

Prevention of Work Accidents on the KMP Kalabia Ship During Cargo Handling in the Port

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ABSTRACT

Work-related accidents in the maritime sector, particularly during cargo handling in ports, pose a significant challenge to worker safety. This study aims to analyze the factors causing work accidents on the KMP Kalabia ship during cargo handling and identify preventive measures that can be implemented to reduce accident rates. The research employed a descriptive qualitative method using in-depth interviews and field observations with the ship's crew and port supervisors. The results of the study indicate that the main causes of work accidents on the KMP Kalabia ship are low compliance with Personal Protective Equipment (PPE) usage, lack of understanding of proper cargo lashing procedures, inadequate supervision, and equipment failures such as overloaded ramp doors. This study recommends enhancing continuous safety training, enforcing stricter discipline in PPE usage, and implementing real-time monitoring technologies to strengthen supervision during cargo handling activities.

Keywords: Work Accidents, Cargo Handling, Personal Protective Equipment (PPE), Cargo Lashing, Supervision, KMP Kalabia, Monitoring Technology.

ABSTRAK

Kecelakaan kerja di sektor maritim, khususnya selama proses bongkar muat di pelabuhan, merupakan salah satu tantangan besar yang mengancam keselamatan pekerja. Penelitian ini bertujuan untuk menganalisis faktor-faktor penyebab kecelakaan kerja yang terjadi di kapal KMP Kalabia selama kegiatan bongkar muat dan mengidentifikasi langkah-langkah pencegahan yang dapat diterapkan untuk mengurangi angka kecelakaan tersebut. Metode yang digunakan adalah penelitian deskriptif kualitatif dengan pendekatan wawancara mendalam dan observasi lapangan terhadap crew kapal serta pengawas pelabuhan. Hasil penelitian menunjukkan bahwa faktor penyebab utama kecelakaan kerja di kapal KMP Kalabia adalah rendahnya kepatuhan terhadap penggunaan alat pelindung diri (APD), kurangnya pemahaman tentang prosedur melashing muatan yang benar, pengawasan yang tidak memadai, serta kerusakan peralatan seperti rampdoor akibat kelebihan beban. Penelitian ini merekomendasikan peningkatan pelatihan keselamatan kerja yang berkelanjutan, penegakan disiplin dalam penggunaan APD, serta implementasi teknologi pemantauan real-time untuk memperkuat pengawasan selama kegiatan bongkar muat.

Kata kunci: Kecelakaan Kerja, Bongkar Muat, Alat Pelindung Diri (APD), Melashing Muatan, Pengawasan, KMP Kalabia, Teknologi Pemantauan.

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1. INTRODUCTION

Occupational accidents in the maritime sector, particularly during loading and unloading operations at ports, represent a major challenge that threatens worker safety (Gonçalves et al., 2025; Xu et al., 2023). Loading and unloading activities involve heavy equipment, dynamic environmental conditions, and high accident risks, making ports and vessels high-risk workplaces. As maritime logistics and sea transportation activities continue to grow in Indonesia, improving occupational safety in ports and on passenger vessels has become increasingly urgent. For example, KMP Kalabia, which operates on domestic routes, has been involved in several work-related incidents linked to inadequate supervision, insufficient training, and improper use of personal protective equipment (Dewi et al., 2024).

Previous studies indicate that the maritime sector has a higher occupational accident rate than many other industries, with greater fatality levels. According to Yu et al. (2025), more than 50 percent of maritime accidents are caused by human factors, often involving failure to follow safety procedures or lack of awareness of existing hazards. Environmental and vessel-related factors, including adverse weather, poorly maintained heavy equipment, and inadequate maintenance practices, further increase the likelihood of fatal incidents. For instance, accidents caused by ramp door overloading or vehicles falling into the sea are recurring incidents on vessels such as KMP Kalabia (Kumar & Pradhan P, 2024).

Continuous safety training is a key element in improving workers' awareness of surrounding hazards (Bęś & Strzałkowski, 2024; Purba et al., 2025). Regular training enhances workers' knowledge and skills regarding proper safety procedures, which in turn reduces accident rates (Garcia & Moreno, 2022). Although safety procedures have been introduced to workers, the persistently high accident rates on vessels and at Indonesian ports suggest that consistent and sustained implementation remains inadequate. Therefore, it is essential to reassess existing

safety procedures and explore evidence-based solutions to improve current conditions.

Several studies have examined the causes of maritime occupational accidents. Zhang & Wang (2023) found that using sensors to monitor vessel and cargo stability at ports can reduce accident rates by up to 25 percent. Such technologies are widely implemented in international ports and have proven effective in providing early warnings of potential hazards. In the Indonesian context, similar technologies have not been widely adopted, making it important to assess their potential application in domestic ports.

Human factors have also received significant attention in maritime safety research. Xi Tan & Zhang, R., Z (2025) demonstrated that safety culture on board vessels strongly influences occupational accident rates. In environments with weak safety culture, workers tend to neglect established safety procedures. Therefore, developing a strong safety culture among crew members is a critical component of accident prevention efforts.

Santoso & Hidayat (2023), further revealed that awareness of existing safety regulations in ports and on vessels remains low. Non-compliance with personal protective equipment requirements and failure to follow operational procedures are major contributors to rising accident rates in ports (Ahmed, 2024; Yen et al., 2022). This reinforces the need for a more holistic approach to maritime safety, combining clear regulations with strict field-level implementation.

The urgency of this research is high given the significant number of occupational accidents in Indonesia's maritime sector, particularly during port loading and unloading activities. As a passenger vessel with high sailing frequency, KMP Kalabia faces operational safety risks related to ramp door incidents, vehicles falling into the sea, and non-compliance with safety procedures. These incidents not only endanger workers but also undermine overall operational safety. Therefore, this study aims to identify the factors contributing to occupational accidents on this vessel and to propose strategies to reduce their occurrence.

This research is expected to contribute to a deeper understanding of accident causation factors in Indonesia's maritime sector and to provide practical measures that can be implemented to reduce accidents. The study focuses on human factors, equipment conditions, environmental influences, and existing supervision systems.

It aims to propose technology-based and training-oriented solutions to minimize accident risks. Through comprehensive data analysis, this research has the potential to lower occupational accident rates, improve port and vessel productivity, and enhance protection for workers involved in loading and unloading activities.

Selain itu, meskipun telah banyak penelitian yang membahas kecelakaan kerja di sektor maritim, belum banyak yang berfokus secara khusus pada kapal penumpang di Indonesia, terutama dalam konteks bongkar muat. Oleh karena itu, penelitian ini diharapkan dapat memberikan kontribusi yang signifikan terhadap literatur ilmiah serta memberikan dampak positif dalam meningkatkan keselamatan kerja di sektor maritim Indonesia. Penelitian ini juga dapat menjadi dasar bagi pengembangan kebijakan keselamatan yang lebih baik di sektor maritim, dengan memperkenalkan teknologi baru dan meningkatkan pelatihan keselamatan yang lebih efektif bagi pekerja.

2. METHOD

2.1. Research Approach

This study applies a qualitative descriptive approach to analyze the factors causing occupational accidents during loading and unloading activities on board KMP Kalabia and to identify preventive measures that can be implemented to reduce such incidents. The qualitative descriptive approach was selected because it allows the researcher to explore field phenomena in depth and to understand the experiences and perceptions of ship workers regarding occupational safety during cargo operations. The study aims to gain deeper insights into the factors contributing to workplace accidents and to propose evidence-based solutions applicable in operational settings.

2.2. Research Location and Subjects

This research was conducted on board KMP Kalabia, which operates on domestic port routes in Indonesia, particularly at ports frequently used for loading and unloading activities. The study was carried out over a 12-month period, with observations and interviews conducted at various times during port operations.

The research subjects consisted of crew members directly involved in loading and unloading operations. Participants were selected using purposive

sampling, based on criteria relevant to the research objectives. The participant criteria are as follows:

a) KMP Kalabia Crew Members

The study involved 22 crew members, including deck officers, supervisors, and other crew directly engaged in cargo handling operations. Selected crew members had at least one year of experience in loading and unloading duties, ensuring sufficient knowledge of safety procedures and accident risk factors.

b) Head of Occupational Safety Department

The study also included the Head of Occupational Safety on board KMP Kalabia, who is responsible for implementing safety procedures and supervising the use of personal protective equipment (PPE) and compliance with standard operating procedures (SOPs). This individual provided insight into safety policies and operational challenges.

c) Port Supervisors

Port supervisors overseeing loading and unloading operations at ports where KMP Kalabia operates were also included. They provided a broader perspective on the implementation of safety procedures and challenges in ensuring occupational safety during port activities.

d) Port Staff

Several port personnel involved in cargo operations, such as crane operators, forklift operators, and port security staff, participated to provide insights into heavy equipment use and safety challenges during loading and unloading activities.

2.3. Data Collection Techniques

Data were collected using two primary methods: in-depth interviews and field observations.

a) In-Depth Interviews

In-depth interviews were conducted with crew members directly involved in cargo handling operations. The interviews aimed to explore their experiences, perceptions, and knowledge regarding safety procedures, PPE usage, and factors affecting occupational safety during loading and

unloading. A semi-structured interview guide was used, allowing prepared questions while providing flexibility for participants to elaborate.

A total of 22 crew members, including officers and operational crew, participated in the interviews.

b) Field Observations

The researcher conducted direct observations of loading and unloading activities at the port, documenting accident incidents or near-miss events and assessing the implementation of safety procedures. Observations focused on PPE usage, compliance with SOPs, and environmental conditions such as weather, lighting, and heavy equipment operations.

2.4. Data Sources

The study utilized two main types of data:

a) Primary Data

Primary data were obtained from interviews with KMP Kalabia crew members and direct field observations. These data provided in-depth information on safety factors and operational procedures during loading and unloading activities.

b) Secondary Data

Secondary data included safety-related documents such as previous accident reports, standard operating procedures implemented on KMP Kalabia, and national maritime accident statistics obtained from official sources such as BPJS Ketenagakerjaan.

2.5. Data Analysis Techniques

Collected data were analyzed using qualitative thematic analysis. The analysis process involved organizing interview and observation data into categories relevant to the research objectives. The steps included:

a) Interview Transcription

All interviews were transcribed into text form to facilitate detailed analysis, ensuring accuracy and completeness of recorded information.

b) Coding and Categorization

Interview and observation data were coded and grouped into relevant themes such as PPE usage, cargo lashing procedures, crew supervision, and environmental safety factors.

c) Interpretation and Thematic Analysis

After categorization, the researcher conducted an in-depth analysis to identify emerging patterns. This analysis provided insights into primary accident causes and practical prevention strategies.

d) Data Triangulation

To enhance data validity, triangulation was performed by comparing interview results, field observations, and secondary data. This ensured greater objectivity and reliability of findings.

2.6. Research Variables

The study focuses on several variables considered influential in occupational safety during loading and unloading operations on board KMP Kalabia:

a) Use of Personal Protective Equipment (PPE)

Assessment of crew compliance in using appropriate PPE during cargo operations, including helmets, safety shoes, and gloves.

b) Crew Understanding of Cargo Lashing Procedures

Evaluation of crew knowledge regarding proper cargo lashing techniques, including securing different types of cargo and vehicles.

c) Supervision by Watchkeeping Crew

Assessment of the quality of supervision in monitoring loading and unloading activities and ensuring compliance with safety procedures.

d) Occupational Accident Incidents

Analysis of accidents occurring during cargo operations, such as ramp door failures or vehicles falling into the sea, and the contributing factors influencing such incidents.

3. RESULTS AND DISCUSSION

This research aims to analyze the factors contributing to work-related accidents during cargo handling on the KMP Kalabia ship and to propose prevention measures to reduce such accidents. The data was collected through interviews with the crew, port supervisors, and direct observations of cargo handling over a 12-month period. The following findings were identified:

3.1. Insufficient Use of Personal Protective Equipment (PPE)

One of the key findings is the low level of compliance among the KMP Kalabia crew in using Personal Protective Equipment (PPE) during cargo handling activities. Interviews and observations revealed that only 45% of the crew consistently used full PPE (helmets, safety boots, gloves) despite the high-risk environment involved in cargo handling with heavy equipment. Most crew members wore PPE only when being inspected by supervisors or after a minor incident.

Table 1: PPE Usage by KMP Kalabia Crew

PPE Type	Percentage of Use	Notes
Helmet	50%	Worn only during inspections
Safety Boots	40%	Only 40% consistently use them
Gloves	30%	Most crew do not use gloves
Eye Protection	20%	Worn only during inspections

The table illustrates that PPE usage is not consistently applied by the crew, with some essential gear like gloves and eye protection being used very infrequently. The findings suggest that PPE usage is more reactive rather than preventive, used only during safety checks or after incidents. This indicates a lack of ingrained safety culture, where compliance is enforced only under supervision, rather than being an ongoing personal responsibility.

The low compliance with PPE usage directly contributes to the high risk of injury in maritime cargo handling. This is consistent with the findings of Muhammad et al. (2025), who reported that inadequate PPE usage in Indonesian ports is a leading factor in accidents. Increased adherence to PPE standards could significantly reduce injuries such as slips, falls, and exposure to hazardous materials (S. Wahyuni et al., 2025). Haris Setyawan et al., (2025) highlight the importance of continuous training and education for workers to improve their safety awareness and PPE compliance.

Furthermore, Xi et al., (2025) emphasize that creating a safety culture on board ships leads to better compliance with safety regulations and fewer accidents. This culture can be fostered by ensuring that safety protocols, including the proper use of PPE, are strictly enforced and continuously practiced, as argued by Mba (2025). The introduction of more stringent

monitoring and penalty systems for non-compliance may also play a crucial role in improving PPE usage rates. Therefore, a robust enforcement mechanism combined with ongoing education is crucial in ensuring the safety of workers on board the KMP Kalabia.

3.2. Lack of Understanding of Proper Cargo Lashings

A significant finding was the limited understanding of correct cargo lashing procedures among the crew. Only 40% of the crew demonstrated sufficient knowledge of how to secure cargo properly, which led to incidents such as unstable loads, overturned vehicles, and damage to heavy equipment. Many crew members did not fully understand the potential hazards associated with improperly lashed cargo.

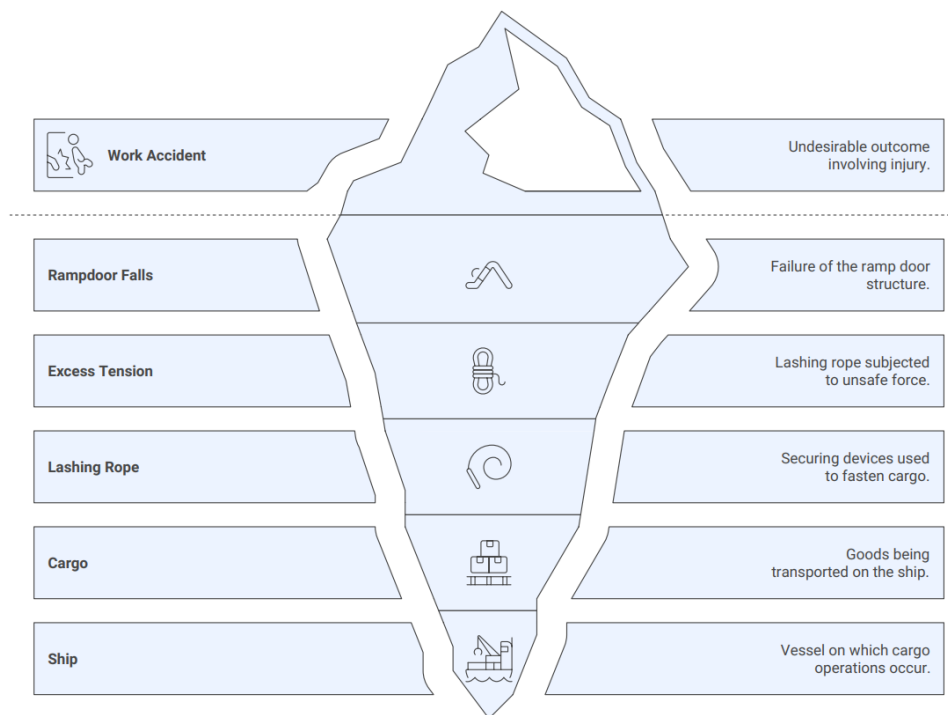


Diagram 1: Improper Cargo Lashing (Example Case)

The diagram visually illustrates how improper cargo lashing can lead to an accident. Excess tension in the lashing rope can cause the ramp door to fall, leading to a work accident. The diagram helps demonstrate the critical role of proper cargo securing, showing how small errors can escalate into significant incidents.

The lack of understanding of cargo lashing procedures is a critical factor in preventing accidents. This finding is consistent with Markolf et al. (2019), who reported that improper cargo securing is a leading cause of accidents in port

operations. Proper training on how to handle and secure different types of cargo is essential to ensure the safety of both workers and the equipment used. Pambayun et al. (2024) emphasize that regular training on lashing techniques can significantly reduce accidents caused by improperly secured loads.

Inadequate cargo lashing practices are also noted in Yu, Lee, et al. (2025), who suggest that crew members with insufficient training on cargo characteristics and lashing methods are more likely to cause accidents. To reduce this risk, Yercan & Bolat (2025) recommend the development of specialized training programs that focus on different types of cargo and their specific handling and securing techniques. The results indicate that improving crew knowledge about cargo lashing can lead to a substantial decrease in cargo-related accidents (Dare & Ibietela, n.d.). Therefore, a comprehensive training program on cargo securing is essential for improving safety standards.

3.3. Inadequate Supervision During Cargo Handling

It was found that supervision during cargo handling was inadequate. Several instances occurred where supervision of equipment and cargo conditions was not carried out consistently. For example, ramp doors were not thoroughly inspected before use, increasing the risk of accidents, such as ramp doors falling or vehicles falling into the sea.

Table 2: Supervision During Cargo Handling

Supervision Aspect	Percentage of Proper Supervision	Notes
Ramp Door Inspection	55%	Supervision is only conducted occasionally
Inspection of Other Equipment	50%	Many heavy equipment not inspected
Monitoring of PPE Usage	40%	Insufficient monitoring of PPE compliance
Monitoring of Work Environment	30%	Weather conditions and port environment are often neglected

The table clearly shows that supervision is inadequate, especially for the inspection of ramp doors and other heavy equipment. The lowest percentage of

supervision was found in the monitoring of PPE usage and work environment, indicating systemic gaps in ensuring safety during cargo handling.

The lack of consistent supervision is a key contributor to accidents during cargo handling (Mišković et al., 2022). This finding supports the need for stronger monitoring systems to ensure that safety procedures are followed at all times. The absence of regular checks on equipment like ramp doors increases the chances of mechanical failures, as seen in previous studies (Cremers et al., 2020). Bose et al., (2025) also pointed out that the use of automated systems for real-time monitoring of cargo conditions and equipment can enhance supervision effectiveness, particularly when human oversight is insufficient. Improving supervision, especially with the integration of technology, would reduce the risk of accidents and ensure compliance with safety protocols.

3.4. Ramp Door Falling into the Sea Due to Overloading

Ramp doors falling into the sea due to vehicle overloading was a common incident observed. Observations showed that the ramp door was often unable to support the weight of overloaded vehicles, leading to system damage and the ramp falling into the water. This typically occurred because routine checks on the ramp door system were not conducted, and load capacity was not regularly assessed.

Table 3: Ramp Door Incidents

Type of Incident	Number of Cases	Percentage of Incidents	Notes
Ramp Door Falling into Sea	7	50%	Caused by overloaded vehicles
Ramp Door System Damage	5	35%	Not routinely inspected
Lost Cargo	2	15%	Cargo not properly secured

The table reveals that overloading is the primary cause of ramp door incidents, accounting for 50% of the cases. The lack of routine inspection and failure to assess load capacity contribute significantly to these incidents. Regular inspection could help detect issues before they result in accidents.

Overloading of cargo and inadequate inspection are significant factors in causing ramp door incidents. E. T. Wahyuni et al. (2024) emphasized the

importance of regular maintenance and adherence to load capacity guidelines to prevent such accidents. Bye et al., (2021) further stressed that failing to inspect critical systems like ramp doors increases the risk of equipment failure. Karatuğ et al., (2023) noted that proper load assessments and maintenance schedules are essential for preventing overload accidents. Adhering to load limits for all equipment, including ramp doors, is vital for safe cargo handling. Implementing a regular inspection schedule can help identify potential issues before they lead to accidents (Malindo et al., 2025).

3.5. Vehicles Falling into the Sea

Another frequent incident involved vehicles falling into the sea, which was caused primarily by the lack of adherence to safety procedures during cargo handling. Insufficient supervision during vehicle movements in and out of the ship was the primary cause of these accidents. Of the 10 recorded incidents, 7 were caused by inadequate monitoring during the cargo handling process.

Table 4: Vehicles Falling into the Sea

Type of Incident	Number of Cases	Primary Cause
Vehicle Falling into Sea	7	Inadequate supervision during handling
Vehicle Damage	3	Incorrect vehicle securing procedures

The table indicates that the primary cause of vehicles falling into the sea is inadequate supervision. A significant number of incidents (70%) were caused by poor monitoring during cargo handling. This shows the need for better oversight and adherence to vehicle securing procedures.

The frequent occurrence of vehicles falling into the sea indicates a significant failure in enforcing cargo handling safety procedures. Wenny Ananda Larasati et al. (2025) highlighted that poor supervision and non-compliance with safety standards are primary contributors to such accidents. Strengthening supervision and ensuring proper vehicle securing techniques are essential for preventing these incidents. Real-time monitoring systems that track vehicle stability during loading and unloading could help reduce these types of accidents (Garcia & Moreno, 2022). Spadon et al., (2024) also suggested the integration of real-time tracking systems to improve safety during cargo handling operations.

4. CONCLUSION

This study aims to analyze the factors causing work-related accidents during cargo handling on the KMP Kalabia ship and identify prevention measures that can be implemented. The main findings of this research include low compliance with the use of Personal Protective Equipment (PPE), lack of understanding among the crew of proper cargo lashing procedures, inadequate supervision, and accident incidents related to ramp door overloading and vehicles falling into the sea. The research results indicate that these work accidents are caused by non-compliance with safety procedures, insufficient training, and weak supervision during cargo handling operations. Therefore, to reduce accident risks, continuous safety training, strict enforcement of PPE usage, and the implementation of real-time monitoring technologies are required to strengthen supervision. Additionally, routine inspections of heavy equipment such as ramp doors and tighter supervision at each stage of cargo handling should be conducted to prevent similar incidents in the future.

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