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Human and Psychological Factors and Seasickness During Transitions to Sea

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ABSTRACT

Seasickness is a natural physiological response to motion, yet it remains a significant Human Factors and Ergonomics (HFE) challenge in offshore operations (Fenn & Froholdt, 2025; Ramic & Lützen, 2024). Research suggests that between 34% and 80% of maritime personnel experience seasickness, depending on occupational setting, vessel type, and environmental conditions (Arnardottir et al., 2022; Chan et al., 2006; Fenn & Froholdt, 2025; Le Cloirec et al., 2024). Beyond nausea and vomiting, seasickness can impair cognitive functioning, reduce situational awareness, contribute to fatigue, and negatively affect safety, well-being, and operational performance. Despite these consequences, seasickness is often perceived as a minor or unavoidable aspect of offshore work. This paper disseminates current evidence and practical guidance regarding the acknowledgement, management, and social support of seasickness among offshore workers. The paper further examines a range of contributing risk factors and reviews evidence-informed coping strategies. Recommended approaches include dietary measures such as moderating food intake before voyages. Behavioural strategies include resting or sleeping, maintaining visual focus on the horizon, remaining in the vessel's centre, seeking fresh air, practising mindful breathing, using acupressure bands, and allowing adequate recovery time before and after offshore work. The findings also identify environmental factors to avoid, including strong odours, excessive heat, overheating, heavy clothing, and visually demanding activities such as reading or prolonged use of electronic devices during transit.

Keywords: Performance influencing factors, Seasickness, Maritime health and safety

INTRODUCTION

Performance Influencing Factors (PIFs) are widely used within human factors and safety science to explain how individual, environmental and organisational conditions shape human performance (Glendon et al., 2006). While PIFs have been applied extensively in high-risk industries such as nuclear power, aviation and offshore operations, their application to seasickness (SS) has received little attention.

Existing research has largely focused on the physiological mechanisms of (SS) and vessel dynamics. However, these essential factors provide only a partial understanding of the operational consequences of SS. Whether an individual becomes seasick and whether that individual can subsequently continue working safely are potentially different human-factors questions.

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This distinction is particularly relevant to offshore wind operations. Offshore wind technicians are routinely transported to wind farms on Crew Transfer Vessels (CTVs), where exposure to vessel motion frequently induces SS before maintenance work begins. Unlike professional seafarers, technicians experience repeated short-duration voyages and therefore have limited opportunity to develop habituation, one of the strongest protective factors against motion sickness (Dobie, 2019). SS may consequently affect concentration, physical capability and decision-making, delay maintenance activities and, in some cases, require vessels to aborted operations (Fenn and Froholdt 2025, 2026; Ramic and Lutzen, 2025). These relationships suggest that seasickness can usefully be conceptualised as a socio-technical human-performance issue, rather than exclusively as a biomedical response to motion.

The present study therefore applies a PIFs perspective to seasickness in offshore operations. Building on Glendon et al. (2006), it develops a process-oriented distinction between primary PIFs, which predominantly contribute to the onset and severity of seasickness, and secondary PIFs, which predominantly influence how emerging symptoms are reported, managed and translated into operational outcomes.

The study combines findings from a scoping review with qualitative interviews involving maritime professionals with relevant offshore experience. The research question guided the study: How do human factors and SS symptoms play a role in the transition from land to sea for technicians, and which mitigating methods are effective in reducing SS and improving coping and recovery in maritime work environments?

The objective is not to replace established physiological models of motion sickness, but to complement them with a broader human-factors framework capable of accounting for the organisational and operational environment in which seasickness occurs.

BACKGROUND: SEASICKNESS AS A HUMAN FACTORS ISSUE

Seasickness is a multifactorial phenomenon resulting from interactions between physiological susceptibility and exposure to a moving environment. Vessel motion remains a fundamental trigger, but symptom onset, severity and recovery vary substantially between individuals and operating conditions.

Research has identified several individual factors associated with susceptibility. These include previous maritime experience, habituation, fatigue, psychological wellbeing, anxiety and gender (Chan et al., 2006; Haward et al., 2009; Park et al., 2022; Le Cloirec et al., 2024). Habituation is among the most consistently reported protective mechanisms, with repeated motion exposure contributing to reduced symptom responses in many individuals.

Psychological conditions may also affect symptom experience. Anticipatory anxiety, poor sleep and psychological distress have been associated with susceptibility and adaptation in motion-exposed environments. These relationships suggest that physiological and psychological responses should not necessarily be considered independently.

Environmental and ergonomic factors constitute a second group of influences. In addition to vessel motion, heat, poor ventilation, odours, noise and vibration may exacerbate discomfort. Characteristics of vessel motion, including heave, sway and surge, can generate different motion exposures, while passengers' location within a vessel affects the accelerations to which they are exposed (Earle et al., 2021; Ramic & Lützen, 2025; Bloothoofd et al., 2025). The organisational and social environment is less frequently incorporated into analyses of SS. Nevertheless, existing research indicates that workplace expectations and social norms can influence the disclosure and management of symptoms (Fenn & Froholdt, 2025, 2026). Workers may balance their physical condition against expectations of productivity, professional identity and concern about imposing additional work on colleagues.

From a human-factors perspective, this distinction is important. Vessel motion and individual susceptibility may contribute to the production of symptoms, but they do not alone determine the operational outcome. Whether a worker reports symptoms, receives assistance, takes sufficient recovery time or continues with a safety-critical task despite impairment also depends on social, organisational and operational conditions.

METHODOLOGY

Study Design

An exploratory multi-method design combined a scoping review with semi-structured qualitative expert-interviews (Kvale and Brinkman, 2015). The two components addressed complementary aspects of the research problem. The scoping review identified factors previously associated with SS and motion sickness in maritime and offshore contexts, while interviews provided experiential accounts of how SS develops, is managed and affects work in operational settings.

The findings were subsequently integrated using the Performance Influencing Factors framework described by Glendon et al. (2006).

Scoping Review

A scoping review was conducted following established methodological guidance for scoping reviews (Peters et al., 2020). The research question was formulated by use of the PICO framework where population (P), phenomenon of interest (I) and the context (CO) were first defined. This process also assisted in defining the inclusion and exclusion criteria for the review. The criteria are presented in the context of the PICO framework in Appendix 1.

The objective was to identify evidence concerning individual, psychological, environmental, task-related, social, organisational and technological factors associated with seasickness in maritime and offshore occupational environments. The search identified 239 articles. Through Covidence, duplicate studies of which there were 115 were both automatically and manually identified and verified. One reviewer assessed the relevance of the

studies based on title and abstract, of which 73 studies remained. This was followed by a full text screening performed independently by two reviewers where 30 additional studies were excluded. Disagreements at any stage were resolved through discussion with a third reviewer. Following the full text screening, 21 studies were retained for inclusion in the review.

Qualitative Interviews and Analysis

Eight semi-structured expert interviews were conducted with maritime professionals with first-hand knowledge of offshore transport and/or the experience and management of SS.

Participants were recruited through purposeful sampling based on their operational and organisational expertise and participation was voluntary. A semi-structured interview guide was developed in relation to the study objectives and informed by principles of qualitative research interviewing (Kvale & Brinkmann, 2015). The interviews lasted approximately 20–40 minutes and were recorded and transcribed. Identifying information was removed or anonymised to reduce the possibility of identifying individual participants. The research was conducted in line with the strict European general data protection rules (GDPR) and data management.

The interview material was analysed through a combined deductive and inductive thematic approach (Kvale and Brinkman, 2015). Initial themes were informed by the PIF domains identified in the analytical framework, while inductive themes allowed patterns not adequately captured by these predetermined categories to emerge from the interview material. Particular attention was given to experiences relating to symptom development, coping and recovery.

Themes were subsequently examined against the complete dataset and interpreted in relation to the distinction between factors associated predominantly with symptom onset and factors influencing the operational consequences of symptoms. This analytical distinction generated the concepts of primary and secondary PIFs presented below.

Analytical Framework

Building on Glendon et al. (2006), PIFs were initially considered in terms of internal and external influences on human performance. However, the literature and interview data indicated that the factors influencing the *development* of seasickness were not necessarily identical to those influencing what occurred *after symptoms had developed*. The study therefore introduces a temporal and process-oriented distinction. Primary and secondary PIFs were identified (Appendix 2).

RESULTS: INTEGRATION OF PRIMARY AND SECONDARY FINDINGS

The integration of the literature review and qualitative findings produced the process-oriented PIF framework illustrated in Figure 1.

Primary Phase

The process begins with the interaction of individual predispositions and environmental exposure. Individual susceptibility, previous experience, habituation, fatigue, psychological state and sleep interact with vessel motion, transit characteristics, environmental conditions and vessel location. These conditions influence the probability and severity of symptom development.

Symptom State

Once symptoms emerge, their existence alone does not determine the operational outcome. The worker enters a transitional state in which physiological symptoms interact with the demands and resources of the surrounding socio-technical system.

Secondary Phase

At this point, organisational, team task-related and technology PIFs become increasingly influential.

A worker experiencing symptoms may disclose them and receive support, alter the planned task, take sufficient recovery time or discontinue work. Conversely, productivity pressure, reluctance to disclose symptoms, insufficient recovery opportunities or high immediate task demands may increase the likelihood that symptoms translate into impaired performance.

Operational Outcomes, Individual Response and Operational Performance

The interaction of these factors may contribute to multiple outcomes. Experience, learning, habituation and organisational learning feed into subsequent exposure. Outcomes include:

- symptom coping;
- sufficient recovery before commencing work;
- modified work activities;
- delayed task commencement;
- reduced work capability;
- degraded performance;
- removal from safety-critical tasks; or
- interruption or cancellation of an operation.

The framework therefore distinguishes becoming seasick from the process by which SS becomes operationally consequential. Figure 1. In Appendix 3 shows the process-oriented Performance Influencing Factors (PIF) framework for seasickness adapted from Glendon et al. (2006).

DISCUSSION

The findings support a conceptualisation of SS as more than a physiological response to vessel motion. Across the data, physiological susceptibility and environmental exposure remain fundamental, but they do not alone explain the operational consequences of SS in offshore work.

Building on Glendon et al. (2006), the principal conceptual contribution of this study is therefore the distinction between primary and secondary PIFs. Primary PIFs help explain whether and to what extent symptoms develop, while secondary PIFs help explain what happens when symptoms occur. This distinction matters since conventional approaches to SS management have predominantly concentrated on exposure reduction and individual countermeasures. Once symptoms occur, the relevant safety question becomes whether the surrounding work system enables the affected individual to respond appropriately.

The interviews demonstrate considerable adaptive capacity among maritime workers. Participants developed individual combinations of behavioural, cognitive, medical and social strategies through experience, learning how their bodies responded to different environmental conditions. Adaptation should therefore not be understood simply as physiological habituation, but as an experiential process of coping and adjustment. Several participants described maintaining a positive mindset and avoiding anticipatory anxiety as important strategies. As one participant noted, *"If you start thinking you'll become seasick before you even leave, you're already halfway there."* These findings support previous research identifying habituation as a protective factor, while extending it by showing how experiential learning is shaped by social and organisational conditions. Management support was important, as one informant explained: *"Our management is pretty cool about it if you come back early there is no shouting."* Workers also exchanged advice, monitored colleagues and provided practical assistance: *"We usually try to take care of them, get them water. Maybe get them to lie down – it helps for some people…"* Such practices suggest that adaptation is not solely individual. Experience, peer support and supportive management may together strengthen collective adaptive capacity and operational resilience.

At the same time, social processes may produce competing effects. Humour can normalise seasickness and reduce embarrassment for some workers, while potentially increasing interpersonal risk for less experienced workers. Similarly, an organisational culture that values determination and continued productivity may provide resilience under ordinary circumstances but may discourage symptom disclosure when a worker's capability is impaired.

A particularly important human-factors implication concerns the distinction between arrival and recovery. Operational planning may treat the end of vessel transit as the point at which a technician becomes available for work. The interview findings challenge this assumption. Participants reported considerable variation in recovery time, indicating that individuals may arrive at the work location before they regain normal functional capacity. This suggests that seasickness management should form part of broader fitness-for-task and work-readiness considerations, particularly before activities requiring balance, sustained attention, climbing, complex maintenance or rapid decision-making.

The approach also has implications for technological development. Current decision-support models can potentially be strengthened by moving beyond weather and vessel-motion characteristics. Future systems could combine environmental exposure with information about transit duration,

individual susceptibility, recovery requirements and task demands. Such systems would move from predicting motion exposure toward supporting decisions concerning human operational readiness.

The distinction between primary and secondary PIFs should not be interpreted as a rigid classification. Some PIFs operate at multiple stages. Fatigue, for example, may increase susceptibility before a journey, intensify the cognitive effects of symptoms during transit and delay recovery after arrival. Similarly, a previous negative experience of seasickness may influence anticipatory anxiety before a subsequent journey, while effective organisational support may affect willingness to disclose symptoms during future operations.

The proposed framework is therefore cyclical rather than purely linear. Experience, habituation, social learning and organisational responses feed back into subsequent exposure. This dynamic represents an important area for future longitudinal research.

LIMITATIONS

Several limitations should be considered when interpreting the findings. Firstly, the qualitative component included only eight participants. The findings should therefore be regarded as exploratory rather than representative of offshore wind personnel generally. While participation was voluntary, introducing potential self-selection bias. Individuals willing to discuss seasickness may differ from those who declined participation or from workers who have left offshore employment because of severe susceptibility. The study did not include objective measurements of vessel motion, physiological response or operational performance. Finally, the distinction between primary and secondary PIFs represents a conceptual proposition derived from the integration of existing literature and exploratory qualitative data. The framework therefore requires empirical validation.

CONCLUSION

This study supports conceptualising SS in offshore wind operations as a socio-technical human performance issue rather than exclusively as a physiological response to vessel motion.

The findings indicate that SS develops through interactions among individual susceptibility, experience, psychological state, experiential learning and environmental exposure. Once symptoms develop, however, the operational outcome is additionally shaped by supervisory responses, peer support, reporting conditions, task demands and opportunities for recovery.

The paper therefore proposes a process-oriented extension of the PIFs framework. Primary PIFs predominantly influence the likelihood and severity of seasickness, whereas secondary PIFs predominantly influence how symptoms are managed and whether they translate into impaired performance or operational risk. This distinction redirects attention from the question of how seasickness can be prevented toward the broader human-factors question of how a socio-technical system should respond when seasickness occurs.

For offshore wind operations, this perspective has practical implications. Technical measures designed to reduce motion exposure should be complemented by organisational arrangements that support symptom disclosure, appropriate recovery, supervisory decision-making and assessment of readiness for safety-critical work. Future decision-support systems may consequently benefit from integrating vessel and environmental data with human-performance factors and work demands. Such an approach could support a transition from predicting seasickness alone toward predicting and managing operational readiness in offshore transits.

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APPENDIX 1

PICO Framework

Table 1: Inclusion and exclusion criteria.

	Inclusion Criteria	Exclusion Criteria
Population (P)	Seafarers, technicians, navy personnel and other groups with maritime experience	Individuals without a maritime experience (except if part of a control group)
Phenomenon of interest (I)	Studies examining human, psychological, ergonomic, or environmental factors Studies describing mitigation methods, interventions, or comfort-related measures	Purely pharmacological trials without relevance to operational or comfort or wellbeing guidelines
Context (CO)	Focus on maritime, offshore, or seafaring contexts	Non-maritime contexts without clear transferability
	Studies addressing seasickness or motion sickness in maritime or occupational contexts	Studies focusing motion sickness in aviation or spaceflight
Design	Studies published from 2000 onwards	Studies predating 2000
	Peer-reviewed articles, conference papers, industry reports, and grey literature	Editorials, opinion pieces, or sources lacking empirical/analytical content and reviews

APPENDIX 2

Primary PIFs

Primary PIFs are factors operating predominantly before or during exposure that influence the probability or severity of seasickness. These include:

- individual susceptibility;
- previous experience and habituation;
- fatigue and sleep;
- psychological state;

- vessel motion;
- transit duration;
- weather;
- temperature and ventilation;
- odours;
- noise and vibration; and
- location on the vessel.

Secondary PIFs

Secondary PIFs are conditions that become particularly important when symptoms are developing or have already occurred and influence their operational consequences. They include:

- supervisory responses;
- reporting climate;
- productivity expectations;
- peer support;
- interpersonal conditions surrounding disclosure;
- workload;
- task demands;
- opportunities for recovery;
- work modification;
- operational decision-making; and
- decision-support systems.

The distinction is analytical rather than absolute. Certain factors can operate at several stages of the process. Fatigue, for example, may increase initial susceptibility and subsequently intensify performance impairment or delay recovery. This prevents the model from treating seasickness as a simple linear sequence and recognises feedback processes involving experience, habituation, learning and future expectations.

APPENDIX 3

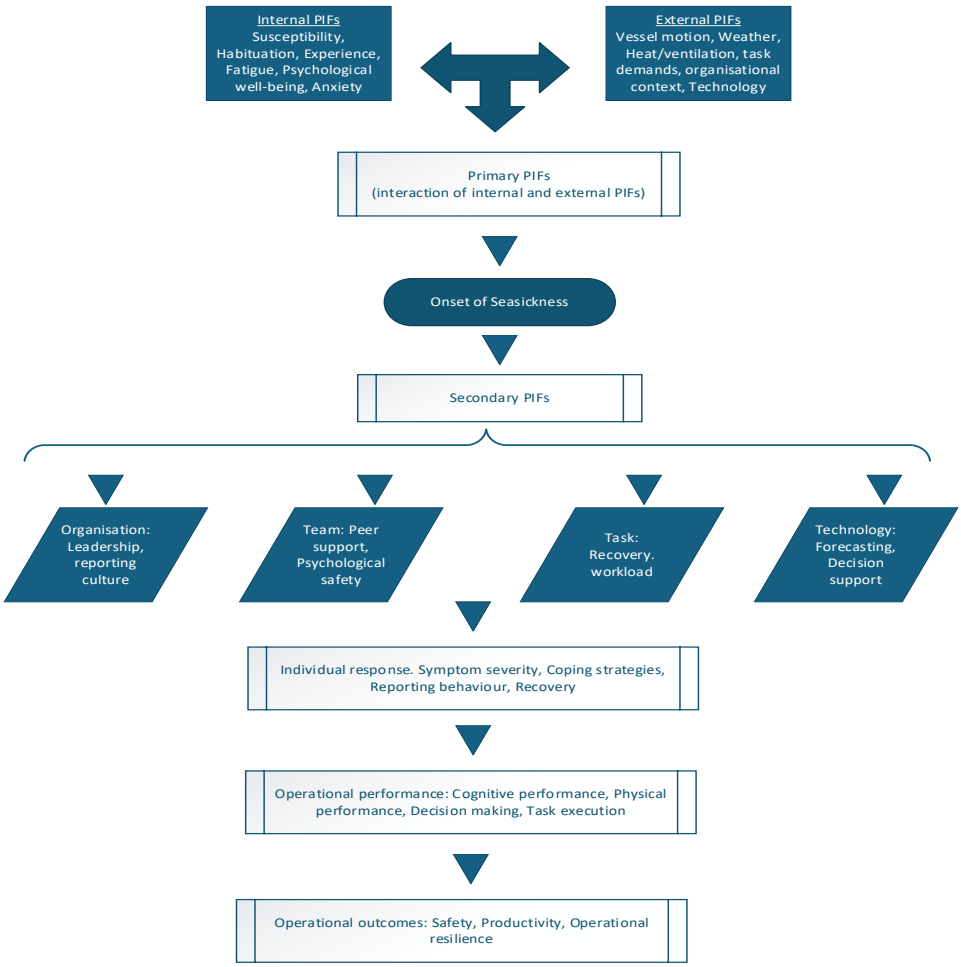


Figure 1: A process-oriented Performance Influencing Factors (PIF) framework for seasickness adapted from Glendon et al. (2006).