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Article

Optimization of Hatch Cover Maintenance on MV. Orient King

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A B S T R A C T

The hatch cover is a critical structural component of a general cargo vessel, designed to safeguard cargo from seawater ingress and maintain watertight integrity. This study evaluates the constraints affecting the execution of planned hatch cover maintenance aboard MV. Orient King. A qualitative single-case study design was employed over a 12-month onboard observation period. Data was collected through semi-structured interviews with three key deck personnel (Chief Officer, Bosun, and Able Seaman), structured operational observations, and a review of maintenance logs. Thematic analysis of the data revealed that maintenance compliance is fundamentally hindered by aggressive marine corrosion, a brittle supply chain causing 2-to-3-month lead times for critical spare parts (e.g., rubber packing, hydraulic hoses), and a dense operational tempo that routinely forces the deferral of scheduled Planned Maintenance System (PMS) tasks. Consequently, temporary repairs are frequently substituted for permanent solutions, elevating the risk of cargo damage. To mitigate these risks, this paper proposes a prioritized action plan, emphasizing strict adherence to the company's Safety Management System (Document No. JSP E41), optimized spare-part inventory control, and enhanced supervisory protocols.

1. Introduction

1.1 Background of the Study

Maritime transportation serves as the primary artery of global logistics, requiring vessels to maintain rigorous operational and structural standards to ensure safe navigation and cargo protection (IMO, 2020). Among the critical components of a general cargo ship, the hatch cover plays an indispensable role in safeguarding the watertight integrity of the cargo hold. The primary function of a hatch cover is to protect stowed cargo from seawater ingress and extreme weather conditions while reinforcing the vessel's structural rigidity (MacGregor, 2021). To ensure continuous operational reliability, hatch covers demand systematic and well-documented maintenance in accordance with a vessel's Planned Maintenance System (PMS).

The necessity of rigorous hatch cover maintenance cannot be understated, particularly in an environment characterized by constant exposure to corrosive elements such as high salinity and humidity (Pohl, 2023). Routine maintenance—encompassing regular inspections, thorough cleaning, corrosion control, and prompt repairs—is fundamental to preventing mechanical failures (IACS, 2019). However, literature indicates that real-world operational variables often challenge the ideal execution of these procedures. Factors such as harsh marine environments, extreme temperature fluctuations, and high operational tempos significantly accelerate material wear and complicate maintenance scheduling.

Despite established PMS protocols, general cargo vessels frequently experience maintenance bottlenecks. Preliminary observations on MV. Orient King suggest that maintaining hatch cover reliability is hampered by complex technical and organizational constraints. These constraints not only degrade the equipment but also elevate the risk of water ingress, which can lead to severe cargo damage and operational disruption.

1.2 Research Objectives

To address the gap between prescribed maintenance theory and actual onboard execution, this study aims to explore the root causes of maintenance inefficiencies on a general cargo vessel. The specific research questions guiding are:

1. What are the primary environmental and organizational constraints affecting the execution of hatch cover maintenance on MV. Orient King?
2. How can the current maintenance practices be structurally optimized to ensure sustained watertight integrity and operational safety?

2. Literature Riview

2.1 Maritime Planned Maintenance Systems (PMS)

Shipboard maintenance is categorized into preventive, corrective, and condition-based strategies. A Planned Maintenance System (PMS) is a structured, preventive framework designed to schedule inspections and part replacements before mechanical failures occur, thereby minimizing operational downtime (Assauri, 2008). In the maritime context, adherence to PMS is not merely a best practice but a regulatory requirement under the International Safety Management (ISM) Code, ensuring that critical safety equipment, such as hatch covers, remains in a state of continuous readiness (IMO, 2020).

2.2 Hatch Cover Watertight Integrity and Corrosion Control

The operational reliability of hatch covers relies heavily on their structural integrity and sealing mechanisms. Watertightness is primarily achieved through the compression of rubber packing against steel coamings (MacGregor, 2021). However, the marine environment introduces aggressive oxidative agents. According to corrosion management principles, high humidity and continuous exposure to saline environments drastically accelerate the degradation of marine steel and the vulcanization of rubber seals (Pohl, 2023). Effective corrosion control requires prompt surface preparation (descaling) and the application of anti-corrosive coatings before structural thinning occurs.

2.3 Operational Constraints in Maritime Maintenance

Recent empirical scholarship highlights that the effectiveness of onboard maintenance is frequently compromised by organizational constraints. Studies indicate that spare parts inventory planning is critical; a lack of onboard critical spares forces crews into making temporary, non-compliant repairs (Sihombing et al., 2023). Furthermore, dense port-call schedules and high operational workloads often

result in the deferral of PMS tasks (Novyanto, 2024). This creates a compounding effect where minor wear evolves into major structural failure, underscoring the need for rigorous supervisory practices and crew competence in executing maintenance under pressure (Rahayu, 2019).

3. Research Methodology

3.1 Research Design

This study employs a qualitative single-case study design. This approach was selected to provide an in-depth, contextualized understanding of the operational constraints affecting maintenance execution on a specific general cargo vessel, MV. Orient King.

3.2 Data Sources, Sampling, and Collection Techniques

Data collection was conducted over a 12-month period during the researcher's onboard sea practicum. Purposive sampling was used to select participants directly responsible for hatch cover maintenance. The informants included:

1. Chief Officer (10+ years of experience): Responsible for overseeing the deck department and PMS compliance.
2. Bosun (8 years of experience): Responsible for leading daily deck maintenance operations.
3. Able Seaman (5 years of experience): Responsible for the physical execution of technical tasks (e.g., grinding, painting, greasing).

Data was triangulated using three primary methods:

1. Semi-Structured Interviews: Conducted in Indonesian, lasting 30–45 minutes each. Interviews were audio-recorded (with informed consent), transcribed, and translated into English for analysis. The interview guide focused on PMS adherence, operational challenges, and spare parts logistics.
2. Structured Observations: Conducted during ocean voyages and cargo operations using a standardized inspection checklist to assess physical equipment conditions and crew workflow.
3. Documentation Review: Analysis of onboard PMS logs, defect reports, and maintenance requisition records.

3.3 Data Analysis

Data was analyzed using thematic analysis. Following the data condensation phase, raw interview transcripts and observation notes were assigned initial codes (e.g., "rust on rails," "waiting for parts," "deferred due to cargo"). These codes were grouped into broader analytical themes (e.g., *Environmental Wear*, *Supply Chain Deficits*). A theme-evidence matrix was utilized to display the data, cross-verifying interview claims against physical observations and maintenance logs to ensure analytical rigor and credibility.

4. Results and Discussion

4.1 Case Context

MV. Orient King is a general cargo vessel primarily engaged in the international transport of bulk cargo. The vessel utilizes a hydraulic folding hatch cover system. Due to its trading routes, the vessel is subject to continuous loading and unloading cycles and is frequently exposed to harsh weather conditions, placing immense stress on the cargo securing equipment.

4.2 Results: Physical Condition and Maintenance Deficits

Structured onboard observations revealed a distinct gap between the prescribed PMS condition and the actual physical state of the hatch covers.

Results: Thematic Findings from Interviews and Observations

Theme 1: Operational Tempo and PMS Deferrals

Observations indicated that while maintenance is routinely scheduled, high-intensity cargo operations force the crew to prioritize logistical tasks over comprehensive upkeep. Maintenance tasks are frequently delayed or rushed.

1. *Chief Officer:* "Maintenance [cleaning, lubrication, hydraulic checks] is scheduled, but because the ship's operations are so dense, we sometimes cannot execute it maximally. Cargo always comes first."
2. *Deck Crew:* "We usually squeeze in maintenance during the voyage or right after cargo operations finish. If the weather is bad or swells are high, we have to postpone it because the deck is too slippery and dangerous."

Theme 2: Supply Chain and Spare Part Shortages

A critical organizational constraint identified was the onboard inventory of essential spare parts. PMS records showed that requisitions for rubber packing and hydraulic hoses experienced prolonged lead times.

Chief Officer: "If there is damage to the rubber packing or a hydraulic hose, we sometimes have to wait a long time for spare parts from the company. We cannot do permanent repairs immediately." Consequently, the crew relies on temporary, makeshift repairs (e.g., using localized sealant instead of replacing the packing strip), leaving the hatch cover vulnerable.

Theme 3: Supervisory Practices and Crew Execution

While the Bosun delegates tasks (rust removal using wire brushes/grinders, greasing, and spot-painting) to the Able Seamen and Ordinary Seamen, the execution sometimes lacks rigorous quality control.

Bosun: "Because it constantly gets hit by seawater and rain, the rust comes back very quickly, especially on the rails. We have to divide our time with other duties, so we can't spend too long on just the hatch cover." This time pressure results in crew members performing tasks based on habit rather than strictly adhering to technical manuals, occasionally leading to incomplete rust descaling before new paint is applied.

4.3 Discussion

The empirical findings from MV. Orient King reveal that the vessel's maintenance regime struggles to transition from a corrective to a purely preventive model. According to maritime maintenance theory (Assauri, 2008), optimal maintenance preserves equipment in its original state. However, the persistent corrosion and degraded rubber packing observed aboard indicate that the current execution is insufficient to mitigate the aggressive marine environment.

The findings align with Sihombing et al. (2023), who argue that logistical readiness is a prerequisite for effective maintenance. The critical shortage of safety-critical spare parts (rubber packing, hoses) forces the crew into a reactive posture. This directly conflicts with the objectives of the International Safety Management (ISM) Code, as temporary repairs compromise the watertight integrity of the vessel, thereby elevating the risk of cargo damage (IMO, 2020).

Furthermore, the deferral of PMS tasks due to high operational tempo and adverse weather highlights a systemic industry challenge (Novyanto, 2024). The lack of rigorous supervisory intervention by the Chief Officer allows minor defects—such as localized paint peeling—to evolve into major structural corrosion. Addressing these issues requires moving beyond crew-level efforts and implementing a holistic realignment of corporate spare-parts logistics and onboard supervisory enforcement.

5. Conclusion

This study concludes that while routine hatch cover maintenance is conducted aboard MV. Orient King, its efficacy is fundamentally constrained by a convergence of environmental and organizational factors. The primary constraints include aggressive environmental corrosion, a brittle supply chain that delays the provision of critical spare parts, and a dense operational tempo that routinely forces the deferral of PMS tasks. Consequently, crew members are frequently restricted to performing temporary repairs under inadequate supervision, which fails to guarantee the long-term watertight integrity of the cargo holds. While limited to a single-vessel case study, these findings highlight broader systemic vulnerabilities in balancing commercial operational demands with rigorous maritime safety maintenance.

To optimize the structural and operational integrity of the hatch covers, the following actions are recommended:

1. Strict PMS Adherence: Maintenance mustbe executed systematically and comprehensively, strictly following the established PMS schedules to arrest corrosion and mechanical wear at early stages.
2. Enhanced Supervision: The Chief Officer must exercise rigorous, documented oversight over the Bosun and deck crew to ensure that all maintenance tasks comply with standardized bureaucratic and technical procedures.
3. Supply Chain Optimization: Shipping management must prioritize and expedite the procurement of essential spare parts—specifically rubber packing and hydraulic components—to eliminate reliance on temporary fixes.
4. Capacity Building: The company should institute mandatory pre-boarding

workshops and technical familiarization programs for crew members, focusing on standard operating procedures (SOP), specifically adhering to Document No. JSP E41 regarding the inspection and maintenance of general cargo hatch covers.

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