Ballast Water Management

2025 Industry Survey Results

Contents

Executive Summary

This report presents the results of a 2025 industry survey conducted by BIMCO on the operational realities of implementing the International Convention for the Control and Management of Ships' Ballast Water and Sediments (BWM Convention). The survey captures quantitative and qualitative input from ship operators BWM, with the objective of identifying recurring operational challenges, underlying causes and practical constraints affecting compliance in real trading conditions.

The survey results confirm that, while global implementation of the BWM Convention has reached a mature phase, significant operational challenges persist across ship types, trades and ballast water management system (BWMS) technologies. These challenges are not isolated or exceptional, but systemic and recurrent, particularly during time-critical port operations, cargo handling and ballast uptake or discharge under challenging water quality (CWQ) conditions.

Operational findings indicate that BWMS performance is frequently constrained by environmental conditions, system behaviour and alarm management. Respondents reported frequent alarm cascades, intermittent shutdowns, sensor faults and unpredictable system responses, often occurring at precisely those moments when crew workload is highest. UV-based systems were reported as especially sensitive to CWQ conditions, with low UV transmittance frequently leading to alarms, automatic shutdowns or forced bypass during ballast uptake.

CWQ was identified as a routine and predictable operational reality in many ports, rivers and estuaries, rather than an exceptional circumstance. As a result, reliance on contingency measures was widely reported as a normal component of BWM in practice. Respondents described regular use of contingency pathways in accordance with IMO guidance, triggered by CWQ, system malfunctions, time constraints and extended repair periods due to limited access to authorised service engineers or spare parts. In several cases, defects required more than two months to resolve, during which contingency measures were unavoidable.

Experiences during third-party inspections indicate that BWMS-related findings remain frequent. Inspection challenges were most commonly linked to system malfunctions, alarms, documentation issues and difficulties demonstrating compliance in situations involving contingency measures. Respondents reported inconsistent interpretation of alarms, system behaviour and contingency actions by inspectors, contributing to compliance uncertainty even where crews were operating in line with manufacturer instructions and IMO guidance.

The survey further highlights the significant human-element implications associated with BWMS operation. Frequent alarms, troubleshooting demands and administrative requirements increase crew workload, particularly during port operations, and were reported to contribute to fatigue and, in some cases, rest-hour exceedances. Training was found to be necessary but not sufficient to prevent operational difficulties, with system complexity, environmental constraints and usability issues emerging as more influential factors than training alone.

Taken together, the findings demonstrate that BWMS operation, CWQ, contingency measures, inspection outcomes and human-element impacts are deeply interconnected. The survey does not seek to assess compliance rates or attribute responsibility to specific technologies or manufacturers. Rather, it provides evidence of a structural gap between regulatory assumptions, system design and real-world operation.

Introduction

Background

The BWM Convention has, since September 2024, reached a mature phase of global implementation. The vast majority of the world fleet is now fitted with approved BWMS and operates under the D-2 ballast water discharge standard. As implementation has progressed, operational experience has increasingly highlighted practical challenges related to system performance, usability and enforcement under real trading and port conditions.

Over recent years, BIMCO members have consistently reported recurring operational issues associated with BWMS reliability, alarm behaviour, CWQ conditions, the application of contingency measures and experiences during port State control (PSC) inspections. These challenges have implications not only for regulatory compliance, but also for crew workload, safety management and operational predictability.

Against this background, BIMCO conducted an industry survey in 2025 to capture structured, evidence-based input from ship operators on their practical experience with BWM. The survey was designed to complement regulatory discussions by providing quantitative data and qualitative insights drawn directly from shipboard operations and company follow-up analysis.

The objectives of the survey were to:

- document common operational and technical challenges encountered during BWMS operation and maintenance
- assess training practices and human-element considerations associated with BWMS use
- examine the impact of CWQ on system performance and compliance
- understand how contingency measures are applied in practice
- capture industry experience during PSC and other third-party inspections.

This report presents the survey results as a standalone industry document. Its purpose is to describe operational realities as reported by ship operators, identify recurring patterns and highlight areas where experience suggests misalignment between regulatory assumptions, system design and real-world operation. The report does not assess individual manufacturers, determine compliance levels for different technologies, nor does it seek to attribute responsibility for the challenges identified.

Survey design and methodology

The BIMCO BWM survey was conducted over a three-month period starting in February 2025. The survey targeted entities with direct operational responsibility for ships subject to the BWM Convention, including shipowners and technical managers.

The questionnaire was designed to collect both quantitative and qualitative information. It covered fleet characteristics, BWMS technologies in use, training practices, operational performance, maintenance experience, contingency measures, PSC inspections and company follow-up analysis of BWMS-related issues.

All responses were subject to quality review prior to analysis. Submissions that were incomplete, internally inconsistent or lacked essential data were excluded to ensure the reliability and coherence of the results. The analysis therefore reflects only validated responses that met the survey's minimum quality criteria.

Certain limitations should be noted. Participation in the survey was voluntary, and results reflect self-reported operational experience. The findings therefore illustrate trends and recurring issues rather than statistically weighted global averages. In addition, the distribution of BWMS technologies reflects market uptake rather than a comparative assessment of system performance.

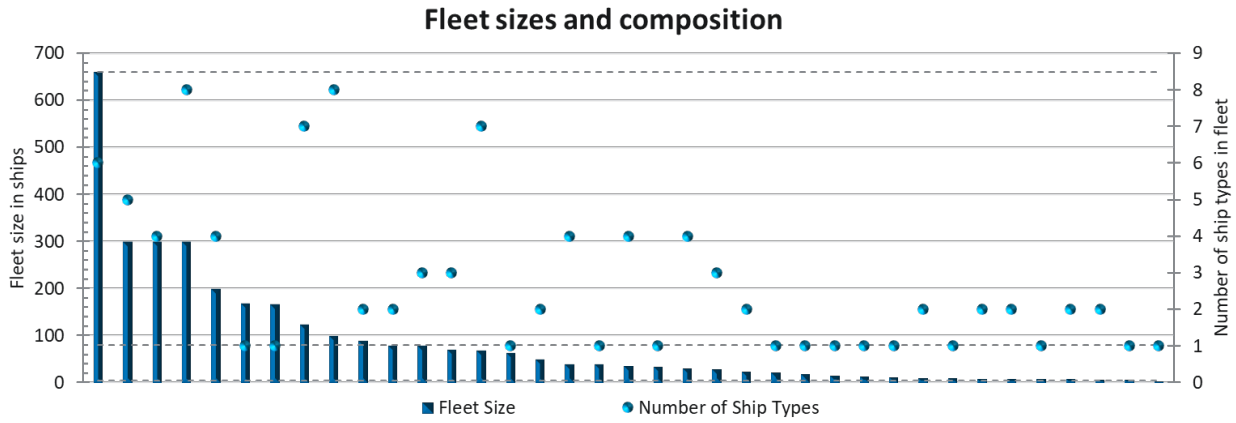
Despite these limitations, the consistency of responses across fleets of different sizes, trades and technologies provides a robust basis for identifying common challenges and cross-cutting themes relevant to BWM implementation.

Data composition

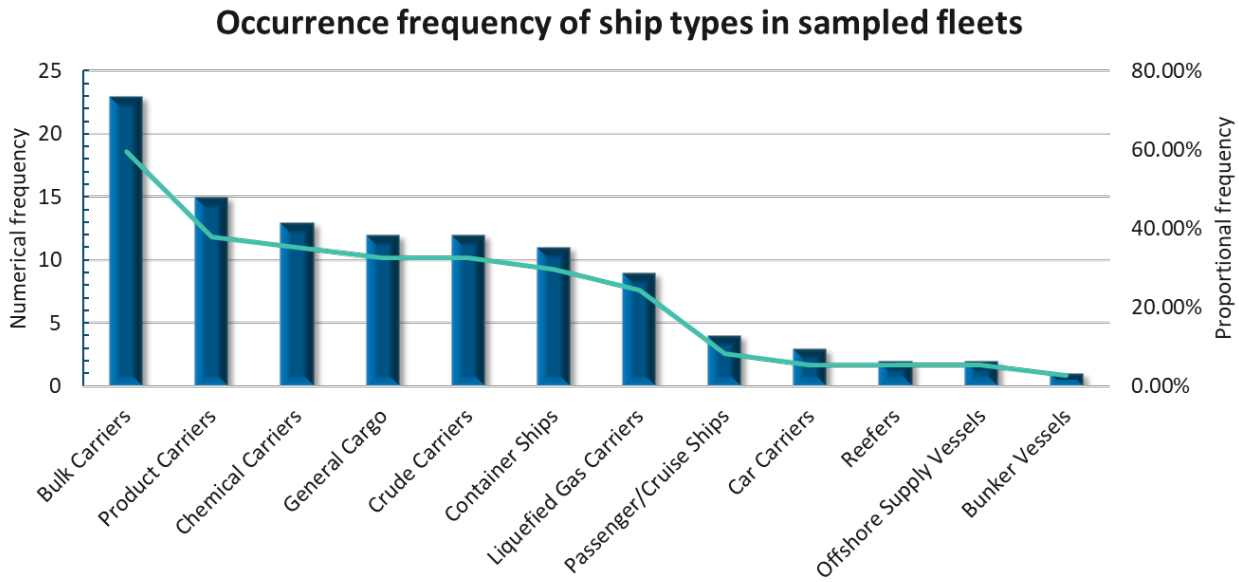
The final dataset comprises responses from 37 companies, collectively representing 3,231 ships. The participating fleets span a wide range of ship types and sizes, operating regions, trading patterns and BWMS technologies, providing a diverse and representative snapshot of industry experience.

Fleet size among respondents varied considerably, ranging from small operators managing fewer than 50 ships to large fleets of more than 100 ships. The largest reported fleet comprised approximately 660 ships, while the smallest comprised four ships. This range enables comparison of operational experience across different organisational structures and resource levels and reflects the diversity of fleet structures and operating models across the industry.

Respondents reported operating fleets with varying levels of ship-type diversity. On average, fleets comprised two to three ship types, with the most diverse fleets operating up to eight ship types and the least diverse operating a single ship type.



While the survey did not capture the proportional distribution of ship types within individual fleets, bulk carriers, product tankers and chemical tankers were the most commonly occurring ship types. This information is intended solely to illustrate the representativeness of the sample across major shipping sectors and should not be interpreted as reflecting the proportional distribution of ship types across the surveyed fleets.



Overall, the composition of respondents provides a comprehensive evidence base for examining BWM operational realities and compliance challenges across the global fleet.

Ballast water management practices

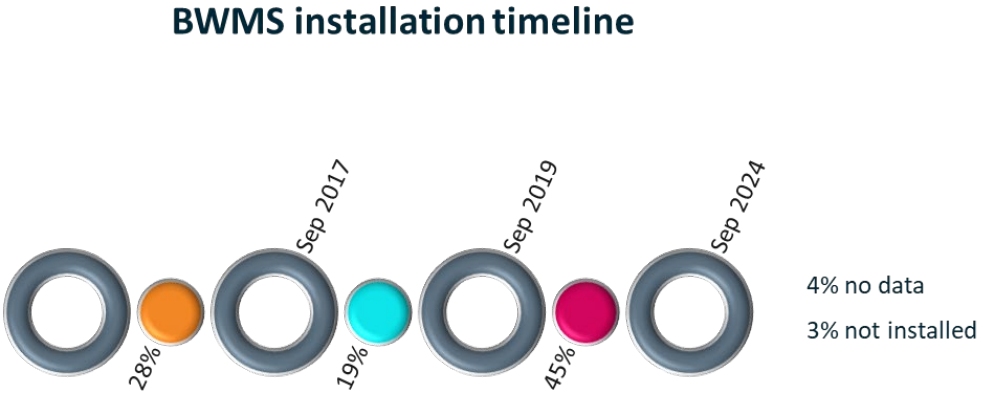
This section summarises BWM practices reported by survey respondents, focusing on the technologies in use and the practical experience associated with crew training and BWMS operation and maintenance.

The information presented highlights prevailing industry practices and common operational characteristics, providing context for the operational challenges discussed in later sections of this report.

BWMS installation and technologies

In total, 97% of the 3,231 ships included in the validated dataset were reported as having an approved BWMS installed. Of these, 93% provided sufficient information to be included in the analysis of installation timelines, while 4% reported BWMS installation but did not provide complete or consistent information on the timing of installation. The remaining 3% of ships were reported as not having a BWMS installed and were excluded from subsequent analysis of system operation and performance.

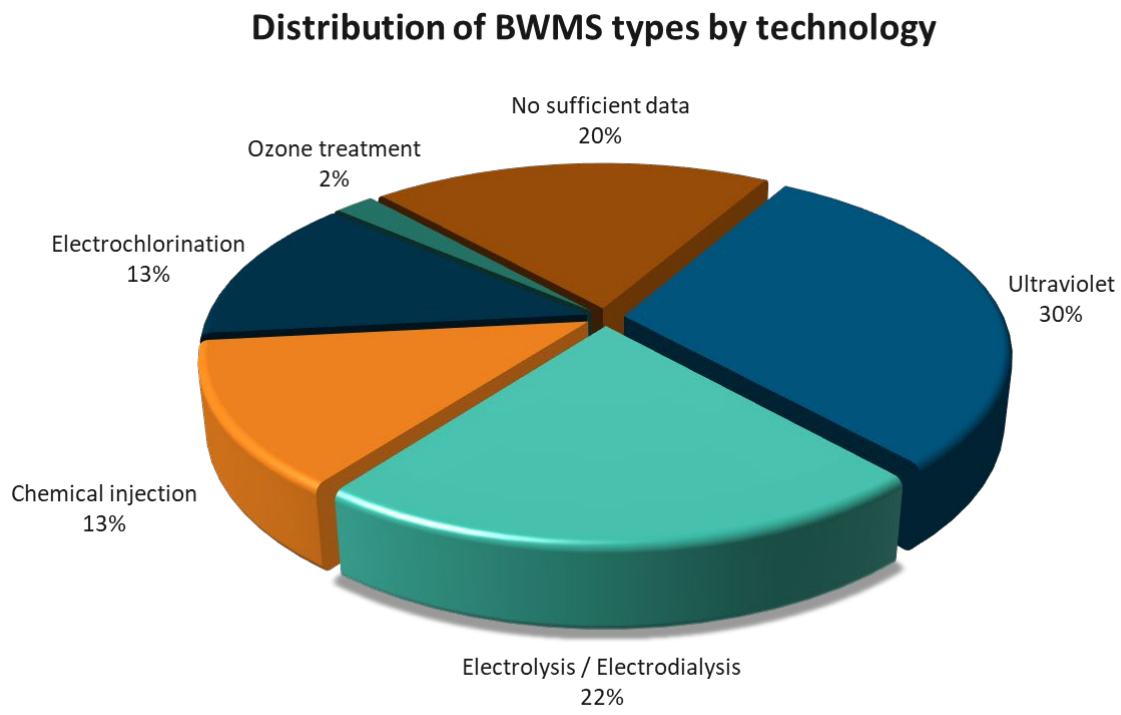
The installation timeline reflects the phased implementation schedule of regulation B-3, which commenced in September 2017. Installations increased steadily from that date onwards, with survey data showing that BWMS installations were distributed relatively evenly across the period from 2017 to 2024. Approximately half of all reported installations occurred between September 2019 and September 2024, corresponding to the later stages of the B-3 compliance schedule, while the remainder were installed prior to September 2019. This distribution suggests sustained installation activity throughout the implementation period rather than a single concentrated retrofit peak.



With respect to technology choice, ultraviolet (UV) treatment systems represent the most widely used BWMS technology in the survey sample, accounting for approximately 30% of installations. This is followed by electrolysis/electrodialysis systems (22%), with chemical injection and

electrochlorination systems each accounting for approximately 13%. Ozone-based systems are used in a very small proportion of the fleet (around 2%). No respondents reported the use of BWMS technologies outside the categories listed in the survey.

To account for variation in fleet size among respondents, percentage-based inputs were translated into absolute ship numbers using the fleet-size data provided. This approach enables a more representative assessment of the distribution of BWMS technologies and installation timelines across the surveyed sample, rather than weighting results by company count alone.



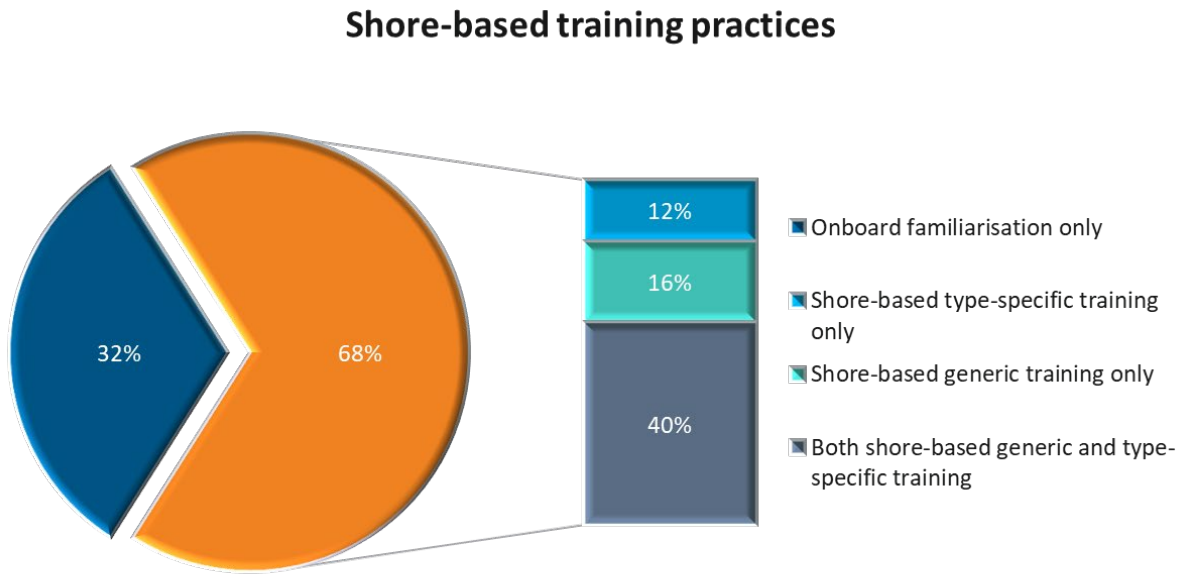
No statistically significant relationship was identified between fleet size and technology selection, although UV systems appear more prevalent among newer installations, while due to the lack of detailed ship-type distribution data within individual fleets, no conclusions can be drawn regarding correlations between BWMS technology choice and ship type.

The diversity of BWMS technologies and installation dates across fleets means that many operators manage heterogeneous systems concurrently. Respondents noted that this heterogeneity has implications for crew familiarisation, maintenance planning, spare-part management and operational consistency, providing important context for the training, operational and maintenance practices discussed in the following sections.

Overall, the distribution of BWMS technologies and installation timelines within the dataset reflects prevailing market uptake trends and regulatory implementation schedules, rather than targeted sampling of specific systems or installation periods.

Training

Survey responses indicate considerable variation in BWMS training practices across fleets of different sizes and compositions. Overall, 68% of respondents reported providing some form of shore-based BWMS training in addition to onboard familiarisation. Within this group, approximately 40% indicated that both generic and type-specific shore-based training was provided. By contrast, 32% of respondents reported relying exclusively on onboard familiarisation for BWMS training.



Clear differences emerge when training practices are considered in relation to fleet size. Larger fleets were more likely to implement structured training programmes combining generic shore-based training, type-specific training and onboard familiarisation. Smaller operators, by contrast, predominantly relied on onboard familiarisation alone.

When assessed in relation to fleet composition, respondents operating liquefied gas carriers, chemical carriers, product tankers and passenger ships more frequently reported providing shore-based, including type-specific, BWMS training. Operators primarily engaged in bulk carrier and general cargo trades reported such training less frequently. Given the survey design and the absence of detailed ship-type distribution data within individual fleets, these observations are indicative only and should not be interpreted as representative of training practices by ship type across the global fleet.

Several respondents reported reliance on informal or experience-based learning, particularly during busy port operations when alarms and troubleshooting demands were most frequent. In some cases, BWMS training was described as reactive rather than proactive, with more structured instruction introduced following operational difficulties or inspection findings.

Respondents identified a range of challenges associated with BWMS training and familiarisation. These included:

- difficulties in interpreting manufacturer instructions, particularly where manuals were perceived as overly technical or insufficiently aligned with operational realities
- limited familiarity with alarm hierarchies, treatment logic and control sequences, especially on ships fitted with multi-stage systems
- challenges arising from crew rotation between ships equipped with different BWMS technologies.

Responses regarding future expansion of shore-based BWMS training were mixed. Among respondents who addressed this question, similar proportions indicated that they do not currently plan to introduce shore-based training, are considering such training, or remain uncertain. A substantial number of respondents did not provide a response, limiting the conclusions that can be drawn regarding future training trends.

Overall, the survey findings indicate that BWMS training practices remain largely dependent on company resources, fleet structure and operational priorities. Respondents identified several factors influencing training approaches, including the absence of regulatory requirements for shore-based or type-specific BWMS training and cost considerations related to travel, simulator access and vendor-provided courses, particularly for small and medium-sized operators. Cultural and logistical factors, including crew turnover and operational schedules, were also reported as influencing whether BWMS training could be prioritised alongside other mandatory training requirements.

BWMS operation

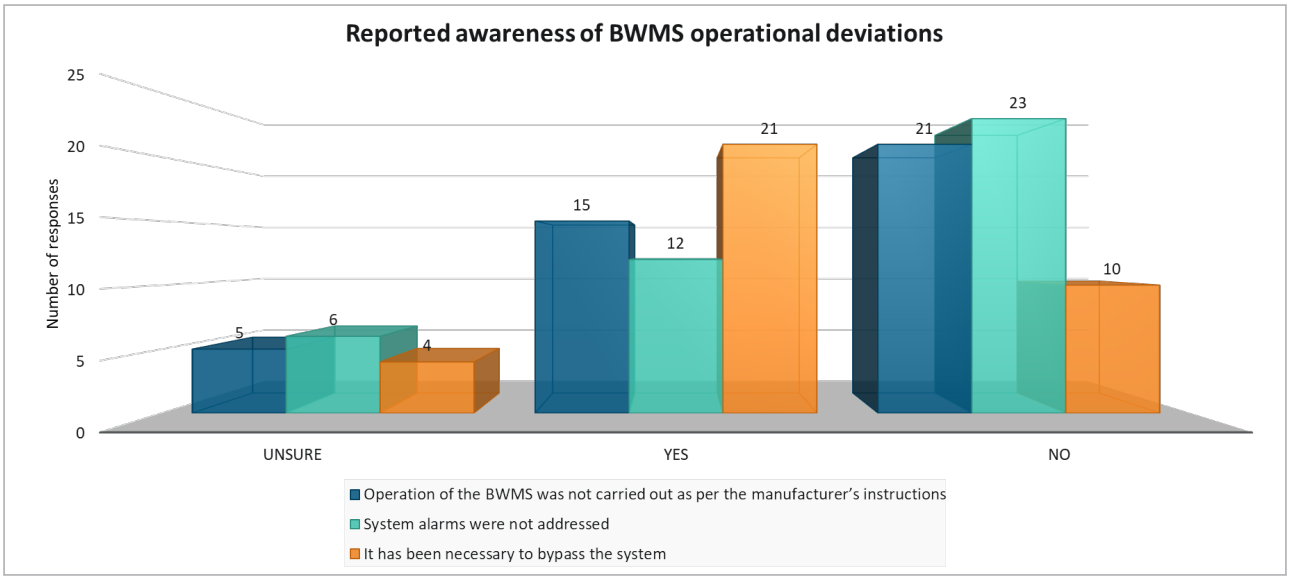
Survey responses indicate that operational challenges remain a significant feature of BWMS use across ship types, trading patterns and system technologies. Respondents reported that BWMS-related issues most frequently arise during time-critical operational periods, particularly during ballast and deballast operations conducted in parallel with cargo handling, port manoeuvring or other high-workload activities.

A recurring theme across responses was the frequency and complexity of alarms generated during BWMS operation. Respondents reported alarm cascades, repeated alarms and alarms perceived as poorly prioritised, making it difficult for crews to distinguish between critical and non-critical conditions. In several cases, alarms were described as recurring despite corrective actions having been taken, contributing to uncertainty regarding system status and reliability.

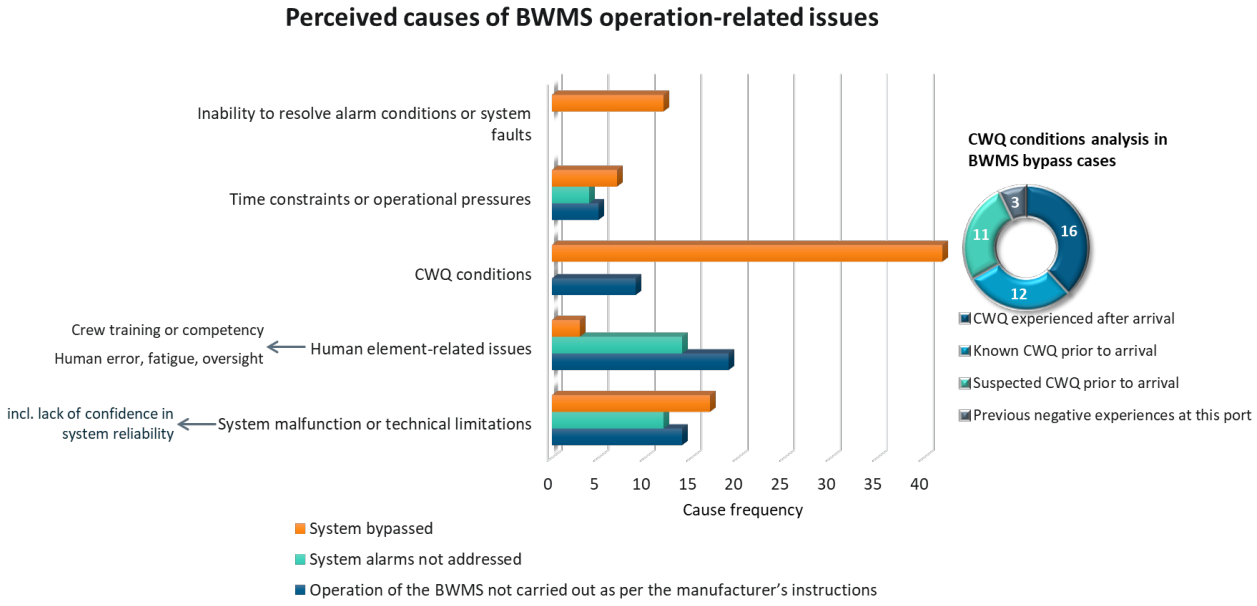
Unpredictable system behaviour was also widely reported. Respondents described instances of automatic system shutdowns, unexpected flow reductions, sensor faults, premature filter clogging and software-related issues. These behaviours were reported across different BWMS technologies and were often described as intermittent, complicating troubleshooting and increasing reliance on manual intervention.

Operational deviations were reported as a consequence of these challenges. These included:

- operation outside manufacturer instructions, often due to system malfunction, conflicting guidance or impractical instructions in real operational conditions
- alarms not being addressed, either because they occurred in rapid succession or because incomplete or inconsistent alarm logic made troubleshooting unclear
- automatic or manual bypassing triggered by system design or alarm responses.



When respondents were asked to identify the underlying causes of operational deviations, system malfunctions or technical limitations and CWQ conditions were most frequently cited. These included alarms triggered by low UV transmittance, sensor faults, software errors, poor integration with ship systems and filter clogging. Human-element-related factors, such as fatigue, distraction during cargo operations, incomplete familiarisation or misinterpretation of alarm logic, were also commonly reported. Operational pressures and time constraints further contributed, particularly where officers had to prioritise cargo operations, berthing or navigational duties over extended troubleshooting of BWMS alarms.



Importantly, these issues were not reported as isolated events but as cumulative in nature. Respondents described situations where a single technical fault cascaded into multiple alarm sequences, increasing confusion and the likelihood of system bypass during busy port operations.

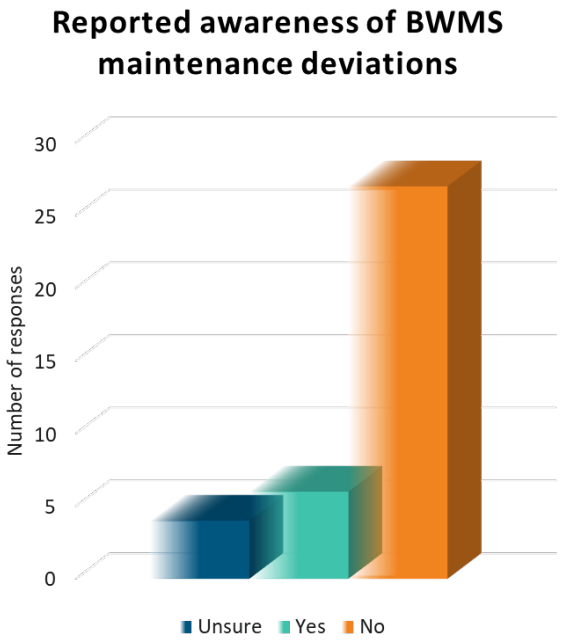
The interaction between BWMS operation and broader shipboard workload was a consistent concern. Frequent alarms and troubleshooting requirements were reported to divert attention from core safety tasks. In some cases, this resulted in increased stress, reduced situational awareness and extended working hours, particularly during port operations. Several respondents noted that BWMS-related demands contributed to fatigue and, in some cases, rest-hour exceedances.

Overall, the survey responses indicate that BWMS operation does not always integrate seamlessly with normal shipboard operations. System behaviour, alarm management and time pressures were frequently reported as limiting crews' ability to operate BWMS strictly in accordance with manufacturer guidance under real trading conditions.

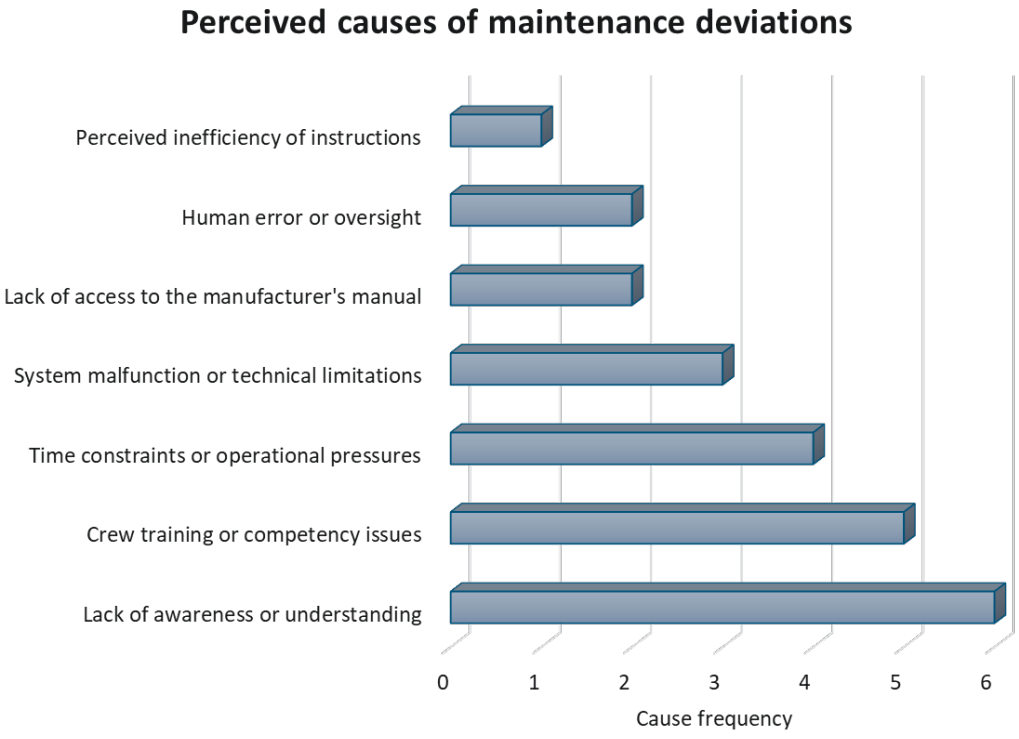
BWMS maintenance and manufacturer support

Survey responses indicate that BWMS maintenance is generally addressed through formal onboard arrangements. The vast majority of respondents (approximately 95%) reported that BWMS maintenance tasks are incorporated into the ship's Planned Maintenance System (PMS), indicating that maintenance is recognised as a routine and structured activity within company safety and maintenance frameworks.

Despite this formal inclusion, respondents reported instances where maintenance was not carried out strictly in accordance with manufacturer instructions. While such cases were limited in number, they highlight practical constraints affecting BWMS upkeep, particularly where external service support or spare parts were required.



Among those respondents who reported deviations, the most frequently cited contributing factors were lack of awareness or understanding of specific maintenance requirements, crew competency limitations and time constraints competing with available maintenance windows. In several cases, respondents explained that prescribed maintenance tasks were impracticable because system behaviour diverged from design assumptions, particularly where sensors, filters or other components failed unexpectedly or required intervention outside planned schedules.



A recurring and significant theme across responses was the limited availability of authorised service engineers and spare parts. Multiple respondents reported prolonged BWMS downtime due to spare-part lead times frequently exceeding two months, including in key trading regions. Insufficient global service coverage and inconsistent regional support were repeatedly cited, increasing operational uncertainty and compliance risk.

Several respondents also raised concerns regarding vendor discontinuity, including situations where third-party component suppliers had exited the market, leaving operators without access to approved replacements or technical support. In such cases, crews reported reliance on temporary workarounds or deferred repairs, increasing the risk of non-compliance or operational disruption.

Maintenance and troubleshooting challenges were further exacerbated by fleet heterogeneity, with many companies operating ships fitted with multiple BWMS types. Respondents noted that this undermines economies of scale in spare-parts management and complicates crew familiarisation, training and maintenance planning. In addition, respondents highlighted that calibration drift, periodic software updates and component ageing introduce variability that is not always adequately captured by routine PMS-based maintenance checks.

Overall, the survey results indicate that while BWMS maintenance is formally embedded in shipboard maintenance systems, effective implementation is constrained by practical realities related to system reliability, service availability, fleet diversity and operational pressures. These factors collectively contribute to maintenance deviations and increase reliance on temporary solutions, underscoring the importance of manufacturer support, service network robustness and realistic maintenance guidance aligned with in-service experience.

Third-party inspections

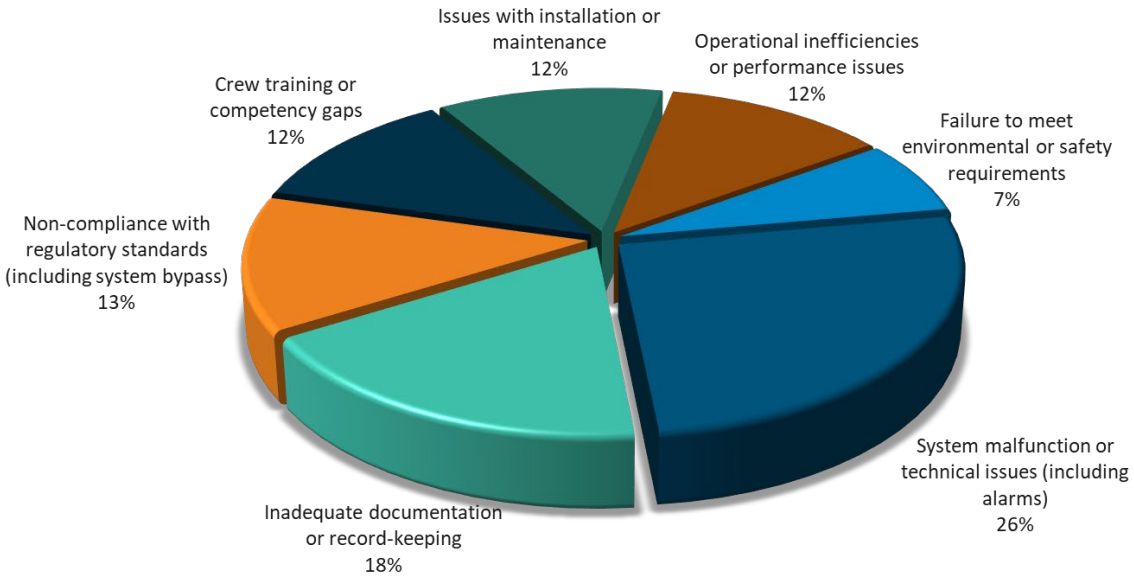
This section summarises experiences related to port State control (PSC) and other third-party inspections as reported by survey respondents. The information reflects ship operators' accounts of issues raised during inspections and subsequent company follow-up and does not represent data provided directly by inspection authorities. The primary objective of this part of the survey was not to quantify inspection findings as such, but to identify underlying operational, technical and procedural factors that contribute to inspection outcomes. The focus is therefore on recurring causes, system behaviours and interface challenges observed in practice, rather than on the frequency or severity of individual inspection deficiencies.

Reported findings

Reported experiences during PSC and other third-party inspections indicate that findings related to non-compliance with the BWM Convention remain frequent, with approximately 60% of respondents reporting awareness of BWMS-related findings.

The most commonly reported inspection findings relate to system malfunction or technical issues, followed by documentation deficiencies and crew training or competency gaps. Other reported categories include performance issues, installation or maintenance deficiencies, and instances of regulatory non-compliance, including system bypassing.

Most commonly reported findings during third-party inspections



System malfunction, alarms and operational behaviour

System malfunction and technical issues were consistently identified as the primary triggers for inspection findings. Respondents reported that persistent alarms, unresolved alarm conditions, erroneous sensor readings, software errors, automatic bypasses and unexpected system shutdowns frequently prompted increased scrutiny during inspections. These issues often occurred during time-critical port operations or in conjunction with CWQ conditions.

Several respondents noted that PSC officers sometimes struggled to interpret alarm hierarchies, system status indicators or diagnostic messages, particularly where alarms were frequent or cascading. In some cases, alarms or automatic system responses were interpreted as evidence of non-compliance with the D-2 standard, even where crews were operating in accordance with manufacturer instructions or applying contingency measures consistent with IMO guidance.

These experiences highlight a recurring disconnect between BWMS operational behaviour, manufacturer guidance and inspection expectations, contributing to uncertainty during inspections.

Documentation and record-keeping

Documentation-related findings were the second most frequently reported category. Respondents indicated that traditional paper ballast water record books (BWRBs) are poorly suited to the operational realities of some BWMS, particularly where frequent alarms, partial treatment cycles or repeated operational adjustments occur during busy port calls.

Crews reported difficulties maintaining accurate and timely records under such conditions, especially when documentation expectations varied between inspectors or ports. Some respondents noted that inspectors requested information or formats not clearly specified in existing IMO guidance, increasing the compliance burden. While the introduction of electronic record books under resolution MEPC.372(80) is expected to address some of these challenges, respondents indicated that uptake remains uneven and practices are not yet harmonised.

Crew interaction during inspections

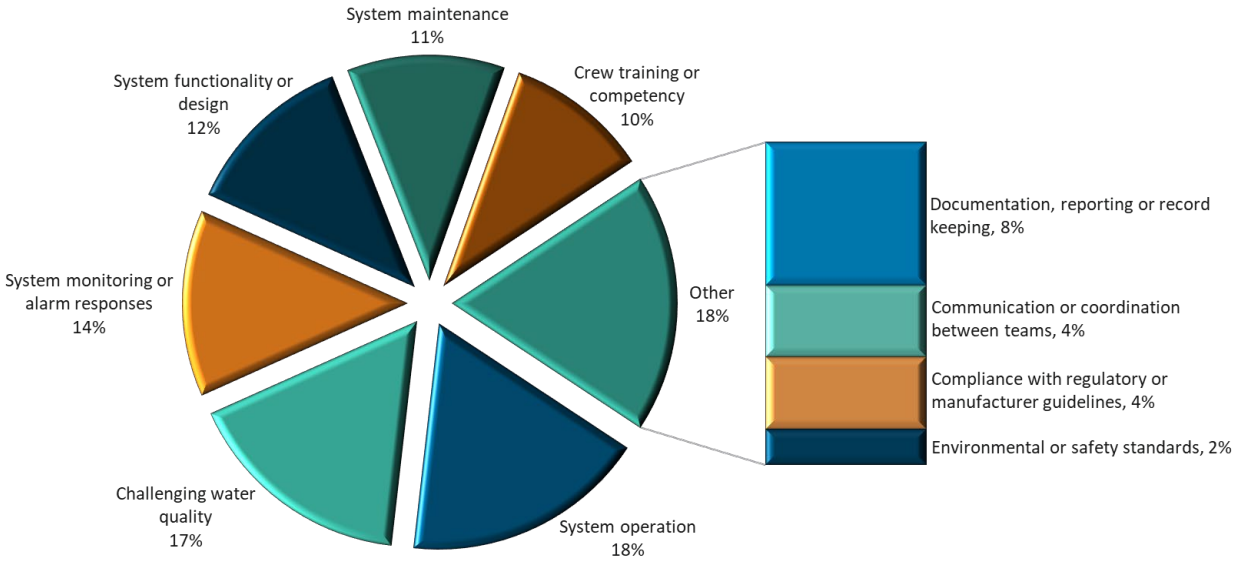
Crew training and competency-related findings were also reported during inspections, most commonly linked to difficulties explaining complex system behaviour, alarm logic, contingency actions or troubleshooting steps to inspectors. Respondents emphasised that these challenges were not necessarily the result of inadequate training, but rather stemmed from the inherent complexity of BWMS, variability across manufacturers and multi-stage treatment logic that is difficult to explain in real time.

Alarm overload during cargo operations, combined with manufacturer instructions perceived as overly technical or insufficiently aligned with operational realities, further limited crews' ability to demonstrate compliance convincingly at the point of inspection.

Follow-up analysis

The root cause analyses of the findings as performed by the companies show a consistent pattern, with system operation and functionality issues (including alarms, shutdowns and control faults) most frequently identified, followed by CWQ, inadequate system monitoring or alarm response, and deficiencies in maintenance or crew familiarisation.

Issues identified through companies' root cause analysis



Importantly, respondents noted that inspection findings often reflect underlying operational challenges already present during normal BWMS operation, rather than isolated or exceptional compliance failures.

Analysis of inspection findings in relation to training practices indicates that companies with more extensive training programmes often reported a higher awareness of issues during inspections, which possibly suggests greater system knowledge and more accurate reporting of deficiencies, rather than poorer system performance. Across all training types, system malfunction remained the most frequently reported issue, followed by training gaps and documentation deficiencies.

No clear correlation was identified between BWMS technology type and inspection findings. UV, electrolysis and chemical injection systems appear most represented in reported issues, largely reflecting their prevalence in the installed fleet rather than a definitive link to performance. Similarly, installation age did not emerge as a decisive factor: older and newer systems alike were reported to experience inspection findings, particularly in relation to alarms, documentation and CWQ-related challenges.

A proportion of respondents reported awareness of incidents with port authorities related to BWMS that directly interrupted or affected ship operations during ballasting or de-ballasting. Where such incidents were described, they were typically linked to system failures, CWQ, time constraints during cargo operations or the handling of flag State dispensations. In some cases,

respondents reported that operations were delayed or suspended pending clarification or acceptance of contingency measures.

Overall, the survey indicates that inspection-related challenges are closely linked to the operational, technical and human-element issues described in other sections of this report. System reliability limitations, alarm behaviour, documentation burdens and the complexity of demonstrating compliance under real operational conditions translate directly into inspection risk. Respondents consistently highlighted that inconsistencies in inspection interpretation, particularly regarding alarms, bypasses and contingency measures, create compliance uncertainty even where crews and companies are acting in good faith and in line with IMO guidance.

CWQ and application of contingency measures

This section presents survey findings related to CWQ and the practical application of contingency measures during ballast water operations. Again, the objective is not to quantify non-compliance outcomes, but to identify recurring operational conditions, system behaviours and decision points that influence how BWM is implemented in practice.

Operational exposure to CWQ

Survey responses indicate that CWQ is a frequent and predictable operational condition, rather than an exceptional circumstance. Respondents reported encountering CWQ regularly in rivers, estuaries, ports with high sediment loads, brackish waters and areas with low UV transmittance. In many cases, CWQ conditions were known or suspected prior to arrival, based on voyage history, port characteristics or previous experience.

CWQ was reported across a wide range of ship types, trades and trading patterns, including port-intensive operations where ballast uptake and discharge must be conducted within narrow operational windows. Respondents emphasised that CWQ often coincides with time-critical cargo operations, amplifying operational pressure on crews.

Respondents consistently reported that CWQ has a direct and material impact on BWMS performance, particularly for systems sensitive to water quality parameters such as turbidity, suspended solids and UV transmittance.

Reported effects include:

- frequent or persistent alarms triggered during ballast uptake
- automatic system shutdowns or reduced treatment capacity
- premature filter clogging and sensor faults
- automatic initiation of bypass sequences in response to alarm thresholds.

These behaviours were described as occurring during normal operation, rather than as isolated failures, and were often reported as recurring at specific ports or regions. Respondents noted that in some cases BWMS performance deteriorated rapidly after ballast uptake commenced, leaving limited time to troubleshoot before cargo operations progressed.

Application of contingency measures in practice

The survey indicates that contingency measures are routinely relied upon in practice, particularly in situations where CWQ prevents normal BWMS operation or where system faults cannot be resolved on board within the available operational timeframe.

Respondents reported applying contingency measures in a range of scenarios, including:

- ballast uptake in CWQ conditions where treatment could not be completed as designed

- system failures occurring during cargo operations
- extended periods awaiting service attendance or spare parts
- repeated alarm cascades that could not be resolved without interrupting operations.

In several cases, contingency measures were described as the only practicable means of maintaining operational continuity, rather than as an exceptional fallback option. Respondents emphasised that decisions to apply contingency measures were typically driven by risk management considerations, including navigational safety, cargo safety and crew workload.

While contingency measures provide operational flexibility, respondents highlighted significant uncertainty regarding their acceptance, particularly during inspections. Inconsistent approaches by port State authorities, lack of designated ballast water exchange (BWE) areas and the impracticality of travelling far offshore for decontamination were frequently cited as compounding factors.

Several respondents noted that the administrative and communication burden associated with contingency measures can be substantial, especially when approvals or clarifications are required within tight operational timelines. Delays in receiving guidance from flag States or port authorities were reported in some cases, increasing the likelihood of operational disruption.

Respondents also expressed concern that the routine nature of CWQ and contingency use is not always reflected in regulatory assumptions or guidance, contributing to uncertainty for crews tasked with demonstrating compliance under difficult conditions.

Operational interdependencies observed

Across the dataset, CWQ, BWMS performance limitations and contingency measures were shown to be closely interlinked. CWQ frequently triggers system behaviours that escalate into alarms, shutdowns or bypasses, which in turn necessitate contingency actions. These dynamics often unfold during high-workload periods, magnifying the operational and human-element challenges described in earlier sections of this report.

Overall, the survey findings suggest that CWQ and contingency measures are not peripheral issues, but core elements of day-to-day BWM, with direct implications for system design assumptions, guidance development and enforcement consistency.

Cross-cutting observations

Across the survey responses, a number of cross-cutting themes emerge that cut across technology type, fleet size and trading pattern. These themes point to systemic characteristics of BWM in practice, rather than isolated technical or operational failures.

A central and recurring theme is the interaction between BWMS technical behaviour and operational workload. Alarms, system interruptions and troubleshooting demands frequently arise during time-critical phases of operation, particularly during cargo operations and port calls. This convergence of system complexity and peak workload amplifies human-element risks, contributing to distraction, fatigue and reduced situational awareness. In this context, compliance challenges are often a function of competing operational priorities rather than a lack of intent or diligence on the part of crews.

The survey highlights alarm behaviour as a key stressor across multiple dimensions of BWM implementation. Alarm cascades, inconsistent alarm logic and limited differentiation between critical and non-critical conditions were reported to affect system operation, crew workload and inspection outcomes alike. Alarm-driven automatic responses, including system shutdowns and bypass activation, frequently act as the immediate trigger for both operational deviations and inspection findings, even where crews are following manufacturer instructions or IMO guidance.

CWQ emerges as a structural constraint rather than an exceptional circumstance. CWQ conditions were reported as routine in many ports, rivers and estuaries, particularly in sediment-heavy or low-salinity waters. These conditions directly affect BWMS performance, especially for systems sensitive to water quality parameters, and often initiate the operational sequences that lead to alarms, shutdowns, bypasses and contingency measures. The survey therefore suggests that CWQ should be understood as an inherent operating condition for a significant portion of the global fleet.

Another cross-cutting observation is the disconnect between system design assumptions and real-world operating environments. Respondents repeatedly reported that prescribed operating or maintenance steps were impracticable under actual trading conditions, due to time constraints, environmental limitations or system behaviour diverging from expected performance. This disconnect contributes to deviations from manufacturer instructions and complicates crews' ability to demonstrate compliance, particularly during inspections.

The findings also indicate that training, while important, is not a standalone solution. Fleets with more extensive training arrangements were often more aware of operational deficiencies and inspection findings but did not experience materially fewer system failures. This suggests that training alone cannot compensate for system complexity, usability limitations, environmental constraints or gaps in manufacturer support.

Finally, the survey highlights that compliance risk frequently arises at the interface between systems, people and enforcement, rather than from individual failures. Operational challenges translate directly into inspection risk when alarm behaviour, documentation practices or contingency actions are interpreted inconsistently. This reinforces the importance of coherence between technical performance, operational guidance and enforcement practices.

Considerations for future work

The survey findings point to several areas where further consideration may be warranted.

First, the results underline the importance of ensuring that non-mandatory guidance reflects operational realities, particularly in relation to CWQ, alarm-driven system behaviour and the practical application of contingency measures. Greater clarity and consistency in how guidance is interpreted and applied could help reduce compliance uncertainty without compromising environmental objectives.

Second, the findings suggest a need to place greater emphasis on operational usability and human-system interaction, including alarm management, system feedback and the clarity of operational instructions. Addressing these aspects may be as critical to effective compliance as further refinements to technical performance standards.

Third, the survey highlights the role of manufacturer support and lifecycle considerations, including global service coverage, spare-part availability and software management, as key enablers of sustained compliance. These factors materially influence a ship's ability to maintain BWMS performance over time.

Finally, the survey indicates that enforcement consistency and shared understanding play a significant role in shaping operational outcomes. Alignment between operational guidance, flag State decisions and port State control practices is essential to ensure that compliance efforts undertaken in good faith can be demonstrated and recognised in practice.

Taken together, these considerations reinforce that effective BWM depends on the alignment of technology, guidance, operational practice and enforcement, rather than on any single element in isolation.

Operational considerations for operators

While this report does not seek to prescribe operational requirements, the survey findings highlight a number of practical considerations that operators may wish to reflect upon when managing BWMS performance and compliance in day-to-day operations and longer-term fleet planning.

Taken together, these considerations underline the importance of viewing BWMS not as a standalone compliance requirement, but as an integrated element of shipboard operations that requires alignment between technical aspects, crew capability, operational planning and external support.

Crew familiarisation and operational capability

The survey indicates that effective BWMS operation depends not only on formal training, but on crews' ability to interpret system behaviour under real operating conditions. Operators may therefore wish to enhance type-specific familiarisation linked to crew duties, including practical troubleshooting scenarios, particularly in relation to alarm logic, system feedback and automatic responses under CWQ conditions and during time-critical operations. Improved understanding of how alarms cascade, trigger shutdowns or initiate bypass can support more confident decision-making and reduce unnecessary operational disruption. Scenario-based learning, peer-to-peer knowledge transfer and targeted refreshers following operational issues may help bridge gaps between formal training and real-world system behaviour.

Voyage planning in CWQ conditions

Given that CWQ and time-critical ballast operations were reported as predictable features of many trades, operators may benefit from integrating BWMS considerations more explicitly into voyage planning and risk assessments. This includes anticipating CWQ exposure, identifying contingency pathways in advance and ensuring timely communication with flag and port State authorities when deviations from normal operation are likely.

Where available, operators may also consider drawing on existing industry information sources, such as the PCWQ database hosted by INTERTANKO, to support risk awareness and planning when trading to ports known to present CWQ conditions.

Documentation practices and evidence of compliance

Difficulties in demonstrating compliance during inspections were closely linked to documentation practices and the frequency of alarms. Operators may therefore wish to review ballast water record-keeping arrangements, including the adoption of electronic BWRBs where feasible, to improve accuracy, traceability and consistency during inspections, particularly where contingency measures or repeated operational adjustments are applied.

Maintenance preparedness and manufacturer engagement

Extended repair periods, spare-part shortages and limited access to authorised service providers were identified as significant operational constraints. Operators may therefore wish to review maintenance strategies to improve preparedness, including the availability of critical spare parts on board or regionally, and engagement arrangements with manufacturers or service providers to support timely fault diagnosis and repair, particularly for ships trading in regions with limited service coverage.

Workload and human-element considerations

Frequent alarms, troubleshooting demands and associated administrative requirements were reported to increase crew workload, particularly during port operations. Operators may therefore wish to take the additional operational burden associated with BWMS into account when assessing work allocation and fatigue management arrangements, especially on port-intensive trades.

Use of operational data and continuous improvement

Several respondents highlighted the value of structured internal follow-up and root-cause analysis of BWMS-related issues. Operators may benefit from developing fleet-wide BWMS performance databases to capture recurring faults, alarm patterns, CWQ exposure and inspection outcomes, supporting evidence-based decision-making and continuous improvement.

Fleet configuration and lifecycle system strategy

The survey indicates that fleet heterogeneity, including the operation of multiple BWMS types across ships, complicates maintenance, training and troubleshooting and undermines consistency in operational performance. Where practicable, operators may therefore wish to consider greater standardisation of BWMS technologies within fleets, taking into account vessel trade, operating profiles and expected exposure to CWQ when selecting systems.

At a strategic level, the findings further suggest that BWMS performance, supportability and human-centred design considerations should be addressed as part of lifecycle fleet planning. This includes considering how BWMS choices interact with crew competence, workload, operational resilience and long-term manageability across different trading patterns.

About

BIMCO

Facilitating trade is at the very heart of our business, and since 1905, we've helped our members keep world trade moving. We make it our business to help our members with theirs.

BIMCO members cover 64% of the world's tonnage and consist of local, global, small and large companies. We are an organisation and global shipping community of 2,100 members in 120 countries.

From our offices in Athens, Brussels, Copenhagen, Houston, London, Shanghai and Singapore we aim to help build a resilient industry in a sustainable future whilst protecting world trade. We do this by finding practical solutions for our members to help them manage risk in a changing world.

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