

Overtime Drivers and Work–Rest Compliance among Indonesian Deck Seafarers: Implications for Maritime Traffic Safety

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Abstract— Work-rest compliance is an important component of maritime safety because deck seafarers are responsible for watchkeeping, lookout, vessel traffic monitoring, bridge communication, and navigational decision-making. Although international regulations emphasize adequate rest to reduce fatigue risk, overtime may still occur due to operational, technical, administrative, and regulatory demands. This study examines overtime drivers and work-rest compliance among Indonesian deck seafarers and discusses their implications for maritime traffic safety. A quantitative descriptive survey was conducted using data from 587 Indonesian deck seafarers. The variables included work-rest regulation status, overtime violation, overtime frequency, rest adequacy, rest disturbance, rest-performance awareness, overtime reasons, and vessel group. Descriptive statistics and chi-square tests were used to analyze the data. The results showed that 71.0% of respondents reported good work-rest regulation status, while 32.0% reported overtime violation and 52.1% reported high overtime frequency. Although 82.8% reported adequate rest and 98.3% recognized that good rest supports performance, 35.9% still experienced high rest disturbance. The main overtime drivers were preparation for Port State Control or external inspection (27.1%), critical equipment or machinery problems (25.9%), administrative reporting (12.8%), additional work due to new regulations (11.2%), and post-dry-docking or additional repair work (11.1%). High overtime differed significantly by vessel group, $\chi^2(4) = 9.901$, $p = 0.042$, and overtime violation also differed significantly by vessel group, $\chi^2(4) = 13.205$, $p = 0.010$. These findings suggest that overtime among deck seafarers is not merely an individual behavior issue, but is shaped by operational and regulatory workload pressures. Strengthening fatigue-risk management requires attention to inspection workload, technical readiness, administrative burden, vessel-type operational patterns, and rest protection.

Keywords— overtime, work-rest compliance, deck seafarers, maritime traffic safety, human factors.

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I. INTRODUCTION

Marine traffic safety depends not only on navigational technology, regulations, and vessel traffic systems, but also on the readiness of deck personnel who operate within the traffic environment. Deck officers and watchkeepers are responsible for maintaining lookout, monitoring vessel movements, interpreting radar and AIS information, communicating with other vessels and shore-based services, and making timely decisions to avoid collision or unsafe situations. These tasks require alertness, situational awareness, communication ability, and adequate recovery before duty. Human-factor studies in maritime safety consistently emphasize that safety performance depends on the interaction between the operator, the shipboard environment, regulatory systems, and operational workload [1], [2], [3].

The human element becomes especially critical in restricted waters, port approaches, high-density traffic areas, and close-quarter encounters. In these conditions, navigators must process multiple sources of information while maintaining safe separation and complying with collision-avoidance rules. Previous simulator-based research on Indonesian seafarers has shown that close-quarter ship encounters reconstructed from AIS data in

Makassar Port can generate measurable stress and workload responses among navigators. The study conducted by Bokau et al. [4] demonstrated that encounter geometry, particularly demanding crossing situations, may influence physiological stress and navigational workload. This supports the argument that maritime traffic safety is not only a technical matter, but also a matter of human readiness before and during safety-critical navigation tasks.

Readiness for watchkeeping is strongly influenced by work-rest conditions. International maritime regulations, including the STCW framework and ILO/MLC principles, emphasize the need to protect rest hours and manage fatigue risk. Work-rest compliance is intended to ensure that seafarers obtain sufficient recovery before performing safety-critical duties. However, compliance may be difficult in real shipboard operations because deck personnel often perform duties beyond routine watchkeeping. These may include port operations, cargo-related tasks, inspection preparation, administrative reporting, emergency duties, maintenance coordination, and other operational demands. Simkuva et al. [5] highlighted that rest-hour optimization for navigation officers is closely linked to operational scheduling and regulatory implementation.

Overtime is therefore an important upstream indicator of pressure on work-rest compliance. When deck seafarers work beyond planned or regulated hours, rest opportunity may be reduced. Repeated overtime can increase fatigue risk and may weaken readiness for watchkeeping, situational awareness, communication,

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and navigational decision-making. Lützhøft et al. [2] emphasized that fatigue in the maritime domain should be understood as a system-level problem shaped by work patterns, information environments, and organizational culture. Similarly, Hasanspahić et al. [1] identified human factors, including fatigue and decision-making limitations, as important contributors to marine accidents.

The issue is not only whether seafarers understand the importance of rest. In many cases, seafarers may recognize that rest is essential, but operational conditions still make rest difficult to protect. Workload may increase due to inspections, paperwork, equipment problems, new regulatory requirements, or post-repair work. Safety regulations and inspections are necessary, but preparation for compliance may also create additional workload if not properly managed. This creates a practical tension in maritime operations: regulatory systems are intended to support safety, but regulatory and administrative requirements may also contribute to overtime pressure onboard, especially when dealing with a high-traffic density [6].

This problem is particularly relevant for Indonesian deck seafarers. Indonesia is an archipelagic country with extensive inter-island shipping, passenger/Ro-ro operations, tug and barge operations, offshore activities, port services, coastal voyages, and international seafarer deployment. Deck personnel may work across different vessel types and operational environments, each with different workload and rest challenges. Indonesian research on bridge duty and collision prevention has emphasized the importance of watchkeeping discipline, regulatory compliance, and crew readiness in preventing collisions at sea [7]. However, empirical evidence on overtime drivers and work-rest compliance patterns among Indonesian deck seafarers remains limited.

Most existing maritime human-factor studies focus on fatigue, situational awareness, simulator performance, bridge resource management, automation, or accident analysis [8], [9], [10], [11], [12]. These studies are valuable, but fewer studies examine the practical operational drivers that create overtime pressure before fatigue becomes visible. This study addresses that gap by mapping overtime drivers and work-rest compliance among Indonesian deck seafarers and linking the findings to fatigue-risk management and maritime traffic safety.

The purpose of this study is to describe work-rest compliance and overtime practices among Indonesian deck seafarers, identify the main operational and regulatory drivers of overtime, and examine whether high overtime frequency and overtime violation differ across vessel groups. The study is guided by the following research questions:

- 1) What is the profile of work-rest compliance and overtime practices among Indonesian deck seafarers?
- 2) What are the main operational and regulatory drivers of overtime among deck seafarers?
- 3) Do high overtime frequency and overtime violation differ across vessel groups?
- 4) What are the implications of overtime drivers and

work-rest compliance challenges for fatigue-risk management and maritime traffic safety?

By answering these questions, this study contributes to a more operationally grounded understanding of maritime fatigue-risk management. The study argues that overtime and work-rest compliance challenges should not be treated only as individual discipline issues. Instead, they should be understood as outcomes of operational workload, inspection demands, technical problems, administrative burden, and vessel-type operating patterns.

II. METHOD

A. Research Design

This study used a quantitative descriptive research design. The objective was to describe patterns of work-rest compliance, overtime practices, rest disturbance, and overtime drivers among Indonesian deck seafarers. The study also used chi-square analysis to examine whether high overtime frequency and overtime violation differed across vessel groups.

This design was considered appropriate because the study did not aim to test a causal model. Instead, it aimed to map operational patterns and identify practical safety implications. The study was positioned within maritime human-factor and traffic-safety research, with overtime and work-rest compliance treated as upstream conditions that may influence fatigue risk and watchkeeping readiness.

B. Data and Participants

The data were obtained from a structured survey of Indonesian deck seafarers. The dataset consisted of 587 respondents, all from the deck department. The focus on deck personnel was intentional because deck seafarers are directly involved in navigation-related duties, including watchkeeping, lookout, vessel traffic monitoring, and bridge communication.

The respondents represented different certificate levels, sea experience groups, vessel types, and sailing regions. Vessel types included bulk carriers, chemical tankers, containers, crude oil tankers, general cargo vessels, tug boats, harbour tugs, LPG carriers, offshore vessels, passenger ships, and Ro-ro vessels. For vessel-group analysis, these were grouped into five operational categories: cargo ships, tankers/gas, tug operations, offshore, and passenger/Ro-ro. Ro-ro vessels were grouped with passenger-type vessels because they were interpreted in this dataset as passenger/vehicle ferry operations rather than conventional cargo operation.

C. Variables and Coding

The main variables used in this study were work-rest regulation status, overtime violation, overtime frequency, rest adequacy, rest disturbance, rest disturbance source, rest-performance awareness, overtime reason, and vessel group.

Work-rest regulation status was derived from dv1, with responses coded as good, conditional, or bad. Overtime violation was derived from dv2, with “yes” indicating overtime beyond the work-hour rule.

Overtime frequency was derived from dv3 and classified into low, quite low, moderate, quite high, and high. For analysis, high overtime was coded by combining “quite high” and “high” categories. Rest adequacy was derived from dv4. Rest disturbance frequency was derived from dv5, and high rest disturbance was coded by combining “frequent” and “very frequent” categories. Rest disturbance source was derived from dv6, including ship vibration, noisy cabin or roommate, engine noise, smartphone use, and uncomfortable cabin. Rest-performance awareness was derived from dv7.

The variable overtime_reason was used to identify the main reported reason for overtime. The analysis focused on the most frequent overtime drivers.

D. Data Analysis

Data were analyzed using descriptive statistics and chi-square tests. Frequencies and percentages were

calculated for all work-rest and overtime indicators. Overtime reasons were ranked based on frequency and percentage. Chi-square tests were used to examine whether high overtime frequency and overtime violation differed across vessel groups.

The analysis was conducted using R statistical software. The results are presented descriptively and interpreted in relation to work-rest compliance, fatigue-risk management, and maritime traffic safety.

The analytical sequence moved from survey preparation and respondent screening to variable coding, descriptive statistics, chi-square testing, and interpretation of maritime safety implications. This framework helped position overtime as an upstream work-rest compliance condition rather than a direct accident outcome.

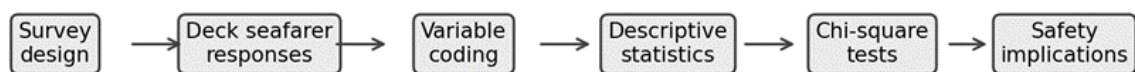


Figure 1. Research framework for overtime and work-rest compliance analysis.

III. RESULT AND DISCUSSION

A. Work-Rest Compliance and Overtime Profile

The descriptive results show that most respondents reported good work-rest regulation status. A total of 417 respondents (71.0%) reported good regulation status, while 97 respondents (16.5%) reported conditional regulation status and 73 respondents (12.4%) reported poor regulation status. This indicates that formal work-

rest regulation was generally present or recognized among the respondents.

However, the presence of regulation did not eliminate overtime. A total of 188 respondents (32.0%) reported overtime violation, while 399 respondents (68.0%) did not. In addition, 306 respondents (52.1%) were classified as having high overtime frequency. This means that more than half of the respondents experienced frequent overtime, even though most reported that work-rest regulation was generally implemented.

TABLE 1.
WORK-REST COMPLIANCE AND OVERTIME PROFILE

Indicator	Category	n	%
Work-rest regulation status	Good	417	71.0
Work-rest regulation status	Conditional	97	16.5
Work-rest regulation status	Bad	73	12.4
Overtime violation	No	399	68.0
Overtime violation	Yes	188	32.0
High overtime frequency	Low/moderate	281	47.9
High overtime frequency	High	306	52.1
Adequate rest	No	101	17.2
Adequate rest	Yes	486	82.8
High rest disturbance	Low/moderate	376	64.1
High rest disturbance	High	211	35.9
Rest supports performance	No	10	1.7
Rest supports performance	Yes	577	98.3

These findings reveal a practical tension. On one hand, most respondents reported good regulation status and adequate rest. On the other hand, overtime remained common. This suggests that formal implementation of work-rest rules may not be sufficient to prevent overtime pressure in daily shipboard operations.

The finding that 98.3% of respondents recognized that good rest supports performance is particularly important. It indicates that the problem is unlikely to be caused by lack of awareness. Instead, overtime and rest disturbance appear to be shaped by operational conditions that make rest difficult to protect. This

supports the system-level view of fatigue described by Lützhøft et al. [2], where fatigue is influenced by work organization, operational culture, and shipboard conditions rather than individual behavior alone.

B. Rest Disturbance Sources

The most common source of rest disturbance was ship vibration, reported by 156 respondents (26.6%). This was followed by noisy cabin or roommate conditions (21.0%), engine noise (18.2%), smartphone use (18.1%), and uncomfortable cabin conditions (16.2%).

TABLE 2.
MAIN SOURCES OF REST DISTURBANCE

Rest disturbance source	n	%
Ship vibration	156	26.6
Noisy cabin / roommate	123	21.0
Engine noise	107	18.2
Smartphone use	106	18.1
Uncomfortable cabin	95	16.2

This result shows that rest disturbance among deck seafarers is strongly influenced by shipboard environmental conditions. Vibration, noise, and cabin-related factors are not fully controlled by individual seafarers, which reinforces the argument that rest quality must be managed at the organizational and vessel-design level. While smartphone use also contributed to rest disturbance, the larger pattern shows that environmental and accommodation factors remain highly relevant.

Rest disturbance is important because sufficient rest hours do not automatically mean effective recovery. A seafarer may have recorded rest time but still experience poor recovery due to vibration, noise, or uncomfortable accommodation. In safety-critical navigation, poor recovery may affect alertness and situational awareness during watchkeeping. Studies on bridge resource

management and situational awareness show that safe navigation depends on sustained attention and effective information processing [3], [8], [13].

C. Main Drivers of Overtime

The most frequently reported overtime driver was preparation for Port State Control or external inspection, reported by 159 respondents (27.1%). The second most common driver was critical equipment or machinery problems, reported by 152 respondents (25.9%). Other major drivers included daily, weekly, or monthly administrative reporting (12.8%), additional work due to new regulations (11.2%), post-dry-docking or additional repair work (11.1%), and other administrative paperwork (7.7%).

TABLE 3.
MAIN OVERTIME DRIVERS

Rank	Overtime driver	n	%
1	Preparation for PSC / external inspection	159	27.1
2	Critical equipment or machinery problems	152	25.9
3	Daily/weekly/monthly administrative reporting	75	12.8
4	Additional work due to new regulations	66	11.2
5	Post-dry-docking or additional repair work	65	11.1
6	Administrative paperwork	45	7.7



Figure 2. Main reported overtime drivers among Indonesian deck seafarers.

This finding is central to the paper. Overtime was driven mostly by inspection preparation, equipment problems, administrative reporting, regulatory additions, and repair-related tasks. These are not simply personal choices by seafarers. They are operational and regulatory workload pressures.

The highest-ranked overtime driver, inspection preparation, highlights a paradox in safety management. Inspections such as Port State Control are designed to improve safety and compliance. However, if preparation for inspections creates excessive additional workload, it may also increase overtime pressure. This does not mean inspection is unnecessary. Rather, it suggests that inspection readiness should be supported by better

workload planning, documentation systems, and crew resource allocation.

The second-ranked driver, critical equipment or machinery problems, indicates that technical reliability is closely connected to human workload. When equipment problems occur, crew members may need to perform additional tasks beyond normal schedules. This may reduce rest opportunity and increase fatigue risk. The relationship between technical systems, human workload, and safety is consistent with maritime human-factor frameworks that treat accidents and risk as system-level outcomes [1], [9].

Administrative reporting also emerged as a major overtime driver. Documentation is important for safety,

quality assurance, and regulatory compliance, but excessive paperwork can become a workload burden. This supports the argument that fatigue-risk management should not only focus on watch schedules, but also on administrative workload and reporting processes.

D. Vessel Group Differences in Overtime

The analysis showed that high overtime frequency differed significantly across vessel groups, $\chi^2(4) = 9.901$, $p = 0.042$. Cargo ships had the highest proportion of high

overtime (59.8%), followed by passenger/Ro-ro vessels (58.2%), offshore vessels (55.6%), tug operations (50.2%), and tankers/gas (41.0%).

Overtime violation also differed significantly across vessel groups, $\chi^2(4) = 13.205$, $p = 0.010$. Offshore vessels had the highest proportion of overtime violation (47.6%), followed by passenger/Ro-ro vessels (41.8%), cargo ships (28.3%), tug operations (29.8%), and tankers/gas (25.7%).

TABLE 4.
HIGH OVERTIME AND OVERTIME VIOLATION BY VESSEL GROUP

Vessel group	n	High overtime %	Overtime violation %
Cargo ships	127	59.8	28.3
Offshore	63	55.6	47.6
Passenger/Ro-ro	67	58.2	41.8
Tankers/Gas	105	41.0	25.7
Tug operations	225	50.2	29.8

These results suggest that overtime pressure is shaped by vessel operational context. Cargo ships, passenger/Ro-ro vessels, and offshore vessels showed relatively high levels of overtime frequency, while offshore and passenger/Ro-ro vessels showed the highest overtime violation. This may reflect differences in port turnaround, service schedules, operational unpredictability, client requirements, passenger/vehicle operations, inspection exposure, or documentation workload.

The lower overtime levels among tankers/gas vessels may reflect more structured operational procedures and safety management systems. However, this interpretation should be treated cautiously because the study did not directly measure company-level policies, manning levels, or voyage schedules. The results show association, not causation.

The finding that overtime differs by vessel group is important for safety management. It suggests that work-rest compliance interventions should not be uniform across all vessel types. Different vessel operations may require different fatigue-risk controls. For example, passenger/Ro-ro and offshore operations may require closer monitoring of overtime violation, while cargo operations may require better planning around port operations, paperwork, and inspection preparation.

E. Implications for Maritime Safety

The findings have several implications for maritime traffic safety. First, frequent overtime among deck seafarers may increase fatigue-risk exposure. Even when formal work-rest regulation is reported as good, overtime may reduce the quality or duration of recovery. This matters because deck personnel perform safety-critical duties that require vigilance, situational awareness, and decision-making.

Second, the results show that work-rest compliance challenges are driven by operational and regulatory workload pressures. Inspection preparation, equipment problems, paperwork, regulatory additions, and repair-related tasks were the main overtime drivers. These findings suggest that fatigue-risk management should

address upstream workload sources rather than focusing only on individual behavior.

Third, vessel-group differences indicate that fatigue-risk management should be operationally specific. Passenger/Ro-ro and offshore operations showed higher overtime violation, while cargo ships showed high overtime frequency. These patterns suggest that regulators, shipping companies, and vessel managers should consider vessel-type operational characteristics when designing work-rest controls.

Fourth, almost all respondents recognized that rest supports performance. Therefore, awareness alone is not enough. Maritime education and training should continue to emphasize fatigue and rest, but organizational systems must also ensure that rest can be protected in actual operations. Bridge resource management, situational awareness, and non-technical skills training are important, but they must be supported by work schedules and staffing practices that allow seafarers to recover [3], [11], [12].

Finally, the findings support a prevention-oriented view of maritime traffic safety. Overtime and rest disturbance are upstream risk indicators. They may not directly cause accidents, but they may weaken human readiness before safety-critical encounters. In restricted waters or heavy traffic, reduced readiness may affect lookout, communication, and collision-risk assessment. This aligns with human-factor research showing that situational awareness, workload, and fatigue are closely related to bridge performance and maritime safety [8], [9], [10].

The practical implications can be summarized as a set of controls that connect the reported overtime drivers with specific fatigue-risk management actions, as shown in Table 5.

From a management perspective, the results indicate that overtime monitoring should not stop at recording the number of extra hours. The reason behind the overtime must also be recorded because the control required for inspection preparation is different from the control required for machinery problems, administrative reporting, or repair work. Reason-based monitoring would allow companies to identify whether fatigue risk comes from operational planning, technical reliability, documentation practice, or vessel service pattern.

TABLE 5.
FATIGUE-RISK MANAGEMENT IMPLICATIONS

Overtime / rest issue	Safety concern	Suggested control
PSC or external inspection preparation	Additional workload may accumulate before or after port calls.	Use rolling inspection-readiness plans, distribute document checks, and maintain digital evidence continuously.
Critical equipment or machinery problems	Unplanned technical work may reduce recovery opportunity.	Strengthen preventive maintenance planning, defect reporting, and shore-side technical support.
Administrative reporting and paperwork	Paperwork after watch may extend duty time and disturb rest.	Standardize electronic forms, reduce duplicate reports, and shift non-urgent administration ashore.
Vessel-group differences	Fatigue exposure may differ across cargo, passenger/Ro-ro, offshore, tug, and tanker/gas operations.	Apply vessel-type-specific fatigue-risk controls, manning review, and overtime monitoring.
Environmental rest disturbance	Recorded rest hours may not equal effective recovery.	Improve accommodation noise/vibration control, cabin management, and practical rest-protection rules.

Inspection-readiness also needs to be shifted from an event-driven activity to a continuous readiness system. When preparation is concentrated shortly before Port State Control or external audit, the workload may be transferred to seafarers during periods that should be used for recovery. Continuous document control, pre-arrival checklists, and shore-side assistance may reduce last-minute work while maintaining regulatory compliance.

For vessel operators, the significant differences across vessel groups indicate that one generic fatigue-risk procedure may be insufficient. Passenger/Ro-ro and offshore operations may need stronger violation monitoring because their service patterns can be time-critical and client-facing. Cargo operations may need better support during port turnaround and documentation-heavy periods. Tug operations may require attention to standby work and unpredictable job calls, while tanker/gas operations should maintain structured work planning without assuming that lower overtime automatically means lower fatigue risk.

For maritime education and training institutions, the findings can be integrated into bridge resource management, watchkeeping, and safety management courses. Rest protection should be taught as part of safe navigation readiness, not only as an administrative requirement. In restricted waters and high-density traffic, a fatigued officer may still follow procedures but may have lower capacity for lookout, communication, conflict detection, and timely collision-avoidance decisions.

F. Study Limitations

This study has several limitations. First, the data were based on self-reported survey responses. Respondents may interpret overtime, rest disturbance, and regulation status differently. Second, the study used a cross-sectional descriptive design, so it cannot establish causal relationships between overtime and maritime safety outcomes. Third, the study did not directly measure fatigue levels, sleep duration, near misses, or navigational incidents in this 587-respondent dataset. Therefore, the findings should be interpreted as evidence of upstream fatigue-risk conditions rather than direct evidence of safety outcomes. Fourth, although vessel-group differences were statistically significant, additional company-level and voyage-level data would be needed

to explain why specific vessel groups experience higher overtime.

IV. CONCLUSION

This study examined overtime drivers and work-rest compliance among 587 Indonesian deck seafarers and discussed their implications for maritime traffic safety. The findings show that most respondents reported good work-rest regulation status and adequate rest, but overtime remained common. A total of 32.0% reported overtime violation, and 52.1% reported high overtime frequency. This indicates that formal regulation and rest awareness do not automatically eliminate overtime pressure in shipboard operations.

The main overtime drivers were preparation for Port State Control or external inspection, critical equipment or machinery problems, administrative reporting, additional work due to new regulations, and post-dry-docking or repair-related work. These findings suggest that overtime is shaped by operational, technical, administrative, and regulatory workload pressures rather than individual behavior alone.

Vessel group was significantly associated with both high overtime frequency and overtime violation. High overtime was most common among cargo ships, passenger/Ro-ro vessels, and offshore vessels, while overtime violation was highest among offshore and passenger/Ro-ro operations. These results suggest that fatigue-risk management should be adapted to vessel operational context.

The study concludes that work-rest compliance should be treated as a system-level maritime safety issue. Regulators, shipping companies, vessel operators, and maritime education institutions should not only promote rest awareness but also address the operational causes of overtime. Practical measures may include better inspection-readiness planning, reduced administrative burden, improved technical maintenance planning, adequate manning, better rest protection, and vessel-type-specific fatigue-risk controls.

Future research should combine work-rest compliance data with fatigue scales, sleep measures, watch schedules, near-miss reports, and simulator-based navigation performance. This would provide stronger evidence on how overtime and rest disturbance affect human readiness during safety-critical maritime traffic situations.

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