

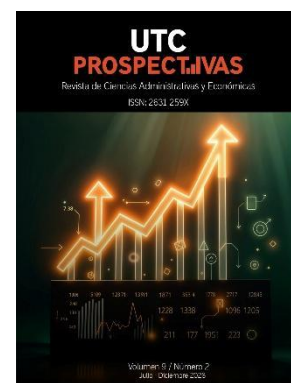
Maritime Quality Management System evaluation and Its Impact on Merchant Vessels.

Evaluación de Sistema de Gestión de la Calidad Marítima y su impacto en buques mercantes

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Abstract:

The objective of this study is to assess the application of the ISO 9001:2015 quality management system (QMS) on board merchant vessels through a survey administered to participants in the 2024/2025 Venezuelan Merchant Marine Officers Course. One of the key elements of maritime activity, from a management perspective, is the implementation of a reliable quality management system. In this regard, there is an extensive body of literature based on more than 50 years of implementation and continuous improvement. A questionnaire was administered to 20 Venezuelan merchant marine officers enrolled in a postgraduate program for promotion to Captain and Chief Engineer at the Higher School of Merchant Marine Studies. All participants had more than 15 years of sailing experience and provided information based on their most recent contracts. This was a quantitative, non-experimental, and descriptive study. The findings indicate that QMS practices are widely applied in maritime operations; however, deficiencies were reported in the provision of quality manuals, prior training, internal auditing, and the communication and follow-up of corrective actions. These results highlight the need to strengthen crew training, audit planning, process monitoring, and the timely communication of corrective measures by shipowners and charter operators. This study seeks to contribute to the improvement of quality management processes on board merchant vessels.

Palabras clave: ISO 9001:2015, quality management on board, crew training.

Resumen:

El objetivo de este estudio es evaluar la aplicación del sistema de gestión de la calidad (SGC) ISO 9001:2015 a bordo de buques mercantes mediante una encuesta aplicada a los participantes del Curso de Oficiales de la Marina Mercante Venezolana 2024/2025. Uno de los elementos clave de la actividad marítima, desde una perspectiva de gestión, es la implementación de un sistema de gestión de la calidad confiable. Al respecto, existe un amplio cuerpo de literatura basado en más de 50 años de implementación y mejora continua. Se aplicó un cuestionario a 20 oficiales de la Marina Mercante Venezolana pertenecientes al programa de posgrado para ascenso a Capitán y Jefe de Máquinas de la Escuela Superior de Estudios de la Marina Mercante. Todos los participantes contaban con más de 15 años de experiencia en navegación y proporcionaron información basada en sus contratos más recientes. Se realizó un estudio cuantitativo, no experimental y descriptivo. Los resultados indican que las prácticas del SGC se aplican ampliamente en las operaciones marítimas; sin embargo, se identificaron deficiencias en la entrega de manuales de calidad, la capacitación previa, las auditorías internas y la comunicación y seguimiento de las acciones correctivas. Estos resultados evidencian la necesidad de fortalecer la capacitación de la tripulación, la planificación de auditorías, el seguimiento de los procesos y la comunicación oportuna de las medidas correctivas por parte de los propietarios y operadores de los buques. El estudio busca contribuir al mejoramiento de los procesos de gestión de la calidad a bordo de buques mercantes.

Keywords: ISO 9001:2015, gestión de la calidad a bordo, capacitación de la tripulación.

I. Introduction

Quality control emerged in the 1930s and gained significant importance in the 1950s and 1960s. Initially, it focused on inspecting products and separating those that were acceptable, according to established standards, from those that were not. In 1931, Walter Shewhart, an American physicist, engineer, and statistician, published *Economic Control of Quality of Manufactured Products*, which set out the basic principles of quality control based on statistical methods, particularly the use of control charts. The Japanese automotive industry was a pioneer in the application of Total Quality Management from the 1950s to the late 1980s. Edwards W. Deming was an American engineer and mathematician who, while serving as a professor at New York University after World War II, traveled to Japan to conduct census studies. His work contributed to the development and widespread application of statistical process control and continuous improvement practices (Deming, 2018).

At the same time, Shigeo Shingo developed and formalized the Zero Quality Control (ZQC) method, which emphasized source inspection and the prevention of errors before they resulted in defects (Shingo, 1986). His work also contributed to process analysis, motion analysis, and time study.

The ISO 9000 family of standards was first published in 1987 and subsequently revised. The main revisions of ISO 9001 were issued in 1994, 2000, 2008, and 2015. This study focuses on ISO 9001:2015 (International Organization for Standardization [ISO], 2015).

Advantages of quality control today

According to Ishikawa (1985), it is possible to develop quality in all steps of the process; it is not enough to find the defects or faults and correct them; what we must do is find the causes of the defects and correct them.

For the author, quality means in its broadest sense quality of work, quality of service, quality of information and quality of process. The basic approach is to control quality in all its manifestations.

Implementation of a Quality Management System

(a) Decision making

Analysis: At this stage, the current situation is studied to determine the state of the company and decide whether or not to implement a quality management system (QMS). Decision-making requires investment in financial and human resources, as well as a commitment to continuous improvement. According to Besterfield et al. (2003), the successful implementation of a quality management system requires leadership, planning, employee involvement, and sustained management commitment. To achieve its objectives, the QMS requires the support of senior management, since responsibility lies not only with those who carry out operational activities but also with those who direct them. Many organizations have been successful when leadership sets an example, which can become an important motivator for employees.

The successful implementation of total quality management involves critical factors, practices, tools, and techniques, including leadership, employee involvement, process management, and continuous improvement (Tari, 2005).

Once management support and leadership for continuous improvement are established, a model, essentially a plan to follow, must be developed. This allows the organization to visualize the process, identify the sequence of events, and determine the resources needed to implement the changes.

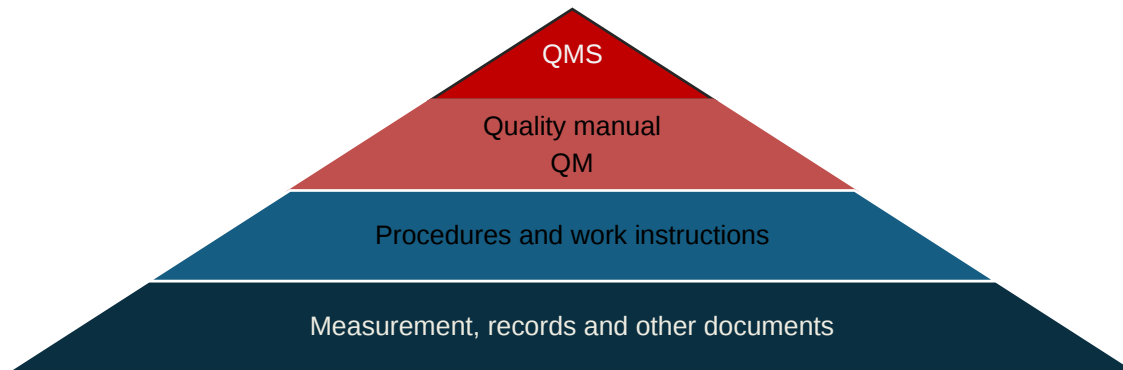
ISO 9001 requires a quality management system that supports improved organizational performance and effectiveness through the planning, control, and improvement of processes, as well as compliance with product or service requirements.

(b) Quality purposes

In a quality management system, "quality purposes" or "quality objectives" refer to the goals and targets an organization sets to achieve excellence in its processes and products/services. These objectives must be consistent with the Quality Policy, measurable, and should guide continuous improvement.

(c) The quality manual is a key document supporting the QMS. It describes the main processes, work instructions, measurement instruments, and records used by the organization.

Figure 1
The Quality Management Pyramid



Note. Croft-Bednarski (2024).

(d) procedures document how a process should be performed, while work instructions provide detailed, step-by-step guidance for specific tasks within a procedure. While procedures are generally required, work instructions are optional but recommended for consistent operations and to ensure tasks are performed as intended.

Performance indicators are parameters obtained from the measurement of activities or processes and are used to assess organizational performance.

A documentation system must be designed to support the maintenance and preservation of documents, whether in paper or electronic format. Documents should be easy to update, store, and share when necessary.

Figure 2.

Guidance on the requirements for Documented Information of ISO 9001:2015. Compilation support



An internal audit programme is a mandatory component of the QMS and should specify the audit frequency.

Under ISO 9001:2015, corrective actions are intended to address nonconformities and prevent their recurrence. Their purpose is to eliminate the root cause of the nonconformity and ensure that it does not recur. This process requires the identification and analysis of the root cause before corrective measures are implemented (Okes, 2019). The standard also requires organizations to establish procedures for identifying, analyzing, and resolving nonconformities and for verifying the effectiveness of the corrective actions taken.

Once the corrections have been implemented, the system returns to the initial decision-making phase and continues through the improvement cycle. Quality improvement tools can support process analysis, problem identification, and the planning of corrective actions throughout this cycle (Tague, 2013).

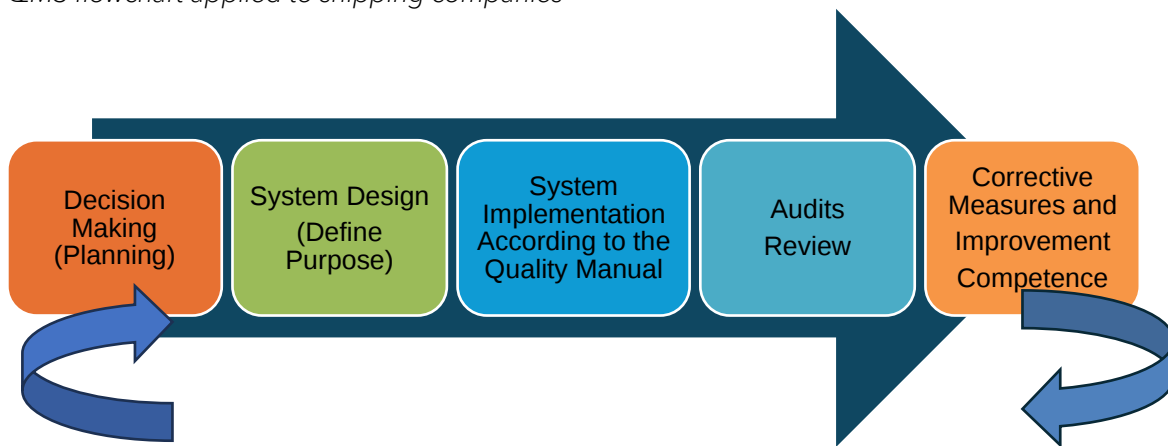
Competence within the quality management system (QMS) can be understood as a functional work structure agreed upon throughout the organization and documented through integrated and effective technical and administrative procedures.

ISO 9001:2015 standards applied to shipping companies

Shipping companies have implemented quality management systems for several years to improve the safety of vessels, cargo, and crews; promote the efficient use of marine fuel; prevent spills; and enhance the environmental performance of their operations.

- This is achieved by establishing the individual's competency, performing work that may affect the performance and efficiency of the Quality Management System.
- This is possible to achieve verification that people are competent, based in their education, training or work experience.

Figure 3
QMS flowchart applied to shipping companies



During their academic training, merchant marine officers develop operational knowledge of the international regulations governing maritime activity. According to the International Maritime Organization (IMO, 2024), the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW), adopted in 1978 and subsequently amended, was the first international instrument to establish basic requirements for the training, certification, and watchkeeping of seafarers. Previously, these standards were established independently by national governments, often without reference to the practices of other countries. As a result, standards and procedures varied considerably, despite the highly international nature of the shipping industry.

The Convention prescribes minimum standards relating to training, certification and watchkeeping for seafarers which countries are obliged to meet or exceed.

Therefore, knowledge of the quality management system (QMS) is not mandatory in the different phases of academic training, and it is learned once on board according to the company's guidelines.

Figure 4
Maritime Crew Training in Quality management environments

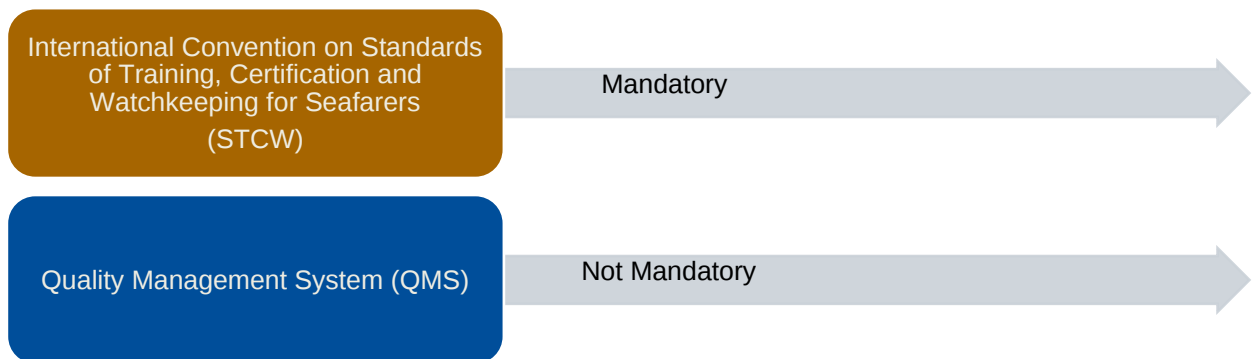
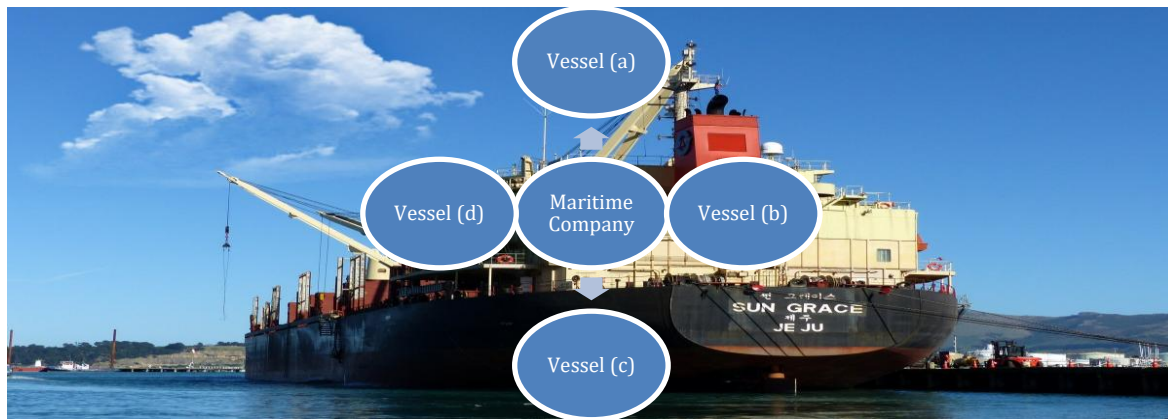


Figure 5
Quality management system in maritime companies

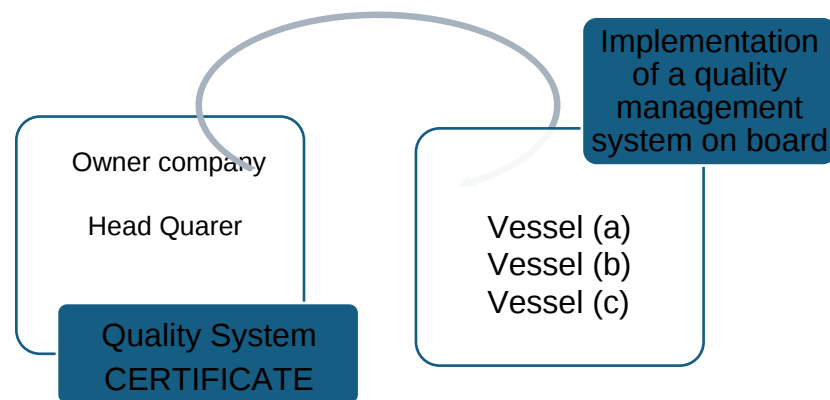




Maritime companies that own or charter vessels may be certified under a quality management system (QMS), which is then extended to the vessels they directly operate. Ship management requires coordination between shore-based management and onboard operations (Zhang & Tang, 2021).

Figure 6

Implementation of a quality management system on board vessels



Regulations, reviews, adjustments and control are transferred to the vessel(s) in the fleet.

II. Methodological Procedure

This quantitative, non-experimental, descriptive study used a structured questionnaire containing open- and closed-ended questions. The instrument was administered to 20 merchant marine officers and addressed QMS implementation, training, monitoring, auditing, and perceived operational results on board.

The confidentiality of the data was respected and informed consent was obtained from the participants in accordance with the provisions of the Bolivarian Republic of Venezuela Constitution, in its articles 28, 58 and 61.

Figure 7

Research development sequence



Data analysis

The information was analyzed using frequencies and percentages for each questionnaire item. Given the small, non-probabilistic sample, the results are interpreted descriptively and are not intended to support statistical generalization to the entire maritime sector.

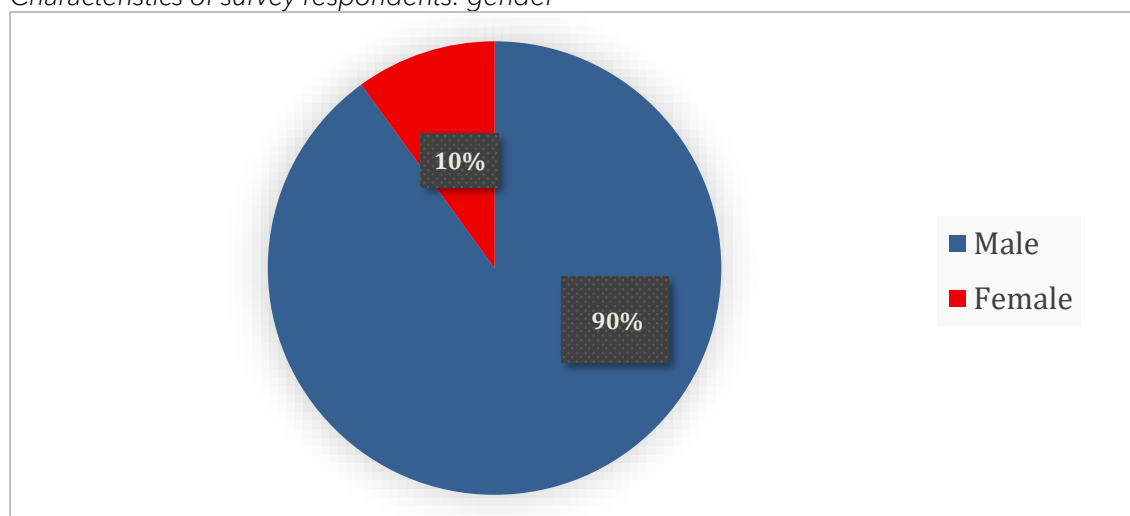
The sample consisted of 20 experienced maritime professionals, which allows for a descriptive account of their responses.

The first section contained five questions designed to describe the respondents' profiles. The second section contained 10 questions on the implementation, monitoring, auditing, and training associated with the QMS on board.

III. Results

Figure 8

Characteristics of survey respondents: gender



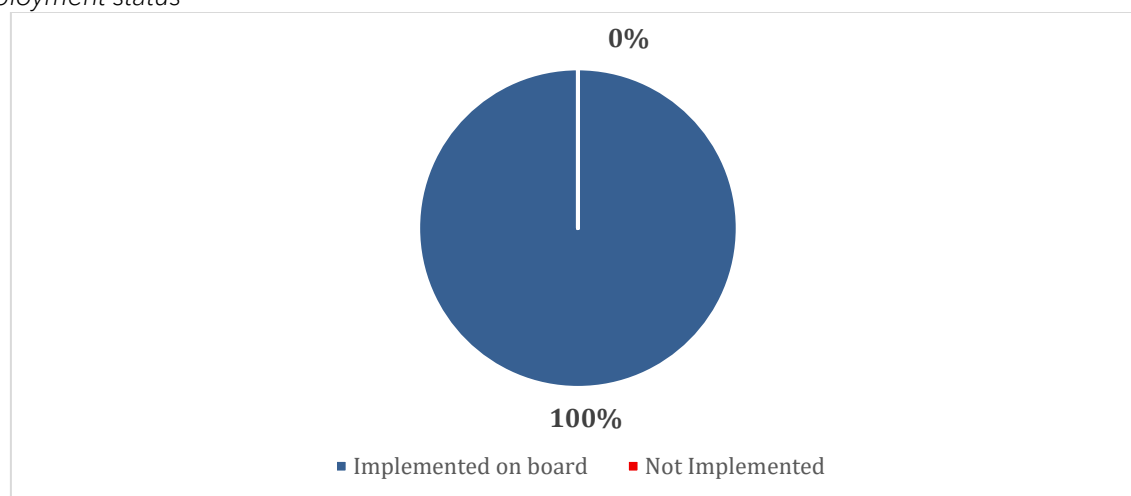
Of the 20 respondents, 18 were men (90%) and two were women (10%).

The IMO–WISTA Women in Maritime Survey Report provides broader contextual information on women's participation in the maritime workforce (International Maritime Organization & Women's International Shipping & Trading Association, 2021).

According to that report, women represented a small proportion of seafarers and were more frequently employed in the cruise sector and in shore-based positions within ship-owning companies.

Figure 9

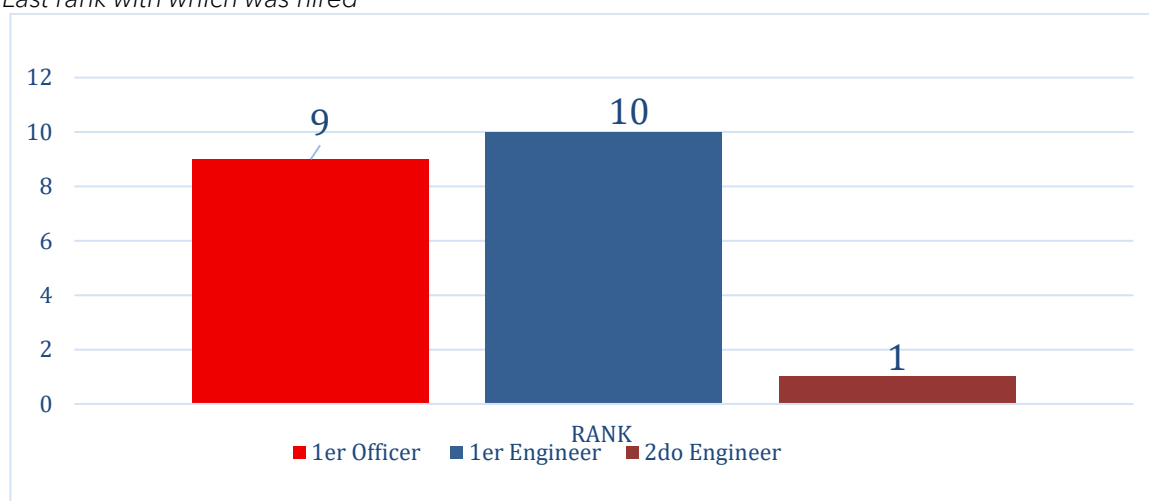
Employment status



All respondents had worked on board a vessel during the previous three years. Their responses therefore refer to relatively recent operational experience with QMS practices.

Figure 10

Last rank with which was hired



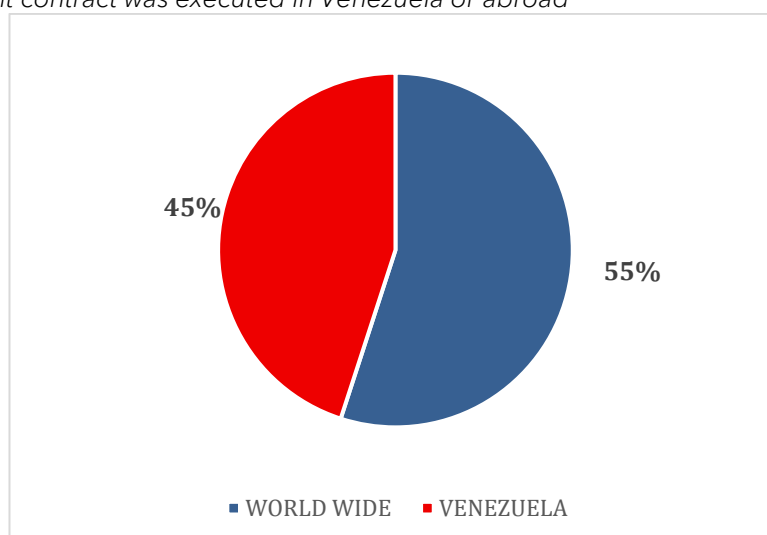
To obtain the professional title of bridge officer or engineer officer, candidates must pass a competency assessment at the Higher School of Merchant Marine Studies in Caracas. The study group consisted of nine first deck officers, 10 first engineer officers, and one second engineer officer.

According to Venezuelan maritime legislation, applicants for the titles of Captain or Chief Engineer must hold the immediately lower-ranking certificate and demonstrate at least 36 months of navigation experience in their specialty while holding that qualification.

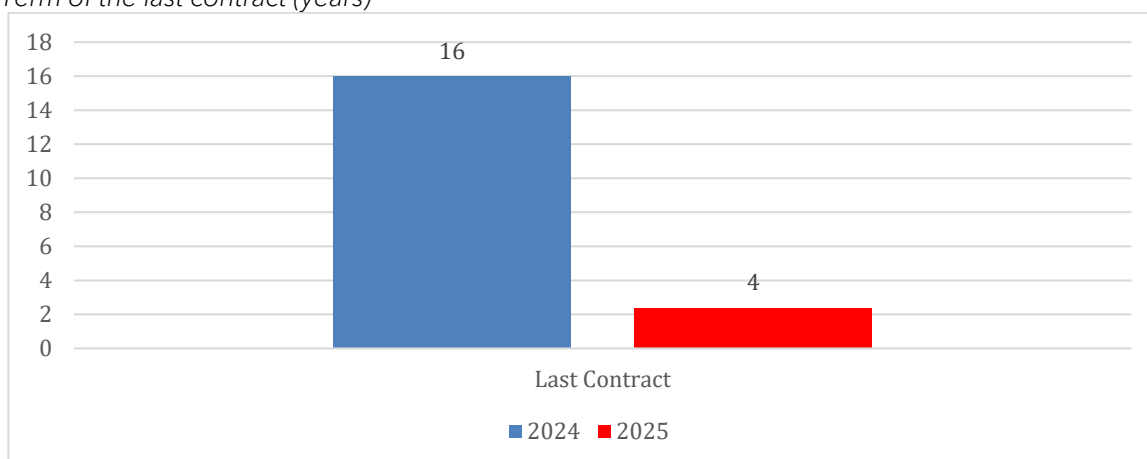
Given the professional requirements associated with these ranks, first deck officers and first engineer officers generally have approximately 15 to 20 years of maritime experience.

Figure 11

The employment contract was executed in Venezuela or abroad

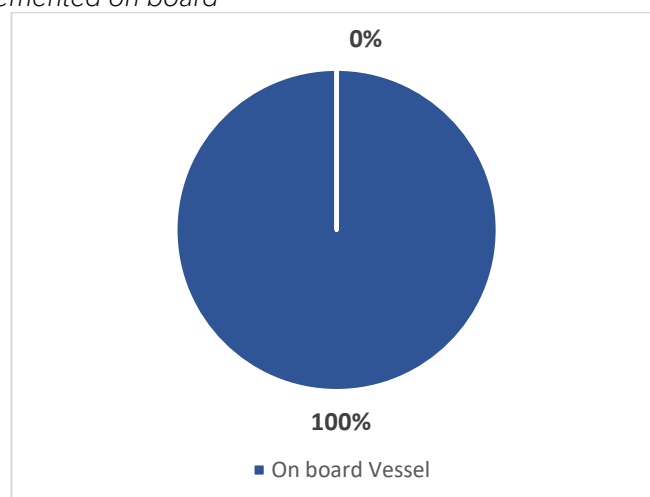
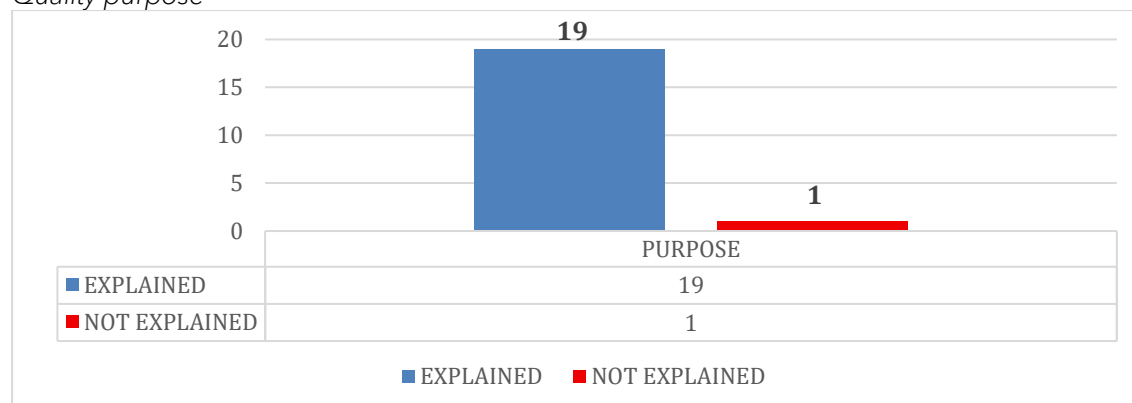


Eleven merchant marine officers completed their most recent contracts in Venezuelan waters, while nine completed theirs in international maritime contexts. These responses provide descriptive information on the application of quality management systems in both domestic and international onboard operations.

Figure 12*Term of the last contract (years)*

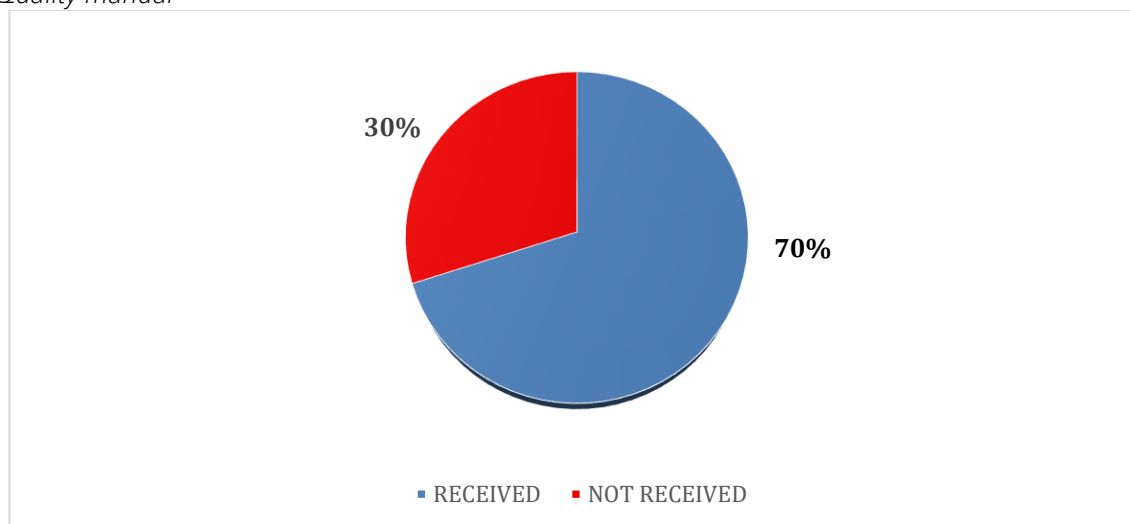
The respondents' most recent navigation contracts ended in 2024 or 2025, indicating that their responses were based on relatively recent professional experience. At the time of the study, conducted in April 2025, four participants had completed their contracts in 2025, while the remaining 16 had completed them in 2024.

ISO 9001:2015 Quality Management System QMS -Survey-

Figure 13*ISO 9001:2015 implemented on board***Figure 14***Quality purpose*

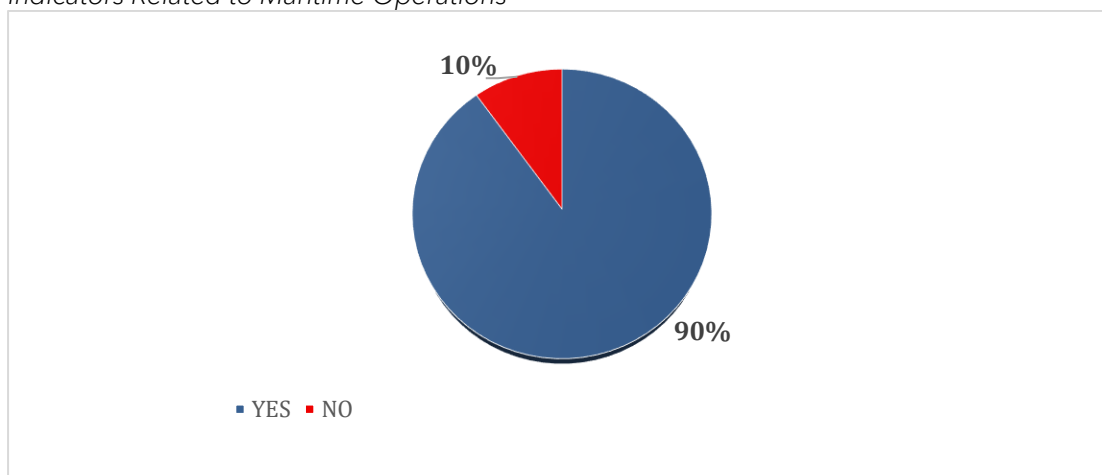
Quality objectives are the goals established by an organization to guide the implementation and improvement of its quality management system (QMS). In this study, 95% of respondents indicated that these objectives had been explained. However, the absence of clearly defined quality objectives, even in a small proportion of cases, may represent a weakness in the QMS. According to López Gumucio (2005), clearly defined and communicated criteria are essential for decision-making and planning; otherwise, the information collected may be incomplete or dispersed, affecting the design and implementation of the system.

Figure 15
Quality manual



The quality manual is a key element supporting quality management (Bureau Veritas, 2010). The auditee should be familiar with the quality manual to adequately prepare for the audit and understand the criteria used to evaluate compliance. During an internal audit, the quality auditor must record the relevant review points. Although procedures, work instructions, ranks, and responsibilities are defined on board, the evaluation criteria should also be included in the quality manual. The survey results show that 30% of respondents had not received the quality manual before the audit.

Figure 16
Indicators Related to Maritime Operations



The parameters used to measure on-board activities, according to the respondents, included the following:

- bunker (marine fuel) consumption.
- navigation time and distance travelled.
- crew working hours.
- crew rest time; and
- other operational indicators.

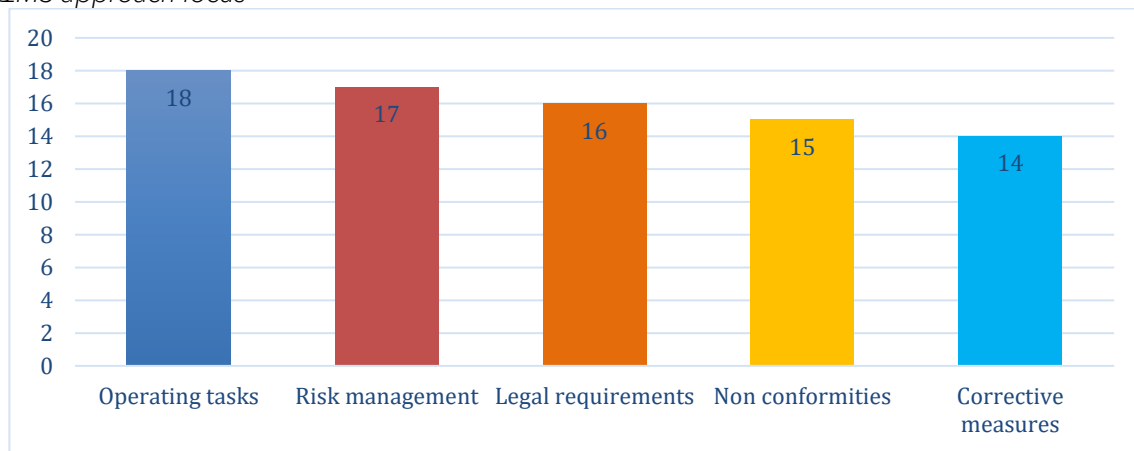
Accurate monitoring of crew working and rest hours is essential because inconsistencies between recorded and actual hours may contribute to fatigue and compromise safety on board (Bhatia et al., 2024).

These indicators may vary according to the operational characteristics of each type of vessel. Maritime companies use key performance indicators (KPIs) to assess their performance in relation to strategic and operational objectives, including fuel consumption, navigation time, distance travelled, operating costs, and other efficiency measures (Grammenos, 2010). Some companies also develop their indicators in accordance with regulations issued by the International Maritime Organization (IMO). However, 10% of the respondents stated that, although the indicators were defined, they were not consistently used for continuous improvement or were not adequately addressed by the shipping company.

2.5 The quality management system approach focused on:

- Define and document daily operating tasks
- In risk management, taking advantage of opportunities to improve maritime operations
- Comply with legal requirements
- Detection of findings or non-conformances.
- Implementation of corrective measures.

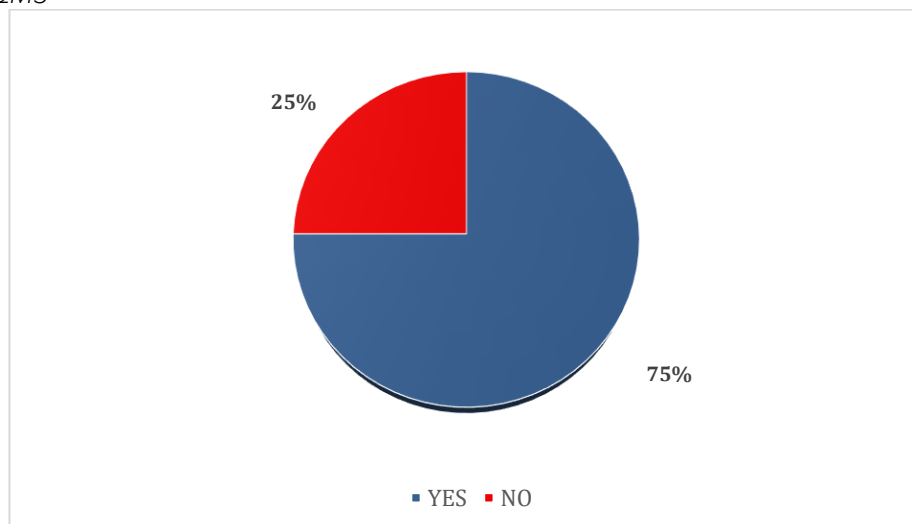
Figure 17
QMS approach focus



The QMS focused on several complementary aspects. Eighteen of the 20 respondents (90%) indicated that it focused on defining and documenting daily operating tasks; 17 (85%) referred to risk management; 16 (80%) mentioned compliance with legal requirements; 15 (75%) reported the detection of findings or non-conformities; and 14 (70%) referred to the implementation of corrective measures.

The most frequently reported areas were daily operating tasks, risk management, and legal compliance. The comparatively lower frequencies for detecting non-conformities and implementing corrective actions suggest that these stages may require additional attention.

Figure 18
Training QMS

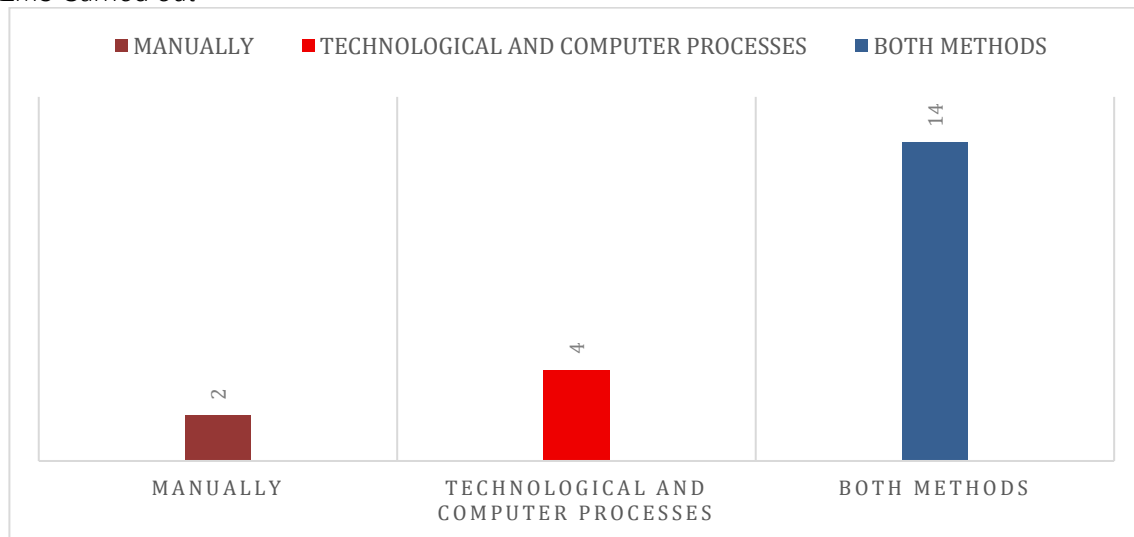


Fifteen merchant marine officers (75%) reported receiving QMS-related training. However, five respondents (25%) indicated that they had not received training before participating in internal audit processes. This finding suggests a need to strengthen prior training and awareness of QMS requirements.

Procedures and documentation of ISO9001.2015 quality management system were carried out:

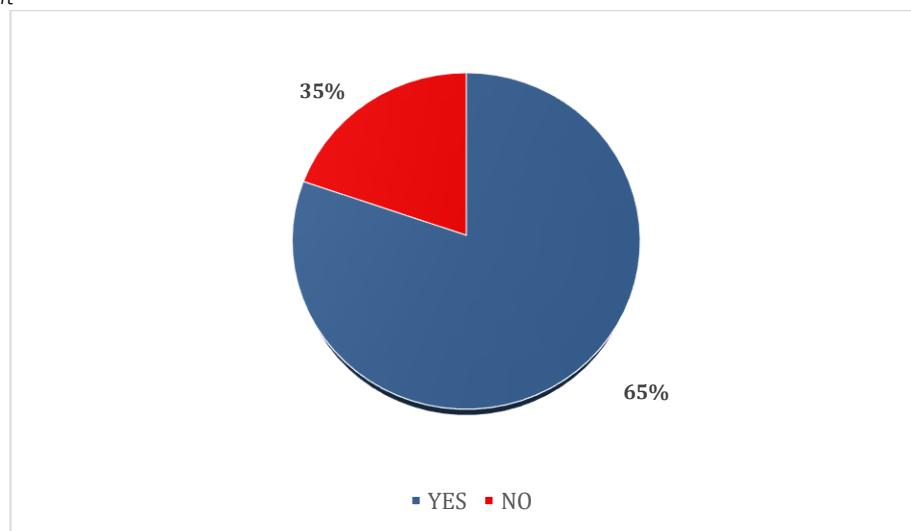
- manually
- through technological and computer processes
- both methods

Figure 19
QMS Carried out



Fourteen respondents (70%) reported that both paper-based and electronic documentation were used. Four respondents (20%) reported exclusively electronic documentation, while two (10%) reported exclusively paper-based documentation. These results indicate that a hybrid documentation system was the most frequently reported approach.

Figure 20
QMS Audit



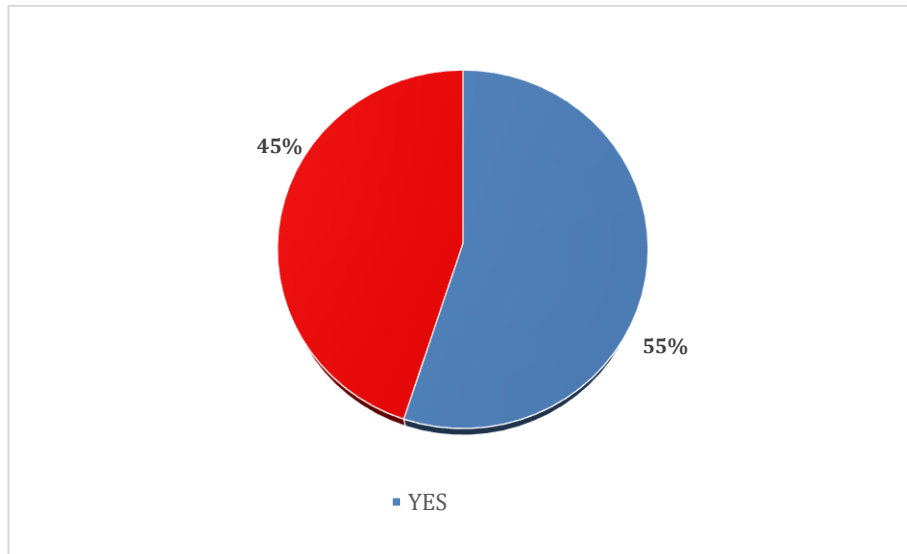
ISO 9001:2015 requires the company to define an internal audit program. This is one or more audits planned for a specific period of time, each with a specific purpose.

Internal audit records should include identified nonconformities, and the conclusions required to assess the conformity of the quality management system with the applicable requirements. However, 35% of respondents

reported that they had not participated in an internal audit during their most recent navigation contract. This result should be interpreted cautiously, since onboard contracts may last between three and six months and may not coincide with the company's scheduled audit period.

Figure 21

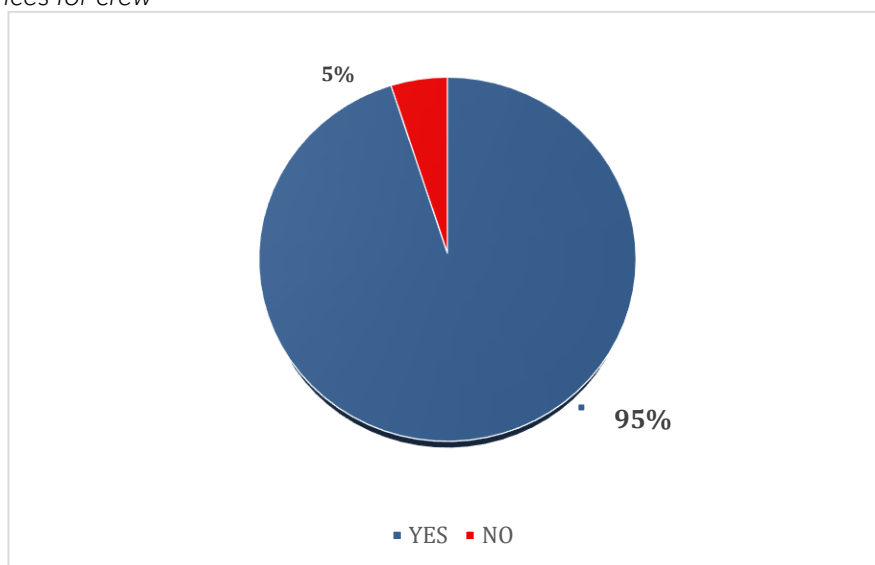
Corrective measures



Eleven respondents (55%) reported observing improvements associated with corrective measures, while nine (45%) did not. The absence of observed improvements does not necessarily indicate that corrective actions were not implemented, since their completion or verification may have occurred after the respondents' contracts ended.

Figure 22

Quality services for crew



The quality of services provided to the crew is included in the quality management system (QMS). Working and living conditions on board, including accommodation, food, recreation, rest, and the work environment, are

important aspects of seafarers' professional experience, well-being, and labour protection (Gekara & Sampson, 2021; International Labour Organization [ILO], 2021). In this study, 95% of respondents indicated that the services provided to the crew and the procedures used to evaluate them were adequately implemented, while 5% reported that these measures were not applied.

Services evaluated on board included:

- evaluation of services provided to the crew, including those offered by local shipping agencies.
- on-site audits of common areas, recreation areas, and cabins; and
- assessment of conditions related to a safe working environment.

QMS practices applied on board included:

- dietary compliance meetings and anonymous surveys.
- safety meetings every two weeks; and
- quality surveys distributed through mobile devices.

IV. Discussion

The main limitations of this research include the geographical restriction of the study, as it focuses solely on the evaluation carried out by merchant marine officers who, despite their extensive knowledge regarding the operation and use of quality management, are inclined towards onboard operations rather than onshore management, which may not reflect the diversity of practices of maritime companies both in Venezuela and abroad.

Prajogo and McDermott (2011) examined the relationship between organizational culture and quality management practices. Their findings suggest that the effectiveness of quality management depends partly on its integration with the organization's culture and strategic orientation. In the context of the present study, this supports the need to evaluate not only the formal existence of QMS procedures but also their consistent application in daily onboard operations.

Therefore, future work should be carried out directly in shipping companies with the personnel responsible for implementing and monitoring quality management, whether they are merchant marine officers or other specialized professionals, so that the results obtained in this research can be compared and verified.

V. Conclusions

The results provide a descriptive view of QMS implementation based on the recent experience of 20 merchant marine officers. All respondents reported that a QMS had been implemented on board, and most indicated that quality objectives, operational indicators, and crew-service evaluation mechanisms were present.

Nevertheless, the findings also identify areas that may require improvement. Thirty percent of respondents had not received the quality manual, 25% had not received QMS-related training, and 35% had not been internally audited during their most recent contract.

In addition, 45% of respondents did not observe improvements resulting from corrective actions during the contract period. This result does not establish that corrective actions were absent, because their implementation may have occurred after the contract ended; however, it indicates a need for clearer communication and follow-up.

Taken together, the findings support strengthening the provision of quality documentation, crew training, internal audit planning, communication of audit results, and verification of corrective actions.

The study does not establish causal effects or population-level estimates. Its contribution lies in identifying operational perceptions and recurring areas of concern that can guide more extensive evaluations of QMS practices on merchant vessels.

A consistently implemented QMS may support safer and more reliable operations when it is integrated into daily work, supported by trained personnel, and accompanied by effective auditing and continuous improvement.

Particular attention should be given to operational risks, crew working and rest conditions, and the quality of services provided on board.

Although ISO 9001:2015 certification is voluntary, its process-based and risk-based approach can complement mandatory maritime safety requirements. The evidence presented here should therefore be interpreted as descriptive support for strengthening implementation rather than as proof that the QMS prevents accidents.

The results are expected to contribute to greater awareness of the importance of applying a QMS on merchant vessels as part of an organization's management strategy. Strengthening crew and administrative staff training and maintaining a clear commitment to continuous improvement may help organizations achieve more consistent operational performance.

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