Their findings indicate that safety-related organizational conditions, including safety equipment, training, and crew competence, are relevant to the development of a positive safety climate among ship personnel [13]. In the present study, the presence of PPE alone was not sufficient to ensure consistent implementation. The effectiveness of PPE use was also related to how

safety expectations were reinforced through supervision and daily working practices.

The influence of supervision was particularly evident during maintenance activities at JMI II Semarang. Activities such as chipping, painting, grinding, cleaning, and work at height involved different hazards and required crew members to apply task-specific safety measures. When officers actively monitored these activities, PPE use tended to be more complete. Conversely, less consistent use was observed during activities where direct supervision was limited. This indicates that supervision can function as an immediate behavioral control mechanism during higher-risk shipboard work.

However, dependence on direct supervision also indicates a weakness in the development of safety culture. A strong safety culture should encourage crew members to apply safety requirements even when direct supervision is absent. If PPE compliance decreases whenever supervision is reduced, safety behavior remains dependent on external control rather than becoming an established part of routine work behavior.

Therefore, improving PPE implementation on board KM. Pantokrator requires supervision to be combined with broader safety-culture development. Officers should provide consistent reinforcement of PPE requirements, particularly before and during high-risk maintenance activities, while crew members should be encouraged to recognize PPE use as an inherent part of safe work rather than merely a requirement imposed by supervisors. This approach would help reduce the gap between formal safety requirements and actual safety behavior during shipboard operations.

4.3 Personal Factors and PPE Compliance

The findings indicate that personal factors influenced the consistency of PPE use among crew members on board KM. Pantokrator. The NVivo analysis identified crew awareness and understanding of PPE as important aspects of PPE implementation. Although crew members generally understood the function and importance of PPE, this understanding did not always result in consistent use during actual

work activities. This finding suggests that having knowledge of PPE requirements is important but does not necessarily guarantee consistent safety behavior.

The observed practices also indicate that crew members' perception of the level of risk associated with a particular task could influence their decision to use PPE. PPE use tended to be more complete when activities were perceived as hazardous, whereas routine activities were more likely to involve incomplete PPE use. This pattern suggests that PPE compliance was partly dependent on how crew members perceived the immediate risk of the task rather than being applied consistently regardless of the perceived level of danger.

This finding is supported by Parawansa et al. (2022), who examined the relationship between personal factors and PPE-use behavior and found relationships between PPE-use behavior and factors including education level, years of service, attitude, and knowledge [10]. Although the study was conducted in a non-maritime industrial setting, its findings provide relevant evidence that individual characteristics can be associated with differences in PPE-use behavior. In the present study, the qualitative findings similarly indicate that individual understanding, awareness, and perception of work risks formed part of the factors influencing PPE implementation.

The findings further indicate that PPE use could be affected by the practical conditions experienced by crew members during work. PPE was not always perceived or used in the same manner across different activities, particularly when equipment was uncomfortable or when the work environment made its use inconvenient. In such circumstances, crew members could become less consistent in maintaining complete PPE use. Therefore, PPE compliance should be considered not only in terms of whether crew members know the requirements, but also whether the equipment can be used appropriately within the conditions of the work environment.

The relationship between personal factors and PPE behavior also needs to be considered together with organizational influences. Individual awareness alone cannot fully explain

inconsistent PPE implementation because the findings of this study also identified supervision, PPE availability, and working conditions as contributing factors. This indicates that PPE compliance results from an interaction between individual behavior and the conditions in which the work is performed.

Accordingly, improving PPE compliance on board KM. Pantokrator should not rely solely on repeatedly reminding crew members about the importance of PPE. Safety communication should also strengthen risk awareness and encourage crew members to recognize PPE use as a routine part of every work activity. At the same time, the organization should ensure that appropriate PPE is available, suitable for the task, and supported by effective supervision. Combining these approaches may help transform PPE use from a situational response to perceived hazards into a consistent safety behavior.

4.4 Implications for Shipboard Occupational Safety

The findings of this study indicate that PPE compliance on board KM. Pantokrator was influenced by several interacting factors, including crew awareness, comfort, PPE availability, completeness of PPE, and supervision. These findings demonstrate that PPE implementation should be understood as a multidimensional aspect of shipboard occupational safety rather than simply a matter of whether PPE is available.

The issue becomes particularly important during maintenance and docking activities. Activities such as chipping, painting, grinding, cleaning, and work at height created different combinations of hazards and required workers to adapt their PPE according to the task. Therefore, shipboard safety management should place particular emphasis on maintenance and docking periods rather than focusing only on routine voyage operations.

From the perspective of the hierarchy of controls, PPE represents the final level of protection after other control measures have been considered [7]. Consequently, PPE compliance should be integrated with hazard identification, safe working procedures,

supervision, and other preventive measures. The observed gap between safety requirements and actual PPE use indicates that strengthening the safety management system requires continuous reinforcement at the operational level.

Based on these findings, several practical measures can be recommended. First, routine PPE inspections should be conducted to identify damaged, unsuitable, or missing equipment. Second, PPE stock should be monitored according to the number of crew members and the requirements of specific work activities. Third, procurement should be scheduled proactively to prevent shortages during maintenance and docking periods. Fourth, toolbox meetings should be conducted before hazardous maintenance activities to communicate the hazards, required PPE, and safe working procedures. Fifth, officers should strengthen supervision and immediately correct incomplete PPE use. Finally, PPE should be selected with consideration for comfort, fit, and suitability to the shipboard working environment so that protective equipment can be used consistently.

5. Conclusions

The study found that PPE implementation on board KM. Pantokrator was not consistently maintained across shipboard work activities, particularly during the intensive maintenance activities conducted during the docking period at JMI II Semarang. Incomplete PPE use was identified during several activities, including mooring, cargo handling, chipping, painting, grinding, cleaning, and work at height. The findings demonstrate that the presence of PPE requirements and available equipment did not automatically result in consistent compliance during actual work.

The NVivo analysis identified three main categories influencing PPE implementation: PPE understanding, constraints, and PPE implementation. Although crew members were generally familiar with PPE and recognized its importance, this understanding was not always reflected in consistent field practices. PPE implementation was influenced by crew

awareness, comfort, equipment availability, consistency of use, completeness of PPE, and supervision.

PPE availability was also identified as an important issue. Although several PPE items were available in adequate quantities, other task-specific equipment was insufficient compared with the number of deck crew members. Procurement and replenishment were not consistently aligned with operational requirements, particularly during periods of intensive maintenance. These conditions could contribute to the continued use of existing equipment and, in some circumstances, the use of inappropriate substitutes.

Supervision was found to have an important influence on PPE compliance. PPE use tended to become more consistent when officers directly monitored work activities, while compliance could decrease during routine activities without direct supervision. This finding indicates that PPE use had not yet been fully established as an internalized safety habit and that further development of safety culture is required to encourage consistent compliance regardless of the presence of supervisors.

Based on these findings, improvements should focus on routine PPE inspection, systematic stock monitoring, timely procurement and replenishment, task-specific PPE allocation, pre-work toolbox meetings, stronger supervision, and the selection of PPE that is suitable and comfortable for shipboard working conditions. PPE compliance should also be reinforced as part of everyday safety behavior rather than being treated only as a requirement for high-risk activities or when supervision is present.

This study is limited to a single-vessel case study involving KM. Pantokrator and therefore the findings cannot be generalized to all passenger vessels or maritime operations. In addition, the observations were concentrated during the docking period at JMI II Semarang, although interviews and supporting observations were also conducted during routine operations. Future studies involving multiple vessels, different ship types, and broader operational contexts are recommended to provide a more comprehensive

understanding of PPE implementation in the maritime sector.

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