Implementation of The Plan Maintenance System (PMS) Function on Lifeboats to Support Sailing Safety on The Jambo VIII Ferry Motor Ship

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Abstract.

Sailing safety on passenger ships such as KMP Jambo VIII is often threatened by lifeboat failure due to suboptimal maintenance, even though the Plan Maintenance System (PMS) has been implemented. This study aims to analyze the implementation of the PMS function on lifeboats and identify its obstacles to supporting sailing safety. This type of qualitative descriptive research was conducted on the KMP Jambo VIII crew population with a purposive sample of 4 key informants (Captain, Chief Officer, Pumpman, Boatswain). The main research instruments were supported by semi-structured interview guidelines, observation sheets, and documentation; data analysis used the Miles and Huberman model (reduction, presentation, conclusion). The results show that the PMS runs through tiered inspections despite being hampered by a busy operational schedule, scarcity of spare parts, and administrative-field gaps. The conclusion recommends regular crew training and PMS digitalization for safety optimization.

Keywords: *Lifeboat; Maintenance; Plan Maintenance System; Ship Safety and SOLAS.*

I. INTRODUCTION

Maritime safety is a top priority in the operation of ships, especially passenger ships like the KMP Jambo VIII, which serves busy routes in the Bali Strait. Maritime accidents are often triggered by extreme weather, fires, or safety equipment failures, where lifeboats play a crucial role in emergency evacuation for crew and passengers.Advances in lifeboat technology, from wood to fiberglass, have improved weather resistance, but still require regular maintenance to maintain operational readiness. In Indonesia, maritime transport supports trade and mobility, but the high risk of inadequate maintenance has led to numerous life-threatening incidents.Problems arise from the lack of consistent implementation of the Plan Maintenance System (PMS) on lifeboats, including daily, weekly, monthly, and annual inspections, which are often hampered by busy operational schedules.

Crew members face differing understanding of PMS procedures, compounded by limited time and maintenance facilities on the ferry.Other challenges include a shortage of spare parts and limited docking facilities, which result in suboptimal maintenance despite the PMS checklist. This has the potential to reduce the effectiveness of lifeboats in emergencies, as stipulated in SOLAS Chapter III, which requires safety equipment to be readily available.Lack of crew supervision and competence further exacerbates the situation, as the ISM Code emphasizes continuous PMS to prevent equipment failure. On ships like the KMP Jambo VIII, short-haul operations reduce maintenance time, compromising navigational safety.This study aims to analyze the implementation of the PMS function on lifeboats on KMP Jambo VIII and identify its obstacles to support shipping safety. The urgency of the research lies in the high risk of maritime accidents in Indonesia, where PMS optimization can save lives according to SOLAS 1974. The novelty of this study is the specific focus on the operational constraints of local ferry vessels with a qualitative descriptive approach during 12 months of PRALA, complementing previous studies.

II. METHODS

This study uses qualitative descriptive types and methods to describe in depth the implementation of the Plan Maintenance System (PMS) function on lifeboats on KMP Jambo VIII to support shipping safety. This approach was chosen because it emphasizes narrative data collection through direct observation, interviews, and documentation during the 12-month Sea Practice (PRALA), without numerical hypothesis

testing, making it suitable for exploring natural phenomena in the field. The research location is on KMP Jambo VIII owned by PT. Dutabahari Menara Line on the Banyuwangi-Surabaya route, with a sign-on time of July 8, 2024, to sign-off on July 15, 2025.The main research instrument was the researcher himself as the key data collector, supported by semi-structured interview guidelines, observation sheets, and PMS checklist documents, while the data analysis technique followed the Miles and Huberman model in Sugiyono (2017) which includes data reduction, data presentation, and interactive conclusion drawing until the data is saturated.

Data collection techniques included participant observation to monitor lifeboat inspections, in-depth interviews with key informants such as the Captain, Chief Officer, Pumpman, and Boatswain, as well as documentation in the form of photos, transcripts, crew lists, and ship particulars. Primary data was obtained directly from the field, while secondary data from literature, journals, and ship reports for triangulation of validity.The study population included all crew members of KMP Jambo VIII involved in lifeboat maintenance, with a purposive sample of 4 key informants (Captain, Chief Officer, Pumpman, Boatswain) selected based on their direct involvement and experience in PMS. This sample selection ensured a comprehensive representation of the roles of the deck and engine departments, in accordance with the principle of data saturation in qualitative research.The research procedure began with the preparation of the KIT proposal, followed by sign-on and adaptation on board, parallel data collection through daily observations, staged interviews, and continuous documentation during PRALA. Next, the data was reduced by categorizing PMS themes and constraints, presented in a descriptive narrative with tables and figures, and then conclusions were drawn with triangulation verification for validity. This process concluded with sign-off and the preparation of a final seminar report.

III. RESULT AND DISCUSSION

Overview of PT. Duta Bahari Menara Line

PT. Duta Bahari Menara Line is a subsidiary of Sinar Alam Corporation which is engaged in shipbuilding, ship maintenance conversion, and ship component manufacturing. The company has been operating for 40 years since its establishment on November 30, 1985. Although this company is a subsidiary of Sinar Alam Corporation, this company has grown and is recognized in the shipping industry. Currently, DML has 5 types of ships to support operations, one of which is the Ro-Ro Passengers ship. In addition, this company is also committed to overcoming every challenge and will consistently provide the best service for consumers. This is also intended to maintain the quality standards of service quality set by the company so that it will add value from the perspective of service users. This research was conducted on board the KMP Jambo VIII, an Indonesian-flagged passenger ship operating in the Bali Strait. The company has a branch office in Ketapang, located at Jalan Gatot Subroto No. 181, Lingkar Kampung Baru, Bulusan, Kalipuro District, Banyuwangi Regency, East Java Province, Code 68455, Indonesia.

Fig 1. KMP Jambo VIII

Source: Personal Document 2024

The KMP Jambo VIII is an Indonesian-flagged Ro-Ro Ferry with its port of registration in Banjarmasin. It was built in 2013 by PT. Duta Bahari Menara Line Dockyard in Banjarmasin. It has a length overall (LOA) of 63.20 meters and a length between perpendiculars (LBP) of 15.00 meters. The KMP Jambo

VIII is equipped with an identification and communication system that meets international standards. It has a Maritime Mobile Service Identity (MMSI) number 52500937. It also uses the Call Sign JZXV as its registered radio code.

Table 1. Shipping Route

Ports of Call	Information
Ketapang	Unloading and loading
Gilimanuk	Unloading and loading
PT. Dutabahari Menara Line Dockyard	Docking

Source: Personal Document 2025

KMP. Jambo VIII is an Indonesian-flagged ferry motor ship (KMP) owned and operated by PT. Dutabahari Menara Line. This ship is classified by the Indonesian Classification Bureau (BKI) and has the Call Sign JZXV, with IMO number 9722479 and MMSI 525009307 as its official identity in the maritime communication system. This ship was built in 2013 in Banjarmasin, and registered with the GT 1216/No. 3627/II.a. Based on the technical specifications, KMP. Jambo VIII has an overall length of approximately 63.20 meters, a width of 15.00 meters, with a draft of 3.20 meters. This ship has a gross tonnage of 1216 tons and a net tonnage of 365 tons, and is capable of carrying a load of up to 600 tons. The navigation system used includes Magnetic Compass, SSB, Radar, GPS, VHF, and EPIRB which support shipping safety and operations.

Research result

The results of this study were obtained through a series of observations, interviews, and documentation during the researcher's Sea Practice (PRALA) onboard KMP. Jambo VIII. All data collected provide a concrete picture of the condition of the lifeboats and the implementation of the Plan Maintenance System (PMS) on the ship. This study focuses on the maintenance, inspection, and testing processes of lifeboats as one of the main safety equipment that must always be in a ready-to-use condition. Based on field data that has been validated through source triangulation and technical triangulation, the researcher presents findings related to how the PMS is implemented by the deck crew, the level of consistency of its implementation, and obstacles that arise during maintenance. All these findings are then systematically described to provide a comprehensive picture of the implementation of the PMS on lifeboats on KMP. Jambo VIII in supporting navigational safety.

1. Data Presentation

This research presents data in the form of observation instruments, interviews, and documentation as follows:

a. Observation Results

Researchers observed the lifeboat inspection process carried out by the deck crew on the KMP Jambo VIII, which is in line with the implementation of the Plan Maintenance System (PMS). The implementation of the PMS on the KMP Jambo VIII is carried out through three main stages: inspection, scheduled maintenance, and testing, with the following details:

1) Daily Inspection

Carried out by the Deck Crew under the supervision of the First Officer, the scope of the inspection includes:

a) Physical condition of the lifeboat
b) Cleanliness of lifeboats and their covers
c) Launch rope condition (falls)
d) Position and safety (gripes and lashing)
e) Lifeboat engine (visual check)
f) The presence of survival equipment

2) Weekly Inspection

Carried out by the First Officer and Bosun, the scope of the inspection includes:

a) Manual winch operation
b) Checking the brake and release gear
c) Checking the fuel tank and engine oil

d) Davit condition and light lubrication

3) Monthly Maintenance

a) Test the function of the lifeboat motor
b) Battery check and recharging
c) Full inspection of survival equipment: Emergency rations, Pyrotechnics (expiry date), First aid kit, Compass, Signal mirror, bailer, sea anchor, Lubrication of davit and winch components
d) Testing of the on-load release gear system

4) Annual Maintenance (Annual Inspection)

a) *Load test*
b) Launch system test
c) Recertification of davits and winches
d) Engine endurance test
e) Fiberglass structure inspection

In conducting observations or direct observation of the activity process, the author found a checklist document that had been determined by the company as one of the standard operating procedures for checking rescue boats, attached:

Fig 2. Inspection of Lifeboats on KMP Jambo VIII

Source: Researcher Document (2024)

The document is part of the Plan Maintenance System (PMS) which contains a report on routine inspections of the rescue boat on KMP. JAMBO VIII for the period of September 2024. The inspection was carried out at two locations, namely at the wind deck position and the twin deck position, focusing on important components such as wires, cranes, crane operations, dynamo engines and ront crates, batteries, rescue boat conditions, and rescue boat lifting ropes/wires. Each item checked through maintenance activities includes; visual inspection, greasing, crane movement function testing, battery checking, to ensuring the physical condition and completeness of the rescue boat remains good.

The inspection results are recorded in the condition column and the results show that all items are declared good, indicating that the rescue boat is in a ready-to-operate condition according to PMS safety and maintenance standards. The inspection is signed by the implementing party and approved by the Third Officer as a form of control and verification of periodic maintenance.In this case, the researcher focuses on discussing the process of implementing the Plan Maintenance System function on the lifeboat on the KMP. Jambo VIII ship. From the research, the researcher found that there were several lifeboat maintenance procedures that were rarely carried out in accordance with the SOP contained in SOLAS Chapter III Regulation 20, such as the infrequent maintenance of lifeboats due to the tight loading and unloading schedule so that they did not carry out procedures in accordance with the existing SOP.After conducting observations, the researcher obtained and collected data to be used as research material. The data and observation results obtained by the researcher are attached as follows:

Table1. Observation Check on Lifeboats

No	Observed Aspects	Date	Observation result	Information
1	Hull and Drain Valve Inspection	05/09/2024	Seldom	Condition is still safe but needs repainting treatment
2	PMS report recording	10/17/2024	Sometimes	Still not consistent on the field
3	Lifeline and drain valve inspection	10/22/2024	Seldom	Less than optimal
4	Davits System Lubrication	11/03/2024	Seldom	Rarely grease the lifeboat lifting wheels and pulley system
5	Checking the condition of the lifeboat engine oil	11/02/2024	Less than optimal	Not done routinely
6	Implementation of boat drill (lifeboat training)	12/27/2024	Seldom	Depending on operating conditions

Source: Personal Document 2025

The data indicates that the failure to implement the Plan Maintenance System procedures on lifeboats in accordance with SOPs could be due to several important procedures, such as infrequent hull and drain valve inspections. Furthermore, davits are rarely lubricated with grease, and the oil condition of the lifeboat engines is rarely checked, making the lifeboat engines unusable in the event of a dangerous situation.

Table 3. Observation of the KMP.Jambo VIII Lifeboat Inspection Process

NO	Aspects observed	Yes	No	Information
1.	Physical condition of the rescue boat (hull, paint, structure)		✓	There is some paint that has faded
2.	The drain plug is installed and working		✓	Sometimes it gets stuck
3.	Engine ; general condition and cleanliness	✓		Cleaned frequently
4.	Engine start test	✓		Often done
5.	Sufficient fuel level		✓	Sufficient fuel
6.	The steering system functions normally	✓		Functioning normally
7.	Resistance-free propeller		✓	Sometimes there are obstacles
8.	Davit and winch are working		✓	Sometimes it gets stuck

Source: Researcher Data (2025)

b. Interview Results

On this occasion, the source of information observed by the researcher was obtained from the results of interviews with the Captain, Chief Officer, Boatswain, and Pumpman, where the following interview results were carried out when the researcher was carrying out sea practice on the KMP. Jambo VIII ship.Based on interviews with sources at KMP. Jambo VIII, a comprehensive understanding was obtained regarding the implementation of the Plan Maintenance System (PMS) on lifeboats as an integral part of the navigation safety system. Captain Napudin explained that the implementation of the PMS on safety equipment, especially lifeboats, has been carried out in accordance with company provisions and applicable regulations, although major maintenance can only be carried out when the ship is in its annual docking period. At the operational level, the deck crew consistently performs routine maintenance through weekly and monthly checklists that include checking the physical condition of the lifeboat, checking ropes and cranes, and evaluating the lifeboat engine. Every maintenance activity is recorded in the PMS form as a form of documentation and an internal monitoring instrument. This statement was reinforced by the Chief Officer who emphasized that daily and weekly checks are an important part of ensuring the readiness of the lifeboat, including checking grips, wires, survival equipment, and cleanliness aspects. In addition, the PMS is considered very helpful in maintaining regular maintenance schedules so that the potential for negligence can be minimized, while heavy maintenance work still awaits the docking facilities.

Similar information was also conveyed by the Boatswain, who explained that the deck crew routinely carried out inspections according to PMS standards, including weekly visual inspections and monthly testing of the lifeboat's engine and equipment functions. He emphasized that major maintenance activities, such as repainting, repairing the lifeboat's structure, or replacing wires, could not be carried out on board due to limited technical equipment and facilities, so they had to wait for the docking schedule.

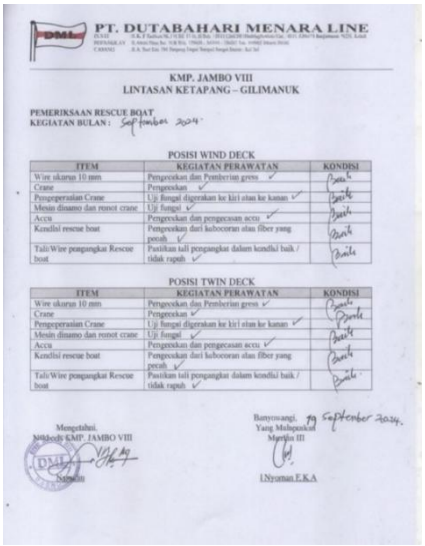
Pumpman also explained that he played a role in supporting the implementation of the PMS, especially in technical aspects, such as checking the battery, small engine, and electrical system on the lifeboat. He added that the daily, weekly, and monthly PMS checklists were always completed completely to ensure the lifeboat's readiness to face emergencies at sea. Overall, the interview results showed that the implementation of the PMS on the lifeboats on KMP. Jambo VIII had been running quite well at the routine maintenance level, but there were still limitations in the implementation of major maintenance which could only be carried out through the annual docking process. These findings confirmed that the implementation of the PMS plays a crucial role in ensuring the operational readiness of lifeboats as the primary safety equipment on the ship.

c. Documentation Results

Fig 3. Checking the Lifeboat

Source: Researcher Documentation

Documentation is an important instrument in qualitative research to provide concrete evidence regarding the condition of the research object and to support the results of observations and interviews. In the context of this research, documentation was conducted during the researcher's twelve-month Sea Practice (PRALA) on KMP Jambo VIII. Documentation includes photographing, recording the ship's technical documents, a Plan Maintenance System (PMS) checklist, and recording visual data related to lifeboat maintenance activities. The documentation provides a concrete picture of how the PMS is implemented administratively and operationally in the field.In general, documentation indicates that the lifeboats on the KMP. Jambo VIII are in fairly good operational condition. The photographs obtained show the physical condition of the lifeboats, including their hull structure, paintwork, the position of the safety ropes (gripes), the condition of the davits, winches, engines, and the completeness of the survival equipment on board. However, the documentation also reveals a number of findings indicating the need for improved maintenance. For example, the exterior paint on the lifeboats appears to be fading due to exposure to extreme sea conditions; several drain plugs appear difficult to open and require lubrication; and the propellers are occasionally blocked by debris and require more regular cleaning.



PT. DUTABAHARI MENARA LINE

KMP. JAMBO VIII
LINTASAN KETAPANG – GILIMANUK

PEMERIKSAAN RESCUE BOAT
KEGIATAN BULAN: September 2024

POSISI WIND DECK

ITEM	KEGIATAN PERAWATAN	KONDISI
Wire ukuran 10 mm	Pengecekan dan Pemberian gress ✓	Baik
Crane	Pengecekan ✓	Baik
Pengoperasian Crane	Uji fungsi digerakan ke kiri atau ke kanan ✓	Baik
Mesin disamo dan ronot crane	Uji fungsi ✓	Baik
Accu	Pengecekan dan pengecasan accu ✓	Baik
Kondisi rescue boat	Pengecekan dari kebocoran atau fiber yang pecah ✓	Baik
Tali/Wire pengangkat Rescue boat	Pastikan tali pengangkat dalam kondisi baik / tidak rapuh ✓	Baik

POSISI TWIN DECK

ITEM	KEGIATAN PERAWATAN	KONDISI
Wire ukuran 10 mm	Pengecekan dan Pemberian gress ✓	Baik
Crane	Pengecekan ✓	Baik
Pengoperasian Crane	Uji fungsi digerakan ke kiri atau ke kanan ✓	Baik
Mesin disamo dan ronot crane	Uji fungsi ✓	Baik
Accu	Pengecekan dan pengecasan accu ✓	Baik
Kondisi rescue boat	Pengecekan dari kebocoran atau fiber yang pecah ✓	Baik
Tali/Wire pengangkat Rescue boat	Pastikan tali pengangkat dalam kondisi baik / tidak rapuh ✓	Baik

Mengetahui,
Nakhoda KMP. JAMBO VIII

Samsuri

Banyuwangi, 09 September 2024.
Yang Melaksanakan
Masinis III

I Nyoman E.K.A

Fig 4. Checklist for KMP Jambo VIII

Source: Ship Documents

Documentation of the PMS checklist for September 2024 shows that inspections were conducted by the deck crew and verified by the third officer. Recorded inspection items included the condition of the lifeboat lifting wire, crane function, dynamo operation, battery condition, and the completeness of other lifeboat equipment. All inspection items were recorded in the condition column, and most were recorded as "good." However, the research results showed that, in the field notes, the researcher found several items that actually required more attention, such as davit lubrication that was not always carried out regularly, and lifeboat engine oil checks that were sometimes delayed due to the ship's busy operational schedule. These minor discrepancies between the documents and field conditions indicate a gap between administrative records and actual maintenance practices.In addition, the documentation also shows the crew's activities in the lifeboat maintenance process, such as greasing mechanical components, checking batteries, testing the lifeboat engine (engine start test), and checking safety equipment such as pyrotechnics, compasses, mirror signals, and sea anchors. This visual documentation proves that most of the PMS procedures were still carried out regularly, although not yet fully optimal at each inspection interval. Thus, the documentation collected during the research provides a strong basis for assessing the consistency of PMS implementation on board the ship, as well as empirical evidence regarding the actual condition of safety equipment, especially the lifeboats.

d. Validity test results (Triangulation)

To improve the validity and reliability of research data, researchers implemented a triangulation process, consisting of source triangulation, technique triangulation, and time triangulation. This triangulation was conducted to ensure that the data collected did not originate from a single perspective or method, but rather through a systematic comparison process, resulting in more objective and credible conclusions.

1) Source Triangulation

Source triangulation was conducted by comparing data from four sources with different positions and responsibilities within the ship's operational structure: the Captain, Chief Officer, Boatswain, and Pumpman. All four sources provided relatively consistent information regarding the implementation of the PMS. They explained that lifeboat maintenance is carried out in stages, ranging from daily to monthly inspections, while major maintenance is only carried out during the annual docking period because it requires specialized shipyard facilities and technicians. Each source also emphasized the role of the PMS in ensuring lifeboat readiness, although they acknowledged obstacles that often affect the quality and consistency of maintenance, such as tight loading and unloading schedules and lack of time for thorough inspections.The consistency of responses across sources indicates that the data on PMS implementation is relatively stable and not influenced by individual bias. This strengthens confidence that the information obtained reflects actual conditions on the ground.

2) Engineering Triangulation

Technical triangulation was conducted by comparing the results of observations, interviews, and documentation. Observations of the lifeboat's immediate condition in the field revealed that several components were not receiving optimal maintenance, such as infrequent davit lubrication and occasional stuck drain plugs. These findings were reinforced by the boatswain's statement that the ship's busy operational activities prevented some procedures from being carried out optimally.From a documentation perspective, the PMS checklist indicates that all inspection items are in "good" status, but direct observation does not always support this status. The discrepancy between documentation and field conditions indicates that PMS recording tends to be more administrative in nature and does not fully reflect the actual quality of care. Therefore, technical triangulation provides a comprehensive picture of how the PMS is implemented, but it also reveals a gap between documentation and the reality of care in the field.

Discussion

The implementation of the Plan Maintenance System (PMS) function on the lifeboats on KMP Jambo VIII has essentially been carried out through a tiered inspection mechanism that includes daily, weekly, monthly, and annual inspections, although the level of consistency varies. Based on observations and documentation, maintenance activities are carried out in the form of checking the physical condition of the lifeboat, the operation of the winch and davit, checking the wire ropes, light lubrication, and testing the

function of the lifeboat engine and the completeness of survival equipment. This is reinforced by the results of interviews with the Captain, Chief Officer, Boatswain, and Pumpman who stated that the PMS plays a role in ensuring that all inspection items are recorded and serves as the main guideline in lifeboat maintenance. Based on the PMS checklist found on the ship, it shows that most components are in "good" condition and ready to operate, and routine inspections have been carried out according to their respective intervals. Through data triangulation, it is known that field observations, interviews, and documentation are mutually supportive, so it can be concluded that the implementation of the PMS has contributed significantly to maintaining the readiness of lifeboats for use in emergencies. Thus, the implementation of the PMS on KMP. Jambo VIII has been running and has become an important element in efforts to improve shipping safety, although there are still certain aspects that require strengthening so that its implementation is optimal.The implementation of the Plan Maintenance System (PMS) on the lifeboats on the KMP Jambo VIII is running well, according to all sources, namely the Captain, Chief Officer, Boatswain, and Pumpman.

They explained that major maintenance on the lifeboats, including thorough structural checks, wire replacement, total painting, and detailed engine inspections, is only carried out once a year during the ship's docking, because this work requires shipyard facilities and technicians. Meanwhile, routine maintenance activities on the ship are still carried out in stages, starting from daily, weekly, and monthly inspections, to ensure the physical condition, completeness, and function of the equipment remain optimal.Daily inspections typically include a visual check of the lifeboat's condition, cleanliness, safety position, and basic equipment. During weekly and monthly inspections, the crew conducts more in-depth checks, such as the condition of the wire ropes, the function of the lifeboat lowering crane, the engine and battery, and survival equipment. All maintenance activities are recorded on the PMS form as evidence of implementation and monitoring. Overall, all interviewees agreed that the PMS significantly assists in maintaining the lifeboat's readiness and ensuring the safety of the voyage on the KMP Jambo VIII.Obstacles that emerged in the implementation of the PMS on the lifeboats of KMP. Jambo VIII stemmed from operational, technical, and human resource factors that impacted the quality of maintenance.

Research observations found that several components, such as the davits, drain plugs, lifeboat paint, and propellers, did not always receive thorough maintenance due to time constraints resulting from tight loading and unloading schedules. Interviews with crew confirmed that maintenance often stalled when operational activity increased, resulting in some procedures being carried out quickly and indefinitely. Furthermore, crew turnover caused differences in the ability to understand the PMS SOP, resulting in unequal inspection quality between periods. While the PMS checklist documentation did indicate that all components were in "good" condition, technical triangulation revealed a lack of synchronization between administrative reports and field conditions, indicating that the records sometimes did not fully reflect the technical reality. Furthermore, limited availability of spare parts on board meant that comprehensive repairs could only be undertaken during docking. Therefore, it can be concluded that the obstacles to the implementation of the PMS on KMP. Jambo VIII were closely related to the ship's operational dynamics, crew competency, and the availability of supporting facilities, which collectively hampered the effectiveness of lifeboat maintenance.

IV. CONCLUSION

This study found that the implementation of the Plan Maintenance System (PMS) function on lifeboats on KMP Jambo VIII has been running through daily, weekly, monthly, and annual inspections supported by company checklists, thus maintaining the operational readiness of safety equipment in accordance with SOLAS Chapter III provisions. Triangulation of data from observations, interviews with the Master, Chief Officer, Pumpman, and Boatswain, and documentation confirmed the effectiveness of the PMS in preventing lifeboat failures, even though major maintenance was limited to the annual docking period. However, limitations of the study lie in the single coverage of local ferry vessels and the 12-month duration of PRALA, which limits generalization to other types of vessels or international routes, as well as reliance on subjective crew data without quantitative measurement of equipment reliability.Practical implications of the study include recommendations for improving PMS oversight through regular crew

training to address operational constraints such as tight schedules and spare parts shortages, as well as digitalizing checklists for administrative-field synchronization. Suggestions for further research include a multi-vessel comparative study using a mixed-methods approach to measure the impact of PMS on actual accident rates, as well as a cost-benefit analysis of optimizing lifeboat maintenance in the maritime digital era. These findings contribute to improving national shipping safety through more adaptive PMS practices.

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