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Analysis of Watchkeeping Implementation During Cargo Lifting Operations to Avoid Collision with Rig Legs: A Case Study of AHTS Logindo

Idham Abdul Aziz Zulkifli[1], Anak Agung Ngurah Ade Dwi Putra Yuda[2], Dian Junita Arisusanty[3], Samsul Huda[4]
[1,2,3,4]Politeknik Pelayaran (Poltekpel) Surabaya
idhamabdul124@gmail.com, dwiputrayuda@poltekpel-sby.ac.id, arisusanty@poltekpel-sby.ac.id, samsul_huda@poltekpel-sby.ac.id

Abstract

The operational integrity of Anchor Handling Tug Supply (AHTS) vessels during cargo lifting operations near offshore drilling rigs represents a critical intersection of navigational safety, human factors, and environmental management. This study examines the implementation of watchkeeping practices on board the AHTS Logindo Stamina while operating at the Soehanah Rig in the Natuna Sea, with particular emphasis on mitigating collision risks with rig legs. A descriptive qualitative approach was employed, drawing data from participant observation, document analysis, and semi-structured interviews with deck and bridge officers. Root causes of operational vulnerabilities were analyzed using the Fishbone (Ishikawa) Diagram across five domains: Man, Method, Machine, Environment, and Management. The findings indicate that although the vessel operates under an established Safety Management System (SMS), watchkeeping effectiveness is often reduced by human factors, including cognitive fatigue and divided attention during complex, multi-task operations. In addition, gaps were identified in the practical application of Standard Operating Procedures (SOPs), particularly in close-quarters communication between bridge and deck teams. Environmental factors, such as hydrodynamic interactions in proximity to the rig structure, further increase station-keeping demands beyond the optimal performance of Dynamic Positioning (DP) systems alone. The study concludes that collision prevention requires a shift from passive monitoring to active and predictive watchkeeping, supported by targeted navigational checklists and strengthened Bridge Resource Management (BRM) practices. These findings contribute to the enhancement of offshore operational safety and provide practical insights for reducing high-risk maritime incidents.

***Keywords**: Maritime Safety, First Aid At Sea, Emergency Training, SOLAS 1974, Tanker*

1. Introduction

The maritime offshore industry operates within a domain characterized by extreme kinetic forces and high-stakes logistical requirements. Central to offshore exploration is the Anchor Handling Tug Supply (AHTS) vessel, which performs hazardous tasks including cargo lifting—the transfer of heavy equipment between the vessel and the rig. This activity requires the vessel to maintain a static position in extreme proximity to the rig structure, often within meters of vulnerable jack-up legs (Batubara et al., 2024).

The proximity required for efficient lifting introduces a severe risk of allision, defined as the striking of a moving vessel against a stationary object (Healy & Sweeney, 1991). Such incidents can lead to catastrophic consequences, including structural failure and environmental pollution. The 2021 accident involving the AHTS Naga 7, which struck a rig leg leading to a total loss, underscores that despite advancements in Dynamic Positioning (DP) technology, the human element of watchkeeping remains the final barrier against disaster (Ung, 2014).

Watchkeeping is governed globally by the Standards of Training, Certification and Watchkeeping for Seafarers (STCW) convention (IMO, 2017). However, the specific demands shift dramatically in the 500-meter safety zone, where the Officer on Watch (OOW) must manage navigational position alongside dynamic deck loads. Existing literature often addresses general navigation or DP reliability but lacks granular analysis of watchkeeping during the specific high-risk window of cargo lifting in Indonesian waters (Nurmala et al., 2024; Lengkoan et al., 2022).

This study aims to bridge that gap by analyzing operations on the AHTS Logindo Stamina. By employing Fishbone Analysis, this report identifies specific factors threatening operational integrity and formulates evidence-based recommendations to safeguard critical offshore infrastructure (Zulkifli, 2025)..

2. Research Methodology

2.1 Research Design

This study adopts a descriptive qualitative research design. This approach is selected for its capacity to provide a detailed, nuanced account of the operational realities on board. Unlike quantitative methods that might focus on collision statistics, descriptive qualitative research allows for the exploration of the process of watchkeeping—how it is experienced, enacted, and occasionally compromised by the crew in real-time. The goal is to describe the phenomenon of watchkeeping comprehensively and analyze the causal links between observed behaviors and collision risks.

2.2 Time and Location of Research

Location: The research was conducted on board the AHTS Logindo Stamina (IMO: 9707405). The vessel was engaged in a long-term charter supporting the Soehanah Rig in the West Belut field, Natuna Sea. This location was chosen due to the high frequency of cargo operations and the challenging environmental conditions of the Natuna Sea, which serve as a stress test for watchkeeping protocols.

Time: Data collection was carried out over a period of 12 months, from September 2023 to September 2024. This extended duration allowed for the observation of operations across different monsoon seasons (West and East), providing a diverse range of environmental contexts.

2.3 Subject of Research: Ship Particulars

Understanding the specific capabilities and limitations of the vessel is crucial for the analysis. Table 1 details the specifications of the AHTS Logindo Stamina.

Table 1. Ship Particulars of AHTS Logindo Stamina

Parameter	**Specification**
Ship Name	AHTS LOGINDO STAMINA
Owner/Operator	PT. Logindo Samudramakmur Tbk
IMO Number	9707405
Flag	Indonesia
Year Built	2014
Classification	ABS (American Bureau of Shipping)
Length Overall (LOA)	70.30 Meters
Breadth Moulded	16.60 Meters
Depth Moulded	6.80 Meters
Draft (Max)	5.40 Meters

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Main Engines	2 x MAK 9M25C (8160 BHP Total)
Propulsion	2 x Controllable Pitch Propellers (CPP)
Positioning	Dynamic Positioning Class 2 (DP2)
Bollard Pull	~100 Tonnes
Bow Thruster	2 x Tunnel Thrusters
Stern Thruster	1 x Tunnel Thruster

2.4 Data Collection Technique

To ensure the reliability and validity of the findings, a triangulation method was employed, utilizing three distinct data sources:

1. Participant Observation: The researcher was embedded within the deck and bridge teams during active operations. Observations were focused on:
   - The 500m Entry Phase: Monitoring the completion of pre-entry checklists and the communication with the rig.
   - The Approach Phase: Observing the OOW's use of radar, visual cues, and DP controls as the vessel backed into the rig.
   - The Lifting Phase: Monitoring the visual vigilance of the deck crew regarding the distance to the rig legs and their communication with the bridge.
   - The Exit Phase: Observing the maneuver to clear the safety zone.
   - *Specific attention was paid to the "blind spots" from the bridge and how the crew mitigated them.*
2. In-Depth Interviews: Semi-structured interviews were conducted to elicit the subjective experiences and technical knowledge of the crew. The respondents were selected based on their direct role in watchkeeping and maneuvering.
   - Master (Captain): To understand the overall command strategy, risk assessment protocols, and decision-making thresholds.
   - Chief Officer (C/O): To investigate the coordination of deck operations, supervision of the ABs, and communication with the bridge.
   - Second Officer (2/O): As the primary navigation officer, to discuss the use of electronic aids (radar, ECDIS) and watchkeeping routines.
   - Able Seaman (A/B): To understand the practical challenges of maintaining a lookout while performing physical labor on deck.
3. Documentation Study: A rigorous review of the ship's documents was conducted to establish the "Work as Imagined" baseline. Key documents included:
   - *Logindo Vessel Operation Manual (LVOM)*.
   - *Bridge Standing Orders*.
   - *Deck Log Books* (to track timing and weather).
   - *Daily Reports* (to cross-reference operations).
   - *IMCA Guidelines* (as a comparative standard).

2.5 Data Analysis Technique

The data analysis followed a structured qualitative process:

1. **Data Reduction:** Raw data from field notes and interview transcripts were reviewed, and irrelevant information was discarded. Key themes related to "collision risk" and "watchkeeping failure" were identified.
2. **Data Display:** The selected data were organized into narrative descriptions and categorized using the Fishbone framework (Man, Machine, Method, Environment, Management).

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Conclusion Drawing/Verification: The categorized causes were analyzed to determine their impact on the primary effect (Collision with Rig Legs). Conclusions were drawn regarding the root causes and verified against the theoretical framework.

3. Results and Discussion

This section presents the findings of the study, structured around the Fishbone Analysis framework. It dissects the operational reality of the *AHTS Logindo Stamina* to understand the systemic factors contributing to collision risk.

3.1 Operational Case Study: December 28, 2023

To ground the analysis in empirical reality, the operation conducted on December 28, 2023, serves as a primary case study. The *Daily Activity Report* outlines the sequence:

- 01:25: Vessel arrived at the field.
- 03:45: Vessel entered the 500m Safety Zone.
- 05:10: Vessel positioned at the Port Side of *Soehanah Rig* for brine transfer.
- 11:00: Vessel pulled out to standby area (waiting on weather/cargo).
- 21:00: Vessel re-entered the safety zone for cargo operations.
- 21:12 - 21:20: Cargo lifting operation (a brief but intense 8-minute window).
- 21:25: Vessel cleared the zone.

Observation of Risk: During the night operation (21:00), the weather conditions were deteriorating. The log noted "Standby at clear area" for several hours prior, indicating marginal conditions. The re-entry at night, combined with the fatigue of waiting, created a high-risk scenario. The vessel had to back down towards the rig leg to allow the crane to reach the cargo deck. At this moment, the stern was within 15 meters of the rig leg. The bridge team relied heavily on the DP system, while the deck crew were focused on the cargo hook, reducing the effective visual lookout for the rig leg distance. This operational snapshot highlights the convergence of multiple risk factors.

Fig. 1 Cargo Lifting

3.2 Factor 1: Man (The Human Element)

The "Man" category is consistently identified as the most volatile variable in maritime safety. On the *Logindo Stamina*, three critical sub-factors emerged:

3.2.1 Fatigue and Vigilance Decrement

The offshore industry typically operates on a 6-hours-on/6-hours-off watch system. However, during intensive cargo operations, the "All Hands" rule often applies, disrupting rest periods.

Interview Insight: The Second Officer noted that maintaining high vigilance during long periods of DP station-keeping is mentally exhausting. The "stare factor"—watching a largely static DP screen—can lead to *highway hypnosis*, where the OOW becomes reactive rather than proactive.

Analysis: In the December 28th case, the crew had been operational since 01:25 AM. By the 21:00 PM cargo run, the cumulative fatigue was significant. Fatigue degrades spatial awareness and reaction time. If the vessel were to suffer a "DP run-off" (sudden loss of position), a fatigued operator might delay the manual takeover by crucial seconds—seconds that are the difference between a near-miss and a collision with the rig leg.

3.2.2 Communication Discipline

An Effective Bridge Resource Management (BRM) relies on "closed-loop" communication. The Bridge must order a movement, the Deck must confirm safe distance, and the Bridge must acknowledge.

Observation: It was observed that communication often became "open-loop" or assumed. The Chief Officer on deck would report "Clear astern" at the start of the maneuver, but potentially fail to provide continuous updates ("Closing... 10 meters... 8 meters... Stop") as the vessel moved.

Root Cause: This is partly due to radio congestion and partly due to the physical distraction of the deck crew who are simultaneously managing the crane wire and swinging loads. The dual role of the deck crew (Lookout + Rigger) is a systemic weakness.

3.2.3 Competence and Situational Awareness

While the officers are certified, their specific "spatial awareness" regarding the underwater geometry of the rig (the spudcans) varies.

Finding: Some junior officers focus solely on the visible leg structure above water. However, the spudcan (footing) of a jack-up rig extends outward underwater. A vessel could be "safe" on the surface but strike the underwater leg with its propeller or rudder if it gets too close. Knowledge of the specific rig geometry was not always evident in the pre-task briefings.

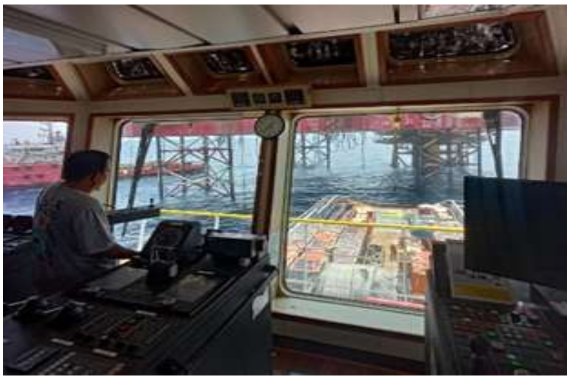

Fig. 2 Watchkeeping

3.3 Factor 2: Method (Procedures and SOPs)

The *Method* refers to the written and unwritten rules governing the operation.

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3.3.1 The SOP vs. Practice Gap

The *Logindo Vessel Operation Manual (LVOM)* provides comprehensive checklists for "500m Zone Entry".

Compliance: The study found that while the checklists were physically completed (ticked), the *quality* of the check was sometimes superficial. For instance, the "Thruster Test" might be rushed.

Deficiency: The existing SOPs lack a specific "Abort Trigger" protocol for rig leg proximity. There is no predefined rule stating, "If distance < 10m without Master's direct command, ALL STOP." This ambiguity leaves the decision to the discretion of the OOW, which varies by individual risk tolerance.

3.3.2 Job Safety Analysis (JSA) Limitations

The JSA for cargo operations primarily focuses on personal injury risks (slips, trips, crushed fingers). The risk of "Allision with Rig" is often treated as a generic navigation hazard rather than a specific operational hazard of the lifting phase. Consequently, the mitigation measures listed are often vague ("Keep safe distance") rather than specific ("Deploy lookout to aft starboard corner").

3.4 Factor 3: Machine (Equipment and Technology)

The *Logindo Stamina* is a robust vessel, but technical limitations exist.

3.4.1 Dynamic Positioning (DP) Limitations

- System: The vessel uses DP2.
- Risk: DP systems rely on reference sensors (DGPS, Laser/Fanbeam). Near a rig structure, "shadowing" can occur, where the rig legs block satellite signals (DGPS) or the laser target is obscured by rain/fog (Fanbeam).
- Observation: On the *Logindo Stamina*, reliance on the DP model is high. If the sensors degrade (common in the Natuna Sea rain), the "model" may drift from reality. If the OOW is watching the screen and not the window, the vessel could drift into the rig leg while the screen shows it holding station.

3.4.2 Radar Blind Spots

The ship's radar is optimized for open-water detection (3-12 miles). At close quarters (10-50 meters), radar returns from the rig legs can be obscured by "sea clutter" or the vessel's own mast structures (blind sectors).

Finding: Radar is effectively useless for fine-scale positioning relative to a rig leg. The OOW must rely on visual sight lines or CCTV. The CCTV cameras on the *Logindo Stamina*, while present, may have blind spots or be obscured by salt spray/rain, reducing their utility as a primary reference.

Fig. 3 Radar at AHTS Logindo Stamina

3.5 Factor 4: Environment (External Conditions)

The Natuna Sea is a hostile operating environment.

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3.5.1 Hydrodynamic Interaction

When a vessel operates very close to a large submerged structure (like a rig leg or spudcan), hydrodynamic forces change.

- Bank Effect: The flow of water around the hull is restricted between the ship and the rig leg, creating a pressure drop that can "suck" the stern of the ship *towards* the leg. This counter-intuitive force can catch inexperienced officers off guard.
- Current Shear: The rig legs disrupt the current flow, creating eddies. A vessel holding station might suddenly experience a change in current direction or force as it moves a few meters, destabilizing the DP model.

3.5.2 Weather Impact

The observation of "Extreme Weather" on Dec 28th highlights the risk. High winds act on the vessel's superstructure (windage), requiring significant thruster power to counteract. If a thruster fails or trips under high load, the wind can drift the vessel into the rig in seconds.


Fig. 4 Bad Weather at Rig Area

3.6 Factor 5: Management

Management factors underpin the safety culture.

3.6.1 Training and Supervision

- Training: While crew have STCW certification, there is no specific mandatory training for "Close Quarters Rig Maneuvering" in the company matrix beyond basic DP induction.
- Supervision: The Master cannot be on the bridge 24/7. When the Master rests, the duty falls to the OOW. The "Authority Gradient" may prevent a junior OOW from calling the Master when they are "unsure" but not yet in "danger," leading to a situation developing beyond recovery.

3.7 Synthesis of Findings: The Path to Collision

The analysis reveals that a collision with a rig leg is rarely the result of a single failure. It is a concatenation of events:

1. Environment: High wind or current pushes the vessel.
2. Machine: DP sensor fluctuates or lags.
3. Man: Fatigued OOW reacts slowly; Deck crew is distracted by cargo.
4. Method: No specific "Abort" criteria exist to trigger an immediate stop.
5. Result: The vessel drifts into the rig leg.

This "Swiss Cheese Model" of accident causation explains why incidents like the *Naga 7* occur despite modern technology. On the *Logindo Stamina*, the barriers are present but porous.

4. Conclusion

Based on the exhaustive analysis of watchkeeping implementation on the *AHTS Logindo Stamina* during cargo lifting operations, the following conclusions are drawn: Dominant Factors: The effectiveness of

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watchkeeping is most critically influenced by the Man factor (specifically fatigue and divided attention of the deck crew) and the Environment factor (hydrodynamic interaction and weather). While the Machine (vessel) is capable, over-reliance on automation (DP) reduces the crew's situational awareness. Procedural Gaps: Standard Operating Procedures (SOPs) for watchkeeping are generally followed but lack granularity for the specific "high-risk" phase of close-quarters lifting. The communication loop between bridge and deck is often fragile and prone to interruption. Impact of Negligence: The potential impact of watchkeeping failure extends beyond simple hull damage. It encompasses total loss of the rig (as seen in *Naga 7*), environmental disaster, and loss of life. The current safety margins on *Logindo Stamina* are maintained largely by individual skill rather than robust systemic defenses. To mitigate the risk of collision with rig legs, the following recommendations are proposed: For the Ship Operator (PT Logindo Samudramakmur Tbk): Implement a "Red Zone" Lookout Protocol: During cargo lifting operations within 20 meters of a rig leg, designate one deck crew member as a *dedicated* lookout. This person should wear a distinct vest (e.g., Red) and have *no* cargo handling duties. Their sole task is to monitor the distance to the leg and maintain an open radio line to the bridge. Enhance JSA and SOPs: Update the Job Safety Analysis for lifting operations to explicitly include "Allision with Rig Leg" as a primary hazard. Include specific mitigation measures such as "Confirm Spudcan Location" and "Test Abort Route." Specific Simulation Training: Introduce simulator training scenarios that specifically replicate "DP Drift-Off" and "Hydrodynamic Suction" near jack-up legs. This will train OOWs to recognize the onset of a collision trajectory earlier. For the Crew of AHTS Logindo Stamina: Reinforce Closed-Loop Communication: The Master must enforce a strict communication protocol where the deck officer provides distance readouts at set intervals (e.g., every 30 seconds) during active maneuvering, even if the position hasn't changed. Visual Verification: Do not rely solely on the DP screen. The OOW must physically verify the vessel's position relative to the rig leg via the window or CCTV every few minutes to combat "screen fixation. For Future Research: Future studies should investigate the use of laser-based proximity sensors (like parking sensors for ships) that could provide an independent audible alarm on the bridge when the vessel closes within a preset distance of a rig leg, removing the reliance on human vigilance alone.

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